

Dyslipidemia and Associated Risk Factors in Obese Children and Adolescents

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Factors in Obese
Children

Muhammad Abdul Quddus¹, Nisar Ahmed², Irum Javed³, Rabia Tahir⁴,
Shahid Iqbal⁴ and Syed Muhammad Sajid Ali Bukhari⁴

ABSTRACT

Objective: To determine the prevalence and associated factors of dyslipidemia (DLD) in obese children and adolescents

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Sheikh Khalifa Bin Zayed Al Nahyan Hospital, Rawlakot, Azad Kashmir, Pakistan from January 2024 to June 2024.

Methods: Children and adolescents aged 5 to 18 years, with a body mass index (BMI) at or above the 95th percentile for their age and gender, were analyzed. Participants underwent fasting blood tests to assess lipid levels. Associations between DLD and categorical variables (diet, physical activity, family history) were assessed using chi-square test taking $p < 0.05$ as statistically significant.

Results: In a total of 189 participants, 103 (54.5%) were boys. The mean age, BMI, and waist circumference were 11.93 ± 4.09 years, 29.02 ± 3.96 kg/m², and 93.47 ± 9.46 cm, respectively. Dyslipidemia was diagnosed in 99 (52.4%) participants. Sedentary life style (79.8% vs. 63.3%, $p = 0.021$), family history of DLD (48.5% vs. 27.8%, $p = 0.003$), screen time ≥ 2 hours/day (74.7% vs. 5.4%, $p = 0.003$), and sleep duration < 8 hours/day (50.5% vs. 34.4%, $p = 0.026$) were found to have significant association with DLD.

Conclusion: This study demonstrated a high prevalence of DLD among obese children and adolescents, with significant associations with sedentary lifestyle, family history, prolonged screen time, and reduced sleep duration.

Key Words: Body mass index, dyslipidemia, fasting, lipids, obesity.

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INTRODUCTION

Obesity and its associated metabolic complications have risen alarmingly in pediatric populations worldwide.¹ Among these complications, dyslipidemia (DLD) is particularly concerning due to its role in increasing the risk of cardiovascular diseases (CVD) and type 2 diabetes mellitus (T2DM).² DLD refers to abnormal levels of blood lipids—total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG).³

The global prevalence of childhood obesity is estimated to be around 8.5%,⁴ while data from adolescent

population from USA⁵ has revealed 21% prevalence of obesity. Recent data shows rapid increase in obesity in both developed and developing nations.⁶

The mechanisms linking obesity to DLD are complex, involving metabolic, genetic, and environmental factors.⁷ Excess adipose tissue, particularly in the abdominal region, promotes insulin resistance, a key factor in lipid metabolism dysfunction.⁸ Insulin resistance creating an atherogenic lipid profile also increases CVD risk.⁹

Identifying DLD and its associated risk factors in pediatric populations is essential to prevent early onset of CVD and related complications. While extensive research has focused on DLD in adults, fewer studies target obese children, despite the increasing prevalence and potential for lifelong health impacts. Many studies focus on genetic factors, overlooking lifestyle and behavioral factors such as diet, physical activity, and socioeconomic status, which significantly contribute to DLD risk. This study aimed to determine the prevalence and associated factors of DLD in obese children and adolescents. The findings of this study may provide valuable insights into potential early interventions and public health strategies to address DLD in obese youth.

¹. Department of Gastroenterology / Cardiology/ Pediatrics / Medicine, Poonch Medical College, Rawalakot, AJK, Pakistan.

Correspondence: Dr. Shahid Iqbal, Department of Pediatric Medicine, Poonch Medical College, Rawalakot, AJK, Pakistan.

Contact No: 0345 1301886

Email: shahidbagh1977@gmail.com

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METHODS

This study was a cross-sectional observational analysis conducted at the outpatient department of pediatrics, Sheikh Khalifa Bin Zayed Al Nahyan Hospital, Rawlakot, Azad Kashmir, Pakistan, during January 2024 to June 2024. Approval from Institutional Ethics Committee was obtained (letter number: 1107, dated: 08-06-2023). Informed and written consents were taken from parents/guardians. Inclusion criteria were children and adolescents aged 5 to 18 years, with a BMI at or above the 95th percentile for their age and gender, indicating obesity according to standard growth charts. Exclusion criteria were participants with known genetic lipid disorders like familial hypercholesterolemia, or metabolic syndrome. Participants with known diabetes mellitus or renal disease were also excluded. Participants currently taking lipid-lowering medications or corticosteroids were also not included. A sample size of 189 was calculated considering the proportion of DLD in children and adolescents as 40%,¹⁰ with 95% confidence level and 7% margin of error. Non-probability, consecutive sampling technique was adopted.

Children and adolescents fulfilling the eligibility criteria were enrolled from outpatient department and demographic characteristics along with anthropometric measurements, including weight, height, and waist circumference were documented. Children and adolescents with a BMI at or above the 95th percentile for their age and gender, according to growth charts were termed obese. Participants underwent fasting blood tests to assess lipid levels, including TC, LDL-C, HDL-C, and TG. The presence of DLD was determined based with any of these: elevated TC (≥ 200 mg/dL), elevated LDL-C (≥ 130 mg/dL), low HDL-C (≤ 40 mg/dL for males and ≤ 45 mg/dL for females), or elevated TG (≥ 150 mg/dL). Pubertal status was labeled based on the participant's age, using general age ranges associated with different stages of puberty as pre-pubertal (5-9 years), pubertal (10-14 years), and post-pubertal (15-18 years). Physical activity was termed sedentary if < 30 minutes of moderate to vigorous physical activity per day or fewer than 3 days of activity per week; moderately if around 30-60 minutes of moderate activity on most days of the week, but not meeting the full recommendations for active status; and active if a least 60 minutes of moderate to vigorous physical activity per day, such as running, cycling, sports, or structured exercises, on 5 or more days per week.

Statistical analysis was performed using SPSS. Descriptive statistics summarized participant characteristics and lipid profiles. Associations between DLD and categorical variables (diet, physical activity, family history) were assessed using chi-square test taking $p < 0.05$ as statistically significant.

RESULTS

In a total of 189 participants, 103 (54.5%) were boys, and 86 (45.5%) girls. The mean age, BMI, and waist circumference were 11.93 ± 4.09 years, 29.02 ± 3.96 kg/m², and 93.47 ± 9.46 cm, respectively. Residential status of 123 (65.1%) participants was rural. Socio-economic status of 94 (49.7%) participants was low. Physical activity evaluation revealed that 56 (29.6%) had sedentary life style. Family history of DLD was documented in 73 (38.6%) children. The mean screen time, and sleep duration were 2.89 ± 1.41 hours/day, and 8.13 ± 1.19 hours/day, respectively. The mean BMI was 29.02 ± 3.96 kg/m². Table-1 shows characteristics of children and adolescents.

Table No. 1: Characteristics of obese children and adolescents

Characteristics		Frequency (%)
Age	5-9	57 (30.2%)
	10-18	132 (69.8%)
Gender	Boys	103 (54.5%)
	Girls	86 (45.5%)
Residence	Urban	66 (34.9%)
	Rural	123 (65.1%)
Socio-economic status	Low	56 (29.6%)
	Medium	94 (49.7%)
	High	39 (20.6%)
Physical activity	Sedentary	136 (72.0%)
	Moderately active	37 (19.6%)
	Active	16 (8.5%)
Family history of dyslipidemia		73 (38.6%)
Screen time (hours/day)	< 2	66 (34.9%)
	≥ 2	123 (65.1%)
Sleep duration (hours/day)	< 8	81 (42.9%)
	≥ 8	108 (57.1%)
Pubertal status	Pre-pubertal	57 (30.2%)
	Pubertal	70 (37.0%)
	Post-pubertal	62 (32.8%)

Dyslipidemia was diagnosed in 99 (52.4%) participants. Details about the lipid profiling of study participants are shown in figure-1.

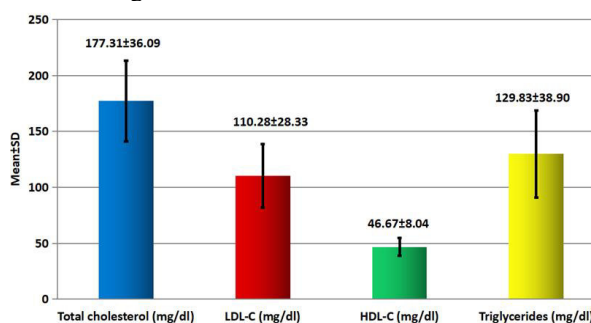


Figure No. 1: Lipid profiling of study participants

Sedentary life style (79.8% vs. 63.3%, $p = 0.021$), family history of DLD (48.5% vs. 27.8%, $p = 0.003$), screen

time ≥ 2 hours/day (74.7% vs. 5.4%, $p=0.003$), and sleep duration < 8 hours/day (50.5% vs. 34.4%, $p=0.026$) were found to have significant association with DLD. Age ($p=0.189$), gender ($p=0.077$), residence

($p=0.861$), socio-economic status ($p=0.100$), and pubertal status ($p=0.414$) did not seem to have any significant linkage with DLD (table-2).

Table No. 2: Association of dyslipidemia with characteristics of obese children and adolescents (N=189)

Characteristics		Dyslipidemia		P-value
		Yes (n=99)	No (n=90)	
Age	5-9	34 (34.3%)	23 (25.6%)	0.189
	10-18	65 (65.7%)	67 (74.4%)	
Gender	Boys	60 (60.6%)	43 (47.8%)	0.077
	Girls	39 (39.4%)	47 (52.2%)	
Residence	Urban	34	32	0.861
	Rural	65	58	
Socio-economic status	Low	34 (34.3%)	22 (24.4%)	0.100
	Medium	50 (50.5%)	44 (48.9%)	
	High	15 (15.2%)	24 (26.7%)	
Physical activity	Sedentary	79 (79.8%)	57 (63.3%)	0.021
	Moderately active	12 (12.1%)	25 (27.8%)	
	Active	8 (8.1%)	8 (8.9%)	
Family history of dyslipidemia		48 (48.5%)	25 (27.8%)	0.003
Screen time (hours/day)	<2	25 (25.3%)	41 (45.6%)	0.003
	≥ 2	74 (74.7%)	49 (54.4%)	
Sleep duration (hours/day)	<8	50 (50.5%)	31 (34.4%)	0.026
	≥ 8	49 (49.5%)	59 (65.6%)	
Pubertal status	Pre-pubertal	34 (34.3%)	23 (25.6%)	0.414
	Pubertal	35 (35.4%)	35 (38.9%)	
	Post-pubertal	30 (30.3%)	32 (35.6%)	

DISCUSSION

This study found that 52.4% obese children and adolescents had DLD reflecting a substantial prevalence of lipid abnormalities in this population. The prevalence of DLD in our study aligns with existing literature, though some variation exists across studies. Our finding of 52.4% DLD prevalence is consistent with studies such as the one by Dundar and Akinci,¹¹ which reported DLD in 56.7% of obese children. This similarity highlights the burden of DLD in obese youth and supports the need for routine lipid screening in this population to address potential cardiovascular risks early. Deeb et al.,¹² reported that 55.3% obese children exhibited DLD, underscoring the strong association between obesity and DLD. Selin Elmaogullari et al. reported a slightly lower DLD prevalence of 42.9% in Turkish obese children, indicating that regional dietary habits, lifestyle, and genetic factors may contribute to variations in DLD prevalence among different populations.¹³

DLD was strongly associated with sedentary lifestyle and high screen time. Brzeziński et al., found that lifestyle factors, especially physical inactivity and prolonged screen time, contributed significantly to adverse lipid profiles in obese children.¹⁰ This association reflects the role of sedentary behavior in the development of DLD and mirrors findings from

Brzeziński et al., who also reported high DLD rates among children with prolonged screen time.¹⁰ Excessive screen time typically replaces physical activity, leading to increased obesity risk and lipid abnormalities.^{14,15} Additionally, sleep duration was inversely associated with DLD in this study, with DLD present in 50.5% of children sleeping less than 8 hours per day, compared to 34.4% of those with adequate sleep ($p=0.026$). Sinha et al.,¹⁶ noted that insufficient sleep is associated with metabolic disruptions and poor lipid profiles in obese youth.¹⁶ Mascarenhas et al., reported that children from low socioeconomic backgrounds tend to have poorer lipid profiles due to limited access to healthy foods and physical activity opportunities.¹⁷ The significant association between sedentary lifestyle and DLD prevalence in this study aligns with findings from Mascarenhas et al., who observed that reduced physical activity is closely linked to DLD and obesity in pediatric populations.¹⁷ This study found that 79.8% of DLD participants had sedentary lifestyle, while only 63.3% of non-DLD participants were sedentary ($p=0.021$). These findings suggest that physical inactivity can exacerbate lipid metabolism disruptions, leading to elevated triglycerides and low HDL-C levels. Dundar and Akinci also noted that physical activity could counteract the effects of obesity on lipid profiles by enhancing HDL-C levels and reducing triglycerides.¹¹ Given these

consistent findings, our study reinforces the recommendation for incorporating structured physical activity into the daily routines of obese children as a preventive measure against DLD.¹⁸

The association between family history of DLD and lipid abnormalities in this study is consistent with findings from Elmaogullari et al,¹³ and Sinha et al,¹⁶ who both observed higher DLD rates in children with a positive family history. In this study, 48.5% of DLD children had a family history of DLD, compared to 27.8% of non-DLD children ($p=0.003$). This association suggests a potential genetic predisposition to DLD, as well as the influence of shared familial lifestyle patterns, such as diet and physical inactivity, that may increase DLD risk.¹⁹ In clinical settings, family history should be taken into account during risk assessment, and proactive measures should be recommended to families with known DLD history to mitigate risks.²⁰

Routine lipid screening should be considered for obese youth to identify at-risk individuals early, while promoting healthy behaviors.^{21,22} Given the strong association between family history and DLD, clinicians should incorporate family medical history into risk assessments for pediatric DLD.^{23,24} School and community health programs aimed at reducing sedentary time and promoting physical activity could be instrumental in addressing this public health concern among children and adolescents.²⁵

This study has several limitations that warrant consideration. First, the cross-sectional design precludes establishing causality between lifestyle factors and DLD. While associations were observed, it is unclear whether lifestyle factors led to DLD or if pre-existing lipid abnormalities influenced participants' behavior. Second, reliance on self-reported data for physical activity, screen time, and sleep duration may introduce reporting bias. Objective measurements or validated questionnaires could provide more accurate data. This study did not evaluate other potentially relevant factors such as dietary patterns, liver function tests, or hormonal profiles, which could offer further insights into DLD in obese youth.

CONCLUSION

This study demonstrated a high prevalence of DLD among obese children and adolescents, with significant associations with sedentary lifestyle, family history, prolonged screen time, and reduced sleep duration. These findings underscore the importance of lifestyle interventions, including promoting physical activity, reducing screen time, and ensuring adequate sleep in pediatric populations. Considering the role of genetic factors, family history should also be incorporated into DLD risk assessments. By addressing modifiable risk factors early, this can potentially reduce the long-term

cardiovascular risks associated with pediatric DLD, promoting better health outcomes in adulthood.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Muhammad Abdul Quddus, Nisar Ahmed, Irum Javed
Drafting or Revising Critically:	Rabia Tahir, Shahid Iqbal, Syed Muhammad Sajid Ali Bukhari
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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