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RISK FACTORS ASSOCIATED WITH OBESITY AMONG SCHOOL CHILDREN

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ABSTRACT

Obesity has become a significant public health concern globally, including in India. The prevalence of obesity among school children is rising, leading to various health implications. Obesity not only impacts the immediate health of these children but also lays the foundation for a host of chronic diseases in adulthood, including diabetes, cardiovascular diseases, and musculoskeletal disorders. The study aimed to assess and find the association between risk factors associated with obesity and with selected socio-demographic variables. 126 subjects were recruited by using non-probability purposive sampling technique. Accu-chek Glucometer was used to monitor blood glucose level. The study revealed that about 55.6% of children belonged to the age group 10-12 years. Adequate fruits intake was reported by 20.6% of obese children and 620.6% of nonobese a children. Roughly equal proportions of obese and non obese children engage in lessthan two hours of physical activity per day. The risk factors which were found to be statistically associated with children obesity were age, height and weight predominantly. The study spotlighted that children obesity is rising at an alarming rate, the dietary determinants of obesity need to be addressed at the level of schools, families, and community.

Keywords: Risk factors, Obese, School children, Schools

INTRODUCTION

Health holds a central role in human well-being and progress, making significant contributions to both economic advancement and extended life spans. The correlation between health, development, and poverty reduction is noteworthy, with development policies also contributing to health accomplishments [1, 2]. Therefore, it is imperative to prioritize health, especially in the pursuit of social and economic development[2].

Globally, obesity has emerged as a critical public health issue, a concern shared by India [1]. The escalating prevalence of obesity among school children has far-reaching health consequences. While immediate health impacts are evident, the roots of numerous chronic diseases in adulthood, such as diabetes, cardiovascular disorders, and musculoskeletal problems, often trace back to childhood obesity [2, 3]. Despite being preventable, obesity's prevalence is on the rise among children and adolescents [4]. In 2016 alone, approximately 340 million young individuals were identified as overweight or obese. Over the span of four decades from 1975 to 2016, obesity rates surged more than fourfold among children [5, 6]. Those in low- and middle-income nations face the dual challenge of insufficient prenatal and early childhood nutrition and exposure to high-fat, high-salt, low-micronutrient diets.

The amalgamation of such dietary patterns with inadequate physical activity contributes to the alarming ascent of childhood obesity, even as under-nutrition concerns persist [7, 8].

The primary cause of obesity lies in the energy imbalance between caloric intake and expenditure. This intricate issue has multifaceted origins, encompassing modifiable factors like physical activity, socioeconomic status, eating behaviors, psychosocial elements, and endocrine disorders [9]. A global trend toward consuming energy-dense, high-fat foods, coupled with reduced physical activity due to sedentary work, urbanization, technological advancements, and changing modes of transportation, has intensified the problem [10, 11].

Childhood obesity is a recognized risk factor for later development of preventable non-communicable diseases (NCDs) in adulthood. As such, interventions aimed at adolescents, focusing on primordial and primary prevention, are pivotal in averting future NCDs [12, 13]. However, limited research, especially case-control studies, have examined the array of factors contributing to childhood obesity. Given that schools are key environments for children, assessing determinants of obesity among students and formulating preventive measures is vital.

In light of this, researchers have designed a study to delve into the nutritional aspects linked to obesity among school children, aiming to discern factors associated with both cases and control groups. This study holds promise for shedding light on critical insights that can inform effective strategies for obesity prevention among young populations.

MATERIAL AND METHODS

Between December 2022 and January 2022, a case-control study was conducted among 126 school children aged 10 to 14 years in Bangalore city, Karnataka, India. Prior to the study, formal administrative approval was obtained. The list of schools from the city's North and South zones was compiled, and employing a simple random sampling technique, two schools from the South zone were chosen for participation. Students in the 3rd to 8th standards from the selected schools were included after gaining permission from school authorities. Parents were briefed about the study's purpose via phone and in-person, and informed written consent from parents and assent from children were obtained.

The size of the study's sample was determined by referencing the proportion of exposure found in both cases and controls, drawing from a prior study conducted by Bhuiyan MU *et al* **[14]**. The sample size calculation employed a formula denoted as (N = [$Z1-\alpha/2$ + $Z1-\beta$]2 P q [r + 1]/[P1 −

P2]2 r). Given the exposure proportion of 59% among cases and 40% among controls, alongside a type I error of 5% and a type II error of 20%, while maintaining a controls-to-cases ratio of 1:1, the necessary sample size was computed as 63 obese children (cases) and 63 non-obese children (controls).

The researcher personally conducted interviews with all the children, collecting data on socio-demographic variables influencing their weight status using a pretested structured interview schedule. Standardized instruments and techniques were employed to measure anthropometric data, including height and weight. A calibrated digital weighing scale was used to measure weight, with measurements taken while the students stood barefoot on the scale. Height was measured using a calibrated digital stadiometer, with measurements taken while students stood barefoot with a horizontal gaze. BMI was computed using the formula: BMI = weight in kilograms divided by height in meters squared, referencing WHO Standard Growth Reference for BMI for specific age and gender.

The children's weights were categorized based on WHO Standard Age and Sex specific Growth Reference charts: "Normal weight" corresponded to the WHO Growth Standard median, and "Obesity" referred to BMI for age greater than 2 standard

deviations above the WHO Growth Standard median. Data was organized using Microsoft Excel and subjected to statistical analysis using descriptive and inferential tests with a significance threshold of P < 0.05.

Descriptive statistics and graphical presentations were generated for each study variable. The distribution of outcome variables was assessed to verify the validity of distributional assumptions, particularly considering that primary outcome variables were discrete. In such cases, simple tests of proportions and chi-squared analysis were employed. The collected data underwent thorough examination for discrepancies and was managed in Microsoft Excel. Statistical analysis was performed using SPSS version 20.0.

RESULTS

A comprehensive interview was conducted with a total of 126 participants to explore the risk factors linked to obesity. The details of the participants' socio-demographic characteristics are presented in **Table 1**.

The study reveals that the majority age group is 10-12 years (55.6%) for both cases and controls, with males dominating (52.4%). Hinduism is the primary religion (cases: 61.9%, controls: 49.2%), and preparatory school years are prevalent (55.6%). Notably, many have heights exceeding 140 cms (cases: 65.1%, controls: 54%), while 76.2% of cases exceed 60 kgs.

BMI-wise, cases mostly fall in the "30-39.9 (Obese)" category (100%), and controls in "18.5-24.9 (Healthy)" (100%). Fathers' education is higher among cases (Secondary: 28.6%), while controls show primary education dominance (33.3%). Mothers' self-employment is common (cases: 25.4%, controls: 28.6%), and fathers are private employees (cases: 33.3%, controls: 42.9%). Family income exceeds 15000 (85.7% both). Nuclear families are common (cases: 69.8%, controls: 77.8%), with larger sizes in cases (77.8%) and smaller in controls (22.2%). Dietary habits reveal vegetarian adherence (cases: 76.2%, controls: 34.9%), and universal junk/fast food consumption. Junk food is often consumed "Once in two days" (cases: 47.6%, controls: 30.2%), while fruits/vegetables are universally consumed. Travel is >1-2 kms for most (52.4%), with equal bicycle and private vehicle use (39.7%). Both cases and controls engage in ≤ 2 hours of daily physical activity (54%), with consistent >2 hours of TV and smartphone use (100%). All reside in urban areas, most have attained menarche (60%), 25.4% report family obesity history, and 87.3% report no health issues, with 37.5% anemia and upper respiratory tract infections each, and 25% other issues.

The **Table 2**, reveals that frequency and percentage distribution of subjects based on range of random blood sugar level and BMI

in both the case and control groups (n=126). For the case group (n=63), in terms of the range of random blood sugar, 92% had levels between 70-130mg/dl, while 8% had levels above 131mg/dl. Regarding BMI, 100% of cases fell into the "30-39.9 (Obese)" category. In the control group (n=63), 100% had random blood sugar levels between 70-130mg/dl. In terms of BMI, 100% were in the "18.5-24.9 (Healthy)" category. No participants were categorized as "Underweight" or "Overweight" in either group.

Table 3 displays the mean and standard deviation of blood glucose level ranges for both the case and control groups, encompassing a total of 126 participants. In the case group, the calculated mean blood glucose level range was 2.0794, accompanied by a corresponding standard deviation of 0.27248. Conversely, the control group exhibited a mean blood glucose level range of 2.0000, with a standard deviation recorded as 0.0000. Evidently, the average blood glucose level range in the case group appears to surpass

that of the control group. Notably, the control group's minimal standard deviation suggests limited variability in reported blood glucose levels within this group.

Table 4 illustrates the relationship between demographic variables and random blood sugar levels, presenting χ^2 values and associated p-values. For individuals aged 10-12 years, 35 had blood sugar levels 70-130mg/dl, χ^2=6.789, p=0.009. Similarly, ages 13-14 had 23 within 70-130mg/dl and 5 above 131mg/dl. In Preparatory class (Class 3 to 5), 35 had levels 70-130mg/dl, χ^2=6.789, p=0.009; for Middle class (Class 6 to 8), 23 had levels within 70-130mg/dl and 5 above 131mg/dl. Among ≤140cm height students, 18 had levels 70-130mg/dl, χ^2=4.856, p=0.028, while 4 had levels above 131mg/dl; among >140cm height, 40 had levels 70-130mg/dl, and 1 had levels exceeding 131mg/dl. Among ≤60kg weight students, 12 had levels 70-130mg/dl, χ^2=3.921, p=0.048, and 3 had levels above 131mg/dl; among >60kg weight, 46 had levels 70-130mg/dl, and 2 had levels exceeding 131mg/dl.

Table 1: Frequency and percentage distribution of socio-demographic variables of school children; n=126 (Case-63 & Control-63)

S. No.	Socio-demographic data	Case		Control	
		Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
	Age in years				
1.	a. 10-12	35	55.6	35	55.6
	b. 13-14	28	44.4	28	44.4
	Gender				
2.	a. Male	33	52.4	33	52.4
	b. Female	30	47.6	30	47.6
	c. Third Gender	-	-	-	-
	Religion				
3.	a. Hindu	36	61.9	31	49.2
	b. Christian	20	30.2	23	36.5
	c. Muslims	07	7.9	9	14.3
	d. Any others	-	-	-	-
4.	Class				

	a. Preparatory (Class 3 to 5)	35	55.6	35	55.6
	b. Middle (Class 6 to 8)	28	44.4	28	44.4
5.	**Height of the student in cms**				
	a. ≤140	22	34.9	29	46
	b. >140	41	65.1	34	54
6.	**Weight of the student in kgs**				
	7. ≤60	15	23.8	63	100
	8. >60	48	76.2	-	-
7.	**BMI status**				
	a. Below 18.5 (Underweight)	0	-	0	-
	b. 18.5-24.9 (Health)	0	-	63	100
	c. 25-29.9(Overweight)	0	-	0	-
	d. 30-39.9(Obese)	63	100	0	-
8.	**Educational status of mother**				
	a. No formal education	4	6.3	6	9.5
	b. Primary education	16	25.4	19	30.2
	c. Secondary education	17	27	16	25.4
	d. Higher Secondary education	15	23.8	14	22.2
	e. Degree and above	11	17.5	8	12.7
9.	**Educational status of father**				
	a. No formal education	4	6.3	2	3.2
	b. Primary education	15	23.8	21	33.3
	c. Secondary education	18	28.6	16	25.4
	d. Higher Secondary education	13	20.6	15	23.8
	e. Degree and above	13	20.6	9	14.3
10.	**Occupational status of mother**				
	Housewife	13	20.6	17	27
	Daily wages	8	12.7	6	9.5
	Self employed	16	25.4	18	28.6
	Private employee	14	22.2	12	19.0
	Government employee	12	19	10	15.9
11.	**Occupational status of father**				
	Unemployed	1	1.6	14	22.2
	Daily wages	14	22.2	27	42.9
	Self employed	19	30.2	16	25.4
	Private employee	21	33.3	6	9.5
	Government employee	8	12.7	14	22.2
12.	**Monthly family income**				
	a. ≤ 15000	9	14.3	9	14.3
	b. >15000	54	85.7	54	85.7
13.	**Type of family**				
	a. Nuclear	44	69.8	49	77.8
	b. Joint	19	30.2	14	22.2
	c. Extended	-	-	-	-
14.	**Family size**				
	a. ≤ 5members	44	69.8	49	77.8
	b. > 6-10 members	19	30.2	14	22.2
	c. > 11-15 members	-	-	-	-
15.	**Type of diet**				
	a. Vegetarian diet	48	76.2	41	65.1
	b. Mixed diet	15	23.8	22	34.9
16.	**Consumption of junk food/fast food**				
	a. Yes	63	100	63	100
	b. No	-	-	-	-
17.	**Frequency of consumption of junk food/fast food**				
	a. Daily	17	27	13	20.6
	b. Once intwo days	30	47.6	19	30.2
	c. Once in a week	9	14.3	20	31.7
	d. Once in a15 days	7	11.1	11	17.5
18.	**Consumption of fruits/vegetables**				
	a. Yes	63	100	63	100
	b. No	-	-	-	-
19.	**Frequency consumption of fruits/vegetables**				
	a. Daily	13	20.6	13	20.6
	b. Once in a two days	21	33.3	21	33.3
	c. Once in a week	18	28.6	18	28.6
	d. Once in a15 days	11	17.5	11	17.5
20.	**Distance of house from school in kms**				
	a. ≤ 1	16	25.4	19	30.2
	b. >1-2	33	52.4	38	60.3

	a. >2	14	22.2	6	9.5
21.	**Mode of travel to the school**				
	a. Walking	14	22.2	14	22.2
	b. Bicycling	25	39.7	25	39.7
	c. School bus	12	19	12	19
	d. Private vehicle	12	19	12	19
	e. Others	14	22.2	14	22.2
22.	**Hours of Physical activity(per day)**				
	a. ≤ 2hours	34	54	34	54
	b. >2hours	29	46	29	46
23.	**Hours of watching TV per day**				
	a. ≤ 2hours	-	-	-	-
	b. >2hours	63	100	63	100
24.	**Hours of watching smart phone per day**				
	a. ≤ 2hours	-	-	-	-
	b. >2hours	63	100	63	100
25	**Place of residence/Area of living**				
	a. Rural	-	-	-	-
	b. Urban	63	100	63	100
26	**Have you Attained Menarche**				
	a. Yes	18	60	18	60
	b. No	12	40	12	40
27.	**History of obesity among family members**				
	a. Yes	16	25.4	16	25.4
	b. No	47	74.6	47	74.6
28.	**(i) Do you have any health issues**				
	a. Yes	8	12.7	8	12.7
	b. No	55	87.3	55	87.3
	(ii) If yes, Specify it				
	a. Anemia	3	37.5	3	37.5
	b. Upper respiratory tract infections	3	37.5	3	37.5
	c. Others	2	25	2	25

Table 2: Frequency and percentage distribution of subjects according to Range of Random Blood Sugar level and BMI in case group and control group; n=126

Sr. No	Variables		Case Group n=63		Control Group n=63	
			f	%	f	%
1.	**Range of Random Blood Sugar**	>70mg/dl	-	-	-	-
		70-130mg/dl	58	92	63	100
		>131mg/dl	05	08	-	-
2.	**BMI**	Below 18.5 (Underweight)	0	-	0	-
		18.5-24.9 (Health)	0	-	63	100
		25-29.9 (Overweight)	0	-	0	-
		30-39.9 (Obese)	63	100	0	-

Table 3: Mean and standard deviation for Range of blood glucose level of the subjects in case group and control group; n=126

S. No.	Groups	Mean	SD
1.	Case	2.0794	.27248
2.	Control	2.0000	.0000

Table 4: Association between range of Random Blood Sugar among children with their selected demographic variables in Case group; n=63

S. No.	Demographic Variables	Range of Random Blood Sugar		χ^2	P– Value
		70-130mg/dl	>131mg/dl		
1.	**Age in years**				
	a. 10-12	35	0	6.789	0.009
	b. 13-14	23	5	df- 1	S*
2.	**Class**				
	a. Preparatory (Class 3 to 5)	35	0	6.789	0.009
	b. Middle (Class 6 to 8)	23	5	df- 1	S*
3.	**Height of the student in cms**				
	a. ≤140	18	4	4.856	0.028
	b. >140	40	1	df- 1	S*
4.	**Weight of the student in kgs**				
	a. ≤60	12	3		
	b. >60	46	2	3.921	0.048
	a. No	11	1	df- 1	S*
	b. NA	31	2		

DISCUSSION

This urban-based case-control study conducted in Bangalore city, Karnataka, India, aimed to uncover risk factors associated with obesity among school children, yielding noteworthy findings. The study meticulously analyzed various risk factors prevalent among cases and controls. The identified risk factors encompassed increased consumption of fast food, inadequate intake of fruits/vegetables, limited physical activity, and the autonomy granted by parents for purchasing snacks.

The investigation disclosed that the frequency of junk food consumption did not exhibit statistically significant links with childhood obesity in this study. This contradicts the findings of Grace G. Angeline *et al*., where elevated fast food intake was associated with adolescent obesity [15]. Similarly, Rathnayake *et al*. highlighted that consuming fast food more than four times weekly elevated the risk of adolescent obesity [16]. Another study by Panda SC from Eastern India underscored fast food intake as a risk factor for adolescent obesity [17]. Vohra *et al*., who conducted research among school-going adolescents in Lucknow, Uttar Pradesh, reported fast food consumption as a risk factor for obesity development. The elevated calorie content and low nutritional value of foods served in fast-food establishments potentially contribute significantly to adolescent obesity [18].

Encouraging parents to prevent their children from independently purchasing snacks could play a pivotal role in curbing the consumption of unhealthy snacks, especially given the easy availability of such items in shops and supermarkets. Parents should take on the responsibility of educating their children about the nutritional value of healthy snacks and the detrimental consequences of unhealthy eating habits. Additionally, imparting the importance of regular breakfast in enhancing overall health and academic performance should be integrated into students' education.

LIMITATIONS OF THE STUDY

The dietary pattern, lifestyle behavior, and physical activity of children in urban areas may be different when compared to children living in rural areas. Recall bias is also one of the major limitations as there could be errors in recollecting the dietary intake.

CONCLUSION

This case-control study examined the factors contributing to obesity among school children in an urban region of Bangalore city, Karnataka. Given that the health of children often foreshadows their well-being in adolescence and adulthood, interventions during childhood can lay the foundation for a higher quality of life in the future. Addressing the issue of childhood obesity necessitates a comprehensive approach

encompassing interventions at school, home, and community levels. School health services should encompass education about balanced dietary choices for children. Within school premises, canteens should prioritize the availability of nutritious foods while avoiding the inclusion of unhealthy options. Encouraging parents to provide nutritious snacks for their children at school is crucial, supported by educating them about choosing locally accessible, affordable, and nourishing food items. Emphasizing the importance of instilling healthy dietary habits in children from an early age is imperative for their long-term well-being.

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