



The role of child development and socioeconomic factors in child obesity in Pakistan

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ABSTRACT

This study intricately explores obesity's nexus with socio-emotional, physical development, and socioeconomic status, vital for global public health. It delves into psychological dimensions by scrutinizing attitudes toward obesity and their link with physical development. Additionally, it highlights obesity's physical implications, impacting overall health, chronic conditions, and healthcare systems. Using the Multiple Indicator Cluster Survey (MICS) dataset among 39,168 children aged 30 to 59 months in Pakistan, it examines socioeconomic factors like access to healthy food and parental education. Through logistic regression on diverse demographic samples, this research unveils significant associations between physical development, socio-emotional well-being, demographics, socioeconomic status, and overweight/obesity prevalence. Understanding these connections is crucial for tailored interventions to address escalating obesity rates, requiring nuanced strategies in diverse demographics and socioeconomic contexts.

1. Introduction

The escalating prevalence of obesity and overweight conditions is an urgent global health crisis, significantly affecting individual health and imposing tremendous strain on healthcare systems worldwide. Obesity, particularly among children and adolescents, has become a significant concern due to its complex relationship with a range of physical, socio-emotional, and socioeconomic factors. The World Obesity Federation's World Obesity Atlas 2023 projects alarming statistics, predicting that by 2035, 51 % of the global population will be classified as overweight, with 25 % falling into the obese category. Even more concerning is the fact that childhood obesity rates are expected to double by 2030 compared to 2020. This disturbing trend disproportionately impacts low- and middle-income countries (LMICs), particularly in regions of Africa and Asia, where limited resources exacerbate the challenges in tackling obesity. The rapidly rising incidence of childhood obesity in these regions calls for urgent intervention, not only to mitigate the

immediate health risks but also to address the broader societal and economic implications associated with this health crisis. The economic burden of obesity is staggering, with global costs projected to exceed £3.3 trillion annually by 2035, representing 3 % of the world's Gross Domestic Product (GDP).¹ This makes obesity not just a medical issue but a major economic concern. In the context of LMICs, the convergence of obesity with undernutrition has resulted in a dual burden of malnutrition. Children in these regions face increased risks not only of obesity but also of related comorbidities such as diabetes, hypertension, and cardiovascular diseases, further straining healthcare systems that are already grappling with the effects of infectious diseases and inadequate health infrastructure (Wolfenden et al., 2019). The complexity of these factors underscores the necessity of addressing childhood obesity as a global health priority, given its profound implications on individual well-being, public health systems, and economies at large. Central to addressing childhood obesity understands the multifactorial nature of its development. A critical aspect of this issue lies in the complex

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¹ <https://www.cieh.org/ehn/public-health-and-protection/2023/march/childhood-obesity-set-to-more-than-double-from-2020-levels/>

relationship between socio-emotional, physical, and socioeconomic factors. Emotional well-being, for instance, has been shown to significantly influence the likelihood of childhood obesity.

The socio-emotional development dimensions of obesity serve as a pivotal focal point due to their profound influence on children mental well-being and the intricate interplay between emotional health and weight-related concerns (Aguiar et al., 2023). Psychological factors such as self-esteem (Lo Buono et al., 2023), body image perception (Lo Buono et al., 2023), and mental health have been identified as crucial contributors to the onset and exacerbation of obesity (Krupa-Kotara et al., 2023). Extensive research underscores the reciprocal relationship between mental health and obesity, suggesting that psychological distress, conditions like depression, and anxiety can heighten the risk of obesity (Abiri et al., 2022; Ding et al., 2022; Fulton et al., 2022). Children experiencing emotional distress often resort to maladaptive eating behaviors as coping mechanisms, leading to weight gain and perpetuating a detrimental cycle (Ding et al., 2022).

Moreover, societal stigmatization and discrimination against children with obesity significantly impact their emotional well-being, exacerbating mental health issues and impeding effective weight management (Cardel et al., 2022; Marwood et al., 2023). Additionally, socio-cultural influences play a pivotal role in shaping attitudes toward body image, impacting people's self-worth perceptions and contributing to the development of obesity (Alsulaimi et al., 2023; Hardie et al., 2022). Media interpretation of idealized body standards often leads to body dissatisfaction among individuals, fostering negative emotional experiences that can precipitate unhealthy eating habits and weight gain (Donnachie et al., 2023; Minadeo & Pope, 2022). Childhood socio-emotional development and resilience constitute fundamental aspects of overall well-being, influencing physical health, psychological stability, and social interactions. Recent research increasingly examines the multifaceted relationship between socio-emotional factors and the prevalence of obesity and overweight among children (Courbet et al., 2022; Muñoz-Oliver et al., 2022). The link between socio-emotional development and obesity lies in the mechanisms of stress regulation and coping strategies (Brodbeck et al., 2022; Urbón & Salavera, 2023). Socio-emotional development encompasses the acquisition of emotional regulation, social skills, and adaptive coping mechanisms (Black et al., 2023; Sappok et al., 2022). Children who exhibit robust socio-emotional skills frequently showcase resilience in facing challenges, maintaining emotional equilibrium, and cultivating positive relationships, aiding in overcoming obesity (Xiao et al., 2022). The escalating rates of obesity worldwide pose a significant public health challenge, requiring comprehensive interventions and strategies. Another determinant is physical activity, which serves as a cornerstone in the multifaceted approach to combat and prevent obesity. To delve into the multifaceted correlation between physical activity and the prevalence of obesity, shedding light on the diverse mechanisms and effects of exercise on managing weight. Several studies emphasize the vital role of physical activity in reducing the likelihood and advancement of obesity. Consistent engagement in physical activity shows an inverse relationship with obesity rates, as confirmed by a multitude of epidemiological inquiries (Akter et al., 2022; Alhashemi et al., 2022; Annesi, 2023; Xiao et al., 2022). Sedentary lifestyles characterized by insufficient physical exertion have been linked to an increased risk of obesity among various age groups, ranging from children to adults (Silveira et al., 2022). The effects of physical activity on obesity are mediated through multifaceted mechanisms involving energy expenditure, metabolic regulation, and body composition (Calcaterra et al., 2022; Xu et al., 2022). Engaging in physical activities elevates energy expenditure, fostering a negative energy balance crucial for weight maintenance (Akalestou et al., 2022). Regular exercise enhances metabolic processes (Calcaterra et al., 2022), influencing hormone regulation (Masi et al., 2022) and favorably impacting adiposity and insulin sensitivity (Tong et al., 2022). Moreover, physical activity influences body composition by promoting muscle development, thereby increasing basal metabolic rate and

facilitating fat oxidation (Ashtary-Larky et al., 2022). The integration of various types and intensities of physical activity, including aerobic exercises like running, swimming, and cycling, as well as resistance training, plays a pivotal role in combating obesity by facilitating calorie expenditure, improving cardiovascular health, augmenting muscle mass, and enhancing metabolic rates for effective long-term weight management (de Paiva et al., 2023). However, maximizing the impact of exercise interventions on obesity requires considering individual preferences, adherence to regimens, and overcoming barriers like child gender, disability, and disciplinary practices, socioeconomics, access, time constraints, and motivational factors hindering widespread adoption and sustainability (Cavallo et al., 2023). Gender disparities in childhood obesity prevalence and manifestations are evident due to differences in dietary habits and physical activity levels between boys and girls, potentially influencing the varying rates of obesity (Akram & Pervaiz, 2025; Domaradzki, 2023; KavehFarsani et al., 2020; Taghizadeh et al., 2022). Children with disabilities encounter distinctive challenges that might increase their susceptibility to higher rates of obesity and overweight; disabilities may serve as both a cause and consequence of obesity (Akram et al., 2024; Amo-Setién et al., 2020; Medina-Rebollo et al., 2023; Neter et al., 2011). Another factor is that disciplinary practices employed by parents or caregivers can significantly impact a child's eating behaviors and weight gain (Ningning & Wenguang, 2023; Pervaiz & Akram, 2019; van der Veek et al., 2019). Parental behaviors, attitudes, economic status, and awareness of nutrition significantly impact children's perception of body image and emotional well-being, thus influencing their susceptibility to obesity during adolescence and adulthood (Abdoli et al., 2023; Akram et al., 2021; Buoncristiano et al., 2021; El Kishawi et al., 2020; Hsu et al., 2022; Pervaiz et al., 2021).

Global trends show a concerning rise in childhood obesity, with significant economic and health consequences. Most research has been conducted in high-income countries, where resources support extensive interventions and monitoring. However, there is a gap in understanding how these trends affect low- and middle-income countries (LMICs). In these regions, limited access to healthy food, lack of safe spaces for physical activity, and financial constraints increase the risk of obesity among children. Rapid urbanization, dietary changes, and more sedentary lifestyles further complicate the issue. There is limited research on the socio-emotional, physical, and socioeconomic factors contributing to childhood obesity in LMICs, particularly in South Asia. The unique social, economic, and cultural contexts in these regions require tailored approaches. This study aims to address this gap by focusing on Pakistan, a rapidly urbanizing country where childhood obesity is growing. It will examine how emotional well-being, physical health, and socioeconomic factors interact to influence childhood obesity. The findings will provide valuable insights for developing targeted interventions in LMICs to address this pressing issue. The subsequent section of this paper presents the approach, followed by the discussion and results. The final segment is devoted to the conclusion, which also includes recommendations for future study directions aimed at fully comprehending and addressing these complex problems.

2. Methodology

The study aims to investigate the impact of socio-emotional development, physical development, and socio-economic factors on obesity and overweight. The dependent variable of the study is obesity and for robustness we used overweight, defined by the WHO (Whitford et al., 2019) as the state of being overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. The study utilizes measures of obesity (weight-for-height (BMI) >2 standard deviations above WHO Child Growth Standards median) and overweight (weight-for-height greater than three standard deviations). The indicators assume value of one when there is prevalence of obesity or overweight and coded as zero otherwise. In our regression analysis, these two indicators have been treated as dependent variables whereas

independent variables include gender (male/female), child disability (Yes and no), discipline (violent and nonviolent),² parental education (categorized as lower secondary and upper secondary), area (rural/urban), and region as provinces (Sindh, Punjab, KPK, Baluchistan), wealth quintiles (ranging from richest to poorest).³ The MICS survey specifically targeted children aged 36 to 59 months, assessing both physical and socio-emotional development through caregiver reports and behavioral indicators. These are our interest key variable **physical development** encompasses changes in a child's body and abilities. It includes growth in size, muscle development (both gross and fine motor skills). A child is considered developmentally on track in the physical domain if they can pick up small objects using two fingers and if their primary caregiver does not indicate frequent illness hindering play. **Physical development is coded as 1 otherwise 0.** **Social-emotional development** focuses on a child's ability to understand and manage emotions, interact with others, and form relationships. Components include emotional regulation, social interactions, empathy, self-awareness, and understanding social norms. A child is developmentally on track in this domain if they get along well with peers, avoid aggressive behaviors, and demonstrate good attention and focus. Both aspects are crucial for a child's overall well-being and learning. **Social-emotional development is coded as 1 otherwise 0.**

We have also run two regression models. Because of the categorical nature of the dependent variable, we have used binary logistic regression for our analysis, which is considered an appropriate statistical technique in case of categorical dependent variable. Odds ratios (ORs) and marginal effects have been used to check robustness the effects of independent variables on our outcome variable.

The study has used the data of children aged 36 to 59 months which has been made available by the Multiple Indicator Cluster Survey (MICS) wave 6 conducted in the four provinces of Pakistan between 2017 and 2020, as part of the Global MICS Programme, a collaborative effort between the United Nations Children's Fund and the Bureau of Statistics (UNICEF, 2023). The number of observations used in our regression models are 39,168.

3. Results

The distribution of factors influencing overweight and obesity, as shown in Table 1, reveals several key findings. Among the sample, 11.35 % of children were identified as overweight, while 7.60 % were categorized as obese. In terms of physical development, a significant proportion (79.75 %) exhibited proficiency in physical attributes, while 62.79 % demonstrated social-emotional development. The gender

² Discipline includes physical punishment and psychological aggression, both of which harm children. Positive discipline methods, focusing on teaching and guidance, are essential. Physical punishment involves actions like shaking, hitting, or spanking, and severe forms include striking a child's face or repeated beatings. Psychological aggression entails non-physical harm, such as shouting, yelling, and using derogatory names. Promoting non-violent discipline methods is crucial for children's well-being. Discipline is follow consider nonviolent is coded as 1 coded 0 otherwise.

³ Since 2000, a widely used approach for analyzing variations in health, education, poverty, and other socio-economic factors involves ranking households by asset ownership, including consumer durables (e.g., TV, fridge, car), housing characteristics (e.g., quality of building materials, toilet facilities, number of rooms), and access to basic services (e.g., water, electricity). The wealth score is based on ownership of durable goods, housing characteristics, and access to basic services. A principal component analysis (PCA) is conducted on a set of indicator variables for the Multiple Indicator Cluster Surveys (MICS) to infer a household's wealth level. In our analysis, we used wealth scores divided into quintiles as constructed by the MICS team UNDP. (2020). *Human Development Report*. <http://hdr.undp.org>. For further analysis, we reclassified these quintiles into two categories: the 1st and 2nd quintiles as "poor," and the 3rd, 4th, and 5th quintiles as "non-poor."

Table 1

factors contributing to overweight and obesity distribution across variables.

Variable		Freq.	Percent	Cum.
Overweight	NO	34,721	88.65	88.65
	Yes	4447	11.35	100.00
Obesity	NO	36,191	92.40	92.40
	Yes	2977	7.60	100.00
Physical Development	NO	7933	20.25	20.25
	Yes	31,235	79.75	100.00
Social Emotional Development	NO	24,592	62.79	62.79
	Yes	14,576	37.21	100.00
Child Gender	Girls	20,364	51.99	51.99
	Boys	18,804	48.01	100.00
Child Disability	No	37,454	95.62	95.62
	Yes	1714	4.38	100.00
Child Discipline	Violent	12,675	32.36	32.36
	Nonviolent	26,493	67.64	100.00
Mother's education	Lower secondary	33,215	84.80	84.80
	Upper secondary	5953	15.20	100.00
Father's education	Lower secondary	25,957	66.27	66.27
	Upper secondary	13,211	33.73	100.00
Wealth index	Poor	20,165	51.48	51.48
	Non_Poor	19,003	48.52	100.00
Area	Urban	9986	25.50	25.50
	Rural	29,182	74.50	100.00
Province	Punjan	13,706	34.99	34.99
	Sindh	7116	18.17	53.16
	KPK	7818	19.96	73.12
	Balochistan	10,528	26.88	100.00

distribution of the sample showed that 51.99 % of the children were girls, with the remaining 48.01 % being boys. Additionally, 4.38 % of the children had disabilities.

In terms of gender distribution, approximately 51.99 % represent females, while 4.38 % of children have identified disabilities. Parental education primarily comprises lower secondary levels, with 84.80 % of mothers and 66.27 % of fathers having achieved this educational level. Economically disadvantaged individuals account for 51.48 % of the cohort. Residential distribution indicates that 74.50 % reside in rural areas, contrasting with 25.50 % in urban locales. Geographically, the population distribution by province is as follows: Punjab (34.99 %), Sindh (18.17 %), KPK (19.96 %), and Balochistan (26.88 %). These findings offer insights into the multifaceted aspects influencing overweight and obesity within this studied population.

The results presented in Table 2 showcase the odds ratios and marginal effects of various factors influencing overweight and obesity within the surveyed population. Children demonstrating physical development show reduced odds of being overweight (OR = 0.925, $p < 0.01$) and obese (OR = 0.835, $p < 0.001$), with corresponding marginal effects indicating a significant decrease in both conditions. Socio-emotional development also contributes significantly, displaying reduced odds of overweight (OR = 0.642, $p < 0.001$) and obesity (OR = 0.538, $p < 0.001$), with consequential diminished marginal effects in both instances.

Distribution showed that 74.50 % of the children lived in rural areas, whereas 25.50 % resided in urban settings. Geographically, the population was distributed as follows: 34.99 % from Punjab, 18.17 % from Sindh, 19.96 % from KPK, and 26.88 % from Balochistan. Further analysis revealed the significant associations between physical and socio-emotional development and childhood overweight and obesity. Children who demonstrated physical development showed reduced odds of being overweight (OR = 0.925, $p < 0.01$) and obese (OR = 0.835, $p < 0.001$). Similarly, socio-emotional development contributed to reduced odds of being overweight (OR = 0.642, $p < 0.001$) and obese (OR = 0.538, $p < 0.001$). Boys exhibited higher odds of being overweight (OR = 1.086, $p < 0.05$) and obese (OR = 1.180, $p < 0.001$) compared to girls, with corresponding increases in marginal effects for both conditions. Additionally, children with disabilities showed higher odds of being overweight (OR = 1.213, $p < 0.001$) and obese (OR = 1.197, $p < 0.01$).

Table 2

Factors influencing childhood overweight and obesity: Odds ratios and marginal effects.

Variables			Overweight		Obesity	
			Odds Ratio	Marginal Effects	Odds Ratio	Marginal Effects
Physical and Socio-Emotional Development	Physical Development	NO Reference				
		Yes	0.925*** (0.0337)	0.992** (0.00347)	0.835*** (0.0372)	0.988*** (0.00287)
	Socio-Emotional Development	NO Reference				
		Yes	0.642*** (0.0249)	0.954*** (0.00427)	0.538*** (0.0244)	0.953*** (0.00380)
Child Related Factors	Child Gender	Girls Reference				
		Boys	1.086** (0.0352)	1.008** (0.00318)	1.180*** (0.0458)	1.011*** (0.00267)
	Child Disability	NO Reference				
		Yes	1.213*** (0.0824)	1.020*** (0.00765)	1.197** (0.0958)	1.013** (0.00632)
Socioeconomic Factors	Child Discipline	Violent Reference				
		Nonviolent	0.756*** (0.0262)	0.972*** (0.00348)	0.685*** (0.0282)	0.973*** (0.00297)
	Mother's education	Lower Secondary Reference				
		Upper Secondary	1.123** (0.0602)	1.012** (0.00561)	1.153** (0.0719)	1.010** (0.00468)
Regional factors	Father's education	Lower Secondary Reference				
		Upper Secondary	0.859*** (0.0340)	0.986*** (0.00366)	0.896** (0.0421)	0.993** (0.00311)
	Wealth index	Poor Reference				
		Non_Poor	1.123*** (0.0425)	1.011*** (0.00374)	1.131*** (0.0512)	1.008*** (0.00314)
Constant	Area	Rural Reference				
		Urban	1.093** (0.0455)	1.009** (0.00423)	1.105** (0.0540)	1.007** (0.00351)
	Province	Balochistan Reference				
		Punjan	0.431*** (0.0193)	0.917*** (0.00423)	0.655*** (0.0339)	0.969*** (0.00380)
		Sindh	0.479*** (0.0242)	0.925*** (0.00464)	0.553*** (0.0335)	0.959*** (0.00387)
		KPK	0.657*** (0.0301)	0.951*** (0.00504)	0.602*** (0.0355)	0.964*** (0.00396)
		0.311*** (0.0133)		0.202*** (0.0101)		
N		39,168	39,168	39,168	39,168	

seEform in parentheses

*** $p < 0.01$.** $p < 0.05$.* $p < 0.1$.

Socioeconomic factors also demonstrated a clear association with childhood obesity. Higher maternal education at the upper secondary level elevated the odds of overweight (OR = 1.123, $p < 0.05$) and obesity (OR = 1.153, $p < 0.05$). Non-poor children showed higher odds of both overweight (OR = 1.123, $p < 0.001$) and obesity (OR = 1.131, $p < 0.001$). Urban residency also increased the odds of overweight (OR = 1.093, $p < 0.05$) and obesity (OR = 1.105, $p < 0.05$) compared to rural areas. Provincial variations were observed, with children from Punjab, Sindh, and KPK exhibiting different odds of overweight and obesity compared to those from Balochistan. Parental education levels were predominantly at the lower secondary level, with 84.80 % of mothers and 66.27 % of fathers having achieved this level of education. Economically, 51.48 % of the children in the cohort were categorized as economically disadvantaged.

4. Discussion

This study investigates the impact of various variables on childhood overweight and obesity in Pakistan, revealing critical insights into the relationship between physical development and socioeconomic factors but there is a gap in socio-emotional development. By comparing these findings with previous literature, particularly from other developing countries, provides a broader perspective on the global trends and

determinants of childhood obesity. Children with positive socio-emotional development are significantly less likely to be overweight and obese. This finding is consistent with studies from other developing (Henninger IV & Luze, 2010) and transition nations, such as Chile, where socio-emotional well-being has been linked to healthier body weights. In Chile, researchers found that children with better socio-emotional development had lower rates of obesity, highlighting the role of emotional and psychological health in preventing obesity (Galván et al., 2014). Similarly, in Guatemala, Philippines and South Africa, socio-emotional development was associated with lower obesity rates, suggesting that emotional well-being contributes to healthier weight outcomes (Varghese et al., 2022). Not only that, but our findings also shows a lower likelihood of overweight and obesity in children who show advanced physical development. Findings from developed countries (Mahumud et al., 2021) and developing nations like Brazil and India are consistent with this (Gupta et al., 2012; Lafia et al., 2022), where early physical development and better physical activity have been shown to reduce the likelihood of obesity. For instance, a study in Brazil highlighted that children who engage in regular physical activities exhibit lower rates of overweight and obesity, emphasizing the importance of promoting physical development from an early age (Ferreira et al., 2021). Similarly, research in India supports the notion that physical development plays a protective role against obesity, with

active children less likely to become overweight (Venkatrao et al., 2020). Our hypothesis, which posited that physical and socio-emotional development significantly influences childhood obesity, was strongly supported. But when gender is taken into account, boys are more likely than girls to be overweight or obese. This gender gap is seen in a number of developing nations (Akaliyski et al., 2022), where boys tend to have higher obesity rates. A study in South Africa reported that boys were more prone to obesity due to differences in physical activity levels and dietary habits compared to girls (Rossouw et al., 2012). In Egypt, similar trends were noted, with boys exhibiting higher obesity rates, potentially due to cultural and societal norms influencing diet and lifestyle (Abd El-aty et al., 2020). However, children with disabilities are at higher risk of being overweight and obese. This trend is also evident such as Nepal and Kenya, where children with disabilities face higher obesity risks. In Bangladesh, researchers found that children with disabilities were more likely to be obese, often due to limited physical activity and social isolation (Sapkota et al., 2023). In Vietnam, similar findings were reported, with children with disabilities exhibiting higher rates of obesity, underscoring the need for targeted interventions (Phan et al., 2020). Nevertheless, nonviolent discipline is associated with lower odds of overweight and obesity. This suggests that supportive parenting practices can contribute to healthier weight outcomes, a pattern corroborated by studies in similar socio-economic contexts like Mexico and the Philippines (Sultana et al., 2021). In Mexico, nonviolent discipline was linked to lower obesity rates among children, highlighting the importance of positive parenting in preventing obesity (Quintana-Navarrete, 2023). In the Philippines, supportive parenting practices were found to be protective against obesity, emphasizing the role of family dynamics in child health (Leon Guerrero et al., 2020). We also included the age of children as older children (48–59 months) have lower odds of being overweight and obese, indicating that age is a protective factor. This may be due to increased physical activity and metabolism changes as children grow, a common observation in other developing countries. In Guam, older children were found to have lower obesity rates, potentially due to higher activity levels and better dietary habits (Leon Guerrero et al., 2020). Higher maternal education (Upper Secondary) increases the odds of both overweight and obesity, while higher paternal education decreases the odds ratio of overweight and obesity. This mixed effect highlights the complex role of parental education in child nutrition and obesity, similar to trends in other developing regions. In China, higher maternal education was associated with increased child obesity, potentially due to greater access to calorie-dense foods and sedentary lifestyles (Ding et al., 2021; Hsu et al., 2022). Conversely, in South Africa, higher paternal education was linked to lower child obesity rates, suggesting that educated fathers may influence healthier lifestyle choices (Modjadji et al., 2022). Parent economic status significantly affects childhood overweight and obesity, with children from non-poor households more likely to be affected. This trend aligns with other developing countries where higher income often leads to increased consumption of calorie-dense foods. In South Africa, researchers found that children from wealthier families had higher obesity rates, attributed to greater access to processed and high-calorie foods (Nwosu et al., 2022). In Ethiopia, similar trends were observed, with wealthier households exhibiting higher child obesity rates due to dietary habits and lifestyle changes associated with increased income (Berhane et al., 2020). Urban children are more likely to be overweight and obese, reflecting urbanization's role in lifestyle changes that contribute to obesity. This urban-rural divide is a common issue in developing countries like Bangladesh undergoing rapid urbanization. The urbanization has been linked to higher obesity rates among children due to changes in diet and reduced physical activity and lifestyles on child health (Hossain et al., 2022). Compared to Balochistan, children in Punjab, Sindh, and KPK have lower odds of being overweight and obese, highlighting regional disparities. Such provincial differences are also seen in other developing countries, often linked to variations in economic development, cultural practices, and access to healthcare

services. Regional disparities in childhood obesity were noted, with children in more developed regions exhibiting higher obesity rates due to lifestyle, dietary differences, economic and cultural factors (Kumar et al., 2022). Our hypothesis, which examined the relationship between socioeconomic status (SES) and childhood obesity, was also supported. Despite the significant contributions of this study, several limitations must be acknowledged. One potential limitation is the reliance on self-reported data, which may introduce biases and affect the accuracy of the findings. Self-reports on physical activity and dietary habits are often subject to social desirability bias, where participants may overestimate their physical activity levels or underreport unhealthy food consumption. Additionally, the cross-sectional design of the study limits the ability to establish causal relationships between the studied variables. Longitudinal studies would provide more robust insights into the long-term effects of physical, socio-emotional, and environmental factors on childhood obesity.

5. Conclusion

In conclusion, this study highlights the multifaceted nature of childhood obesity, emphasizing the importance of physical, socio-emotional, socioeconomic, and environmental factors. The findings suggest that a comprehensive, multi-pronged approach is necessary to address childhood obesity, one that integrates physical activity and emotional well-being. Interventions that focus on promoting both physical fitness and emotional health, while addressing socioeconomic disparities, are likely to be more successful in reducing obesity rates in children. Future research should also consider exploring other factors that may contribute to childhood obesity, such as cultural influences, and environmental contexts. Understanding how these factors interact with physical and socio-emotional development could help create more targeted and effective interventions.

CRedit authorship contribution statement

Tingting Wang: Writing – review & editing. **Shahla Akram:** Writing – original draft. **Mehboob Ul Hassan:** Writing – review & editing. **Fajar Khurram:** Writing – review & editing. **Muhammad Farrukh Shahzad:** Writing – review & editing.

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No

Ethics approval statement

I affirm ethical research practices by utilizing publicly available data (<https://mics.unicef.org/surveys>), ensuring privacy, and providing unbiased insights for the Journal. This study didn't require ethical approval, as it did not involve any human/animal data or pictures.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data openly available in a public repository that issues datasets with DOIs <https://mics.unicef.org/surveys>.

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