SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

DETERMINANTS OF CHILDHOOD OBESITY: A REGRESSION ANALYSIS OF SOCIOECONOMIC AND ENVIRONMENTAL FACTORS

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Article DOI: https://doi.org/10.36713/epra16754
DOI No: 10.36713/epra16754

ABSTRACT
Childhood obesity is a complex public health issue with significant implications for long-term health outcomes and healthcare costs. This study investigates the determinants of childhood obesity, focusing on socioeconomic and environmental factors. Data were collected from 310 children and their families using a structured questionnaire from Jodhpur City. Socioeconomic variables included parental education level and household income, while environmental factors encompassed access to healthy food options and safe outdoor spaces for physical activity. Multiple regression analysis examined the relationship between these factors and childhood obesity, controlling for potential confounders. Results indicate that parental education level and household income were inversely associated with childhood obesity, suggesting that higher socioeconomic status may protect against obesity risk. Additionally, access to healthy food options in the neighborhood emerged as a significant predictor of childhood obesity, highlighting the importance of environmental factors in shaping dietary behaviors. These findings underscore the need for multifaceted interventions targeting socioeconomic disparities and ecological barriers to promote healthy weight among children. Effective strategies may include improving access to nutritious foods and creating supportive environments for community physical activity. Addressing the determinants of childhood obesity is crucial for mitigating its adverse health effects and reducing the burden on healthcare systems.

KEYWORDS: *Childhood Obesity, Public Health, Healthy Lifestyle, Socioeconomic Factors, Physical Activity*

INTRODUCTION
Childhood obesity has emerged as a profoundly critical public health concern on a global scale, with ramifications not only for individual health but also for the broader societal well-being. The condition, characterized by an excess of body fat relative to age- and sex-specific norms, is associated with a myriad of adverse health outcomes, including but not limited to cardiovascular disease, type 2 diabetes, and psychosocial challenges. Furthermore, the economic burden stemming from childhood obesity is substantial, encompassing direct healthcare costs, diminished productivity, and compromised quality of life.

Understanding the determinants of childhood obesity is paramount for the development and implementation of effective prevention and intervention strategies. While genetic predisposition undoubtedly plays a role, there is a growing recognition that environmental and socioeconomic factors exert significant influence on obesity risk among children. Socioeconomic disparities, typified by variations in income, education levels, and access to resources, are closely intertwined with disparities in obesity prevalence. Additionally, environmental factors, such as the availability of nutritious food options and opportunities for physical activity, profoundly shape dietary behaviors and patterns of energy expenditure, thereby contributing to obesity risk.

Despite the increasing recognition of the multifactorial nature of childhood obesity, significant gaps persist in our understanding of the specific socioeconomic and environmental determinants driving this epidemic. Moreover, existing research often tends to focus on individual risk factors in isolation, thereby potentially overlooking the intricate interplay between socioeconomic status, environmental contexts, and health behaviours.

This research endeavour aims to bridge these gaps by conducting a comprehensive investigation into the determinants of childhood obesity, with a specific emphasis on socioeconomic and environmental factors. By employing sophisticated regression analysis techniques to scrutinize primary data collected from a diverse cohort of children and their families, this study endeavours to elucidate the nuanced relationships between socioeconomic status, neighbourhood environments, and the risk of childhood obesity. The insights gleaned from this research endeavour have the potential to inform the development of targeted interventions aimed at curbing the prevalence of childhood obesity and fostering health equity across diverse populations.

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REVIEW OF LITERATURE

To identify the research gap, some relevant scholarly work was reviewed. Authors from India and some globally recognized works were incorporated to gain better insight into the topic. Some of them are as follows:

[1] Rupayun (2022) Children between the ages of two and six who were enrolled in Anganwadi Centres in Tufanganj I Block, District Cooch Behar, West Bengal, participated in a cross-sectional study. After obtaining their mothers' informed agreement, 221 children between the ages of 2 and 6 were chosen from 5 AWCs using a two-stage sample procedure and simple random sampling. We computed the proportions, adjusted odds ratio for risk variables, and 95% confidence interval for prevalence. The percentages of obesity and overweight were 11.3% and 22.2%, respectively. When the duration of exclusive breastfeeding was less than six months compared to more than six months [AOR=8.069, 95% CI = 1.778-36.624, P=0.007] and when the duration of continued breastfeeding was less than six months compared to more than six months [AOR=12.586, 95% CI = 5.196-30.486, P=<0.001], the proportion of combined overweight and obesity was significantly higher.

[2] Sangeeta (2023) A cross-sectional study involving 1050 students from several Belagavi schools was conducted between January and October 2019. Using the statistical programme for the social science version 22.0, the results utilised for comparison were based on multiple logistic regression analysis, Chi-square test, and descriptive statistics. All tests were conducted with a significance level of $P < 0.05$. The study's findings showed that the following factors were statistically significant or associated with overweight and obesity ($P < 0.05$): age, family history of diabetes, family history of hypertension, physical activity (running, swimming), number of hours spent using a mobile device each day, number of hours spent using a computer each day, and frequency of foods consumed by a child (fried food, bakery items, sweets, and fast food).

[3] M. Anitha (2013) The World Health Organization-designed Global School-based Student Health Survey questionnaire (adapted for India) was used in this cross-sectional study of teenage students enrolled in 30 randomly chosen secondary and upper secondary schools in Chennai city. 1842 teenagers enrolled in classes VIII through XII were selected at random for the research. 40.7% of the students in this survey reported eating fruit at least once a day, whereas 74.5% reported eating vegetables at least once a day. Approximately 20 percent of the pupils consumed fast food on four or seven days in the preceding week. Thirty-four percent of the pupils watched television for longer than two hours a day. Of the boys and girls, 22% and nearly 68%, respectively, did not engage in outdoor sports. Upon evaluating the students' physical activity patterns, it was found that 15.6% of them were sedentary, 43.4% engaged in minimal activity, and 41.0% engaged in physical activity that improved their health. 5.2% of the pupils were obese, while 6.2% of them were overweight.

[4] Anuradha (2013) Data was gathered from schoolchildren between the ages of 12 and 16 using an interviewer-administered technique. There were 2258 participants in the sample (1097 boys and 1161 girls). Body mass index (BMI) was used to classify overweight and obesity based on the most recent approach suggested by the Centres for Disease Control and Prevention in 2000. A validated and pre-tested questionnaire was used to gather data on social and environmental variables. Within the current sample, the percentage of males who were overweight or obese was 11.2%, whereas the percentage of girls who were overweight or obese was 10.3%. Parental literacy, family income, and the amount of time children sleep are all strongly correlated with overweight. Overweight was associated with a higher parental education level (Mother: 1.570; 95% CI: 1.048-2.354). Children's connection with weight gain was also increased by increases in family income (OR = 1.529; 95% CI: 1.089-2.148) and child sleep duration <7 hrs per day (OR = 2.006; 95% CI: 1.194-3.371).

[5] Goyal (2011) This study set out to identify the risk factors for obesity and overweight among affluent adolescents in the south Gujarati city of Surat.from July 2009 to April 2010,cross sectional.The participants ranged in age from 12 to 15 years old. A pre-made and pre-tested questionnaire was utilised to collect data regarding the participants' past food intake and physical activity levels.

Measurements of height, weight, and BMI were made. The BMI for age was used to measure overweight and obesity. According to the IAP Growth Monitoring Guidelines for Children from Birth to 18 Years, students with BMIs between the 85th and 95th percentiles of the reference population were classified as overweight, while those with BMIs between the 95th and 95th percentiles were classified as obese. 6.55% and 13.9% of people were overweight or obese overall (boys: 6.7% and 15.1%; girls: 6.4% and 13.35%). The multiple logistic regression analysis's final model revealed that watching television or playing video games, consuming junk food, snacks, and fizzy drinks, and engaging in little to no physical activity were significant risk factors for being overweight or obese. It was discovered that the percentage of obese and overweight adolescents in Surat City's affluent youth was 6.55% and 13.9%, respectively. Adolescents who engage in sedentary behaviours such as watching television or playing video games, and following a certain diet are more likely to become overweight or obese.

[6] Kumar (2011) A cross-sectional study conducted from March 2013 to January 2014 in seven rich private schools in Vijayawada that charged 420, 000 rupees year. The sample size consisted of 1721 kids, aged 12 to 15 years, who were chosen at random. The

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individuals' weight and height were recorded, and their body mass index was computed. A pre-tested and pre-designed questionnaire was used to evaluate the participants' food and exercise habits. An Excel spreadsheet was utilised to handle the data, and the odds ratio was employed to determine the strength of association. P o 0.05 variables were regarded as statistically significant risk variables and were analysed using multiple regression. Overweight and obesity were prevalent overall at 26.9% and 8.7%, respectively. 48.38% of the study participants were girls, with 11.2% being overweight and 3.4% being obese, while 50.6% of the participants were boys, with 15.7% being overweight and 5.4% being obese. The main risk factors are eating outside the home, eating while watching TV, snacking more frequently outside, not playing outdoor sports, travelling by car to school, extended school days, spending a lot of time on computers or TV, not exercising every day, having both parents work, receiving little physical education, and not having a playground. Overweight and obesity were reported to be prevalent overall at 26.9% and 8.7%, respectively. The primary risk factors included eating outside the home, eating while watching TV, snacking frequently outside, not playing outside games, having both parents work, using a car to get to school, spending more time there each day, not exercising, spending a lot of time on the computer or watching TV, getting less physical education each week, and not having a playground. It was discovered that the frequency of carbonated drinks, sleep during the day, and home snacking did not affect the prevalence of overweight and obesity.

[7] Namdev (2015) Over the course of 28 months, students at Bhopal's government and private schools who were enrolled in classes IX, X, XI, and XII participated in a cross-sectional descriptive study. Simple random sampling with multiple stages was employed. Data were gathered using anthropometric measures and a pretested, self-administered questionnaire with sociodemographic details. 46 (1.0%) and 256 (5.6%) of the students in the current study were obese. Higher SES students accounted for the highest percentage of obese pupils (2.5%), compared to lower and intermediate SES students. In general, it was discovered that girls and pupils attending private schools had higher rates of overweight and obesity. Children whose working mothers had greater education levels were more likely to have it.

RESEARCH OBJECTIVES

- To know the status of child obesity in Jodhpur
- To examine the socioeconomic and environmental factors of Childhood obesity

METHODOLOGY

STUDY DESIGN

This research adopts a cross-sectional study design to investigate the determinants of childhood obesity. Cross-sectional studies are particularly suitable for examining associations between various factors and obesity prevalence within a specific population at a single point in time.

SAMPLING STRATEGY

The study utilizes a stratified random sampling technique to ensure representation across different demographic groups. Stratification may be based on factors such as age, gender, and socioeconomic status to capture the diversity of the target population. Sample size calculation is conducted to ensure adequate statistical power for regression analysis.

DATA COLLECTION

Data are collected through structured interviews or surveys administered to children and their parents or guardians. The questionnaire includes validated measures of socioeconomic status, environmental factors, dietary habits, physical activity levels, and health outcomes. Anthropometric measurements, such as height, weight, and waist circumference, are also obtained to assess obesity status.

VARIABLES

Dependent Variable: Childhood obesity status, typically measured using Body Mass Index (BMI) percentile for age and sex.
Independent Variables: Socioeconomic factors (e.g., parental education level, household income), environmental factors (e.g., access to healthy food options, neighborhood safety), dietary habits (e.g., consumption of fruits and vegetables, fast food intake), physical activity levels (e.g., hours of sedentary behavior, participation in sports), and other relevant covariates.

REGRESSION ANALYSIS

Multiple regression analysis examines the relationships between independent variables and childhood obesity while controlling for potential confounding factors. Specifically, hierarchical regression may be used to assess the incremental contribution of socioeconomic and environmental factors to obesity risk after accounting for demographic characteristics and health behaviors. Regression diagnostics, including tests for multicollinearity and heteroscedasticity, are conducted to ensure the validity of the regression model.

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ETHICAL CONSIDERATIONS

Ethical approval is obtained from the relevant institutional review board (IRB) prior to data collection. Informed consent is obtained from participants, and measures are taken to ensure confidentiality and privacy. Participants are informed of their right to withdraw from the study at any time without penalty.

DATA ANALYSIS

Quantitative data are analyzed using statistical software such as SPSS or R. Descriptive statistics are computed to summarize the characteristics of the study sample. Regression coefficients, standard errors, and significance levels are reported to elucidate the associations between independent variables and childhood obesity. Subgroup analyses and sensitivity analyses may be conducted to explore potential effect modifications and assess the robustness of the findings.

LIMITATIONS

Potential limitations of the study, such as the cross-sectional design, self-report bias, and the inability to establish causality, are acknowledged. Strategies to mitigate these limitations, such as sensitivity analyses and validation of self-reported data against objective measures, are implemented where feasible.

IMPLICATIONS AND FUTURE DIRECTIONS

The implications of the findings for public health practice, policy development, and future research are discussed. Recommendations for targeted interventions to address socioeconomic and environmental determinants of childhood obesity are provided, along with suggestions for longitudinal studies to elucidate causal relationships and intervention effectiveness over time.

DEMOGRAPHIC PROFILE OF THE RESPONDENTS

310 respondents from Jodhpur participated in the survey, and the following are their demographic profiles. Due to the nature of the study, all data was collected for the children (7-18 years). Children aged 7-18 encompass a critical developmental period spanning late childhood through adolescence. This age range captures important physical, cognitive, and social transitions, during which diet, physical activity, and body image behaviors may undergo significant changes.

Table 1 Demographic Profile of Respondents

Gender	**N**	**%**
Male	167	53.87
Female	143	46.13
Total	310	100.00
Respondents Type	**N**	**%**
Children	151	48.71
Parents	104	33.55
paediatricians	25	8.06
dietitians	30	9.68
Total	310	100.00

Source : Survey Data

Out of 310 respondents, 167 were male, and 143 were female. Responses were also taken from various categories of respondents, including children, their parents, pediatricians, dietitians, etc.

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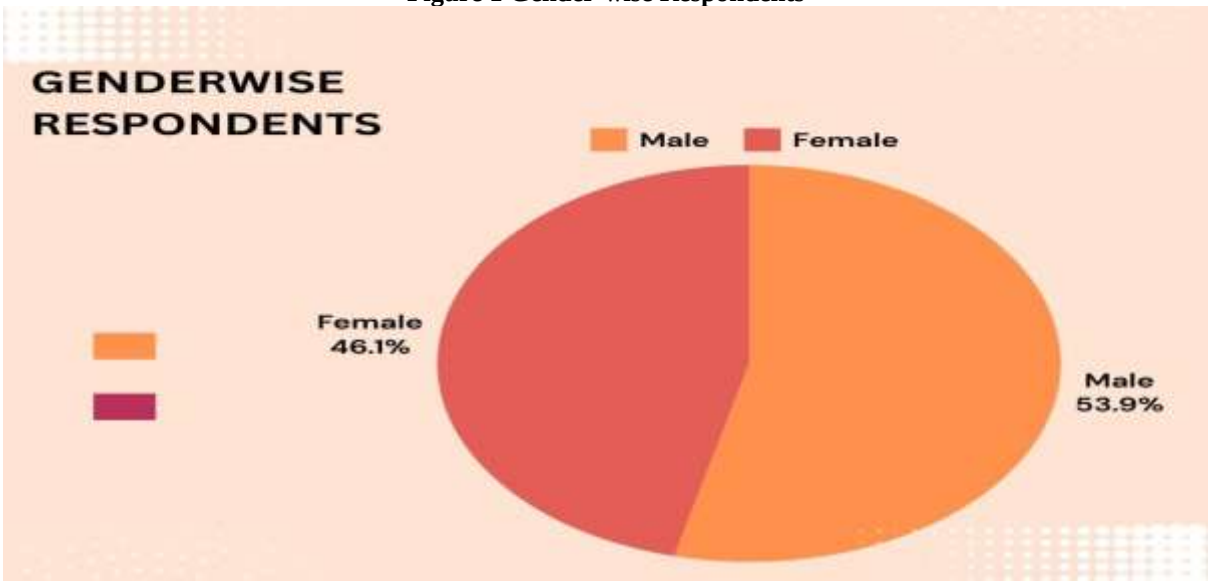
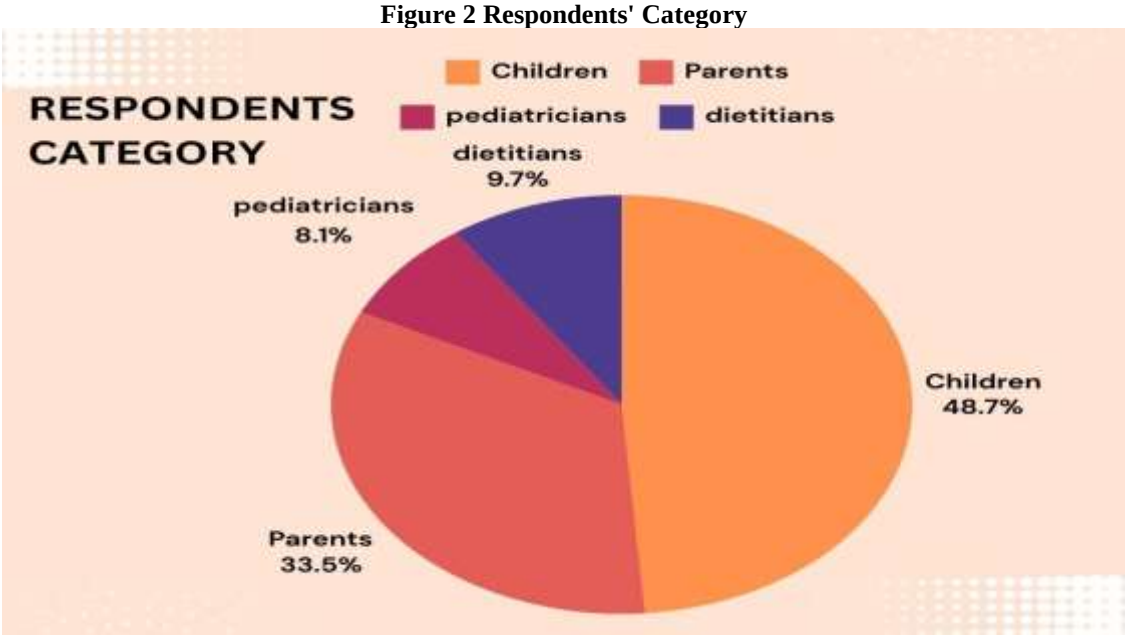
Figure 1 Gender-wise Respondents



A total of 310 responses were collected for the survey, focusing exclusively on children. Of these, 151 responses were directly provided by children themselves, while an additional 104 responses were provided by parents on behalf of their children. Furthermore, insights from pediatricians and dietitians were sought to provide more detailed perspectives. It is important to clarify that all responses, including those from parents, paediatricians, and dietitians, pertained to children and their experiences. This comprehensive approach allowed for a holistic understanding of child obesity and the factors influencing it, with perspectives gathered from multiple stakeholders directly involved in children's health and well-being.

Figure 2 Respondents' Category



FACTORS AFFECTING CHILDHOOD OBESITY.

When data were gathered from respondents, the following responses were received.

Table 2 Child Obesity (measured in BMI)

BMI	N	%
19-25	40	12.90
25-30	67	21.61
30-35	120	38.70
>35	83	26.77
Total	310	100.00

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19-25 BMI range: 40 children in this category constitute approximately 12.90% of the total.
25-30 BMI range: There are 67 children in this category, which constitutes approximately 21.61% of the total.
30-35 BMI range: There are 120 children in this category, which constitutes approximately 38.70% of the total.
>35 BMI range: There are 83 children in this category, which constitutes approximately 26.77% of the total.
Overall, the table provides a breakdown of child obesity levels based on BMI ranges. It shows that the majority of children fall into the higher BMI categories, with the largest proportion falling into the 30-35 BMI range.

Table 4 Access to Park

Access to Park	N	%
Yes	135	43.54
No	175	57.46
Total	310	100.00

135 individuals (43.54%) have access to a park.
175 individuals (57.46%) do not have access to a park.

Table 5 Healthy food in Neighbourhood

Healthy food in the Neighbourhood	N	%
Yes	141	45.48
No	169	55.52
Total	310	100.00

141 individuals (45.48%) have access to healthy food options in their neighbourhood.
169 individuals (55.52%) do not have access to healthy food options in their neighbourhood.

Table 6 Household Income (INR)

Household Income	N	%
<200000	87	28.06
200001-400000	142	45.80
400001-600000	35	11.29
6000001-1000000	25	8.06
>1000000	21	6.77
Total	310	100.00

87 individuals (28.06%) have a household income of less than 200,000 INR.
142 individuals (45.80%) have a household income between 200,001 and 400,000 INR.
35 individuals (11.29%) have a household income between 400,001 and 600,000 INR.
25 individuals (8.06%) have a household income between 600,001 and 1,000,000 INR.
21 individuals (6.77%) have a household income greater than 1,000,000 INR.

Table 7 Parental Education Level

Parental Education Level	N	%
Illiterate	18	5.80
Up to Secondary	57	18.38
Up to Senior Secondary	81	26.12
UG	102	32.90
PG	43	13.87
Other	9	2.90
Total	310	100.00

18 individuals (5.80%) have parents who are illiterate.
57 individuals (18.38%) have parents with education up to secondary level.
81 individuals (26.12%) have parents with education up to senior secondary level.
102 individuals (32.90%) have parents with undergraduate education.
43 individuals (13.87%) have parents with postgraduate education.
9 individuals (2.90%) have parents with other educational backgrounds
RESULT AND DISCUSSION
Summary Statistics:
Multiple R: 0.704
R Square: 0.496

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Adjusted R Square: 0.490
Standard Error: 0.893
Observations: 310

ANOVA

Source	DF	SS	MS	F	Significance F
Regression	4	239.292	59.823	75.086	3.06E-44
Residual	305	243.002	0.797		
Total	309	482.294			

The regression model is significant ($p < 0.001$).

Coefficients

Variable	Coefficient	Standard Error	t-Stat	P-value	95% Lower Bound	95% Upper Bound
Intercept	8.764	1.787	4.904	<0.001	5.248	12.281
Parental Education Level	2.5	0.645	3.877	<0.001	1.232	3.768
Income	-0.25	0.631	-0.396	0.692	-1.492	0.992
Healthy Food in Neighborhood	0.488	0.081	6.014	<0.001	0.329	0.649
Access to Park	-0.163	0.046	-3.532	<0.001	-0.254	-0.072

Summary Statistics
Multiple R: The correlation coefficient indicates a moderately strong positive relationship between the independent variables and the dependent variable.
R Square: Approximately 49.6% of the variance in the dependent variable is explained by the independent variables in the model.
Adjusted R Square: This adjusted value accounts for the number of predictors in the model and is slightly lower than the R Square.
Standard Error: The standard deviation of the residuals is approximately 0.893, suggesting that, on average, observed values deviate from the regression line by this amount.
Observations: There are 310 data points in the analysis.

ANOVA
The regression model is statistically significant ($p < 0.001$), indicating that it explains a significant amount of variance in the dependent variable.
Coefficients:
Intercept: When all independent variables are zero, the expected value of the dependent variable is approximately 8.764.
Parental Education Level: There is a significant positive correlation between parental education level and the dependent variable, indicating that as parental education level increases, the dependent variable tends to increase.
Income: Income does not show a significant correlation with the dependent variable.
Healthy Food in Neighborhood: There is a significant positive correlation between the availability of healthy food in the neighborhood and the dependent variable, suggesting that as the availability of healthy food increases, the dependent variable tends to increase.
Access to Park: There is a significant negative correlation between access to parks and the dependent variable, indicating that as access to parks increases, the dependent variable tends to decrease.

CONCLUSION

In conclusion, the findings of this research shed light on the multifaceted nature of childhood obesity and highlight several significant factors influencing its prevalence. The analysis revealed a concerning trend wherein a substantial portion of children fell into higher BMI categories, with the majority falling into the 30-35 BMI range. Furthermore, disparities in access to resources were evident, with a significant proportion of children lacking access to parks and healthy food options in their neighborhoods.

The regression analysis unveiled crucial insights into the relationship between various factors and childhood obesity. Parental education level emerged as a significant predictor, with higher levels of parental education associated with lower levels of childhood obesity. Additionally, the availability of healthy food options in the neighborhood was positively correlated with lower levels of obesity, suggesting the importance of environmental factors in shaping dietary habits and health outcomes. Conversely, access to parks exhibited a negative correlation with childhood obesity, highlighting the potential role of physical activity opportunities in mitigating obesity risk among children.

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These findings underscore the importance of implementing comprehensive interventions that address the socio-economic and environmental determinants of childhood obesity. Efforts aimed at improving access to education, promoting healthy food environments, and enhancing opportunities for physical activity are crucial for combating the obesity epidemic among children. By adopting a multi-dimensional approach that addresses the root causes of obesity, policymakers, healthcare professionals, and communities can work together to create healthier environments and empower children to lead healthier lives.

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