Original Research

Cardiometabolic Risk Factors in Obese Pediatric Patients: An Observational Study in a Tertiary Care Hospital

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ABSTRACT

Aim: This study aimed to evaluate cardiometabolic risk factors among obese pediatric patients aged 6–18 years and assess gender-based differences in anthropometric, clinical, laboratory, and lifestyle parameters.

Material and Methods:A cross-sectional observational study was conducted over 12 months at a tertiary care hospital, including 100 obese pediatric patients aged 6–18 years (BMI ≥95th percentile). Data were collected on demographic details, anthropometric measurements (weight, height, BMI, waist circumference), clinical parameters (blood pressure, Tanner staging), laboratory investigations (fasting blood glucose, insulin, HbA1c, lipid profile), and lifestyle factors (screen time, physical activity). Cardiometabolic risk factors, including metabolic syndrome, insulin resistance, and hypertension, were assessed. Statistical analysis was performed using SPSS version 26.0, with a significance level of $p<0.05$.

Results: No significant gender-based differences were observed in demographic parameters, anthropometric indices, blood pressure, fasting blood glucose, insulin levels, HbA1c, HDL, LDL, triglycerides, or lifestyle habits. Metabolic syndrome prevalence was comparable between females (33%) and males (28%), as were insulin resistance (43% in females vs. 38% in males) and hypertension (24% in females vs. 26% in males). These findings suggest an equal burden of cardiometabolic risk factors across genders.

Conclusion: Cardiometabolic risk factors are evenly distributed among male and female obese pediatric patients. Early identification, regular screening, and comprehensive gender-neutral intervention strategies are essential for preventing long-term cardiometabolic complications associated with childhood obesity.

Keywords: Obesity, Pediatric, Cardiometabolic Risk, Insulin Resistance, Hypertension.

Introduction

Childhood obesity has emerged as one of the most significant public health challenges worldwide, with its prevalence rising alarmingly over the past few decades. It is no longer confined to high-income countries; developing nations are now experiencing a surge in childhood obesity rates due to rapid urbanization, shifts in dietary patterns, and increasingly sedentary lifestyles. Obesity in children is not merely a cosmetic concern but a complex medical condition associated with significant health risks, including a heightened predisposition to cardiometabolic disorders such as hypertension, insulin resistance, dyslipidemia, and type 2 diabetes mellitus. These conditions, if left unchecked, can track into adulthood, increasing the risk of cardiovascular diseases and premature mortality.[1-3] Cardiometabolic risk refers to a cluster of interrelated risk factors that significantly elevate the chances of developing cardiovascular diseases and metabolic disorders. In pediatric patients, these risks often manifest early in the form of obesity-related complications, including elevated blood pressure, impaired glucose tolerance, abnormal lipid profiles, and systemic inflammation. The interplay between genetic predisposition, environmental factors, lifestyle behaviors, and metabolic dysregulation contributes to the development of these risk factors. Early identification and intervention are crucial in mitigating long-term health consequences, yet many children remain undiagnosed until advanced stages of these conditions are reached.[4-6] Obesity in children is often measured using the Body Mass Index (BMI), waist circumference, and other anthropometric indicators. While BMI serves as a primary screening tool, it does not fully capture fat distribution or central adiposity, which are strongly linked to cardiometabolic risks. Waist circumference and waist-

to-height ratio have gained recognition as complementary measures for identifying children at higher risk for metabolic complications. Additionally, blood pressure monitoring, lipid profile assessments, fasting blood glucose, and insulin resistance markers are essential tools in the evaluation of cardiometabolic risk factors in pediatric obesity.[7,8] Dietary habits and lifestyle behaviors play a pivotal role in the development and progression of obesity-related cardiometabolic risks. Increased consumption of calorie-dense, nutrient-poor foods, coupled with decreased physical activity and prolonged screen time, contribute significantly to weight gain and metabolic dysregulation in children. Sedentary lifestyles, characterized by excessive time spent on digital devices and limited physical exercise, have become increasingly common, further exacerbating obesity and its associated health risks. Parental education, socioeconomic status, and family dynamics also exert significant influence over a child's dietary choices and activity levels.[9,10] Genetic predisposition and family history are critical components in understanding cardiometabolic risks in obese pediatric patients. Children with a positive family history of obesity, diabetes, or hypertension are at a considerably higher risk of developing these conditions themselves. Shared genetic factors, combined with similar environmental exposures and lifestyle habits within families, contribute to this increased susceptibility. Furthermore, hormonal imbalances, such as elevated cortisol and leptin resistance, are often observed in obese children and are associated with increased cardiometabolic risk.[11] Insulin resistance, one of the most common metabolic abnormalities in obesity, serves as a key link between excess body fat and cardiometabolic complications. Insulin resistance can lead to impaired glucose metabolism, increased triglyceride synthesis, and reduced HDL cholesterol levels, forming a vicious cycle that further exacerbates cardiovascular risks. Similarly, hypertension in obese children is often characterized by increased arterial stiffness, endothelial dysfunction, and heightened sympathetic nervous system activity, all of which contribute to elevated blood pressure and increased cardiovascular risk.[12] Metabolic syndrome, a clustering of risk factors including abdominal obesity, elevated blood pressure, high fasting glucose, and abnormal lipid levels, is increasingly being recognized in obese pediatric populations. The presence of metabolic syndrome in childhood significantly raises the risk of developing type 2 diabetes and cardiovascular diseases later in life. Identifying and addressing these risk factors at an early stage are essential steps in preventing long-term health complications.[13] Despite the increasing burden of pediatric obesity and associated cardiometabolic risks, there is still a lack of comprehensive data on the prevalence and distribution of these risk factors, particularly in resource-limited settings. Most studies focus on adult populations, leaving a critical gap in the understanding of how these risk factors manifest and progress in children. Observational studies play a crucial role in bridging this gap by providing valuable insights into the prevalence, patterns, and determinants of cardiometabolic risks in obese children.[14] This study aims to evaluate the prevalence and distribution of cardiometabolic risk factors among obese pediatric patients in a tertiary care hospital setting. By assessing parameters such as anthropometric indices, blood pressure, lipid profile, fasting glucose, insulin resistance, and lifestyle habits, this study seeks to identify key risk factors contributing to cardiometabolic complications in obese children. The findings are expected to provide evidence-based insights for clinicians, healthcare policymakers, and caregivers, facilitating early detection, targeted interventions, and effective management strategies to reduce the long-term burden of obesity-related health complications in children.

Material and Methods

This cross-sectional observational study was conducted at a tertiary care hospital over a period of 12 months with the aim of evaluating cardiometabolic risk factors among obese pediatric patients aged 6–18 years. A total of 100 obese pediatric patients were included in the study. The inclusion criteria comprised children aged 6–18 years diagnosed with obesity (BMI ≥95th percentile for age and sex, based on WHO growth standards), with no known chronic illnesses affecting metabolic outcomes, and with parental or guardian consent for participation. Children on medications affecting lipid or glucose metabolism (e.g., corticosteroids), those with genetic or syndromic causes of obesity (e.g., Prader-Willi syndrome), and children with acute or chronic infections at the time of enrollment were excluded. Participants were recruited using a purposive sampling technique from both the pediatric outpatient department and inpatient wards of the hospital.

Data collection was carried out using a structured case record form (CRF), which included detailed demographic information such as age, gender, socioeconomic status, and family history of obesity, diabetes, hypertension, and cardiovascular diseases. Anthropometric measurements were performed, including weight (measured using a calibrated electronic scale), height (using a stadiometer), Body Mass Index (BMI) (calculated as weight in kilograms divided by height in meters squared), and waist circumference (measured using a flexible measuring tape at the midpoint between the lower rib and iliac crest). Clinical evaluations included blood pressure measurements using an age-appropriate cuff size following standardized protocols and Tanner staging to assess pubertal development.

Laboratory investigations included fasting blood glucose levels, fasting lipid profile (Total cholesterol, HDL, LDL, and triglycerides), fasting insulin levels, HbA1c levels, and liver function tests (AST and

ALT). Additionally, a lifestyle assessment was performed using standardized tools to evaluate dietary habits through a 24-hour dietary recall questionnaire, physical activity levels using a validated physical activity questionnaire, and screen time recorded as average hours per day spent on devices. Cardiometabolic risk factors were assessed by identifying the presence of metabolic syndrome (based on International Diabetes Federation (IDF) criteria for children and adolescents), early signs of insulin resistance using the HOMA-IR index, and the presence of hypertension (based on age-specific guidelines).

Ethical approval for the study was obtained from the Institutional Ethics Committee (IEC). Written informed consent was obtained from the parents or legal guardians, and assent was secured from children older than 7 years. Strict measures were implemented to ensure data confidentiality and anonymity throughout the study.

Data were analyzed using SPSS version 26.0. Descriptive statistics, including mean, standard deviation, and percentages, were calculated for demographic, anthropometric, and laboratory parameters. For inferential analysis, an Independent t-test was used to compare continuous variables between subgroups (e.g., gender, age groups), while a Chi-square test was employed for categorical variables (e.g., presence or absence of metabolic syndrome). The Pearson correlation coefficient was calculated to determine relationships between BMI and cardiometabolic risk factors. A p-value of <0.05 was considered statistically significant.

The primary outcome measures included the prevalence of metabolic syndrome among obese children, frequency of abnormal fasting blood glucose, lipid profile, and blood pressure, and the association between BMI and cardiometabolic risk factors. Additionally, the study aimed to identify modifiable lifestyle factors contributing to cardiometabolic risks. This methodology ensures a comprehensive evaluation of the cardiometabolic health profile of obese pediatric patients, providing valuable insights into potential intervention strategies.

Results

Table 1: Demographic and Family History by Gender

The demographic analysis revealed no statistically significant differences between male and female participants in terms of age, socioeconomic status, or family history of obesity, diabetes, and hypertension. The mean age of female participants was 11.83 ± 3.79 years, while for males, it was 12.18 ± 3.30 years ($p = 0.65$). The distribution of socioeconomic status was also comparable, with the majority of participants belonging to the middle socioeconomic class (48% in both groups), followed by the low socioeconomic class (33% in females vs. 26% in males) and the high socioeconomic class (19% in females vs. 26% in males).

When assessing family history of obesity, it was observed that a significant proportion of participants in both genders had a positive family history (67% in females vs. 64% in males; $p = 0.72$). Similarly, a family history of diabetes was noted in 38% of females and 41% of males ($p = 0.78$). Regarding hypertension, a family history was reported by 36% of females and 26% of males ($p = 0.29$). These findings suggest that both male and female obese children share similar demographic and hereditary risk profiles for cardiometabolic complications, reinforcing the importance of targeted preventive measures across genders.

Table 2: Anthropometric and Clinical Parameters by Gender

Anthropometric parameters, including weight, height, BMI, and waist circumference, showed no significant gender-based differences. The mean weight was 56.3 ± 14.1 kg in females and 54.8 ± 15.8 kg in males ($p = 0.52$). Similarly, the mean height was 138.7 ± 14.6 cm in females and 141.5 ± 15.3 cm in males ($p = 0.33$). The BMI values were comparable between females (29.3 ± 4.8 kg/m²) and males (28.8 ± 5.1 kg/m²) ($p = 0.71$), indicating similar degrees of obesity in both groups.

Waist circumference, an important indicator of central obesity, was also comparable between the two groups (82.1 ± 9.5 cm in females vs. 81.7 ± 10.4 cm in males; $p = 0.85$).

For blood pressure measurements, no significant differences were observed in both systolic and diastolic values. The mean systolic blood pressure was 121.4 ± 11.2 mmHg in females and 119.8 ± 9.7 mmHg in males ($p = 0.45$). The mean diastolic blood pressure was 81.2 ± 7.6 mmHg in females and 79.6 ± 8.3 mmHg in males ($p = 0.39$). These findings indicate that anthropometric and clinical parameters associated with obesity and hypertension were evenly distributed across genders.

Table 3: Laboratory Parameters by Gender

The laboratory findings demonstrated no significant differences between genders in terms of fasting blood glucose, fasting insulin, HbA1c, HDL, LDL, and triglycerides. The mean fasting blood glucose was 98.2 ± 12.4 mg/dL in females and 96.7 ± 14.1 mg/dL in males ($p = 0.61$). Similarly, fasting insulin levels were 13.2 ± 5.3 uIU/mL in females and 12.8 ± 4.8 uIU/mL in males ($p = 0.73$).

HbA1c levels, a key indicator of glycemic control, were comparable between females (5.6 ± 0.4%) and males (5.5 ± 0.5%) ($p = 0.48$).

Regarding the lipid profile, HDL (good cholesterol) levels were 44.2 ± 9.1 mg/dL in females and 45.1 ± 10.3 mg/dL in males ($p = 0.66$). Similarly, LDL (bad cholesterol) levels were 112.5 ± 17.8 mg/dL in females and 109.7 ± 19.2 mg/dL in males ($p = 0.52$).

Triglyceride levels were also similar between the groups (132.7 ± 35.6 mg/dL in females vs. 129.8 ± 38.2 mg/dL in males; p = 0.71).

These findings indicate no significant gender-based differences in metabolic parameters, suggesting that both male and female obese children are at comparable risk for metabolic disturbances.

Table 4: Lifestyle and Cardiometabolic Risk Factors by Gender

Lifestyle and cardiometabolic risk factors showed no significant differences between male and female participants. Screen time was 5.4 ± 1.8 hours/day in females and 5.7 ± 2.0 hours/day in males (p = 0.43). Physical activity levels were slightly higher in males (1.4 ± 0.7 hours/week) compared to females (1.2 ± 0.6 hours/week), but the difference was not statistically significant (p = 0.26).

For metabolic syndrome, 33% of females and 28% of males were diagnosed with the condition (p = 0.58). Similarly, insulin resistance was identified in 43% of females and 38% of males (p = 0.61).

The prevalence of hypertension was also similar, with 24% of females and 26% of males diagnosed with elevated blood pressure (p = 0.81).

These findings highlight that lifestyle behaviors and cardiometabolic risk factors are distributed evenly across genders, emphasizing the need for gender-neutral intervention strategies in managing obesity and its associated complications.

Table 1: Demographic and Family History by Gender

Parameter	Sub-Parameter	Female (n=42)	Male (n=58)	p-value
Mean Age (years)	—	11.83 ± 3.79	12.18 ± 3.30	0.65
Socioeconomic Status	Middle	20 (48%)	28 (48%)	—
	Low	14 (33%)	15 (26%)	—
	High	8 (19%)	15 (26%)	—
Family History of Obesity	Yes	28 (67%)	37 (64%)	0.72
	No	14 (33%)	21 (36%)	—
Family History of Diabetes	Yes	16 (38%)	24 (41%)	0.78
	No	26 (62%)	34 (59%)	—
Family History of Hypertension	Yes	15 (36%)	15 (26%)	0.29
	No	27 (64%)	43 (74%)	—

Table 2: Anthropometric and Clinical Parameters by Gender

Parameter	Sub-Parameter	Female (n=42)	Male (n=58)	p-value
Weight (kg)	—	56.3 ± 14.1	54.8 ± 15.8	0.52
Height (cm)	—	138.7 ± 14.6	141.5 ± 15.3	0.33
BMI (kg/m²)	—	29.3 ± 4.8	28.8 ± 5.1	0.71
Waist Circumference (cm)	—	82.1 ± 9.5	81.7 ± 10.4	0.85
Blood Pressure (mmHg)	Systolic	121.4 ± 11.2	119.8 ± 9.7	0.45
	Diastolic	81.2 ± 7.6	79.6 ± 8.3	0.39

Table 3: Laboratory Parameters by Gender

Parameter	Sub-Parameter	Female (n=42)	Male (n=58)	p-value
Fasting Blood Glucose (mg/dL)	—	98.2 ± 12.4	96.7 ± 14.1	0.61
Fasting Insulin (uIU/mL)	—	13.2 ± 5.3	12.8 ± 4.8	0.73
HbA1c (%)	—	5.6 ± 0.4	5.5 ± 0.5	0.48
Lipid Profile (mg/dL)	HDL	44.2 ± 9.1	45.1 ± 10.3	0.66
	LDL	112.5 ± 17.8	109.7 ± 19.2	0.52
	Triglycerides	132.7 ± 35.6	129.8 ± 38.2	0.71

Table 4: Lifestyle and Cardiometabolic Risk Factors by Gender

Parameter	Sub-Parameter	Female (n=42)	Male (n=58)	p-value
Screen Time (hours/day)	—	5.4 ± 1.8	5.7 ± 2.0	0.43
Physical Activity (hours/week)	—	1.2 ± 0.6	1.4 ± 0.7	0.26
Metabolic Syndrome	Yes	14 (33%)	16 (28%)	0.58
	No	28 (67%)	42 (72%)	—
Insulin Resistance	Yes	18 (43%)	22 (38%)	0.61
	No	24 (57%)	36 (62%)	—
Hypertension	Yes	10 (24%)	15 (26%)	0.81
	No	32 (76%)	43 (74%)	—

Discussion

The demographic characteristics of the study population revealed no significant gender-based differences in age, socioeconomic status, or family history of obesity, diabetes, and hypertension. These findings are consistent with a study by Freedman et al. (2009), which reported that family history of obesity and diabetes is equally prevalent among male and female children with obesity, reinforcing the genetic predisposition as a major risk factor for cardiometabolic complications.[1] Similarly, Kelishadi et al. (2007) highlighted the role of socioeconomic status in shaping dietary and physical activity patterns, which contribute to obesity irrespective of gender.[2]

The comparable family history of hypertension between genders in our study aligns with findings from Nguyen et al. (2010), which emphasized that hereditary factors influencing blood pressure are not significantly affected by gender. This reinforces the importance of targeted interventions for both boys and girls with a family history of hypertension to mitigate the risk of future cardiovascular diseases.[3]

The anthropometric parameters, including weight, height, BMI, and waist circumference, were similar between male and female participants. This is in line with findings by Ogden et al. (2014), who reported that BMI distribution does not vary significantly by gender among children with obesity. [4] The comparable waist circumference between genders in our study aligns with the work of Taylor et al. (2010), which found no significant gender differences in central adiposity among obese children.[5]

Blood pressure measurements were also similar across genders, with no statistically significant differences in systolic or diastolic values. These results are consistent with a study by Flynn et al. (2010), which noted that hypertension prevalence in children is influenced more by obesity severity than gender. These findings underscore the need for routine blood pressure monitoring in all obese children, regardless of gender, to identify early signs of hypertension.[6]

The laboratory findings revealed no significant gender-based differences in fasting blood glucose, fasting insulin, HbA1c, or lipid profile parameters. These results are in agreement with Weiss et al. (2008), who reported that metabolic disturbances such as insulin resistance and dyslipidemia are similarly distributed among male and female obese children.[7] Our findings also align with Della Corte et al. (2013), who observed that glycemic control (HbA1c levels) is not significantly influenced by gender in pediatric populations.[8]

The comparable HDL, LDL, and triglyceride levels in our study reflect findings from Magge et al. (2011), which showed that dyslipidemia is a common cardiometabolic risk factor in obese children but is not significantly different between boys and girls. These results emphasize the need for lipid profile assessments in all obese children as part of routine cardiometabolic risk screening.[9]

Lifestyle factors, including screen time and physical activity levels, were similar between genders, indicating that sedentary behaviors and insufficient physical activity are equally prevalent in obese boys and girls. These findings are consistent with Tremblay et al. (2011), which reported high levels of sedentary behavior among obese children irrespective of gender.[10] The slightly higher physical activity levels in males observed in our study align with trends noted by Borrud et al. (2009) but were not statistically significant.[11]

The prevalence of metabolic syndrome, insulin resistance, and hypertension was also comparable between genders. These results are supported by Cook et al. (2009), who found that metabolic syndrome prevalence is primarily influenced by obesity severity and age rather than gender.[12] Similarly, Reinehr et al. (2008) observed no significant gender differences in the prevalence of insulin resistance among obese children.[13] The comparable hypertension rates in our study align with findings from Sorof et al. (2008), which suggested that obesity is the primary determinant of elevated blood pressure in children.[14]

Conclusion

This study highlights that cardiometabolic risk factors, including anthropometric, clinical, laboratory, and lifestyle parameters, are evenly distributed across genders among obese pediatric patients. No significant gender-based differences were observed in parameters such as BMI, blood pressure, fasting glucose, insulin resistance, or lipid profiles. These findings emphasize that both male and female obese children face comparable risks for developing cardiometabolic complications. Early screening, regular monitoring, and targeted lifestyle interventions are essential for effective prevention and management of these risks, regardless of gender. This study underscores the need for comprehensive, gender-neutral strategies to address childhood obesity and its associated health consequences.

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