

A Randomised Clinical Assessment of Early Cardiovascular Risk Profiles among School Students with Elevated BMI

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Abstract: *Childhood and adolescent obesity is increasingly recognized as a precursor to early cardiovascular disease (CVD)¹. This study aimed to evaluate early biochemical and metabolic markers of cardiovascular risk—specifically lipid profile, apolipoproteins, homocysteine, high-sensitivity C-reactive protein (hs-CRP), and thyroid function—among school-aged students with elevated body mass index (BMI), to identify early atherogenic and inflammatory changes predisposing to future CVD.*

Keywords: Childhood obesity, Dyslipidaemia, Homocysteine, hs-CRP, Cardiovascular risk, School health

1. Introduction

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality worldwide, accounting for a significant proportion of premature deaths in both developed and developing nations¹. While traditionally considered an adult health concern, growing evidence suggests that the early determinants of cardiovascular risk often originate during childhood and adolescence¹. Factors such as obesity, hypertension, dyslipidemia, sedentary lifestyle, and unhealthy dietary patterns, once rare in pediatric populations, are now increasingly prevalent among school-aged children². Early identification and intervention in this demographic could substantially alter the trajectory of cardiovascular health in later life.

The school environment presents a unique and practical setting for early screening, prevention, and education, as it encompasses a large segment of the youth population during formative years.

This study aims to conduct a **randomized clinical evaluation** to assess the prevalence and early indicators of cardiovascular risk factors among school students with elevated BMI.

2. Methods

Study design and setting

This randomized clinical evaluation was conducted among school students aged 12–18 years at Akash International School, Devanahalli, Bangalore, India, during September 2025. The study aimed to assess early biochemical and metabolic markers associated with cardiovascular risk among obese adolescents.

Study population

A total of 10 obese school students were randomly selected from a screened cohort based on body mass index (BMI >

22.9 kg/m²). Each participant underwent detailed anthropometric assessment and biochemical evaluation.

Inclusion criteria

- 1) Age between 12 and 18 years.
- 2) BMI > 22.9 kg/m² (WHO Asia-Pacific classification for overweight/obesity).
- 3) Clinically healthy and attending regular school activities.
- 4) Availability of written informed consent from both the student and guardian.

Exclusion criteria

- 1) Known metabolic or endocrine disorders (diabetes mellitus, thyroid disease, or metabolic syndrome).
- 2) Chronic inflammatory or infectious diseases.
- 3) History of cardiovascular, renal, or hepatic disorders.
- 4) Recent use of vitamin B12 or folate supplementation (within 3 months).
- 5) Current or recent use of lipid-lowering, hormonal, or immunomodulatory drugs.

Study procedure

Eligible students were evaluated following standardized protocols.

Anthropometric measurements: Height and weight were recorded using calibrated instruments, and BMI was calculated as weight (kg)/height² (m²).

Blood sampling: 5 mL of venous blood was collected under aseptic precautions. Serum was separated by centrifugation and analyzed within 2 hours.

Biochemical analysis:

The following parameters were measured:

Advanced lipid profile: HDL-C, LDL-C, triglycerides, Apo A1, and Apo B, inflammatory marker: High-sensitivity C-reactive protein (hs-CRP), metabolic marker: Homocysteine, hormonal marker: Thyroid-stimulating hormone (TSH)

3. Results

Inflammatory, Metabolic and Hormonal Profile

Sl No	hs-CRP (mg/dl)	Homocysteine (μmol/L)	TSH (μIU/mL)	RBS (mg/dl)
Normal range	<3	5-15	0.4-4.0	<140
1	5.8	12.61	4.02	99.7
2	2.7	14.1	2.9	89.8
3	1.9	27.47	0.881	82.2
4	0.9	13.3	2.5	93.4
5	0.6	31.1	0.926	112.3
6	3.4	25.21	1.89	83
7	1.2	16.2	2.23	87.4
8	1.1	65	1.35	82.7
9	5.2	9.77	2.99	82
10	0.2	25.43	1.05	70.7

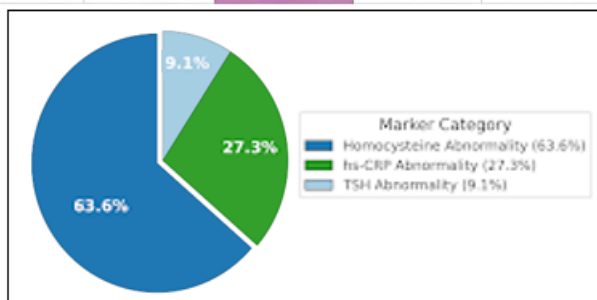


Figure 1.2: Distribution of Abnormal Biochemical Markers (Homocysteine, hs- CRP, and TSH)

S.No.	BMI (kg/m ²)	HDL (mg/dL)	LDL (mg/dL)	Triglycerides (mg/dL)	Apo A1 (mg/dL)	Apo B (mg/dL)	Apo B/A1 ratio	Lp(A)
Normal Range	18.5–22.9 (Asian)	>40 (M)/>50 (F)	<100	<150	110–180	55–125	<0.9	<30
1	30.3	38	90	172	116	76	0.7	15.6
2	28.9	33	110	137	108	88	0.8	5.6
3	27.9	41	84	78	107	68	0.6	26.7
4	26.8	27	77	234	89	74	0.8	86.9
5	26.6	34	64	149	97	57	0.6	20.2
6	24.4	36	56	38	94	54	0.6	2.8
7	24.2	51	88	111	124	69	0.6	9.8
8	23.9	43	74	108	116	64	0.5	4.3
9	23.7	47	70	137	124	59	0.5	6.5
10	23.1	34	107	97	135	58	0.8	20

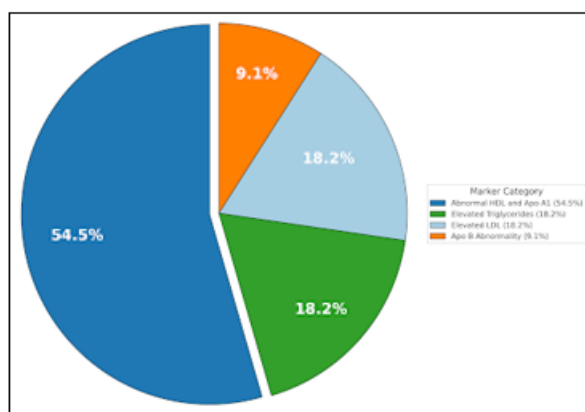


Figure 2.2: Proportion of Abnormalities in Lipid Profile

Among the 10 obese school students assessed, multiple deviations from established reference ranges were identified (Tables 2.1 and 2.2). All participants (100%) exhibited BMI values above the Asian cut-off for normal weight, confirming obesity across the study cohort. Low HDL cholesterol was observed in 60% (6/10) of students, indicating reduced cardioprotective lipoprotein levels.

Evaluation of inflammatory, metabolic and hormonal parameters (Figure 1.1&1.2) revealed that homocysteine elevation was the most frequent abnormality, detected in 6 out of 10 students (60%), suggesting early endothelial dysfunction and vascular risk. High-sensitivity C-reactive protein (hs-CRP) was elevated in 3 students (30%), indicating a state of subclinical inflammation. Mild TSH elevation was observed in one student (10%), suggesting borderline hypothyroid tendency, which may further contribute to metabolic imbalance. All students (100%) had RBS values within the normal range (<140 mg/dL), indicating normal glycaemic status.

The combined pattern of raised hs-CRP and homocysteine underscores early biochemical evidence of metabolic inflammation and cardiovascular risk even among asymptomatic obese adolescents.

Advanced Lipid Panel/ Extended Cardiac Risk Profile

Elevated LDL cholesterol (>100 mg/dL) was present in 20% (2/10) of participants. Hypertriglyceridemia (>150 mg/dL) was also detected in 20% (2/10) of the cohort, including one student with markedly elevated levels. Apolipoprotein analysis revealed reduced Apo A1 concentrations (<110 mg/dL) in 40% (4/10) of students, while Apo B levels remained within the reference range in all participants, with no cases reminding above the upper limit. The Apo B/A1 ratio was below the high-risk threshold (<0.9) in 100% (10/10) of the students. Elevated lipoprotein(a) [Lp(a)] levels (>30 mg/dL) were identified in 10% (1/10) of participants.

Overall, the findings indicate a high burden of obesity-associated dyslipidemia characterized predominantly by low HDL cholesterol, reduced Apo A1 levels, and hypertriglyceridemia, while maintaining largely normal LDL cholesterol, Apo B levels, and Apo B/A1 ratios. This pattern suggests early metabolic and cardiovascular risk in obese school-aged children, underscoring the importance of early screening and preventive interventions.

4. Discussion

This randomized clinical assessment demonstrates that school students with elevated BMI already exhibit early cardiovascular risk driven by interrelated metabolic and inflammatory mechanisms³. Excess adiposity alters lipid metabolism through insulin resistance and adipokine dysregulation, resulting in a characteristic dyslipidemic profile². The predominance of low HDL cholesterol, elevated triglycerides, and reduced Apo A1 levels indicates impaired reverse cholesterol transport and early qualitative lipoprotein dysfunction, even though LDL cholesterol and Apo B levels were largely within normal limits. These findings suggest that atherogenic changes in childhood obesity begin with functional lipid abnormalities before overt quantitative lipid elevation.

Inflammation and endothelial dysfunction further contribute to early atherogenesis². Elevated hs-CRP reflects chronic low-grade inflammation associated with adipose tissue expansion, while the high prevalence of hyperhomocysteinemia suggests increased oxidative stress and vascular injury, potentially accelerating endothelial damage². Thyroid function and random blood sugar levels were largely preserved, indicating that these cardiovascular risk pathways operate independently of overt hypothyroidism or hyperglycaemia. However, the study is limited by its small sample size (n=10), which may restrict the generalizability of the findings. Larger, multicentric studies are required to validate these observations and establish definitive associations. Collectively, the findings emphasize the importance of early screening and preventive lifestyle interventions in overweight and obese children.

5. Conclusion

School students with elevated BMI show early cardiovascular risk markers, including dyslipidemia, inflammation, and hyperhomocysteinemia, despite normal glycaemic and thyroid status. Environmental factors such as sedentary lifestyle, increased screen time, and unhealthy dietary patterns likely contribute to these abnormalities. The findings underscore the necessity of early cardiovascular risk screening and intervention programs within school settings.

Lifestyle modification strategies focusing on balanced nutrition, regular physical activity, and early awareness of cardiovascular health should be implemented to mitigate the risk of future cardiovascular disease.

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