

Original Research Article

A study of the relationship between hypertension, blood sugar, lipid profile, subcutaneous and visceral fat thickness in obese and overweight children

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ABSTRACT

Background: Childhood obesity has become a significant global public health concern, with rising prevalence contributing to increased risks of metabolic disorders, including hypertension, dysglycemia, and dyslipidemia. These conditions predispose affected children to cardiovascular diseases (CVDs) and type 2 diabetes in adulthood. Understanding these associations is critical for early intervention.

Methods: A prospective study was conducted among 64 children aged 5-15 years, categorized as normal, overweight, or obese based on body mass index (BMI) according to IAP growth charts. Anthropometric measurements, blood glucose, lipid profiles, and fat thickness (via USG) were analyzed. Statistical significance was determined at $p < 0.05$ using the R statistical package.

Results: Blood pressure: stage 1 hypertension was observed in 50% of obese children and 20% of overweight children, while all normal-weight children had normal BP ($p < 0.05$). Blood glucose: Mean fasting blood glucose was 88.94 mg/dl (normal), 117.06 mg/dl (overweight), and 157 mg/dl (obese) ($p < 0.05$). Lipid profile: Obese children exhibited elevated triglycerides (TG) (165 mg/dl), lower high-density lipoprotein (HDL) (30 mg/dl), and higher low-density lipoprotein (LDL) (108 mg/dl), with significant differences compared to other groups ($p < 0.05$). Fat thickness: Mean subcutaneous and visceral fat thickness (VFT) increased progressively with BMI ($p < 0.05$).

Conclusions: Childhood overweight and obesity are linked to significant cardiometabolic risks, including hypertension, hyperglycemia, and dyslipidemia. Early detection and targeted interventions are essential to prevent long-term complications. Future studies should involve larger cohorts and incorporate detailed dietary assessments to better address the ongoing childhood obesity epidemic.

Keywords: Childhood obesity, Hypertension, Dysglycemia, Dyslipidemia, BMI, Cardiometabolic risks

INTRODUCTION

Childhood obesity has become one of the most pressing global public health issues in recent years. According to the world health organization (WHO), the prevalence of childhood overweight and obesity has risen alarmingly, with estimates indicating that over 340 million children and adolescents aged 5-19 years were overweight or obese in 2016.¹ This rapid escalation is of particular concern due to its association with a range of metabolic

disorders, including hypertension, impaired glucose metabolism (dysglycemia), and dyslipidemia.

Obesity in childhood sets the stage for a cascade of adverse health outcomes, contributing significantly to the risk of CVDs and type 2 diabetes mellitus (T2DM) in adulthood. Research indicates that obesity-related metabolic dysfunctions often cluster together, amplifying the long-term risks.² Among these dysfunctions, hypertension in children has shown a strong correlation

with both subcutaneous and visceral adiposity, with visceral fat playing a particularly prominent role in metabolic derangements.³

In parallel, dysglycemia and abnormal lipid profiles have been identified as critical markers of metabolic syndrome in children with obesity. Elevated TG, reduced HDL, and increased LDL levels often signal the early onset of atherosclerosis, a precursor to cardiovascular disease.⁴ Subcutaneous and VFT, measurable via ultrasound or other imaging techniques, has been shown to be an essential marker of cardiometabolic risk, highlighting the role of fat distribution over general adiposity.⁵

Preventative strategies to mitigate these risks must begin early, as evidence suggests that metabolic dysfunctions in childhood have a high probability of persisting into adulthood.⁶ This underscores need for research focusing on both early detection and targeted interventions to curb the ongoing childhood obesity epidemic.

The study aims to investigate relationships between hypertension, dysglycemia, dysglycemia, lipid profiles, and fat distribution (subcutaneous and visceral) in overweight and obese children. By identifying the key associations and risk factors, research seeks to provide insights for designing effective management strategies.

METHODS

Type of study

It was a prospective study.

Study setting

Conducted in the outpatient (OPD) and inpatient (IPD) departments of pediatrics at Navodaya medical college.

Study duration

Study conducted from 1st March 2024 to 1st June 2024.

Sampling method

Children aged 5-15 years were categorized into three groups based on BMI, calculated using the IAP growth charts: *Control group*: Normal indices.

Overweight group: BMI between the 23rd to 27th adult equivalent percentile.

Obese group: BMI above 27th adult equivalent percentile.

Sample size

Total of 64 children (36 boys and 28 girls). Boys: 20 with normal indices, 10 overweight, 6 obese. Girls: 14 with normal indices, 9 overweight, 5 obese.

Inclusion criteria

Children aged between 5-15 year, children attending the OPD or IPD of Navodaya medical college and group classification based on BMI and IAP growth chart standards were included.

Exclusion criteria

Children with known genetic or endocrine disorders affecting growth or metabolism and presence of any acute or chronic illness unrelated to obesity excluded from study.

Procedure

Anthropometric measurements: Weight-Measured using a standardized weighing machine. Height-Measured with a calibrated height bar.

BMI calculation: Formula: weight (kg)/height (m²).

Fat thickness measurement: Subcutaneous fat-Measured using a 7.5 MHz ultrasound probe. Visceral fat-Measured using a 3.5 MHz ultrasound.

Blood analysis: Blood samples collected for fasting blood glucose and lipid profiles.

Statistical analysis

All measurements and results were recorded in Microsoft excel 2010. Data were analyzed using the R statistical package (R Core Team, 2021). Statistical significance was determined using p values less than 0.05.

RESULTS

Table 1 demographic distribution of a total of 64 children across different weight categories: control, overweight, and obese groups, classified by gender. Among the 64 children, 36 are boys and 28 are girls. In the control group, there are 20 boys and 14 girls, representing children with a healthy weight. The overweight group consists of 10 boys and 9 girls, while the obese group includes 6 boys and 5 girls. This classification provides a comparative understanding of weight status distribution among boys and girls in the study population.

Table 1: Demographic data of children.

Gender	Control group	Overweight group	Obese group
Boys	20	10	6
Girls	14	9	5

Figure 1 shows blood pressure 1) All control children had normal BP 2) In obese children 50% had stage 1 hypertension, 20% had pre hypertension and 30% had normal BP 3) In overweight children 30% had stage 1

hypertension, 10% had pre hypertension 60% had normal BP. $P < 0.05$ and is statically significant.

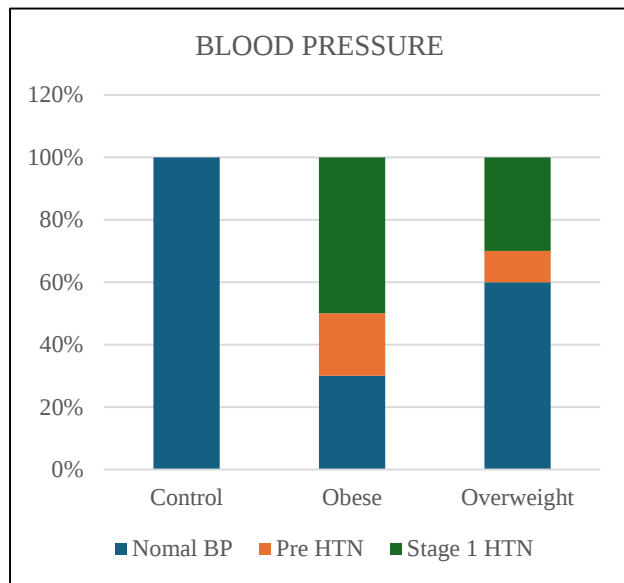


Figure 1: Blood pressure of children.

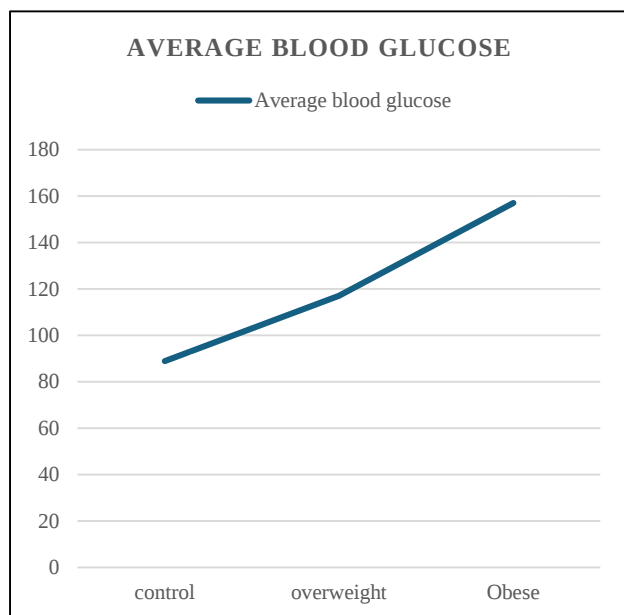


Figure 2: Blood glucose in children.

Figure 2 shows blood glucose 1) average blood glucose was 88.94 mg/dl in control group 2) 117.06 mg/dl in overweight group 3) 157 mg/dl in obese group. $P < 0.05$ and is statically significant.

Table 2: Lipid profile of children.

Groups	TG	HDL	LDL
Control	100	50	70
Overweight	142	35	80
Obese	165	30	108

* $P < 0.05$ and is statically significant

Table 2 presents mean lipid profile values, including TG, HDL, and LDL, among children categorized into control, overweight, and obese groups. The control group shows a mean TG level of 100 mg/dl, HDL of 50 mg/dl, and LDL of 70 mg/dl. In the overweight group, TG levels are elevated at 142 mg/dl, while HDL levels are reduced to 35 mg/dl, and LDL increases to 80 mg/dl. The obese group demonstrates the highest TG (165 mg/dl) and LDL (108 mg/dl) levels, with the lowest HDL (30 mg/dl). The $p < 0.05$, indicating that the differences observed between the groups are statistically significant. This data suggests a worsening lipid profile with increasing weight status, highlighting potential cardiovascular risks associated with childhood obesity.

Table 3: Fat thickness of children.

Groups	SFT (cm)	VFT (cm)
Control	1.74	0.80
Overweight	2.20	1.84
Obese	2.91	2.52

* $P < 0.05$ and is statically significant.

Table 3 presents the mean fat thickness measurements in children across different weight categories. Subcutaneous fat thickness (SFT) and VFT increase progressively from the control to the obese group. The control group shows the lowest SFT (1.74 cm) and VFT (0.80 cm), while the overweight group has higher values (SFT: 2.20 cm, VFT: 1.84 cm). The obese group exhibits the highest fat thickness, with SFT at 2.91 cm and VFT at 2.52 cm. The $p < 0.05$ indicates that the differences are statistically significant, suggesting increased fat accumulation with rising weight status.

DISCUSSION

The findings of this study reveal significant increases in blood pressure, fasting blood glucose levels, triglyceride levels, and abdominal fat thickness in children who are overweight or obese. These metabolic changes are consistent with global trends, which identify childhood obesity as a growing public health concern.^{7,8} The Indian pediatric population is no exception, with a sharp rise in obesity prevalence over the past two decades due to rapid urbanization, changes in dietary habits, and lifestyle shifts.⁹

Sedentary lifestyles, characterized by reduced physical activity and increased screen time, play a pivotal role in the development of obesity and related metabolic disturbances in children. Studies have shown that screen time, including television watching, gaming, and smartphone use, is directly associated with lower energy expenditure and higher consumption of calorie-dense foods, contributing to a positive energy balance and fat accumulation.^{1,10} An Indian study also highlights that urban children are more susceptible to these behaviours due to limited access to open spaces and recreational facilities.⁶

The dietary patterns of overweight and obese children often include high intakes of calorie-dense fast foods rich in saturated fats, sugars, and salts. This shift from traditional diets to processed foods has led to increased triglyceride levels, lower HDL cholesterol, and higher LDL cholesterol, which are common components of dyslipidemia.^{7,8} Indian research supports these findings, demonstrating that children with higher BMI exhibit significant lipid profile abnormalities, including elevated TG and cholesterol.¹¹

Abdominal fat thickness, encompassing both subcutaneous and visceral fat, is a key indicator of metabolic risk in children. Visceral fat, in particular, is associated with insulin resistance, systemic inflammation, and hypertension.¹⁴ Indian studies have shown that abdominal adiposity in children correlates strongly with fasting glucose levels and blood pressure, highlighting the urgent need for early interventions.¹⁵

The evidence underscores the critical need for public health strategies to address childhood obesity. These should include lifestyle interventions promoting physical activity, limiting screen time, and advocating balanced diets. Parental education programs focusing on the long-term health consequences of childhood obesity and community-based initiatives to provide healthier food options and recreational spaces are essential.¹⁶ Future research should also explore culturally tailored interventions to mitigate the unique challenges faced by Indian children in combating obesity and its complications.

Limitations

The limitations of the study were that it was conducted only in one tertiary care center with a small study group and syndromic obesity not excluded.

CONCLUSION

Overweight and obesity are major risk factors for chronic diseases such as diabetes, CVDs, and hypertension. Early identification and treatment of childhood obesity are essential to prevent long-term health complications. This study highlights the need for further research in this area, involving larger sample sizes and more detailed dietary histories to better understand and combat the childhood obesity epidemic.

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