

Physical Activity and BMI among Higher Secondary Students of Government Schools in Siliguri Sub-division of Darjeeling District, West Bengal

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ABSTRACT

Background: In India, the problems of underweight and overweight/obesity runs hand in hand. As the age increases from childhood to adolescent, the burden of overweight/obesity is found to be increased than underweight.

Objectives: To evaluate the level of physical activity (PA) among school-going adolescents and explore its association with body mass index (BMI).

Methods: Descriptive study with cross-sectional design was conducted in Government Higher Secondary Schools in Siliguri sub-division, Darjeeling district, from May 2019 to September 2020. Multistage random sampling was done. Sample size was 1,012. International Physical Activity Questionnaire (IPAQ) self-administered questionnaire was used. Collected data were entered into Microsoft Excel and analyzed by SPSS (version 22).

Results: Mean BMI was 21.02 (SD \pm 3.59) kg/m². The majority (71.2%) had normal BMI, 19.4% were overweight, and 9.4% were underweight. Most (54.45%) do moderate PA, and 34.98% do high PA. The proportion of overweight people was highest among those with low PA (89.7%) and lowest among those with high PA (4%). This association was statistically significant ($p < 0.001$). The low PA category as compared to moderate PA had significantly higher odds of being overweight than normal BMI. But the high PA as compared to moderate PA had significantly lesser odds of being overweight than normal BMI.

Conclusions: The prevalence of both overweight and underweight was higher among rural participants. Physical activity level was moderately negatively correlated with BMI. Study findings would be helpful to take proper planning and actions to prevent such problems.

Keywords: Body mass index, Government schools, Higher secondary students, Physical activity.

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INTRODUCTION

The issues of underweight and overweight/obesity coexist in both India and West Bengal. As a result, we are now dealing with both issues. The World Health Organization (WHO) has referred to overweight and obesity as a worldwide epidemic. Obesity prevalence among adolescents (12–19 years) is still rising despite a slowdown in the previously rapid rise in children (2–11 years).¹

It is thought that several variables, including population changes, dietary transitions, and the globalization of economic activities, have contributed to this situation.² The demand for research on lifestyle-related illnesses and disorders in adolescents is critical and escalating.³

The adolescent period is very crucial in everyone's life due to changes in physical, mental, social, and other dimensions of health leading to vulnerability to risky behaviors. School-based physical education activities may significantly lower childhood and adolescent obesity, chronic disease, and, eventually, adult mortality.

The present study wanted to make an idea about PA and to measure the BMI of school school-going adolescent age-group in the Siliguri sub-division of Darjeeling district. Siliguri sub-division of Darjeeling district was chosen for conducting this study as the area was easily accessible by the investigators though the area was a large one. Getting the correct responses from the study participants was easier as all the selected schools were Bengali medium, so there was no communication problem and no difficulties in understanding the questionnaire. There were no

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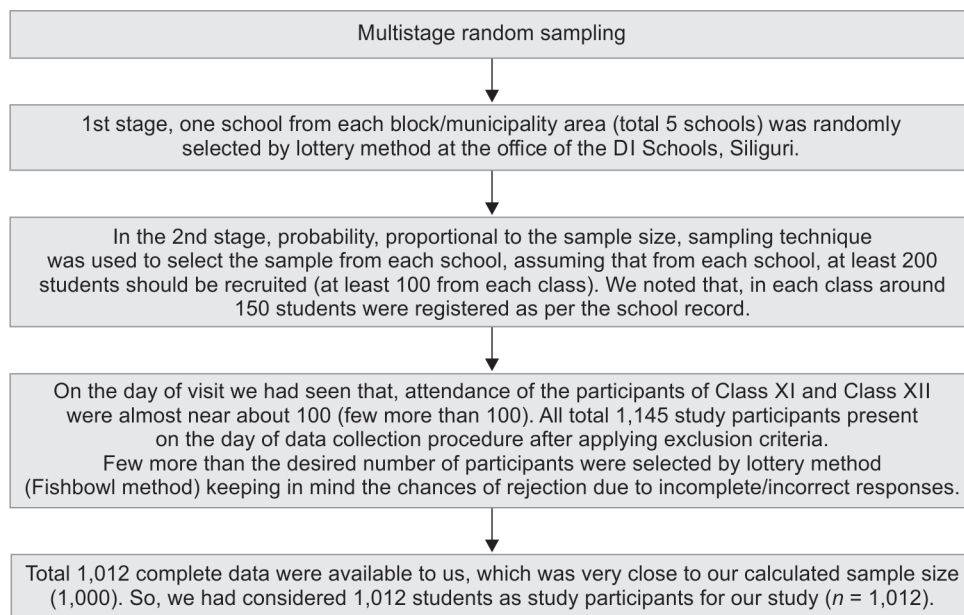
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such relevant studies conducted in that area previously, that was another reason for selecting the Siliguri sub-division of Darjeeling district for conducting this study.

A quantitative method using a structured questionnaire was used. To review several aspects in the selected group this method answered to the purpose of the study and the possibility to measure the results in numbers.

Flowchart 1: Flowchart of sampling technique



MATERIALS AND METHODS

An observational, descriptive study with a cross-sectional design was conducted among the students of class XI and class XII from selected Government Higher Secondary schools in Siliguri sub-division of Darjeeling district, West Bengal, from May 2019 to September 2020.

Students of class XI and class XII from selected Government Higher Secondary Co-education Bengali medium schools in Siliguri sub-division of Darjeeling district, West Bengal. Siliguri sub-division consists of four Community development blocks (rural blocks) and one urban municipal corporation area.

Using Cochran's formula for cross-sectional research, sample size was calculated. According to a recent survey, 10% of pupils in higher secondary schools were determined to be obese (based on the WHO's adolescent BMI).⁴ The sample size (n) was estimated using the following formula, assuming a 95% confidence interval ($\alpha = 0.5$) and a 20% relative precision: $n = Z^2_{(1-\alpha/2)} P(1-P)/e^2$. With a 10% non-response rate, an additional 100 students were included. According to the formula above, final sample size was 1,000. The number of students we had for the final sample was 1,012 ($n = 1,012$) (Flowchart 1).

Data were collected with the help of the following tools:

- Predesigned and pretested, structured, self-administered questionnaire.
- Stadiometer (standardized and repeatedly calibrated)
- Bathroom type weighing machine (standardized and repeatedly calibrated)

International Physical Activity Questionnaire, long last 7 days self-administered format (IPAQ; October 2002),⁵ was used in this study to ask the five activity domains independently for the assessment of PA. For scoring purposes, the guidelines for scoring protocol for Short Forms (November 2005) was used for ease of scoring. Sociodemographic data was also collected. Overall, the IPAQ questionnaires produced repeatable data (Spearman's rho clustered around 0.8), with comparable data from short and long forms.

Criterion validity had a median rho of about 0.30, which was comparable to most other self-report validation studies. The "usual week" and "last 7 days" reference periods performed similarly, and the reliability of telephone administration was similar to the self-administered mode.⁶

The questionnaire was translated into Bengali language from English by experts, as all the study participants were from Bengali medium schools and understood Bengali very well (as per information from the School Authority). So, both Bengali and English versions were used in the same questionnaire. The questionnaire was validated by experts. A pretesting and Pilot study was performed.

Physical activity was measured by the Metabolic Equivalent Task (MET) method (as per IPAQ guideline-November 2005⁵). The MET parameters selected were determined by work done during the IPAQ Reliability Study, which was conducted in 2000–2001.⁶

Physical activity was divided into 3 categories: Category 1 (Low PA)—Total PA (MET-minutes/week) < 600 MET-minutes/week; Category 2 (Moderate PA)—Total PA (MET-minutes/week) = 600–2999 MET-minutes/week; and Category 3 (High PA)—Total PA (MET-minutes/week) \geq 3000 MET-minutes/week.

The BMI of the students was classified as per WHO BMI-for-age z-score reference tables⁷ for boys and for girls. In this study, Severe Thinness and Thinness categories were clubbed into Underweight Category (BMI < -2SD), Overweight and Obese were clubbed into Overweight category (BMI > +1SD) to facilitate the comparison and statistical analysis to find out the association between the variables.

Permission was taken from the Office of the District Inspector of Schools (DI Office), Siliguri. At first, all the students of class XI and XII who attended on that day were counted. After applying the exclusions criteria, the students were recruited according to our required sample size. Informed consent was taken from the participants. Parents' consent was taken for the minors (<18 years). The participants were explained about the purpose of the study and their rights to participation. In each school the

data collection procedure was divided into a few sessions like an introductory session, questionnaire filling up session, height-weight measurement session, and IEC/Health education session (IEC Letter Momo no. 285/G/S, dated 02.07.2019). Height and weight were measured while wearing school uniform but after removing shoes and bags, maintaining the protocol in standing position

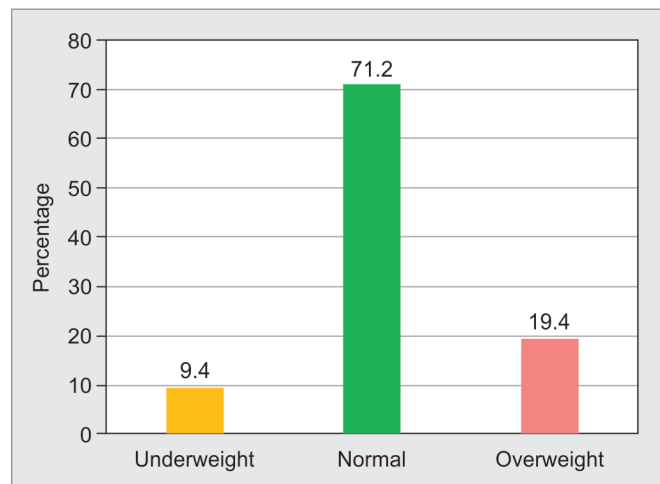


Fig 1: Distribution of the study participants according to category of BMI (n = 1,012)

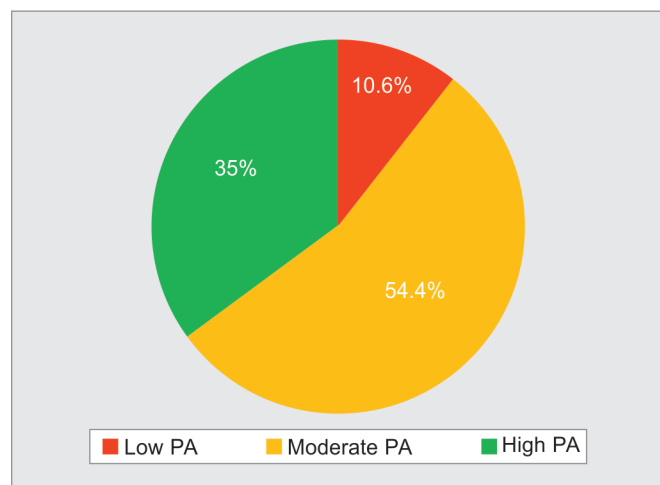


Fig 2: Distribution of the study participants according to category of PA (n = 1,012)

with the help of standardized and well-calibrated instruments. The process of this study was initiated in May 2019.

The collected data were checked for consistency, and completeness, entered into Microsoft Excel and analyzed with IBM SPSS (version 22). Data presented by numbers, frequencies, percentages, proportions, mean, standard deviation, and associations are shown by bivariate analyses using Chi-square test with suitable corrections (Fisher's Exact Test) and predictors shown by multinomial logistic regression analyses.

Approval was taken from the Institutional Ethics Committee of North Bengal Medical College and Hospital, Darjeeling. (Memo no: IEC/NBMC/18-19/27, dated 07.01.2019)

RESULTS

The present study focused on prevalence, associated factors and the predictors of both underweight and overweight. This study was a large-scale community-based study. Mean age of the study participants was 16.94 (SD ± 0.936) years, (range: 16–19 years).

The present study found that the participants belonged mostly to 16 years of age (40.3%). Most of them were male (57.3%), belonged to Hindu (67.8%), General caste (53.2%), followed by Scheduled Tribes (21.6%). The majority of the study participants belonged to SES class IV (27.6%) followed by SES class III (26.2%) as per Modified B. G. Prasad Scale (November 2019, AICPI- 328).

Mean BMI was 21.02 (SD ± 3.59) kg/m². Figure 1 shows that most of the study participants were within Normal BMI (71.2%), 19.4% were overweight (including Overweight and Obese), and 9.4% were underweight.

Figure 2 shows that the majority of the individuals (54.4%) were doing moderate PA, whereas 34.9% were doing high PA and 10.5% of the participants were doing low PA. The majority of the study participants came from rural areas, used walking and bicycling as modes of transportation, enjoyed playing outdoor sports (football and cricket) in their spare time, and put in a lot of work in their gardens and homes. As a result, they were physically active, and the majority of them were doing moderate PA, followed by high PA.

According to Table 1, the percentage of overweight people was largest among the low PA category (89.7%), next among the moderate PA category (15.6%), and finally among the high PA category (4%). It was determined that this correlation was statistically significant (p = 0.001). The BMI of the study participants was adversely linked with their level of PA. r² = 0.138 is the coefficient of determination. The moderate correlation measured by Spearman's Correlation coefficient (r) is 0.37.

Table 2 shows the predictors of BMI by Multinomial logistic regression analyses. The SES class was clubbed into three categories

Table 1: Association of PA level with BMI of the study participants (n = 1,012)

Physical activity level	Category of BMI			Total n (%)	Statistical test	
	Underweight n (%)	Normal n (%)	Overweight n (%)		Fisher's exact test** Value	Fisher's exact** p-value
Low PA	0 (0)	11 (10.3)	96 (89.7)	107 (100)	102.12	0.000*
Moderate PA	49 (8.9)	416 (75.5)	86 (15.6)	551 (100)		
High PA	46 (13.0)	294 (83.0)	14 (4.0)	354 (100)		
Total	95 (9.4)	721 (71.2)	196 (19.4)	1,012 (100)		

*Statistically significant; **Fisher's exact test was performed (instead of normal Chi-square test) as one observed cell value (not expected cell value) is Zero.⁸

Table 2: Predictors of overweight* (overweight and obesity) and underweight* (thinness and severe thinness) as compared to normal BMI; Multinomial logistic regression analyses ($n = 1,012$)

Variables	Overweight		Underweight	
	Adjusted odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value
Age (in years)				
16	4.50 (1.53–17.58)	0.011**	0.38 (0.15–0.93)	0.034**
17	2.53 (1.04–12.66)	0.043**	0.49 (0.19–1.23)	0.129
18	3.58 (1.21–15.74)	0.027**	0.42 (0.13–1.13)	0.089
19***	1	–	1	–
Gender				
Male	0.97 (0.61–1.55)	0.894	2.80 (1.64–4.79)	0.000**
Female***	1	–	1	–
Residence				
Rural	1.04 (0.58–1.98)	0.901	2.11 (1.15–3.88)	0.016**
Urban***	1	–	1	–
SES class				
Class I and II	2.00 (1.14–3.52)	0.016*	1.52 (0.91–2.53)	0.11
Class III	0.58 (0.30–1.12)	0.106	1.08 (0.62–1.88)	0.79
Class IV and V***	1	–	1	–
Dietary pattern				
Unhealthy diet	24.62 (12.51–50.11)	0.000**	6.33 (2.94–14.93)	0.000**
Average diet	2.81 (1.40–5.65)	0.004**	1.01 (0.62–1.64)	0.95
Healthy diet***	1	–	1	–
Physical activity				
Low PA	18.53 (9.24–36.05)	0.000**	8.30 (3.76–18.32)	0.000**
High PA	0.303 (0.15–0.58)	0.000**	1.49 (0.94–2.30)	0.087
Moderate PA***	1	–	1	–

*Overweight includes overweight category and obese category; *Underweight includes Thinness category and Severe thinness category; ** $p < 0.05$ considered statistically significant; *** These parameters were set to one because it was redundant. The reference category for this Multinomial logistic regression was Normal BMI. SES class was clubbed into three categories. First category included class I and II, second category included class III, and third category included class III and class IV of Modified B. G. Prasad Scale (November 2019, AICPI-328) for better interpretation of findings

for better interpretation of findings. First category included class I and II, second category included class III, and third category included class III and class IV. 16, 17, and 18 years as compared to 19 years of age had significantly higher odds of being overweight than normal BMI.

Residents of rural areas as compared to urban area had significantly higher odds 2.11 (95% CI: 1.15–3.88) of being underweight than normal BMI.

SES classes I and II had significantly greater odds of being overweight than normal BMI [2.00 (95% CI: 1.14–3.52)] than SES classes VI and V.

The odds of being overweight relative to a normal BMI were considerably higher in the low PA category than in the moderate PA category. However, the likelihood of being overweight than in the normal BMI was significantly lower in the high PA category compared to the moderate PA category.

DISCUSSION

Tribal populations are more in the tea garden areas of Siliguri sub-division of Darjeeling district. Naturally, the percentage of the ST category was relatively higher. As the majority of study participants

were from rural areas, most of them belonged to middle and lower middle SES class. A longitudinal study in a rural block in West Bengal by Lahiri et al.⁹ shows that 13.5% of the respondents belonged to class I SES and 31.5% were from class IV. These findings were close to our findings.

The prevalence of Overweight in our study is 19.4% which is similar to the worldwide data given by WHO.¹⁰ A study done by Ługowska et al.¹¹ shows the prevalence of overweight and obesity was 18.1% and 5.65% in the 16–18 years age-group; 75% were normal and 1.4% were underweight. This result was very close to our study findings. Similar results found by Shete et al.¹² showed 82 (39.6%) children were underweight, 82 (39.6%) were normal weight, 25 (12.1%) were overweight, and 18 (8.7%) were obese. Several studies in India showed a higher prevalence of Overweight around 30%.^{13,14} According to these studies, India has both the problems of underweight/malnutrition and overweight/obesity side by side. In present study, the prevalence of underweight was half of the prevalence of overweight, which was not much less. So, our study findings were close to the above-mentioned studies.

The combined prevalence of childhood overweight and obesity was estimated to be 19.3% in a systematic review by Ranjani et al.,¹⁵

which was a significant increase from the prior prevalence of 16.3% reported in 2001–2005. This finding was consistent with our current research.

According to Kelishadi et al.,¹⁶ a high PA level had a strong negative correlation with BMI. Boys who eat few fruits, live in cities, and spend less time exercising are significantly more likely to be overweight. Only the amount of time spent exercising and the amount of energy expended were substantially linked to becoming overweight in girls. Similar findings were found by Goyal et al. among school-going adolescents in India.¹⁷

A study by Goyal et al.¹⁷ shows that early adolescents are at higher risk of becoming overweight or obese than late adolescents. Their finding was similar to the present study.

Residents of rural areas as compared to urban areas had significantly higher odds of being underweight than normal BMI. This result may be due to the unequal availability of foods in rural areas compared to urban areas leading to nutritional deprivation followed by underweight BMI in a country like India.¹⁷

It is worth noting that SES classes I and II had significantly greater odds of being overweight than normal BMI than SES classes VI and V. Excessive calorie intake is usually found among high SES class. A cross-sectional study conducted in Puducherry by Radhika et al.¹⁸ found that there was a significant relationship between excessive calorie intake and BMI (OR = 18.4, 95% CI: 6.1–54.6).

Lahiri et al.'s longitudinal study⁹ revealed that the risk of developing obesity due to insufficient physical exercise was 6.58 (95% CI: 3.92–11.03) times higher. The outcome was far less than what the current study found.

Conclusions and Recommendations

Parents and school teachers can play an important role in changing the lifestyle and behavior of the students. Active intervention both at the school level and at home will be effective for preventing the development of healthy life style. The village health, sanitation and nutrition day (VHSND) sessions (for rural areas) and urban health, sanitation and nutrition day (UHSND) sessions (for urban areas) could be utilized effectively at the sub-center level to teach teenagers about their health, diet, and the role of physical activities. Adolescent Friendly Health Clinics (AFHCs) should be used as a good platform at the Primary Health Center and Community Health Center(BPHC/CHC) levels.

Limitations

There is a chance of being wrongly/incorrectly answered as the questionnaire was a self-reported questionnaire. There might be chances of some errors in anthropometric measurements which could not be ruled out. Several attempts were made to reduce the chances of bias. Despite adequate monitoring, the chances of some students copying responses from others could not be ruled out. During the data collection, we repeatedly requested all the students to give individual correct information, and we standardized all the instruments before taking height and weight by repeated calibration in each school to reduce instrumental error during measurements.

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