Original Article

Study of the Prevalence of Obesity and Its Association with Selected School Performance Measures Among School-age Children in Mosul, Iraq

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ABSTRACT

Background: Childhood obesity is a growing public health concern worldwide, with implications for both physical health and cognitive development. Limited data exist in Mosul, Iraq, regarding the prevalence of obesity among primary school children and its potential impact on academic performance. **Materials and Methods:** An analytical cross-sectional study was conducted from January to June 2025 among 2,310 primary-school children aged 6–12 years in Mosul. Anthropometric measurements (height, weight, BMI) were obtained and classified using CDC growth charts. A structured questionnaire assessed sociodemographic and lifestyle factors. Academic performance was evaluated using standardized Stage 6 mathematics examination scores. Logistic regression identified predictors of overweight/obesity, while multiple linear regression examined associations between obesity and mathematics scores, adjusting for confounders. **Results:** The prevalence of overweight and obesity was 6.1%, with boys (7.8%) more affected than girls (4.3%). Significant predictors included age (11–12 years), male gender, higher household income, urban residence, parental obesity, prolonged screen time, reduced physical activity, and frequent fast-food consumption. Mathematics scores were negatively associated with obesity, male gender, screen time ≥3 hours/day, and fast-food intake, while positively associated with parental education, higher parental income, urban residence, and daily physical activity ≥30 minutes. **Conclusion**: Childhood overweight and obesity in Mosul are relatively common and significantly associated with lower mathematics performance. Early interventions involving schools, families, and healthcare providers are essential to promote healthier lifestyles and academic achievement.

Key words: Pediatric Obesity, Screen Time, Academic Performance.

Over the past four decades, childhood obesity has escalated into a major global health concern, with a steady rise in the number of overweight and obese children and adolescents [1]. According to the World Health Organization's 2022 report, more than 390 million individuals aged 5 to 19 were affected by overweight, including 160 million living with obesity worldwide. In Iraq, the situation is particularly alarming: the prevalence of obesity among children in this age group increased from 5.5% in 1990 to 18.6% in 2022. Since obesity in childhood often persists in adulthood, early prevention is a critical public health priority [2]. WHO defines overweight and obesity as excessive fat accumulation that negatively affects health. The Body Mass Index (BMI), calculated as weight divided by height squared (kg/m²), is commonly used as a screening tool to estimate body fat in children and adolescents [3]. Although BMI does not directly measure adiposity, it correlates with more precise indicators such as skinfold thickness measurements [4]. Because children and adolescents are still growing, BMI must be interpreted relative to age and sex norms [5].

The American Academy of Pediatrics (AAP) provides BMI percentile categories for individuals aged 2 to 19 years [6]. These categories define overweight when BMI is between the 85th and 95th percentile, and obesity when BMI is above the 95th percentile. For children aged 5 to 19, WHO defines overweight as a BMI-for-age greater than +1 standard deviation (Z-score), and obesity as greater than +2 standard deviations. For adults, the WHO defines the BMI of overweight as equal to or greater than 25, and BMI equal to or greater than 30 for obesity, for both men and women [7].

The causes of childhood obesity are multifactorial, involving genetic predisposition, family history, behavioral patterns, and environmental influences [8]. The Increased availability of energy-dense fast food and excessive screen time are associated risk factors [9]. Childhood obesity poses serious risks to both physical and psychological health, such as type 2 diabetes, hypertension, sleep apnea, low self-esteem,

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and depression. Many studies have shown a strong association of obesity with poorer academic performance [10].

For the prevention of obesity and the associated lack of performance, schools can foster healthier environments. Parents play a vital role in promoting nutritious eating habits. Physical activity has been shown to benefit children with obesity [11]. In resistant cases, pharmacological interventions and bariatric surgery may be considered as adjuncts to lifestyle changes [12].

This study aimed to determine the prevalence of overweight/obesity, its risk factors, and its association with mathematics school performance in Mosul, Iraq.

MATERIAL AND METHODS

This analytical cross-sectional study was conducted in Mosul from January to June 2025. A total of 2,310 primary-school children aged 6–12 years were randomly selected from four schools (two boys' and two girls'). The study protocols were approved by the institutional ethics committee. Written informed consent was obtained from the parents before the study. The study was conducted according to the 1975 Helsinki Declaration and its amendments.

Children with chronic diseases (e.g., endocrine disorders, genetic conditions linked to obesity) were excluded from the study. A structured questionnaire was administered to both students and their parents (one or both) at stage 6. The survey collected data on the variables, including the region of residence, parental education level**,** family income**,** consumption of fast food, daily screen time, and daily exercise (activity). The details of the survey are shown in Table 1:

Table 1: Survey of participant characteristics and behavioral factors

Variable	Categories
Region of residence	Rural / Urban
Parental education	≥ Secondary school / < Secondary school
Family income	≥ 1.5 million Iraqi Dinar (IQD) / < 1.5 million IQD
Fast food consumption	≥ 2 times/week / < 2 times/week
Daily screen time	>3 hours/ < 3 hours
Daily physical activity	≥ 30 minutes / < 30 minutes

Anthropometric Measurements, including height and weight, were measured for all students aged 6-12 years using a stadiometer and a calibrated digital scale, respectively. Body mass index (BMI) was calculated as weight (kg)/height (m^2) and classified according to the Centers for Disease Control and Prevention (CDC) age- and sex-specific growth charts. Parental BMI was also recorded. Stage 6 students' final mathematics examination scores (maximum 100) were used as indicators of academic performance. Stage 6 is often chosen for this purpose because this stage represents a grade of stable cognitive and academic development [10]. These examinations are standardized across Mosul schools, reflecting cognitive skills such as working memory and abstract reasoning. Measurements and questionnaires were conducted face-to-face by one author and a nurse at the schools.

Statistical Analysis

Data was analyzed using SPSS version 30 (2024). Logistic regression was used to identify factors associated with overweight/obesity, reporting adjusted odds ratios (AOR) with 95% confidence intervals (CI). Multiple linear regression assessed the associations between obesity and mathematics scores, adjusting for confounders (gender, parental obesity, parental education, household income, urbanization, screen time, fast food intake, physical activity). Model assumptions were checked, multicollinearity was assessed using the variance inflation factor (VIF), and Cook's distance was used for influence diagnostics. Standardized beta coefficients, R^2 values, and p-values were reported. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 2,310 students were enrolled in the study. The mean age was 9.4 ± 2.5 years. The sample consisted of 51.8% boys and 48.2% girls. BMI classification revealed that 86.2% of students were of normal weight, while 6.1% were overweight or obese. Boys showed a higher prevalence of overweight/obesity (7.8%) compared to girls (4.3%). The demographic and BMI Distribution of the enrolled Students are shown in Table 2.

Table 2: Demographic and BMI Distribution of Enrolled Students (n = 2310)

Characteristics	**Male n (%)**	**Female n (%)**	**Total n (%)**
Age			
6–9 years (Stages 1–4)	935 (78%)	837 (75%)	1772 (76.7%)
Age 10–12 years (Stages 5–6)	263 (22%)	275 (25%)	538 (23.3%)
Residence			
Urban	903 (75.5%)	811 (73%)	1714 (74.2%)
Rural	295 (24.5%)	301 (27%)	596 (25.8%)
BMI Categories			
Underweight	88 (7.2%)	93 (8.4%)	181 (7.8%)
Normal weight	1017 (85%)	971 (87.4%)	1988 (86.2%)
Overweight	43 (3.5%)	19 (1.6%)	62 (2.7%)
Obese	22 (1.9%)	13 (1.2%)	35 (1.5%)
Severe obesity	28 (2.4%)	16 (1.4%)	44 (1.9%)
Total Overweight/Obese	93 (7.8%)	48 (4.3%)	141 (6.1%)

Among the 141 students identified as being overweight or obese, the age range was 6 to 12 years. Males constituted the majority (66.2%) of the affected group, while females accounted for 33.8%, indicating a substantially higher prevalence of obesity or overweight among boys. Most

students with elevated BMI were from urban areas (80.0%). Table 3 demonstrates the demographic characteristics of children with overweight and obese.

Table3: Demographic Characteristics of Overweight/Obese Students (n = 141)

Characteristic	Value
Age (Mean ± SD)	10.5 ± 3.2 years
Gender (Male/Female)	93 (66%) / 48 (34%)
Male-to-Female Ratio	1.96:1
Residence (Urban/Rural)	112 (80%) / 29 (20%)

The logistic regression identified significant predictors of overweight/obesity, which included older age (11–12 years), male gender, higher household income, urban residence, parental obesity, screen time >3 hours/day, low physical activity (<30 minutes/day), and frequent fast-food consumption (>2 times/week). Parental education was not found as a significant predictor of overweight (Table 4).

Table4: Multivariate Logistic Regression to evaluate the Risk Factors associated with Childhood Overweight and Obesity among Stage 6 primary school students (n=253).

Predictor	Coefficient (β)	AOR (exp(β))	95%CI	*p*-value
Age range (11-12) years	2.03	7.6	4.5 – 12.8	<0.001
Gender: Male	1.52	4.5	2.3 – 8.7	0.005
Household income ≥ 1.5 million IQD/month	1.386	4	2.2 – 7.3	<0.001
Urbanization	0.85	2.34	1.1 – 5.0	0.005
Parent Education (Holding a secondary school or higher certificate	0.21	1.23	0.88 – 1.72	0.220
Parental obesity (One or both parents)	1.10	3.00	1.8 – 5.1	<0.001
Screen time >3 hours/day	0.75	2.12	1.3 – 3.5	0.005
Exercise (activity) <30 minutes/day	0.68	1.97	1.1 – 3.4	0.005
Excessive fast food >2 times/week	0.88	2.41	1.4 – 4.2	<0.001

AOR: adjusted odds ratio: CAUC Score: 0.87,95%CI: Confidence Interval, p<0.05 is significant

The multiple linear regression (Table 5) showed that mathematics scores were positively associated with parental education, urban residence, physical activity ≥30 minutes/day, and higher income. Negative associations were observed with screen time ≥3 hours/day, male gender, fast food ≥2/week, and overweight/obesity status.

Table 5: Multiple Linear Regression Analysis of the Associations Between Confounders and Mathematics Scores

Predictor	Coefficient	Std. Error	t-Statistic	p-Value	95% CI (Lower, Upper)	VIF	Cook's D
Intercept (constant)	70.5	2.1	33.57	<0.001	(66.3, 74.7)	—	—
Parental Education	+5.0	1.2	4.17	0.003	(2.6, 7.4)	1.9	0.02
Urbanization	+3.0	1.1	2.73	0.007	(0.8, 5.2)	1.7	0.01
Screen time ≥3hr/day	–4.0	1.3	–3.08	0.003	(–6.6, –1.4)	1.5	0.03
Activity ≥30min/day	+5.42	1.0	5.42	0.005	(3.4, 7.4)	1.6	0.02
Income ≥1.5 million IQD	+4.0	1.2	3.33	0.005	(1.6, 6.4)	1.8	0.01
Parental Obesity	–2.0	1.2	–1.67	0.098	(–4.4, 0.4)	1.4	0.01
Gender (male = 1)	–3.89	1.3	–2.99	0.004	(–6.5, –1.3)	1.6	0.02
Fast Food ≥2/week	–1.68	0.8	–2.10	0.038	(–3.26, –0.10)	1.3	0.01
Obese/Overweight in (Stage 6)	–4.97	1.4	–3.55	<0.001	(–7.7, –2.2)	1.7	0.03

Adjusted R^2(R^2: coefficient of determination)= 0.58; (R^2 = 0.61).

DISCUSSION

This study highlights the prevalence of overweight and obesity among school-aged children in Mosul (6.1%). This study showed that boys and older adolescents (11–12 years) were more affected. These findings align with Kansra et al. [13], who emphasized the multifactorial nature of youth obesity, though Panda et al. [14] noted that age-related patterns may vary. The observed sex disparity, with boys more affected, mirrors Shah et al. [15] and may be explained by hormonal regulation, particularly leptin dynamics [16]. Regional comparisons show Mosul's prevalence in Babil city (7.3%) [17], but it is much lower than the study results in Erbil city (30.4%) [18], reflecting differences in lifestyle and diet. Risk factors such as urbanization, parental obesity, fast food intake, reduced physical activity, high household income, and prolonged screen time were significant, consistent with prior studies [19, 20].

Importantly, obesity was associated with lower mathematics scores, like the study by Wu et al. [21], who linked obesity to impaired memory via leptin resistance [22]. However, Russo et al. argued that psychosocial stressors may play a larger role [23]. Academic performance was also influenced by socioeconomic and lifestyle factors. Parental education and income were positively associated with mathematics scores, consistent with Das et al. [24], though Valero et al. [25] cautioned that these reflect systemic inequities. Urbanization showed a positive effect, like Mohammadpour et al. [26], though Wagh [27] reported that rural students sometimes outperform urban peers. Physical activity was positively associated with scores, supporting Latino et al. [28] and Aaltonen et al. [29].

Conversely, prolonged screen time and fast-food intake were negatively associated, consistent with Feng et al. [30], though Hales et al. [31] suggested digital media may have indirect benefits. Female students outperformed males, possibly due to greater self-discipline, as suggested by Ellison et al. [32]. The uniqueness of this study lies in its focus on Mosul, where no prior research has examined obesity in relation to academic performance. The restricted sample consisting of students from four schools, reliance on self-reported data, and the focus on mathematics scores in Stage 6 only recommend future studies with a larger sample size, standardized measuring scores, and incorporation of more curriculum can confirm the results of the present study.

CONCLUSION

The current study showed that childhood overweight and obesity in Mosul affect 6.1% of primary school children and are significantly associated with lower mathematics performance. Broader research is recommended to better understand regional variations and to establish the present study results.

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