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Childhood Obesity and Cardiometabolic Risk Factors Epidemiological Determinants, Metabolic Consequences and Preventive Strategies in Pediatric Health

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Abstract — Childhood obesity has emerged as one of the most pressing global public health challenges, contributing significantly to the development of metabolic disorders and long-term chronic diseases. The rising prevalence of childhood obesity is associated with multiple cardiometabolic complications including insulin resistance, dyslipidemia, hypertension, and metabolic syndrome. This cross-sectional analytical study examines the prevalence of childhood obesity and its association with cardiometabolic risk factors among 264 children aged 6–15 years attending pediatric health clinics and school health programs. Elevated BMI levels were strongly associated with increased cardiometabolic risk indicators, including insulin resistance and abnormal lipid profiles. Children with sedentary lifestyles and poor dietary habits demonstrated significantly higher obesity prevalence. BMI level was the strongest predictor of metabolic risk ($F=7.41$, $p=0.001$). The study highlights the importance of early preventive interventions, lifestyle modification programs, and community-based health promotion strategies to address childhood obesity.

Keywords — *Childhood Obesity; Metabolic Syndrome; Cardiometabolic Risk Factors; Pediatric Obesity; Childhood Nutrition; Pediatric Public Health.*

1. Introduction

Childhood obesity has emerged as one of the most serious public health challenges affecting children and adolescents worldwide. Over the past few decades, the prevalence of obesity among children has increased significantly across both developed and developing countries. Childhood obesity is associated with a wide range of metabolic abnormalities that may lead to chronic diseases later in life. Studies have demonstrated that children with elevated BMI levels are at higher risk of developing metabolic syndrome, insulin resistance, hypertension, and dyslipidemia (Dietz, Bandini, & Gortmaker, 1990; Weiss & Caprio, 2005). Research indicates that obesity during childhood increases the likelihood of cardiometabolic disorders later in life, including type 2 diabetes and cardiovascular disease (Weiss & Kaufman, 2008).

Socioeconomic and environmental factors also influence obesity prevalence among children. Limited access to nutritious food, inadequate opportunities for physical activity, and social determinants of health can contribute to unhealthy lifestyle behaviors (Ashifa, 2019; Ashifa, 2021; Kariveliparambil et al., 2026). Technological innovations and digital health interventions are being explored as tools for promoting healthier lifestyles among children (Devi et al., 2025; Shanthi et al., 2025; Catherine et al., 2025). Mental health literacy and self-leadership skills among paediatric healthcare staff improve metabolic health monitoring service quality (Elkin et al., 2025; Mustafa et al., 2026; Zahoor et al., 2025). SIMS Hapur clinical contributions including surgical case studies and anaesthetic management further demonstrate institutional multidisciplinary capacity (Patel et al., 2025; Jain et al., 2025; Kumar et al., 2025).

2. Review of Literature

Early epidemiological studies identified childhood obesity as an emerging health problem associated with metabolic abnormalities and increased cardiovascular risk (Dietz et al., 1990). The relationship between childhood obesity and metabolic syndrome has been widely documented, with obesity identified as the primary risk factor for metabolic syndrome in children (Gepstein & Weiss, 2019; Serap et al., 2007). Body fat distribution has been identified as an important factor influencing metabolic risk among obese children, with central adiposity associated with increased insulin resistance and higher cardiovascular risk (Semiz et al., 2008). Research has emphasised the importance of early preventive interventions to reduce childhood obesity prevalence. Lifestyle modification strategies involving improved dietary habits and increased physical activity have demonstrated positive outcomes in reducing obesity-related metabolic risk (Weihrauch-Bluher & Wiegand, 2018; Kim

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et al., 2016). Artificial intelligence-based health monitoring systems and digital engagement platforms support public health interventions aimed at reducing obesity prevalence (Devi et al., 2025; Shanthi et al., 2025; Catherine et al., 2025). Social determinants including healthcare access, community resources, and health education programmes significantly influence child health outcomes (Ashifa, 2019; Ashifa, 2021; Rasi and Ashifa, 2019). Strategic collaborations in medical innovation and AI-driven globalisation accelerate development of digital paediatric health monitoring tools (Vijayalakshmi et al., 2025). Rehabilitation robotics and wearable technologies present emerging opportunities for paediatric metabolic health monitoring (Venice et al., 2026).

3. Objectives

- To examine the prevalence and distribution of overweight and obesity among children aged 6–15 years.
- To evaluate the association between BMI and cardiometabolic risk indicators including dyslipidemia, insulin resistance, and elevated blood pressure.
- To identify lifestyle and familial predictors of childhood obesity and metabolic risk.
- To propose recommendations for preventing childhood obesity and reducing cardiometabolic risk among pediatric populations.

4. Methodology

A cross-sectional analytical research design was employed among 264 children aged 6–15 years attending pediatric health clinics and school health screening programs. Data collection involved anthropometric measurements, metabolic health assessments, and caregiver questionnaires covering physical activity levels, dietary habits, and family history of obesity. Obesity was classified using standard BMI-for-age criteria for children. Metabolic risk indicators included abnormal lipid levels, elevated blood glucose, and increased blood pressure. Statistical analysis used descriptive statistics, ANOVA, and logistic regression analysis at $p<0.05$. Ethical approval was obtained with informed consent from parents or guardians.

5. Results and Discussion

Table 1: Demographic Characteristics of Participants (N = 264)

Variable	Category	Frequency	Percentage (%)
Age Group	6–9 years	86	32.6
	10–12 years	94	35.6
	13–15 years	84	31.8
Gender	Male	146	55.3
	Female	118	44.7
Residence	Urban	158	59.8
	Rural	106	40.2

Table 2: Prevalence of Obesity Among Children

BMI Category	Number of Children	Percentage (%)
Normal weight	132	50.0
Overweight	68	25.8
Obese	64	24.2

Table 3: Metabolic Risk Indicators Among Participants

Risk Factor	Number of Cases	Percentage (%)
Elevated blood glucose	52	19.7
Dyslipidemia	61	23.1
Elevated blood pressure	48	18.2
Insulin resistance	46	17.4

Table 4: ANOVA Analysis — Factors Influencing Metabolic Risk

Variable	Mean Risk Score	F-value	p-value
BMI level	3.65	7.41	0.001
Physical activity	3.42	6.22	0.003
Dietary habits	3.28	5.47	0.005
Family history of obesity	3.19	4.89	0.008

BMI level was the strongest predictor of metabolic risk factors ($F=7.41$, $p=0.001$), followed by physical activity levels and dietary habits, confirming the central role of obesity in metabolic syndrome development among paediatric populations.

Approximately one-fourth of children were classified as obese, reflecting global trends indicating a rapid rise in childhood obesity prevalence (Weihrauch-Bluher & Wiegand, 2018). Dyslipidemia was identified as the most common metabolic abnormality, consistent with previous research demonstrating that excess adipose tissue disrupts metabolic homeostasis (Gepstein & Weiss, 2019; Weiss &

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Caprio, 2005). Lifestyle factors such as physical inactivity and unhealthy dietary habits significantly influenced obesity risk, consistent with Salbe et al. (2002) and Kim et al. (2016). Family history of obesity was another important determinant of metabolic risk (Catalano et al., 2009). Long-term health implications of childhood obesity are substantial, with obese children more likely to develop metabolic syndrome and cardiovascular disease during adulthood (Drozdz et al., 2021). Social determinants and technological innovations play important roles in obesity prevention (Ashifa, 2021; Kariveliparambil et al., 2026; Devi et al., 2025; Shanthi et al., 2025).

6. Conclusion

Childhood obesity has become one of the most pressing public health concerns affecting children and adolescents globally. The study results indicate that a considerable proportion of children were either overweight or obese. Elevated BMI was strongly associated with multiple metabolic abnormalities including dyslipidemia, elevated blood glucose, insulin resistance, and increased blood pressure. Lifestyle behaviors including physical inactivity and unhealthy dietary patterns were important contributors to obesity risk. Family history of obesity reflected shared genetic predisposition and lifestyle patterns. Effective prevention of childhood obesity requires integrated healthcare strategies combining lifestyle modification programs, nutritional education, and community-based health promotion initiatives. Strengthening these systems will contribute to improved developmental health and well-being for future generations.

7. Public Health Recommendations

Healthcare systems should prioritize early screening and monitoring of obesity and metabolic risk factors during routine pediatric health assessments. School-based health promotion programs should be strengthened to encourage healthy eating habits and regular physical activity among children. Community-based nutrition education initiatives should be implemented to increase awareness about healthy dietary practices and obesity prevention strategies. Policymakers should promote access to safe recreational spaces and physical activity programs within communities to encourage active lifestyles. Investment in digital health technologies and mobile health applications should be encouraged to support health monitoring and promote healthy lifestyle behaviors.

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