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The Relationship between Serum Lipids and Obesity among Elementary School in Birjand: A Case Control Study

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ABSTRACT

Background: Childhood obesity could induce some risk factors for cardiovascular disease (CVD) including serum lipid abnormalities, hypertension, and atherosclerosis. The present study aimed to comparison the lipid profile in normal children with cases having overweight, obesity and central obesity.

Methods: In this case control study, which was conducted 2013, serum lipids for three groups of children including cases with overweight (Body mass index (BMI): 85-95th percentiles to age and sex and waist circumference (WC) <90th percentile to age and sex = Case group1), central obesity without general obesity (BMI <85th percentiles and WC ≥ percentile 90 = Case group 2) and central obesity with general obesity (BMI ≥95th percentile and WC ≥ percentile 90 = Case group 3) were compared with control group (BMI < 85th percentiles WC <90th percentile). Data were analyzed using software SPSS-16 by chi-square and ANOVA tests at significance level α=0.05.

Results: Each group consisted of 100 individuals. The highest mean of serum lipids and the highest extent of dyslipidemia existed in the children having central obesity along with general obesity. So that 49%, 28%, and 38% students of this group show hypertriglyceridemia, hypercholesterolemia, and low high-density lipoprotein cholesterol (HDL-C). Odd ratio of hypertriglyceridemia, hypercholesterolemia and low HDL-c, in children with at least one abnormal index (BMI and /or WC) compared with control group were 3.73 (95% CI: 1.98, 6.99), 1.37 (95% CI: 0.71, 2.65) and 2.98 (95% CI: 1.51, 5.87), respectively.

Conclusions: With regard to the relationship between central obesity and adverse changes in lipid profiles, the screening children for central obesity to prevention of cardiovascular disease are recommended.

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Introduction

Obesity is the most common chronic metabolic diseases which influences the children and adolescents [1]. Childhood obesity resulted in epidemic levels in developing and developed countries. Overweight and obesity of childhood are known to have significant impact on physical and psychological health [2]. Childhood obesity engages the risk factors for cardiovascular disease (CVD) including blood lipid abnormalities, hypertension, and atherosclerosis [3].

Pathological examinations indicate that atherosclerosis has begun from childhood and the extent of atherosclerosis changing in children has correlated with risk factors in adults[3].

Ccardiovascular disease results in high number of worldwide per year, so that these diseases have been accounted as the most important factor of death in developed countries. They are mentioned as multi-factor diseases having several risk factors. Obesity is one of the preventive factors in cardiovascular disease [4].

Indexes could be used to measure obesity are body mass index (BMI), waist circumference (WC), and waist to hip ratio (WHR). Waist circumference is stronger index to determine health risk than BMI [1]. Obesity and overweight raises adverse changes in lipid profiles as complications of obesity [5-6]. While, decreasing or increasing the related obesity indices such as BMI and waist circumference might affect the parameters of lipid [7]. In 2012, among each 5 children at age group 8-17 years old, a child had an adverse lipid concentration of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), or non-high-density lipoprotein cholesterol (non-HDL-C)[8]. Anthropometric indexs can be used in detecting the individuals exposed to the risk factors of atherosclerotic diseases. Since these techniques are inexpensive, easy to use, and non-invasive, they can be used in epidemiological studies [5]. Despite of the relationship between obesity and adverse lipid profiles, yet prevalence of hypercholesterolemia or hypertriglyceridemia in obese children and the impact of obesity on lipid profile have remained unknown.

Rrecognition of the children exposed to risk factors of non-communicable diseases particularly cardiovascular diseases could prevent prevalence of cardiovascular diseases via the initial prevention actions to regulate these risk factors.

The present study aimed to examine the relationship between overweight, obesity, and central obesity with lipid profile in the 7-12 years old students of Birjand, south Khorasan Province, East of Iran.

Methods

In this case-control study, which was conducted in 2013, four groups of children according to anthropometric indexes were selected among elementary school children in Birjand, south Khorasan Province, East of Iran. These students were identified in the previous study on determining the prevalence of obesity in the primary school children [9]. There, clustering sampling method was applied to select the sample group. Overweight and obesity were considered based on percentages of Center for Diseases Control and prevention (CDC) Transmitted after prevention for BMI. Thus, 85-95th percentiles were considered as overweight with respect to age and sex; and ≥ 95th percentile as obese. In order to determine central obesity, waist circumference equal or more than percentile 90 to age and sex referred.The sample size based on the study by Fesharakinia et al. on the relationship between BMI and serum lipids in elementary school cchildren of Birjand [10] was calculated. According to HDL-C in children with normal BMI (44.2±9.2 mg/dl) and obese students (47.6 ±7.5 mg/dl)[10] and at confidence level (95%) and power (80%), 100 students per each group were studied.

Four groups were selected as follows:

- Case 1: Body mass index: 85-95th percentiles to age and sex and waist circumference <90th percentile to age and sex (overweight).
- Case 2: Body mass index <85th percentiles to age and sex and waist circumference equal or more than percentile 90 to age and sex (central obesity without general obesity).
- Case 3: Body mass index ≥95th percentile to age and sex and waist circumference equal or more than percentile 90 to age and sex (central obesity with general obesity).
- Case 4: Body mass index <85th percentiles to age and sex and waist circumference < 90th percentile to age and sex.

Control group were matched of age, gender and residence with cases groups by using group-matching method.

The students who according definition was in one of the cases group and their parents to participate in the study were satisfied by convenience sampling method were selected.

Students with endocrine disease were excluded of the study. Levels of blood lipids in the cases group and the control group after 12 hours fasting were measured. The blood sample was taken in vacuum tubes 5 ml containing separator gel and clot activator manufactured by Bacton Dickinson (U.K). The obtained samples were immediately centrifuged and their respective lipid levels through applying enzymatic procedure using German Rosh kits, with Biochemical Auto-analyzer Prestige 24i (Japan) were determined.

Values greater than the 90^{th} percentile about non-HDL-C, LDL, TC, TG, and values less than 10^{th} percentile about HDL were considered as dyslipidemia. In this regard, TG was considered greater than 100 at age group 7-9 years old, and greater than 130 at age group 10-12 years old, and cholesterol was considered greater than 200, LDL was considered greater than 130, and non-HDL was considered greater than 145, and HDL less than 40 was considered as dyslipidemia. Mean of serum lipids and frequency of dyslipidemia were calculated in each group and compared between different groups, and also were calculated in the cases groups, separately and then were compared with control group. The collected data were analyzed by SPSS software (Chicago, IL, USA) (16) using descriptive statistics (mean and standard deviation) and according to the normal distribution of data using of ANOVA, Tukey test, chi-square test, Pearson correlation coefficient at the 0.05 significant level.

Results

Each group consisted of 100 students. Average age of cases and control groups students was 9.5±1.7 and 9.7±1.3 year, respectively. There was no significant difference between both groups. There were 50% girls and 50% boys in the groups.

Mean of cholesterol, triglycerides, and LDL were higher in the children with BMI ≥ 95th percentile than group with age and sex and WC equal or more than percentile 90, which age, and sex (central obesity with general obesity) and mean of HDL was lower in this group rather than other groups. Mean of serum lipids in the groups under study have been represented in Table 1. With regard to ANOVA, there was a significant difference on mean cholesterol, triglycerides, HDL and LDL in the studied groups (P<0.001).

Results from Tukey test indicated that there was a significant difference as for mean cholesterol, LDL, and non-HDL in the students with BMI: 85-95th percentiles (overweight) and BMI < 85th percentiles to age and sex and WC≥90th percentiles (central obesity without general obesity) and the students with BMI ≥ 95th percentiles to age and sex and WC ≥ 90th percentiles (central obesity and general obesity). Moreover, there was a significant difference on students with BMI < 85th percentiles to age and sex and WC ≥ 90th percentiles (central obesity and general obesity) and normal students as well as two other groups. There was no significant difference about mean TG and HDL in students with overweight and students of control group.

The highest extent of hypertriglyceridemia, hypercholesterolemia and high LDL was existed in the students with central obesity and general obesity(case3), so that 49%, 28% and 24% of students in this group had Hypertriglyceridemia, hypercholesterolemia and high LDL, respectively. The highest amount of low HDL was existed in the group of students with central obesity with general obesity (case 3) (Table 2).

Table 1: Comparison means of lipids serum in the study groups

Groups	Case 1[a]		Case 2[b]		Case 3[c]		Control		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P* value
Triglyceride (TG)	88.9	36.1	105.5	54.6	121.6	60.8	74.6	29.3	0.001
Total cholesterol (TC)	170.4	22.2	169.1	31.2	187.4	37.7	168.9	28.7	0.001
Low-density lipoprotein cholesterol (LDL-C)	96.5	21.1	97.2	24.4	109.5	23.9	95.1	20.9	0.001
Non-high-density lipoprotein cholesterol (non-HDL-C)	119.1	22.7	121.4	31.8	141.1	39.4	113.9	24.3	0.001
High-density lipoprotein cholesterol (HDL-C)	51.3	10.2	48.1	11.5	45.7	11.7	54.1	11.3	0.001

[a] Overweight: body mass index 85-95 percentile for the age and sex
[b] Central obesity without general obesity: body mass index <85 percentile and waist circumference ≥90 percentile for the age and sex
[c] Central obesity with general obesity: body mass index ≥95 percentile and waist circumference ≥90 percentile for age and sex
[d] Control: body mass index <85th percentile and waist circumference <90 percentile

Table 2: Comparison the frequency of dyslipidemia in the study groups

Groups	Control [a]	Case 1[b]		Case 2[c]		Case 3[d]	
	n (%)	n (%)	*P* value	n (%)	*P* value	n (%)	*P* value
Triglyceride (TG)	13 (13.0)	20 (20.0)	0.182	38 (38.0)	0.001	49 (49.0)	0.001
Total cholesterol (TC)	13 (13.0)	8 (8.0)	0.249	15 (15.0)	0.663	28 (28.0)	0.009
Low-density lipoprotein cholesterol (LDL-C)	5 (5.0)	8 (8.0)	0.390	11 (11.0)	0.108	24 (24.0)	0.001
Non-high-density lipoprotein cholesterol (non-HDL-C)	11 (11.0)	12 (12.0)	0.845	22 (22.0)	0.033	40 (40.0)	0.001
High-density lipoprotein cholesterol (HDL-C)	11 (11.0)	13 (13.0)	0.382	30 (30.0)	0.001	38 (38.0)	0.001

[a] Control: body mass index <85th percentile and waist circumference <90 percentile
[b] Overweight: body mass index 85-95 percentile for the age and sex
[c] Central obesity without general obesity: body mass index <85 percentile and waist circumference ≥90 percentile for the age and sex
[d] Central obesity with general obesity: body mass index ≥95 percentile and waist circumference ≥90 percentile for age and sex

Existence of a variety of dyslipidemia in each of the cases groups compared to control group has been represented in Table 3. In case 3 group (central obesity and general obesity) odds of all types of dyslipidemia significantly higher than the control group. The highest value of odds ratio was related to high triglyceride (OR=6.43; 3.18, 12.97). In student with central obesity without general obesity (case 2) odd ratio of high triglyceride, high non -high-density lipoprotein cholesterol (non-HDL-C) and Low high-density lipoprotein cholesterol (HDL-C) significantly higher than the control group. In case 1 group (overweight) significant association was not found in types of dyslipidemia between case and control groups.

Table 3: Odds ratio estimates of dyslipidemia in the cases groups in comparison with control group [a]

Groups	Case 1[b]	Case 2[c]	Case 3[d]	All cases
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Triglyceride (TG)	1.67 (0.78, 3.58)	4.16 (2.05, 8.47)	6.43 (3.18,12.97)	3.73 (1.98, 6.99)
Total cholesterol (TC)	0.58 (0.23, 1.47)	1.19 (0.56, 2.66)	2.61 (1.23,5.35)	1.37 (0.71, 2.65)
Low-density lipoprotein cholesterol (LDL-C)	1.65 (0.52, 5.23)	2.40 (0.80, 7.19)	6.08 (2.21, 16.69)	3.21 (1.20, 8.29)
Non-high-density lipoprotein cholesterol (non-HDL-C)	1.09 (0.45, 2.61)	2.31 (1.05, 5.08)	5.30 (2.51, 11.22)	2.61 (1.32, 5.20)
High-density lipoprotein cholesterol (HDL-C)	1.19 (0.50, 2.81)	3.52 (1.65, 7.54)	4.91 (2.30, 10.32)	2.98 (1.51, 5.87)

[a] Control: body mass index <85th percentile and waist circumference <90 percentile
[b] Overweight: body mass index 85-95 percentile for the age and sex
[c] Central obesity without general obesity: body mass index <85 percentile and waist circumference ≥90 percentile for the age and sex
[d] Central obesity with general obesity: body mass index ≥95 percentile and waist circumference ≥90 percentile for age and sex

The highest correlation coefficient was observed between triglycerides and body mass index (BMI) (r=0.474) and triglycerides and weight (r=0.455). correlation coefficient between low high-density lipoprotein cholesterol (HDL-C) and weight ,body mass index and WC were negative (Table 4).

Table 4: correlation coefficient between body mass index (BMI) weight and waist circumference (WS) with lipid serum in study group

Lipid	Weight	BMI	WC
Triglyceride (TG)	0.455	0.474	0.342
Total cholesterol (TC)	0.253	0.277	0.203
Low-density lipoprotein cholesterol (LDL-C)	0.269	0.296	0.237
High-density lipoprotein cholesterol (HDL-C)	-0.209	-0.270	-0.201
Non-high-density lipoprotein cholesterol (non-HDL-C)	0.338	0.286	0.332

Correlation is significant at the 0.01 level (2-tailed).

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Discussion

In the study by Dr Nazem et al, the highest mean of cholesterol, triglycerides, and LDL; and the lowest mean of HDL; and the highest amount of dyslipidemia have been seen in the students with central obesity with general obesity (case 3). The students with central obesity without general obesity have been more likely exposed to risk compared to control group or the group with overweight especially in hypertriglyceridemia and low HDL.

Although the students with overweight had lower level of serum lipids than obese students, they had higher triglycerides and lower HDL than control group, while there was no difference between them and control group within cholesterol and LDL. It can be concluded that central obesity was an important risk factor in dyslipidemia nevertheless longing with central and general obesity its destructive effect was more on lipid profile.

In a study within relationship of serum lipids and anthropometric index among 6-18 years old students of Isfahan, a significant relationship between all lipids except HDL and obesity, overweight and central obesity was seen [11].

Mean of cholesterol, triglycerides, and LDL have been greater in the students with overweight and obesity than the students with normal weight[3]. Although, there, central obesity has not been mentioned the prevalence of central obesity along with general obesity is more and increasing serum lipids might have been associated to central obesity in obese students.

In the study by Fesharakinia et al prevalence of hypertriglyceridemia has been greater in obese students than students with normal weight [10]. However, no significant relationship was observed between prevalence of other dyslipidemia and obesity and overweight [10].

In Mashhad, average triglycerides, cholesterol, and LDL have been greater in the obese children than children with normal weight while, average HDL has been less, that shows good consistency with this study[12].

The relationship between serum lipids and anthropometric indexes has been supported in other studies, e.g. in U.S., 45.8% of children with overweight had abnormal lipid. Further, children with highest BMI had the lowest HDL [13]. In India, higher amount of cholesterol, LDL, and triglycerides were in obese children. There was a significant relationship between BMI and lipid profile [14].

In the present study, a significant association was found between amounts of BMI and WC and triglycerides, cholesterol, LDL, and HDL. In the study by Fesharakinia et al., a significant relationship existed between BMI and triglycerides, total cholesterol, and LDL [10].

In Tehran about lipid glucose study, there was a significant relationship between BMI and various types of dyslipidemia, however, WHR kept its significant association only with hypertriglyceridemia and low HDL-C [15].

In the present study , the highest correlation coefficient was existed between BMI and triglycerides, while a significant correlation was witnessed between BMI, waist circumference, and weight and all serum lipids.

In a study on 6-11 years old children in Qatar, the highest correlation coefficient existed between waist circumference and triglycerides. Moreover, a high correlation was witnessed between waist circumference and high LDL cholesterol, and an inverse correlation was between waist circumference and HDL [16].

In China, by increasing BMI, amount of TC and TG increases, that a negative relationship was witnessed between HDL and BMI [17]. In Arabia, a positive correlation was between BMI and ccholesterol and LDL, and a negative correlation was between BMI and HDL. There was no correlation between BMI and triglycerides [18].

In other studies on other age groups including premenopausal women and the elderly, a high correlation existed between waist circumference and serum lipids [19-20]. Obesity was associated with lipid disturbances, especially with HDL-C reduction, in obese non-diabetic patients [21]. These results indicate that WC is the main parameter associated with serum lipid levels [20]. In this study, as the sample group has been selected in the previous study, frequency students with BMI ≥95th percentile to age and sex and WC less than percentile 90 to age and sex was low and we could not compared a group with BMI ≥95th percentile and WC <90th percentile (general obesity without central obesity) with others groups, and this can be regarded as restriction in this study.

The results of this study can be a guide for clinicians to screening of obese children for lipid profile.

As a limitation of this study, due to the non-random sampling and differences geographical and cultural, results may not be representative for the whole overweight or obese Iranian students.

Conclusions

The highest adverse changes in lipid were in the students with central obesity and general obesity. It seems that central obesity can be a stronger index to predict abnormal blood lipids than general obesity while in most of cases, central obesity is followed by general obesity, it is suggested all the obese children especially the children with central obesity are examined in sake of dyslipidemia. As measurement of anthropometric indices especially waist circumference, weight, and height is an easy and non-invasive measure, it can be used as a means for screening in detection of the students who are exposed to risk of dyslipidemia.

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Conflict of interest statement

The authors declare that they have no conflicts of interest.

References

1. Hertelyova Z, Salaj R, Chmelarova A, Dombrovsky P, Dvorakova MC, Kruzliak P. The association between lipid parameters and obesity in university students. *J Endocrinol Invest.* 2015; In press.

2. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. *J Family Med Prim Care*. 2015;4(2):187-192.

3. Kermanshahi H, Nazem F, Tavilani H, Jalili M. Study of Biochemical and Anthropometrical Risk Factors of the Cardiovascular Disease in Overweight-Obese and Normal Weight Adolescent Boys. *Scientific Journal of Hamadan University of Medical Sciences.* 2012; 18(4):15-21. [Persian]

4. Anand SS, Islam S, Rosengren A, Franzosi MG, Steyn K, Yusufali AH, et al. Risk factors for myocardial infarction in women and men: insights from the INTERHEART study. *Eur Heart J*. 2008;29(7):932-934.

5. Fumani A, Sharifan R, Zare M, Kazemi Z. Investigating the relationship of serum lipid and lipoprotein with body mass index (BMI). *Medical Science Journal Islamic Azad University-Mashhad Branch*. 2010; 6(2):117-122. [Persian]

6. Friedland O, Nemet D, Gorodnitsky N, Wolach B, Eliakim A. Obesity and lipid profiles in children and adolescents. *J Pediatr Endocrinol Metab*. 2002;15(7):1011-1016.

7. Ishizaka N, Ishizaka Y, Toda E, Koike K, Nagai R, Yamakado M. Impact of changes in waist circumference and BMI over one-year period on serum lipid data in Japanese individuals. *J Atheroscler Thromb*. 2009;16(6):764-771.

8. Kit BK, Kuklina E, Carroll MD, Ostchega Y, Freedman DS, Ogden CL. Prevalence of and trends in dyslipidemia and blood pressure among us children and adolescents, 1999-2012. *JAMA Pediatr*. 2015;169(3):272-279.

9. Taheri F, Kazemi T, Chahkandi T, Namakin K, Zardast M, Bijari B. Prevalence of Overweight, Obesity and Central Obesity among Elementary School Children in Birjand, East of Iran, 2012. *J Res Health Sci.* 2013;13(2):157-161.

10. Azita F, Asghar Z, Gholam-Reza S. Relationship of body mass index with serum lipids in elementary school students. *Indian J Pediatr*. 2009:76(7):729-731.

11. Hashemipour M Soghrati M, MalekAhmadi M, Soghrati M. Anthropometric indices associated with dyslipidemia in obese children and adolescents: a retrospective study in Isfahan, Iran. *ARYA Atheroscler.* 2011;7(1):31-39.

12. Horri M,Vakili R. Evaluation of cardiovascular and lipid profile abnormalities in obese children and adolescents. *Iran J Med Sci*. 2006;31(2):87-90.

13. Cook S, Kavey RE. Dyslipidemia and Pediatric Obesity. *Pediatr Clin North Am*. 2011;58(6):1363-1673.

14. Kaur S, Kapil U. Dyslipidemia among obese children in National Capital Territory (NCT) of Delhi. *Indian J Pediatr*. 2011;78(1):55-57.

15. Zarif Yeganeh M, Shakersain B, Azizi F, Yngve A, Hedayati M. Central obesity as a reliable predictor for hypertension and dyslipidemia: Tehran Lipid Glucose Study. Iranian *Journal of Endocrinology & Metabolism*. 2010;12(3):251-259. [Persian]

16. Rizk NM, Yousef M. Association of lipid profile and waist circumference as cardiovascular risk factors for overweight and obesity among school children in Qatar. *Int J Pediatr Obes*. 2011;6(Suppl)1:53-58.

17. Song L, Lu J, Song H, Liu H, Zhang W, Zhao H. Study on the relationship between obesity and lipid metabolism in children and adolescent in Yinchuan. *Wei Sheng Yan Jiu*. 2014;43(5):779-783.

18. Al-Ajlan AR. Lipid profile in relation to anthropometric measurements among college male students in Riyadh, Saudi Arabia: a cross-sectional study. *Int J Biomed Sci*. 2011;7(2):112-119.

19. Rocha FL, Menezes TN, Melo RL, Pedraza DF. Correlation between indicators of abdominal obesity and serum lipids in the elderly. *Rev Assoc Med Bras*. 2013;59(1):48-55.

20. Moreira-Andrés MN, del Cañizo-Gómez FJ, Losa MA, Ferrando P, Gómez de la Cámara A, Hawkins FG. Comparison of anthropometric parameters as predictors of serum lipids in premenopausal women. *J Endocrinol Invest*. 2004;27(4):340-347.

21. Stępień A, Stępień M, Wlazeł RN, Paradowski M, Banach M, Rysz J. Assessment of the relationship between lipid parameters and obesity indices in non-diabetic obese patients: a preliminary report. *Med Sci Monit*. 2014;16(20):2683-2688.