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Body mass index: Comparison among rural and urban school children in Odisha

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Abstract
Objectives: The study aims to assess the Body Mass Index (BMI) and identify associated factors among school students, and to determine the prevalence of underweight, normal weight, overweight, and obesity based on BMI classification, and examine the relationship between BMI and socio-demographic factors.
Methods: Body mass index is a key indicator of a healthy life, and it varies spatiotemporally. The cohort study involves a survey using a set of questionnaires designed to correlate with various categories, administered to 438 school-going children from rural and urban areas. The main research instrument was the authors' own questionnaire of demographic information, lifestyle and behavioural factors, sleep patterns, dietary habits, and physical activity. The data were analysed using the number and frequency of variable categories, arithmetic mean and standard deviation, t-test, chi-square test, and ANOVA. The significant difference is taken ($p<0.05$, 0.01, 0.001).
Results: The study provides insight that urban males are found to be overweight and healthy in comparison to rural males, whereas underweight shows its prevalence in rural males, and no rural male is found to be obese. Rural females showed the highest percentage of healthy individuals, whereas underweight and overweight individuals are predominant in urban females, and cases of obesity are observed in rural females.
Conclusion: This polarity of BMI variance calls for healthcare interventions to address the unique challenges that arise with different age groups in various settings.

Keywords: Body mass index, rural and urban schools, statistical tests, correlates

Introduction

The body mass index (BMI) is frequently used to determine an individual's weight relative to their height. Started in the early nineteenth century as the brainchild of Adolphe Quetelet, the advent of BMI centred on studying populations rather than individuals. Eventually, the BMI scale skyrocketed as the go-to tool for analysing an individual's health status [1].

Despite its shortcomings, the BMI scale remains a useful tool in population studies related to health and weight distribution. Apart from the physiological aspect, the negative impact of BMI also extends towards the onset of negative psychological impact at a societal level, leading to the stigmatisation of individuals coping with body image issues. The notion of fitting into the particular mould of "healthy and perfect" often leads to unhealthy obsession, which significantly reflects in the form of unhealthy dieting habits and disorders, and a skewed perception of one's body [2, 3].

BMI is considered popular due to its simplicity, accessibility, and familiarity. In contrast to other anthropogenic tests that require a storehouse of understanding and sometimes sophisticated equipment. The BMI only requires a bare minimum of two easily measurable parameters, i.e., height and weight. These factors not only make the BMI time efficient but also cost-effective [4]. The impending hazard of overweight and obesity has therefore emerged as a plague in modern times across the globe. The problem of obesity in children not only persists into their adult years but also leads to a plethora of ill effects on the body. The children and adolescents in particular share a higher susceptibility towards becoming obese [5, 6]. The problem of obesity in India extends to socioeconomic factors beyond borders, with the key factors being classes, religion, and age groups [7]. The case of Odisha solidifies itself as a classic example of a state that faces the dual hurdle of undernutrition and overnutrition [8, 9, 10].

The availability of data regarding the prevalence of obesity rates in school children residing in Odisha is scarce. Therefore, it becomes crucial to conduct studies focusing on bridging this scarcity, thereby opening out new avenues of future studies and developing strategies, especially in the field of child welfare. This study is a humble effort towards honing the understanding of the status of obesity among rural and urban children in the form of a comparative study.

Methodology

Study site

The study is carried out in rural school Ballabh Shankhali Charimauja Government High School, Jantuali, Nuagaon, Bhadrak, Odisha, India, 756 129 (Fig.1). The population covers the students from class II to X with age range from 8 years to 16 years in both boys (male) and girls (female) and from 14 years to 18 years in both boys (male) and girls (female) from classes VIII to XII of urban school, Shri Balaram Dixit International School, Gopabandhupur, Nalanga, Bhadrak, Odisha, India, 756 181 (Fig.2).

Materials

For the study, a standard measuring tape is used to precisely measure the height in feet and inches or meters, and a standard digital scale is used to accurately determine the weight in kilograms (kg). The sample size is 138 (males are 45 and females are 93) in the rural school, and is 300 (males are 180 and females are 120) in the urban school.

Fig 1: Rural school

Fig 2: Urban school

Study design

The study was cross-sectional and conducted using a diagnostic survey questionnaire based on a direct interview technique. The interviews were conducted by the authors and their collaborators, who, if needed, explained in detail the individual questionnaire items and answers to the respondents. The main research instrument was the authors' own questionnaire based on demographic information, lifestyle and behavioural factors, sleep patterns, dietary habits, and physical activity.

Before the main part of the study, the reliability of the questionnaire was assessed using the test–retest method [11]. During the interviews, data on the respondents' height and body weight were obtained. On that basis, the body mass index (BMI) was calculated for each respondent, which was then used to categorise all study participants following WHO criteria [12, 13] into four groups (Table 1).

Table 1: Body mass index categorisation according to WHO

Classification	(BMI kg/m^2)
Underweight	<18.50
Normal range	18.50-24.99
Over weight	>25.00
Obese	>30.00

Source: adapted from WHO,1995,2000,2004

Statistical analysis

The data were analysed in terms of number and frequency of various categories, arithmetic mean, standard deviation, t-test, chi-square test, and analysis of variance (ANOVA).

Results

The cohort study involved a survey on a list of questionnaires designed to correlate with various categories, conducted among 438 school-going children from rural and urban areas. The Hindus constituted a majority of our study, followed by other religions. In terms of gender, females constituted more than half of the sample population in the rural area, while the same trend is shown by males in the urban area. The percentage of respondents (Table 1) and sociodemographic status (Table 2) is depicted.

Table 1: Percentage of respondents

Variables /correlates	Correlates	Rural (138)	Urban (300)
Religion	Hindu	98.6	97.7
	Others	1.4	2.3
Gender	Male	32.1	60.1
	Female	67.9	39.9
Do you watch TV or mobile?	yes	99.3	100
	No	0.7	0
Do you use mobile or TV during meal?	yes	43.4	68
	No	56.6	32
How many hours do you spent in front of screen per day (TV/Mobile)?	1 hr	69.6	26.3
	2 hr	25.3	55.7
	3hr	5.1	17.7
	5hr	-	0.3
	>5 hr	-	
Do you attend any kind of sports or recreational activities?	Yes	94.9	46
	No	5.1	54
Do you use cell phone before sleep?	Yes	55.1	66.9
	No	44.9	33.1
How many hours of sleep do you get daily?	5hr	5.8	12
	6hr	8.7	40.7
	7hr	31.9	36.3
	8hr	53.6	11
How many meals do you get in a day?	1	0.7	2.7
	2	14.6	
	3	60.6	92.3
	More than 3	24.1	5

How often you eat fruits and vegetables?	Daily	84.1	49
	Twice in a week	12.3	48.3
	Rarely	3.6	2.7
	Monthly	--	---
Do you eat fast food or street food?	Yes	97.1	94.3
	No	2.9	5.7
How often do you consume fast food or street food?	Daily	7.2	8.7
	Weekly	65.9	75.7
	Monthly	16.7	8.3
	Rarely	10.1	7.3
How much water do you drink daily? (in lt)	1	12.3	-
	2	45.7	24.2
	3	35.5	49.7
	4	6.5	26.2
How often do you eat snacks between meals	Never	8.7	6
	Sometimes	73.2	61.7
	Rarely	2.9	4.7
	Always	15.2	27.7
How often do you eat breakfast?	Everyday	94.1	93.7
	Few times a week	4.4	6
	Rarely	--	0.3
	Never	1.5	--
How often do you exercise in a week?	Never	14.7	5.3
	Occasionally	2.2	55.3
	Sometimes	18.4	29.3
	Always	--	9
	Once in a week	64.7	1
How long is your average workout session?	<15 minutes	13.8	43.8
	15-30 min	23.9	52.8
	1hr	60.1	3
	More than 1 hr	2.2	0.3
Do you engage in recreational activities (walking, swimming, running)?	Yes	8.7	49
	No	91.3	51

Table 2: Sociodemographic status of the study

Variable		Rural (138)	%	Urban (300)	%	Total (438)	%
Gender	Male	45	32.60	180	60.00	225	51.36
	Female	93	67.40	120	40.00	213	48.64
Religion	Hindu	136	98.55	293	97.67	429	97.95
	Others	2	1.55	7	2.33	9	2.05

Comparison of BMI among age groups and gender

The t-test is conducted between the males and females belonging to the same areas of the same age groups. The body mass index is found to be significant in some age ages of 15,16, and 18 in urban areas and ages 11 and 16 in rural areas, respectively (Table 3). The ANOVA is performed by taking gender and area as the two parameters of study are found to deviate from the average value (Table 4). The percentage of underweight individuals is predominantly found in both urban and rural areas, except for urban males. The healthy individuals were mostly centred around urban males, followed by rural males and females. The lowest percentage of healthy individuals is found in rural females. The percentage of obesity is found to be highest in the case of rural females, followed by urban males. In contrast, the percentage of overweight individuals is found to be highest in urban males, followed by urban females and rural females, and is nonexistent in rural males (Table 5). Out of the total sample population, the percentage of male and female respondents in urban areas is found to be higher as compared to rural areas (Table 6).

Table 3: Age and gender wise comparison of BMI within groups using t-test

Area (rural and urban)	Age (female vs male)	P value
Urban	14	0.26
	15	0.002 S*
	16	0.0005 S**
	17	2.60
	18	0.029 S*
Rural	11	0.017 S*
	12	0.212
	13	0.261
	14	0.34
	15	0.117
	16	0.0001 S**

(S* = Significant difference at $p < 0.05,0.01$, S** = Significant difference at $p < 0.001$)

Table 4: Gender wise comparison of mean BMI using ANOVA

Area	Gender	Mean	SD	P value
Rural	Male	16.81	3.25	0.08
	Female	18.16	4.69	
Urban	Male	22.21	1.94	7.5
	Female	20.32	1.99	
Rural	Female	18.16	4.69	0.87
Urban	Female	20.32	1.99	
Rural	Male	16.81	3.25	3.88
Urban	Male	22.21	1.94	

Table 5: Gender wise comparison of BMI grades

Variables	Rural (percentage)		Urban (percentage)	
	Male	Female	Male	Female
Underweight	71.11	66.66	2.78	81.67
Healthy	28.89	27.96	89.44	15
Overweight	0	1.07	8.33	3.33
Obese	0	4.30	0.05	0

Table 6: Gender-wise distribution of sample in percentage (n=438)

Rural (percentage)		Urban (percentage)	
Male (45)	Female (93)	Male (180)	Female (120)
10.27	21.23	41.10	27.40

Comparative Assessment Between Both Genders in Rural and Urban Areas

Rural and Urban Females

In this cross-sectional investigation, overweight and obesity were dichotomized as absent or present using body mass index (BMI). The data is collected through a self-reported set of 16 questions, focusing on key factors of obesity, including screen usage and patterns, sleeping patterns, dietary habits, and physical activity. Apart from using percentage as a raw metric for both rural and urban areas, a primary statistical analysis test in the form of a chi-square (X^2) test of independence is performed to assess associations between each correlate of overweight or obesity status. The statistical significance was set at $p<0.05$.

Digital screen engagement patterns revealed universal adoption across both geographical cohorts. The percentage of obese individuals in rural areas is found to be lower in those who used screens during repast as compared to those who didn't use digital screens during meals. This trend, however, showed a complete reversal in the case of urban females, where the individuals using phones during meals recorded showing higher obesity as compared to those who didn't.

The screen time duration profiles diverged geographically, revealing the highest percentage of obese individuals recorded using the phone for an average of 1 hour (3.23%) in rural areas and 2 hours (2.5%) in urban areas. Pre-sleep phone usage is highly associated with obesity rates in both rural and urban areas.

Sleep duration analysis revealed geographical variations in circadian hygiene, predominantly in urban areas. The data shows sleep deprivation being highly prominent in urban areas as compared to rural areas; however, despite having sound sleep durations, females in rural areas recorded higher rates of obesity as compared to urban females.

The alimentary rhythms were dominated by tripartite daily meal intake in both rural and urban, out of which 4.30 % of rural and 3.33% of urban females are found to be obese. The highest prevalence of fast-food intake is observed every week in both rural and urban areas, with 5.38% and 1.67% of individuals found to be obese. The consumption of snacks between meals is highly centered around every week in rural areas, as compared to an occasional basis in urban areas, with the highest obesity rates belonging to the same category.

The lack of recreational activities is most prevalent in urban females, of which 2.50 % of females are found to be obese, in contrast to rural females, where the highest percentage is observed in the females who attended some form of recreational activity, out of which 4.30% are found to be obese. The average workout duration varied between rural and urban groups, and the frequency of fast-food consumption monthly has an impact on overweight and obese, and is found to be significant ($p>0.05$) (Table 7).

Rural and Urban Males

In contrast to the female cohort, the data obtained from the comparative study between 180 urban and 45 rural males showed a higher percentage of obesity rates in urban males in all the correlating parameters.

In terms of screen usage during meals, urban males showed a much higher percentage than rural males. A similar pattern emerged during the comparative study of the groups on pre-sleep screen usage. The duration of quality sleep varied between the two groups, with the highest recorded sleeping time being 6 hours, and obesity rates of 4.44% in urban males and 8 hours in the case of rural males.

The consumption of daily breakfast is found to be higher in both groups, with alimentary rhythms dominated by tripartite daily meal intake in both urban areas, with an obesity rate of 6.67% and 62.22% in the case of rural males. The fruits and vegetables formed a major dietary component in rural males as compared to urban males.

In terms of daily hydration, the highest percentage of obesity is found in those taking 4 litres of water, in the case of rural males. A higher prevalence of snacking habits is observed in the case of both rural and urban males, along with a high percentage of obesity.

Rural males are found to be more active than urban males, with a daily activity duration of 1 hour. Both groups engaged in some form of recreational activity, along with engaging in mild to intense exercise (Table 7).

Table 7: Comparative assessment between both genders of rural and urban area

Variables		Overweight/obesity Rural Female (93)				Overweight/obesity Urban Female (120)						Overweight/Obesity Rural Male (45)		Overweight/Obesity Urban Male (180)					
		Absent		Present		Absent		Present				Absent		Absent		Present			
		N	%	N	%	N	%	N	%	X^2	P	N	%	N	%	N	%	X^2	p
Do you watch TV or mobile?	Yes	87	93.55	5	5.38	116	96.67	4	3.33	0.50	0.45	45	100	166	92.22	14	7.78	0.82	0.05
	No	1	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Do you use mobile or	Yes	44	47.31	2	2.15	66	55	3	2.5	0.3	1.00	15	33.33	125	69.45	10	5.55	0.6	0.2

TV during meal?										2								0	8
	No	44	47.31	3	3.23	50	41.66	1	0.83	0.60	0.27	30	66.67	41	22.77	4	2.22	0.76	0.09
How many hours do you spent in front of screen per day (TV/Mobile)?	1 hr	65	69.89	3	3.23	21	17.50	-	-	0.57	0.33	28	62.22	55	30.55	3	1.66	0.64	0.22
	2 hr	17	18.28	2	2.15	79	65.83	3	2.5	0.64	0.21	16	35.56	77	44.77	8	42.77	0.75	0.10
	3hr	6	6.45	-	-	16	13.33	1	0.83	0.46	0.54	1	2.22	33	18.33	3	1.66	0.38	0.76
	5hr	-	-	-	-	-	-	-	-	-	-	-	-	1	0.55	-	-	-	-
	>5 hr	-	-	-	-	-	-	-	-	-	-	-	-		-	-	--	-	-
Do you attend any kind of sports or recreational activities?	Yes	83	89.25	4	4.30	42	36.66	1	0.83	0.47	0.53	44	97.78	87	48.33	8	4.44	0.83	0.05
	No	5	5.38	1	1.07	74	61.67	3	2.50	0.69	0.16	1	2.22	79	43.89	6	3.33	0.38	0.78
Do you use cell phone before sleep?	Yes	53	56.99	3	3.23	77	64.16	3	2.5	0.42	0.65	20	44.44	87	48.33	8	4.44	0.67	0.18
	No	35	37.63	2	2.15	39	32.50	1	0.83	0.47	0.51	25	55.56	79	43.89	6	3.33	0.68	0.17
How many hours of sleep do you get daily?	5hr	3	3.23	-	-	1	0.83	-	-	-		5	11.11	32	17.78	3	1.67	0.48	0.50
	6hr	9	9.68	2	2.15	39	32.50	-	-	0.01	0.94	1	2.22	75	41.67	8	4.44	0.74	0.39
	7hr	26	27.96	1	1.07	55	45.83	4	3.33	0.45	0.57	17	37.78	48	26.67	2	1.11	0.53	0.40
	8hr	50	53.76	2	2.15	21	17.50	-	-	0.55	0.36	22	48.89	11	6.11	1	0.56	0.68	0.17
How many meals do you get in a day?	1	1	1.07	-	-	-	-	-	-			-	-	--	-	-	-	-	-
	2	15	16.13	1	1.07	2	1.67	-	-	0.40	0.72	4	8.89	4	2.22	2	1.11	0.66	0.20
	3	51	54.84	4	4.30	111	92.50	4	3.33	0.60	0.27	28	62.22	150	83.33	12	6.67	0.71	0.14
	> 3	21	22.58	-		3	2.5	-	-	-	-	13	28.89	12	6.67	-	-	-	-
How often you eat fruits and vegetables?	Daily	79	84.95	3	3.23	41	34.17	1	0.83	0.40	0.70	37	82.22	101	56.11	4	2.22	0.63	0.23
	Twice in a week	11	11.83	2	2.15	71	59.17	3	2.50	0.75	0.11	4	8.89	61	33.89	10	5.56	0.52	0.42
	Rarely	1	1.07	-	-	4	3.33	-	-	-	-	4	8.89	4	2.22	-	-	-	-
	Monthly	-		-	-	-		-	-	-	-	-	-	-		-	-	-	-
Do you eat fast food or street food?	Yes	87	93.55	5	5.38	113	94.17	4	3.33	0.49	0.49	3	6.67	153	85	13	7.22	0.43	0.61
	No	1	1.07	-	-	3	2.5	-	-	-	-	42	93.33	13	7.22	1	0.55	0.79	0.07
How often do you consume fast food or street food?	Daily	5	5.38	-	-	8	6.67	-	-	-	-	5	11.11	18	10.00	-	-	-	-
	Weekly	63	67.74	5	5.38	97	80.83	2	1.67	0.76	0.09	23	51.11	115	63.89	13	7.22	0.74	0.11
	Monthly	11	11.83	-	-	7	5.83	1	0.83	0.99	0.00	12	26.67	16	8.89	1	0.55	0.53	0.39
	Rarely	9	9.68	-	-	4	3.33	1	0.83	0.69	0.16	5	11.11	17	9.44	-	-	-	-
How much water do you drink daily? (in lt)	1	12	12.90	1	1.07	-	-	-	-	-	-	4	8.89	-		-	-	-	-
	2	48	51.61	1	1.07	34	28.33	1	0.83	0.37	0.81	14	31.11	34	18.89	3	1.67	0.60	0.27
	3	25	26.88	2	2.15	54	45.00	2	1.67	0.50	0.44	22	48.89	87	48.33	5	2.78	0.61	0.26
	4	3	3.23	1	1.07	28	23.33	1	0.83	0.7	0.09	5	11.11	45	25.00	6	3.33	0.5	0.4

										6								2	2
How often do you eat snacks between meals	Never	9	9.68	1	1.07	0		0	-	-	-	2	4.44	14	7.78	4	2.22	0.50	0.46
	Sometimes	63	67.74	4	4.30	89	74.17	3	2.50	0.52	0.41	33	73.33	87	48.33	6	3.33	0.71	0.13
	Rarely	4	4.30	-	-	4	3.33	-	-	-	-	-	-	9	5.00	1	0.55	-	-
	Always	12	12.90	-	-	23	19.17	1	0.83	0.49	0.47	9	20	56	31.11	3	1.67	0.48	0.49
How often do you eat breakfast?	Everyday	83	89.25	5	5.38	106	88.33	3	2.50	0.58	0.30	40	88.89	161	92.78	11	6.11	0.75	0.10
	Few times a week	2	2.15	-	-	10	8.33	1	0.83	0.42	0.66	4	8.89	5	2.78	2	1.11	0.63	0.24
	Rarely	-	-	-	-	10	8.33	-	-	-	-	-	-	-	-	1	0.55	-	-
	never	3	3.23	-	-	-		-	-	-	-	1	2.22	-	-	-		-	-
How often do you exercise in a week?	Never	15	16.13	-	-	4	3.33	-	-	-	-	6	13.33	11	6.11	1	0.55	0.49	0.47
	Occasionally	2	2.15	-	-	78	65.00	3	2.50	0.38	0.78	1	2.22	80	44.44	5	2.78	0.37	0.80
	Sometimes	15	16.13	2	2.15	30	25.00	1	0.83	0.62	0.24	8	17.78	52	28.89	5	2.78	0.54	0.38
	Always	-	-	-	-	4	3.33	-	-	-	-	-	-	20	11.11	3	1.67	-	-
	Once in a week	56	60.22	3	3.23	-		-	-	-	-	30	66.67	3	1.67	-	-	-	-
How long is your average workout session?	<15 minutes	14	15.05	1	1.07	22	18.33	2	1.67	1.00	0.00	4	8.89	98	54.44	9	5.00	0.46	0.55
	15-30 min	22	23.66	1	1.07	94	78.33	2	1.67	0.47	0.53	10	22.22	58	32.22	4	2.22	0.52	0.41
	1hr	51	54.84	3	3.23	-	-	-	-	-	-	29	64.44	8	4.44	1	0.55	0.79	0.07
	More than 1 hr	1	1.07	-	-	-	-	-	-	-	-	2	4.44	2	1.11	-	-	-	-
Do you engage in recreational activities (walking, swimming, running)?	Yes	82	88.17	5	5.38	50	41.67	-		0.77	0.08	38	84.44	91	50.55	6	3.33	0.73	0.12
	No	6	6.45	-	-	66	55.00	4	3.33	0.46	0.55	7	15.56	75	41.67	8	4.44	0.53	0.39

Discussion

The purpose of this research is to identify the various factors that contribute to the condition of overweight or obesity through a comparative study among rural and urban individuals. By the hypothesis, the study concludes the prevalence of overweight and obesity in rural females and both urban males and females. It also supports the evidence of [14, 15, 16] and deviates from the findings in rural males and urban females. The average BMI in the case of rural males and rural females falls within the WHO standards and IAP 2015, while the mean value of BMI in rural and urban males was on par with the WHO standard of 19.6% and 18.5% [12, 17].

The usage of screens for longer periods and lower duration of physical activity contribute towards an increased percentage of obesity in both rural and urban individuals; these findings are found to be consistent with the findings of [18, 19, 20]. However, our study shows deviations from the findings of [21] in terms of mean BMI in adolescent males and screentime use. In terms of gender higher number of obese individuals are found to be males, which deviates from the findings concluded by [22].

Sleep, in many cases, played a crucial role in influencing the BMI of the study group. Our analysis of understanding this relationship between sleep and its effects on BMI revealed a higher prevalence of overweight and obesity in both rural and urban individuals of both genders with poor sleep quality compared to those who had healthy sleeping hours. Similar conclusions were also derived from numerous scientific and academic works of recent times [23, 24, 25, 26], which further solidify the hypothesis on a strong relationship between sleep quality and quantity with obesity in individuals.

Correlating the association between physical activity and BMI reveals an inversion between high levels of physical activity and the risk of being overweight and obese. The study aligns with the findings of [23, 27, 28]. The set of data also coincides with the findings of [29] on a sample population based in Queensland, observing a negative correlation between engagement in physical activity and the risk of obesity. In comparison to the urban population, the individuals in rural areas showed higher participation in physical activities (more than or equal to 1 hour) along with passive recreational activities involving walking, swimming, and running. This may be since in rural areas, most of the individuals reached schools by walking, and also due to participating in weekly physical exercise drills in school premises.

In terms of dietary habits, the rural subjects perform much better than the urban subjects when it comes to frequency and repetition of junk food, along with higher consumption of fruits and vegetables as part of the daily diet. This may arise due to less availability and accessibility of junk food in rural areas as compared to urban areas. Therefore, the prevalence of higher engagement in physical activity along with consumption of healthier dietary options leads to lower rates of obesity in rural individuals as compared to urban individuals [30].

Conclusion

The study provides insight that urban males are found to be overweight and healthier in comparison to rural males, whereas underweight is more prevalent among rural males, and no rural male is found to be obese. Rural females showed the highest percentage of healthy individuals, whereas underweight and overweight are predominant in urban females, while higher case of obesity is observed in rural females. All the BMI grades show regional variation and are associated with the parameters taken into consideration in the study. This study provides baseline data to extend further extensive research in the field of BMI. This polarity of BMI variance necessitates healthcare interventions to address the unique challenges that arise with each of the groups, ensuring adequate nutrition. Understanding the relationship between the parameters and their underlying role in regulating BMI and their variations in different settings enables the development of effectively designed large-scale strategies to tackle the issues of obesity and undernutrition among school-aged children.

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