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The Prevalence of Dyslipidemia in Pediatric Obesity and its relation to Life Style of Obese Children

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Abstract. Background: Pediatric overweight contributes to adulthood obesity, leading to increased mortality and morbidity. There are a number of environmental and genetic factors that can have an effect on one's weight, including nutrition and physical activity. It is important to note that the prevalence of dyslipidemia in children and adolescents serves as a warning signal at both the individual and population levels. This is because having an excessive amount of body weight might lead to health concerns associated with dyslipidemia. Aim: To evaluate the prevalence of dyslipidemia and the relationship between metabolic health and dietary and physical activity habits in obese children and adolescents. Methodology: A cross-sectional and case control study was conducted on 62 children aged 4-14 years at Ibn-Sena Taching Hospital and and Alwafaa center for endocrine and diabetes mellitus from 1st February 2024 to 1st November 2024. The sample consisted of 22 obese children and 40 normal weight children without dyslipidemia. Data was collected through questionnaires, height, weight, BMI, waist circumference, and blood samples. Independent t-test and Fisher Exact test. Results: The study revealed that obese children have a mean age of 10.97 years, higher cholesterol, triglyceride, and LDL levels, and lower HDL levels. Only 4 of these children with higher waist circumference and BMI had dyslipidemia, a prevalence of 18.2%. These children had a family history of obesity. Playing video game was 75.0% in dyslipidemic obese children, and no significant differences was found in snacks. Conclusion: Children with a BMI over normal were frequently affected by dyslipidemia. Children with dyslipidemia were older and had elevated fundamental anthropometric measurements, such as waist circumference and BMI, compared to overweight and obese children without lipid abnormalities.

Highlights:

1. ediatric obesity links to adult dyslipidemia, morbidity, and genetic factors.
2. Cross-sectional study of 62 children; BMI, waist, and lipid tests.
3. Dyslipidemia in 18.2% obese children; high BMI, cholesterol, triglycerides.

Keywords: Dyslipidemia, Life style , Pediatric obesity, Prevalence

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Introduction

Overweight in children contributes significantly to the obesity pandemic in adults, which in turn increases the burden of death and illness in later life. Excessive fat buildup is a hallmark of overweight, which is controlled by environmental and genetic variables such as nutrition and physical activity (PA) (1).

Obesity and overweight among children and adolescents are becoming increasingly prevalent worldwide; the proportion of obese children rose from 0.9% and 0.7 in 1976 to 7.8% and 5.6 in 2016 for boys and girls, respectively (2). Central and Eastern Europe is likewise affected, even if the rate of this growth differs by nation (3). An even more concerning statistic is the high proportion of children who suffer from severe obesity, which can reach up to 5.5% in some groups (4).

Children who are overweight face a number of health and mortality risks, both now and in the future. In the pediatric population , obesity can have a number of negative consequences , including but not limited to the following : type 2 diabetes mellius, dyslipidemia , non-alcoholic fatty liver disease, hypertension, coronary heart disease, psychological disorders, and decreased educational atttainment (5-7).

The complicated emergence of overweight in children and adolescents is caused by a number of risk factors and mechanisms that are connected with one another. The decisions that people make in their lifestyles, such as insufficient or nonexistent physical activity, irregular eating patterns, and sleep disorders, appear to be major variables among the environmental factors that contribute to overweight and obesity (2, 8).

Research indicates that the incidence of dyslipidemia is lower in lean children compared to obese children, with rates ranging from 20% to over 40% (10, 11). In contrast to the overall pediatric population, the prevalence of aberrant lipid levels is expected to range from 8% to 20% (9).

The co-occurrence of obesity and cholesterol problems was evaluated in many populations, including those from Ghana, the United Arab Emirates, Brazil, Denmark, Germany, the United States, and China (9–15). However, to this day, there has been no publication of any data from comparable research conducted with a sizeable sample of children from a country in Central or Eastern Europe, which has experienced considerable shifts in social and economic status over the course of the last 30 years (16).

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At the individual and societal levels, the prevalence of lipid problems in children and adolescents should serve as a significant warning indicator. In addition to implementing efficient screening techniques for children who are overweight or obese at a young age (17), treatment approaches are also necessary. The implementation of appropriate diet and/or physical exercise has been shown time and time again to considerably enhance the lipid profile, mostly by altering the body fat percentage, in spite of the fact that there was no significant drop in weight (18).

Aim:

In the context of children and adolescents who are obese, the purpose of this study is to ascertain the prevalence of dyslipidemia as well as the association between patterns of dietary and physical activity and metabolic health.

Methods

Study design:

A hospital based cross-sectional and case control study of sample size (62) children aged (4-14 years) attended to the Ibn-sena Teaching Hospital and Alwafaa center for endocrine and diabetes mellitus during the period extended from 1st February 2024 to 1st November 2024. The studied sample was divided into 22 obese children and 40 normal weight child without dyslipidemia. Child with dyslipidemia but the weight within normal range, nephrotic syndrome, Type I diabetes Mellitus was excluded.

Data collecting tool:

Surveys to assess obesity and dyslipidemia. Waist circumference, height, weight, and body mass index (BMI) were evaluated. Blood samples for lipid profile assessment were collected from the participating children. Measure lipid profile by spectrophotometric analysis. Also the questionnaire involved the assessment of family history, going to school, taking snakes.

Body weight and body height:

It was determined that the child's weight could be accurately determined by using a digital scale (MensorWE150, Poland) while they were standing barefoot and wearing underwear. The body weight and height were recorded to the closest 0.1 kg and 0.001 m, respectively. Every day, the scale was adjusted to the correct reading. In order to determine the circumference of the waist, an ergonomic measuring tape (model 201;

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Seca GmbH & Co, KG, Hamburg, Germany) was utilized to take the measurement on a horizontal plane.

Laboratory parameters:

Laboratory testing was administered to all minors who were recruited no later than 30 days following their initial study session. The University Clinical Center's Central Clinical Laboratory collected venous blood samples between 7 and 9 a.m. after an overnight fast, processed them within 1 hour, and evaluated them within 6 to 8 hours (UCC).

The subsequent laboratory parameters were ascertained:

1. Lipid profile assessed with an enzymatic technique.
2. Blood glucose level was tested.

Taking into consideration the findings of the National Health and Nutrition Examination Surveys (NHANES) conducted in the United States of America and the Lipid Research Clinical (LRC) Prevalence Study, dyslipidemia is defined as having triglycerides (TG) > 1.7 mmol/L (150 mg/dL), total cholesterol (TC) > 5.2 mmol/L (200 mg/dL), LDL-C > 3.4 mmol/L (130 mg/dL), or HDL-C < 1.03 mmol/L (40 mg/dL) (19, 20). The 95th percentile of the American population is represented by these results.

The research was executed in compliance with the Helsinki Declaration, receiving authorization from an independent bioethics committee at the University of Nineveh/College of Pharmacy (permission number: 2024047). The child's involvement in the program required the written approval of each parent or legal guardian.

Statistical analysis:

The t-test for independent two means was used to compare the numerical parameters between the studied groups and the Fisher Exact test for the categorical parameters. Pearson correlation coefficient was estimated. The p value ≤ 0.05 considered significant. The analysis was done by SPSS-26.

Result and Discussion

The mean age of obese children was 10.97±2.461 years as demonstrated in table (1). Moreover, among the males, the mean age was 10.9±2.079 years and among the females was 11.04±2.832 years.

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Table (1): Mean age in years among the studied sample.

Age /years	Mean	Standard deviation
Males	10.90	2.079
Females	11.04	2.832
Total	10.97	2.461

The figure (1) illustrated the statistical characteristics of the waist circumference and BMI of the studied sample and showed that the mean waist circumference was 95.22 cm, the median was 94.5 cm, minimum and maximum values of 70.0 cm and 124.0 cm respectively. BMI mean and median were 32.2 and 31.0 respectively, the minimum and maximum values were 25.0 and 58.0 in that order.

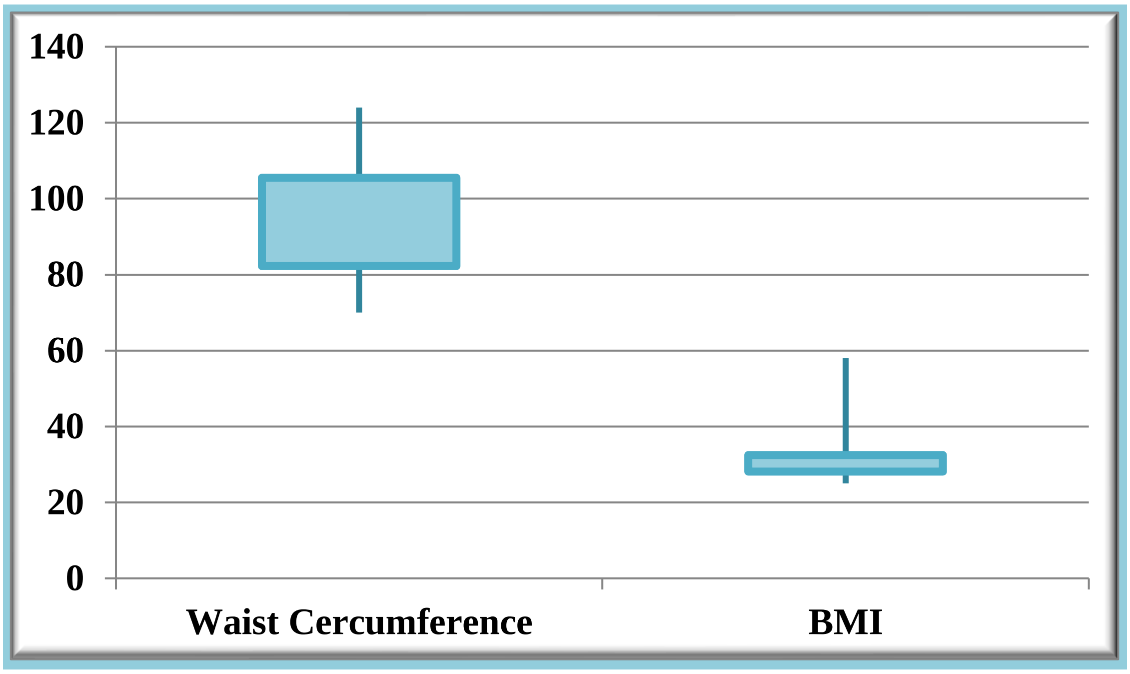

Figure (1): Statistical characteristics of waist circumference and BMI.

The correlation of the BMI of obese children with the lipid profile was demonstrated in table (2) which showed significant direct correlations with cholesterol, triglyceride, and LDL while the correlation with HDL was indirect with statistically significant association.

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Table (2): Association between the BMI of obese children and their lipid profile.

Correlations of BMI with	Value	Std. Error	Approx. T	p-value
Cholesterol	0.307	0.155	0.482	0.035
Triglyceride	0.260	0.108	0.267	0.002
HDL	-0.119	0.074	-0.537	0.049
LDL	0.225	0.116	1.033	0.014
Atherogenic index	0.187	0.108	0.849	0.406
Blood sugar	0.117	0.136	0.527	0.604

When comparing the mean levels of lipid profile between obsess and normal BMI children, the cholesterol, triglyceride, LDL were higher among the obese children in relation with their levels among the normal BMI children; these differences were statistically significant, conversely, the HDL mean level among the obese was significantly lower, as shown in table (3).

Table (3): Comparison of the lipid profile between obsess and normal BMI children.

	Overweight and obese group (n=22)	Normal BMI group (n=40)	p-value*
	Mean ±SD	Mean ±SD	
Cholesterol	160.04±42.789	134.23±4.574	0.000
Triglyceride	102.71±27.418	89.728±3.833	0.004
HDL	37.43±12.189	46.55±6.932	0.000
LDL	112.45±5.601	63.60±6.223	0.000
Atherogenic index	5.150±1.104	4.56±2.887	0.361

**Independent t-test for two means*

*Independent t-test for two means

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Out of the 22 included overweight and obsess children, only 4 children showed dyslipidemia and the prevalence of dyslipidemia was 18.2% as demonstrated in figure (2).

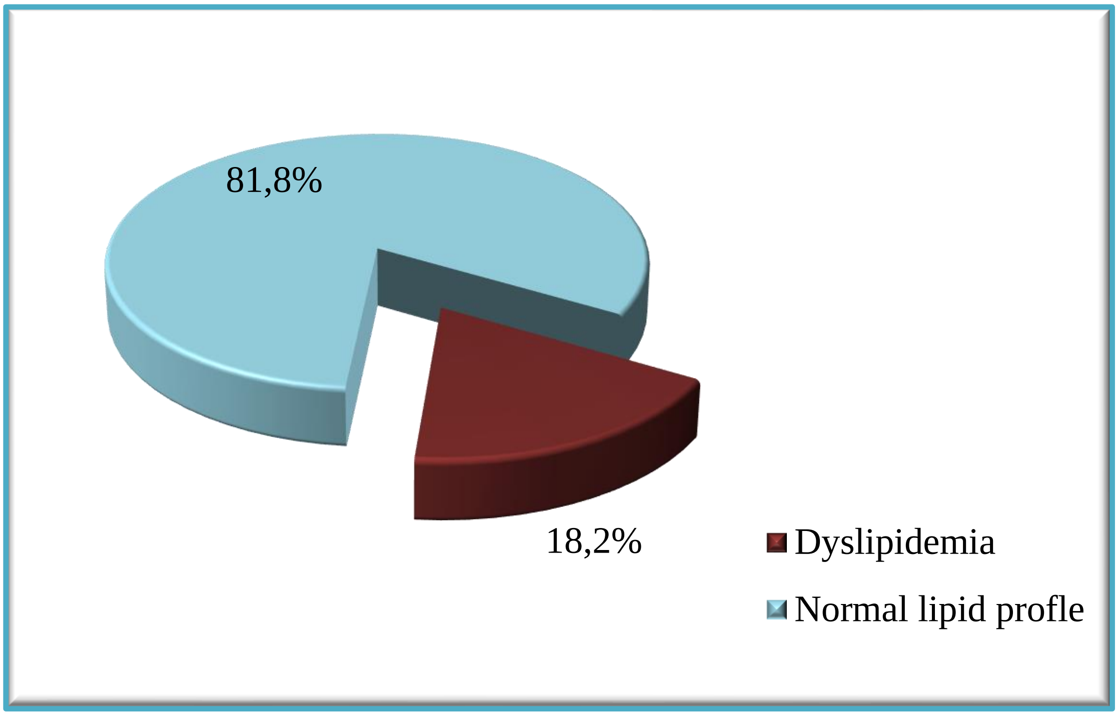

Figure (2): Prevalence of dyslipidemia.

Comparison of the studied parameters between Dyslipidemic and normal lipid cases demonstrated that obsess children with dyslipidemia were older than those with normal lipid profile with a statistically significant difference (p=0.038). Moreover, the waist circumference and BMI among the Dyslipidemic obese children were 105.25±9.328 cm and 34.25±2.787 respectively which were significantly higher than those among the obese children with normal lipid profile. The differences regarding D3 level and blood sugar were statistically not significant as shown in table (4).

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Table (4): Comparison of the studied parameters between Dyslipidemic and normal lipid cases.

	Dyslipidemia group (n=4)	Normal lipid group (n=18)	p-value*
	Mean ±SD	Mean ±SD	
Age (years)	13.25±0.957	10.472±2.416	0.038
Waist Circumference (cm)	105.25±9.328	93.00±7.051	0.007
BMI	34.25±2.787	31.75±1.483	0.017
D3 (ng/mL)	10.50±2.516	10.04±4.485	0.849
Blood sugar (mg/dL)	79.25±15.129	80.97±31.334	0.917

**Independent t-test for two means*

Comparison of the studied parameters between Dyslipidemic and normal lipid cases was shown in table (5). This table elicited that all the obese children with dyslipidemia had family history of obesity while only 33.3% of obese children with normal lipid had positive family history; the difference was statistically significant (p=0.029). Video game was reported among 75.0% of Dyslipidemic obese children and among only 16.7% of the normal lipid obese children; the difference was statistically significant (p=0.046). Going to school and snacks showed no significant difference.

Table (5): Comparison of the studied parameters between Dyslipidemic and normal lipid cases.

		Dyslipidemia group (n=4)	**Normal lipid group (n=18)**	**p-value***
		No. (%)	**No. (%)**	
Family history	**Yes**	4(100.0)	6(33.3)	**0.029**
	No	0(0.0)	12 (66.7)	
Go to school	**Car**	3(75.0)	4(22.2)	0.077
	Bicycle	1(25.0)	14(77.8)	
Video game	**Yes**	3(75.0)	3(16.7)	**0.046**
	No	1(25.0)	15(83.3)	

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Snacks	**Yes**	1(25.0)	8(44.5)	0.616
	No	3(75.0)	10(55.5)	
**Fisher Exact test*				

Discussion:

Chronic energy imbalance including food consumption and physical exercise leads to obesity (21). In this century, one of the biggest public health problems is the rising incidence of childhood and teenage obesity. Numerous organs can be negatively impacted by childhood obesity, and it raises the chance of chronic illnesses such dyslipidemia (22).

The present study showed that the mean age of the obese children was 10.97±2.461 years, which was corresponding to that reported by Dündar et al., (23), in which the mean age of the patients was 11.4 ± 3.0 years.

Presented correlations showed statistical significance, indicating substantial direct relationships of BMI with LDL, triglycerides, and cholesterol, but an indirect link with HDL that was statistically significant, this results was clearly differed from that concluded by Brzeziński et al., (17), which did not demonstrate any significant correlation between the measured anthropometric parameters, birth weight, or gestational age at birth, and the various lipids.

LDL, cholesterol, and triglyceride values were substantially higher in the high BMI group than in the normal BMI group ($p < 0.05$). Among the risk factors for CVD, lipids are particularly significant. Numerous studies have demonstrated that pediatric obesity is linked to low HDL-C levels and elevated TC, LDL-C, and TG levels (24, 25). If insulin resistance is present, lipidosis will become more severe, and an increased amount of fatty acids will be released into the bloodstream. There is an increase in the synthesis of triglycerides, the secretion of very low-density lipoprotein (VLDL), and the entry of free fatty acids into the liver. Hypertriglyceridemia then appears. Cholesteryl esters take the role of VLDL in both HDL and LDL for the VLDL-triglyceride complex.

Shrinkage happens when triglyceride-rich HDL and LDL undergo lipolysis. HDL leaves the circulation quite quickly. Then, an atherogenic lipid profile develops, which includes low HDL, high triglycerides, and high LDL-C (10, 26).

According to the Bogalusa Heart Study, elevated BMI between the ages of 5 and 17 was linked to aberrant levels of insulin, TG, LDL, and HDL (27). Our study indicated

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that BMI and TG levels were positively correlated, but BMI and HDL-C were negatively correlated. There was no relationship between BMI and either TC or LDL-C values. A research on the risk factors for CVD revealed that waist circumference SDS was a useful signal for dyslipidemia and BMI-SDS was a significant predictor for hypertension (28). Despite the fact that obesity is defined by a variety of factors, visceral fat, or waist circumference, is a good indicator of insulin resistance, fatty liver, cholesterol levels, and hypertension (29, 30).

In the current study, 18.2% of participants had dyslipidemia. In various communities, obese children were shown to have varying rates of dyslipidemia (31-34). Deeb et al. (31) discovered that 55.3% of children who were obese had dyslipidemia, whereas Brzezinski et al. (32) estimated that the frequency was almost 69.9%. In addition to decreased HDL and higher LDL readings, Korsten-Reck et al. (33) discovered a 45.8% incidence of dyslipidemia in obese children. Hypertriglyceridemia was the most prevalent single lipid anomaly in a prior study of Turkish children, which found that 42.9% of them had dyslipidemia (34). Atabek et al. found that 47.3% of people in Turkey had dyslipidemia. The same center conducted a second research in 2013 that found that among children who were obese, this percentage rose to 51.9% (35, 36). This indicated that the prevalence of obesity-related dyslipidemia in Turkish children was likely to rise.

BMI and dyslipidemia have been linked in recent research on overweight people. According to the current study, there were statistically significant differences in age, waist circumference, and BMI between the obese children with dyslipidemia and those with a normal lipid profile. According to a research by Suarez et al. (37) 30% of people had cholesterol levels that were near possible danger levels, 16% had triglycerides, and 28% had LDL cholesterol. Overweight people's lipid levels were found to differ considerably from the general population's. Similar research indicates that abnormal levels for LDL, HDL, triglycerides, and cholesterol are linked to obesity. Lipid levels of overweight children (38–40) showed significant abnormalities. The levels of HDL cholesterol were lower in children who were overweight, while the levels of LDL cholesterol, triglycerides, and cholesterol were higher in children who were overweight. This was in comparison to children who were of normal weight (39–41). According to a research by Reck et al., 45.8% of overweight children had aberrant lipid profiles (33). According to a related study, obese children's LDL cholesterol is nine times higher than

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that of children of normal weight (42). However, one study found no correlation between LDL levels and BMI (43). Additionally, A similar conclusion was reached in the Dündar et al. study (23). According to previously published findings from studies conducted in Europe and other continents (9, 11–13), children with lipid problems were older and had greater waist circumference, body fat percentage, and BMI percentile values. The anthropometric measurements, however, don't seem to have any clinical relevance. Bioimpedancy levels and mean age/BMI do not differ significantly. According to Meral et al.'s study (44), there was no statistically significant difference in HDL levels between the groups with normal and high BMIs.

All of the obese children with dyslipidemia in the current research sample had a family history of obesity; this was much greater than the percentage identified in the Tawfik et al. study (45), when 61% of the study's participants had a family history. The current findings were also greater than those reported by Pretto et al. (46) among Brazilian children aged 8 years, with 48.5% of them having a family history.

Numerous research have looked at the connection between obesity and TV and video game playing, but there aren't many that examine the connection between computer game addiction and obesity (47). Significant statistical differences between individuals with and without dyslipidemia were discovered in this investigation. According to a research by Kocakoğlu et al. (47) children's BMI percentile values increased as their daily computer game playing time increased. A research by Goldfield et al. (48) found a strong correlation between blood lipid levels and blood pressure and computer game playing. According to our research, playing video games might trigger impulsive eating and energy-dense snacking, which can raise blood cholesterol levels.

The current study's limited sample size may be the reason for the lack of substantial differences in lifestyle, snacks negative behaviors, and school attendance.

Conclusion

Children with a BMI exceeding the usual range were often impacted by dyslipidemia. Children with dyslipidemia were older and had elevated fundamental anthropometric measurements, such as waist circumference and BMI, compared to overweight and obese children without lipid abnormalities

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Authors' Contribution

Concept: Frdoos Hameed Abow, Esraa Azzam Altaan; data collection or processing: Esraa Azzam Altaan; analysis or interpretation and literature search: Zahraa Hazim Alsarraf; writing: Zahraa Hazim Alsarraf and Frdoos Hameed Abow

Conflict of Interests

The authors assert that they possess no conflicting interests.

Ethical Approval

This study was approved by the University of Nineveh/ College of Pharmacy in addition to Ethics Committee of Nineveh MOH (approval number: 2024047).

Funding/Support

This study was approved by the University of Nineveh/ College of Pharmacy in addition to Ethics Committee of Nineveh MOH (approval number: 2024047).

Informed Consent

All children and their guardians provided consent to participate in the study

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