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Community-Level Physical Activity Opportunities, Safe and Supportive Environment Factors, and Their Association with Overweight and Obesity Among School-Aged Children and Adolescents in Pakistan- A Cross-Sectional Study

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Abstract

Background: Childhood overweight and obesity pose significant global public health challenges, with Pakistan witnessing a rising prevalence and consequent adverse health impacts. External factors including parental, peer, school, and community influences shape children's health behaviors during their developmental years.

Purpose: This study aimed to assess opportunities for physical activity, safe and supportive environments for physical activity, and their association with overweight and obesity among school-aged children and adolescents aged 9 to 17 years in Pakistan.

Methods: A population-based cross-sectional study was conducted, involving a representative multistage random cluster sample of 3,371 school-aged children and adolescents (9 to 17 years old) and their families from seven randomly selected districts in Punjab, Pakistan. Overweight (> +1 SD) and obesity (> +2 SD) were determined using the World Health Organization reference from 2007. Various statistical analyses including the Chi-square test, Pearson correlation coefficient, Linear regression, and logistic regression were employed.

Results: The study comprised 3,371 Pakistani school children aged 9 to 17 years and 3,371 families from 62 schools. The prevalence of overweight and obesity among Pakistani school-aged children and adolescents was 16.8% and 10.3%, respectively. At the socio-ecological community level, factors such as the availability of physical activity opportunities in the community (OR 1.34, 95% CI 1.03-1.74, $p < 0.05$), residing in a safe community (OR 0.47, 95% CI 0.37-0.61, $p < 0.001$), and living in a supportive community (OR 0.49, 95% CI 0.38-0.64, $p < 0.001$) were associated with a lower risk of obesity among students.

Conclusion: The study highlights the concerning prevalence of overweight and obesity among Pakistani school-aged children and adolescents, emphasizing the significant impact of community-level environmental factors. Disparities in opportunities and safety within supportive community environments were observed concerning physical activity, especially among overweight and obese children residing in rural areas. Recommendations advocate for interventions targeting community-level determinants to effectively address this public health concern, in line with established guidelines. Ongoing monitoring, intervention, and future research are essential to comprehensively combat overweight, obesity, and related behavioral factors.

Keywords: Obesity and Overweight; Pakistan Youth Study; Body Mass Index; Physical Activity Support; Opportunities

1. Introduction

Childhood overweight and obesity remain significant health concerns, with enduring impacts [1]. Early unhealthy behaviors can lead to lasting negative effects [2], influenced by various external factors [3]. Global prevalence rates have surged in recent years [4], affecting countries across income levels [5]. In 2016, WHO reported that 18% of children and adolescents worldwide were overweight or obese [6], with profound short and long-term health consequences [1-6]. Understanding sedentary behavior and diet-related habits in childhood is critical for prevention, given their persistence and challenges to change later in life [7], particularly after age 35.

The socio-ecological concerns regarding obesogenic environments' impact on children's health, driven by the high prevalence of obesity among school-aged children and adolescents, underscore the need for action [9]. Parents' perceptions of the neighborhood influence children's physical activity, emphasizing the importance of residing near safe play spaces to mitigate obesity risks [10]. Community factors such as design, school accessibility, and

safety influence parental decisions on outdoor play [11]. Evolving built environments, with increased traffic and fast-food outlets, restrict recreational spaces, affecting children's activity levels and diets [11,12]. Addressing childhood obesity requires examining community factors and implementing holistic environmental improvements [13].

Obesity is a pressing global concern, particularly among Pakistani youth, where approximately half of the population is classified as overweight or obese [16-19]. This trend has led to increased early fatalities, emphasizing the need for preventive measures [20]. Projections indicate a worrying trajectory, with millions of Pakistani school-aged children expected to be obese by 2030 [21]. Despite these challenges, Pakistan lacks operational policies to address obesity effectively, and limited research underscores the need for comprehensive baseline data to assess its prevalence [22,23]. Childhood obesity poses serious health risks globally, including insulin resistance and type 2 diabetes [16]. Schools offer potential intervention platforms, where efforts to regulate physical activity and food choices hold promise in combating this issue [8-13]. Urgent action is imperative to mitigate the health risks associated with childhood overweight and obesity both in Pakistan and worldwide.

This study aims to explore socio-ecological community-level factors associated with overweight and obesity among school-aged children and adolescents aged 9 to 17 in Pakistan, using a nationally representative sample. By adopting an ecological perspective, we seek to understand the diverse influences on children's weight status, enabling the development of comprehensive strategies for prevention and intervention. The findings will inform targeted interventions and policies to address overweight and obesity in this population, both in Pakistan and globally.

2. Materials and Methods

2.1 Study design, setting, and participants

In the summer of 2023, a population-based cross-sectional study was conducted to assess the prevalence of overweight and obesity among school-aged children and adolescents (9 to 17 years old) across seven randomly selected districts in Pakistan. Utilizing a stratified multistage random cluster sampling method, 4,108 students (97.80%) completed questionnaires out of 4,200 participants enrolled from 62 schools in urban and rural areas, including Lahore, Gujranwala, Gujrat, Sheikhupura, Narowal, Hafizabad, and Sialkot. Parental responses were also collected, with 3,371 parents (82.05%) completing the questionnaire. Children aged 9-11 years and adolescents aged 12-17 years were included, sampled from grades 4th to 12th, while grades 1 to 3 were excluded due to questionnaire limitations [1]. Public schools granted permission with approval from the Punjab school education department, while private schools consented independently. A nominal fee was charged, with public schools incurring 20 PKR and private schools paying 10,000.00 PKR to address socioeconomic disparities. Instances of school refusal led to the random selection of alternative institutions. Furthermore, participation was voluntary, and ethical approval was obtained from the Institutional Review Board of Shanghai University of Sport (Protocol: 1816111009;2022), with informed consent from participants and their parents or guardians.

2.2 Measure Weight status

On predetermined dates, trained professionals from Rescue-1122 visited the selected schools to conduct anthropometric measurements of weight and height in the classroom. To ensure comprehension, the questionnaire, written in English, was read aloud to children in lower grades. Data collection directly from students was carried out with strict confidentiality of their responses maintained throughout the process. Body weight and height measurements were prioritized, with weight recorded to the nearest 0.1 kg and height to the nearest 0.5 cm [1-3,24]. Measurements were conducted during the early mornings or late evenings to minimize daily variations. Weight status classification utilized the World Health Organization child growth reference 2007, defining overweight as a BMI above +1 standard deviation (SD) and obesity as a BMI above +2 SD [3,29]. The age range covered by the reference tables (5 to 19 years) aligned with the selected school grade cohorts (primary, middle, secondary, and higher secondary schools) [25,45]. Trained rescue professionals were responsible for conducting all measurements, ensuring accuracy and consistency.

2.3 Community-Level Factors

The community-level factors related to social-ecological influences focused on the neighborhood environment and its impact on physical activity and the parents reported that their neighborhood would either never be considered unsafe for kids or would always be considered safe. for this study. The parents self-reported questionnaire used in this study included the following items: (1) What choices for physical activity are available in your immediate surroundings? (Reliability coefficient = 0.73). This item aimed to assess the availability and accessibility of physical activity options within the immediate neighborhood of the participants. It helps understand the variety of opportunities for physical activity in the community [15]. (2) Investigating students' regular activities in a safe setting? (Reliability coefficient = 0.77) [14]. This item explored the extent to which students engage in regular

activities in a safe environment. It assessed whether the community provided a secure setting for children to participate in physical activities. (3) How about a life study of students that is supported by the community? (Reliability coefficient = 0.73) [15]. This item aimed to determine the level of community support for the students' overall well-being and development. It assessed whether the community actively encouraged and supported students in leading a healthy and active lifestyle. In this study, the reliability coefficient, measured through Cronbach's alpha, was determined to be 0.79 for the questionnaire. Additionally, a previous study reported a test-retest reliability coefficient of 0.78, indicating the consistency of the questionnaire over time. The Global School-based Student Health Survey's (GSHS) Pakistan questionnaire was used as the basis for this study [28], incorporating items from previous studies conducted by Mushtaq et al. [29], Kim et al. [30] and Callahan-Myrick et al. [31]. These studies provided valuable insights and established the reliability and relevance of the questionnaire items for assessing community-level factors related to physical activity and the supportiveness of the neighborhood environment.

2.4 Statistical Analysis

IBM SPSSv.26 Statistical Analysis was utilized for data analysis, as referenced [1-3]. Age was precisely calculated by subtracting the date of birth from the examination date, while z-score values for BMI-for-age were determined using the World Health Organization's AnthroPlus software [1-3]. Overweight and obesity were defined based on the WHO child growth reference 2007. Frequency distribution analysis was employed to determine the prevalence of body-weight status. Bivariate analysis, employing the chi-square test as the trend test [16,27,29], was utilized to compare body-weight status prevalence with socio-ecological community-level factors. The Pearson correlation coefficient (r) was employed to measure the correlation between independent variables and body weight. Linear regression analysis was conducted to explore the predictive power of socio-ecological community-level factors as independent variables in relation to body weight. Additionally, binary logistic regression analyses were performed to assess the effect of community-level socio-ecological factors on the occurrence of overweight and obesity, with odds ratios (OR) and 95% confidence intervals calculated [1-3,16,29]. Statistical significance was set at $p < 0.05$.

3. Results

The study analyzed data from 3,371 school children aged 9 to 17 years and their families. Among them, 566 (16.8%) were classified as overweight and 347 (10.3%) as obese. The response rate from families was high, with all questionnaires matching the students' serial numbers. Missing responses led to the exclusion of corresponding serial numbers during analysis. Urban respondents constituted 60.4% of the sample, while rural respondents made up 39.5%. The majority identified as Muslims (96.1%), with non-Muslims comprising 3.9% of the sample population.

Table 1 Chi-square test to assess the association of opportunities for physical activity in community environments and safe and supportive community environment factors with overweight and obesity by residence-specific trend.

		Weight Status					
		Underweight	Healthy	Overweight	Obesity		
Characteristics	**Residence**	***n (%)***	***n (%)***	***n (%)***	***n (%)***	χ^2	***p-value***
Analysis of opportunities for physical activity available in community environments							
Yes	Urban	74 (19.2)	223 (57.9)	59 (15.3)	29 (7.5)	52.79	<0.001
	Rural	22 (8.1)	118 (43.4)	78 (28.7)	54 (19.9)		
No	Urban	335 (18.6)	1115 (61.8)	218 (12.1)	137 (7.6)	87.18	<0.001
	Rural	103 (11.3)	468 (51.5)	211 (23.2)	127 (14.0)		
Analysis of students' lives in a safe community environment.							
Yes	Urban	339 (18.4)	1136 (61.7)	230 (12.5)	137 (7.4)	89.03	<0.001
	Rural	111 (12.0)	483 (52.2)	224 (24.2)	108 (11.7)		
No	Urban	70 (20.1)	202 (58.0)	47 (13.5)	29 (8.3)	78.87	<0.001
	Rural	14 (5.5)	103 (40.4)	65 (25.5)	73 (28.6)		
Analysis of students' lives in a supportive community environment.							
Yes	Urban	339 (18.4)	1136 (61.7)	230 (12.5)	137 (7.4)	78.27	<0.001
	Rural	111 (12.2)	479 (52.8)	209 (23.0)	108 (11.9)		
No	Urban	70 (20.1)	202 (58.0)	47 (13.5)	29 (8.3)	86.51	<0.001
	Rural	14 (5.1)	107 (39.1)	80 (29.2)	73 (26.6)		
Total		534 (15.8)	1924 (57.1)	566 (16.8)	347 (10.3)		

The findings in **Table 1** reveal significant links between weight status and community-level factors. In rural areas, 28.7% of overweight and 19.9% of obese students, along with 15.3% of overweight and 7.5% of obese boys, had parents reporting opportunities for physical activity. Safety concerns were prevalent, especially in rural areas, where 25.5% of overweight and 28.6% of obese children's parents felt the environment was unsafe for their daughters.

Moreover, 29.2% of overweight and 26.6% of obese children's parents from rural areas perceived the community as unsupportive. Chi-square tests affirm significant associations between all community parameters and weight status, underlining the role of community-level environmental factors in childhood overweight and obesity prevalence.

Table 2 Correlation of weight status of students and community level factors.

	Characteristics	1	2	3	4
1	**Weight Status**	—			
2	**Opportunities for physical activity available in community.**	-0.059**	—		
3	**Students' lives in a safe community.**	0.095**	-0.740**	—	
4	**Students' lives in a supportive community.**	0.104**	-0.739**	0.963**	—

Note: $N = 3371$; **$p < 0.01$.

The results from **Table 2** indicate significant correlations between body weight status and community-level environmental factors. Specifically, there is a notable positive correlation ($r = 0.095$**) between weight status and the perception of safe community environments, with individuals perceiving their community as safe having a higher weight status. Similarly, a positive correlation ($r = 0.104$**) exists between weight status and the perception of supportive community environments, implying that individuals perceiving their community as supportive tend to have a higher weight status. Conversely, a negative correlation ($r = -0.059$**) is observed between weight status and the availability of opportunities for physical activity in the community, suggesting that individuals perceiving fewer opportunities for physical activity in their community are more likely to have a higher weight status.

Table 3 Linear regression analysis of weight status of students and community level factors.

		Unstandardized Coefficients		Standardized Coefficients		
	Characteristics	B	SE	β	t	Sig.
	Constant	1.755	0.154		11.390	<0.001
1	**Opportunities for physical activity available in community.**	0.075	0.054	0.036	1.392	0.164
2	**Children lives in a safe community.**	-0.123	0.140	-0.057	-0.876	0.381
3	**Children lives in a supportive community.**	0.396	0.138	0.185	2.867	0.004

SE = Standard error.

The linear regression analysis revealed that among the three variables examined, only one demonstrated a significant association with weight status. Children living in a supportive community showed a significant positive association ($\beta = 0.185$, SE = 0.138, $p = 0.004$) with weight status. However, opportunities for physical activity available in the community ($\beta = 0.36$, SE = 0.54, $p = 0.164$) and children living in a safe community ($\beta = -0.57$, SE = 0.140, $p = 0.381$) did not exhibit significant associations. Although the overall model had a low R^2 value of 0.012, indicating limited variance explained, the F-statistic of 13.322 ($p < 0.001$) suggested that the collective variables had a statistically significant effect on weight status, despite the lack of individual significance. Further details are available in **Table 3**.

Table 4 Odds ratios from two logistic regression analyses of community level factors and risk association with overweight and obesity.

	Overweight vs. Non-Overweight	Obese vs. Non-Obese
Characteristics	**Unadjusted OR (95% CI)**	**Unadjusted OR (95% CI)**
Opportunities for physical activity available in community.		
Yes	1.40 (1.13-1.73)**	1.34 (1.03-1.74)*
No	Ref.	Ref.
Children lives in a safe community.		
Yes	0.86 (0.68-1.08)	0.47 (0.37-0.61)***
No	Ref.	Ref.
Children lives in a supportive community.		
Yes	0.74 (0.59-0.92)**	0.49 (0.38-0.64)***
No	Ref.	Ref.

Level of significance *$p < 0.05$, **$p < 0.01$, ***$p < 0.01$, CI = Confidence Interval, OR = Odds Ratio
Note: Reference category (respectively): Ref.

Table 4 the logistic regression analyses revealed significant associations between variables related to opportunities for physical activity, community safety, and supportive community atmosphere, and the prevalence of overweight and obesity among school-aged children and adolescents. Regarding overweight, while living in a safe community did not show a significant association, the availability of opportunities for physical activity in the community (OR 1.40, 95% CI 1.13-1.73, $p < 0.01$) was associated with higher odds of being overweight. Conversely, residing in a supportive community (OR 0.74, 95% CI 0.59-0.92, $p < 0.01$) was linked to lower odds of overweight. For obesity, all three factors showed significant associations. Living in a safe and supportive community and having opportunities for physical activity in the community (OR 1.34, 95% CI 1.03-1.74, $p < 0.001$) were associated with higher odds of obesity, emphasizing the importance of community-level factors in addressing overweight and obesity among children and adolescents.

4 Discussion

The discussion highlights significant associations between weight status and various community-level factors. For instance, findings reveal disparities in the availability of opportunities for physical activity, safety concerns in community environments, and perceptions of supportive community environments, particularly among overweight and obese children in rural areas. The results underscore the influence of community-level environmental factors on the prevalence of overweight and obesity among children, emphasizing the need for interventions targeting community-level determinants to address this public health issue effectively.

This study revealed significant associations between students' weight status and community-level factors such as the lack of opportunities for sports activities and parents' concerns about the city's safety and suitability for children [3, 29]. Interestingly, previous studies conducted in the same region among Pakistani school-aged adolescents between the ages of 12 and 17 did not find a significant association between community-level factors and students' body mass index [3, 29]. Additionally, a Chinese study indicates that school support for physical activity (PA) and availability of and access to community PA resources are associated with school-level and individual-level moderate to vigorous physical activity (MVPA) participation among Chinese school-aged children [27]. Ecological models emphasize the role of both individual characteristics and the environment in determining the likelihood of overweight or obesity [32]. The neighborhood, as a part of the community, plays a crucial role in providing social support from neighbors and ensuring safety from criminal activities [33]. In line with Pearson and colleagues' findings, this study found that children living in less secure and unsupportive neighborhoods had a higher risk of being overweight or obese [33]. The level of safety in the neighborhood significantly influences a child's ability to engage in outdoor activities and participate in additional physical activities [33, 34]. Children residing in unsafe neighborhoods are less likely to engage in regular outdoor physical activity [33]. Moreover, research suggests that children with limited opportunities for physically active play are more susceptible to being overweight or obese [35]. These findings highlight the importance of community-level factors in shaping children's weight status and emphasize the need for interventions that address environmental barriers to physical activity and promote community safety.

Creating safe neighborhoods that support physical activity and provide opportunities for sports and active play can significantly contribute to reducing the prevalence of overweight and obesity among children [10,19]. Collaborative efforts between community members, local authorities, urban planners, and health professionals are essential for implementing effective strategies that enhance the community environment and facilitate healthier behaviors. This study further highlighted the importance of supportive neighborhoods where neighbors help and look out for each other's children, creating a sense of security and trust among parents, leading to increased outdoor play among children [33]. When children feel protected and supervised, parents are more likely to allow them to play outside, promoting physical activity. Additionally, the study found that children growing up in underserved areas had a higher risk of being overweight or obese, suggesting the critical role of community amenities such as parks, sidewalks, and recreation centers in influencing adolescents' exercise frequency and weight status [35]. In Pakistan, the majority of parents reported a lack of opportunities for sports activities and perceived their communities as unsafe for their children [15], highlighting the need for interventions addressing community-level barriers to physical activity and promoting neighborhood safety.

The study offers valuable insights into Pakistan's health challenges and global trends, providing essential data on school children and adolescents. It examines the correlation between community-level environmental factors and body weight issues, presenting a comprehensive analysis and employing robust sampling techniques for a diverse representation of Pakistan's population. As the first of its kind in Pakistan, it underscores the importance of nuanced analyses despite some nonsignificant findings. Overall, it lays the groundwork for future interventions and policies targeting overweight and obesity in Pakistan and beyond, especially for underrepresented populations.

The current study has some major limitations. The study's limitations include its cross-sectional design, reliance on self-reported data, focus solely on school-age children and adolescents aged 9 to 17 years, exclusion of younger age groups, reluctance of some girls' school principals to permit measurements, and reliance solely on BMI

calculations without assessing body fat percentage. These limitations necessitate careful interpretation of the findings and indicate areas for future research.

5 Conclusions

In conclusion, the study highlights the concerning prevalence of overweight and obesity among Pakistani school-aged children and adolescents, with a focus on the influential role of community-level environmental factors. The findings underscore disparities in physical activity opportunities, safety perceptions, and supportive environments for physical activity, particularly evident among overweight and obese children in rural areas. These results highlight the critical need for interventions aimed at addressing community-level determinants to effectively tackle this public health issue. Our recommendations align with established guidelines and stress the importance of continuous monitoring, intervention, and further research efforts to comprehensively combat overweight, obesity, and associated behavioral factors.

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