



Prevalence of overweight and obesity and its association with Screen Time, Physical Activity among School-Going Adolescents: A Cross-Sectional Study.

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Abstract

Background: Adolescent obesity is increasingly linked to sedentary behaviour, recreational screen exposure, and inadequate physical activity. School-based evidence from India remains limited, particularly regarding the independent and combined effects of these behaviours. **Objectives:** To determine the prevalence of overweight and obesity among school-going adolescents and assess their associations with recreational screen time and moderate-to-vigorous physical activity. **Methods:** This cross-sectional study was conducted at urban and rural field practice areas of ACSR Government Medical College, Nellore, Andhra Pradesh, India, from April to September 2023. Two hundred adolescents aged 12-17 years were assessed using a structured questionnaire and standardized anthropometric measurements. Recreational screen time exceeding 2 hours/day and physical activity below 60 minutes/day were classified as adverse behaviours. Body mass index-for-age was categorized using age- and sex-specific reference standards. Associations were examined using chi-square tests, analysis of variance, and multivariable logistic regression. **Results:** The mean age was 14.5 ± 1.6 years; 52.0% were boys. Excessive screen time was reported by 57.0%, and 61.0% had insufficient physical activity. Overall, 22.0% were overweight and 18.0% were obese. Overweight or obesity was more frequent among adolescents with excessive screen time than among those with lower exposure (51.8% vs 24.4%) and among insufficiently active participants than sufficiently active participants (51.6% vs 21.8%). After adjustment, excessive screen time (adjusted odds ratio: 2.54; 95% confidence interval: 1.32-4.89) and insufficient physical activity (adjusted odds ratio: 2.87; 95% confidence interval: 1.45-5.69) remained independently associated with overweight or obesity. Adolescents with both adverse behaviours had the highest prevalence of excess weight. **Conclusion:** Excessive screen exposure and insufficient physical activity were common and independently associated with overweight and obesity. Integrated school-based strategies addressing both behaviours are needed.

Keywords: Adolescents; body mass index; obesity; physical activity; screen time; sedentary behaviour; school health.



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INTRODUCTION

Adolescent overweight and obesity have become major public health concerns because excess weight established during the school years frequently persists into adulthood and contributes to early metabolic, cardiovascular, musculoskeletal, and psychosocial morbidity. A recent global synthesis documented a substantial burden of excess weight among children and adolescents, with marked variation across countries and a continuing rise over recent decades.¹ Indian evidence also demonstrates increasing overweight and obesity across urban and rural settings, although prevalence estimates differ according to age, socioeconomic conditions, geographic region, and the growth reference applied.² Body mass index-for-age remains the most practical epidemiological measure for school populations because it incorporates developmental differences related to age and sex.³

Adolescence is also a period of rapid change in daily movement behaviour. Academic demands, motorized transport, reduced outdoor play, and widespread access to smartphones, online entertainment, social media, gaming, and streaming platforms have increased sedentary time. Current physical-activity guidance recommends an average of at least 60 minutes of moderate-to-vigorous activity per day for children and adolescents.⁴ Movement guidelines additionally advise limiting recreational screen exposure to no more than two hours daily.⁵ Nevertheless, many adolescents fail to achieve the activity recommendation while simultaneously exceeding the screen-time threshold.

The relationship between screen exposure and obesity is biologically and behaviourally plausible. Prolonged screen use can displace active recreation, reduce total energy expenditure, encourage snacking, increase exposure to energy-dense

food advertising, and disrupt sleep timing. Systematic reviews and meta-analyses have generally identified a positive association between screen time and overweight or obesity, although the magnitude varies because screen exposure is commonly self-reported and digital devices are used for both educational and recreational purposes.^{6,7} Screen-based sedentary behaviour is not simply the inverse of physical activity; an adolescent can accumulate substantial activity yet also spend several hours using screens. Several behavioural and environmental pathways can therefore operate concurrently.⁸

Large observational studies have shown that high screen exposure and low activity can jointly correspond to less favourable body mass index profiles.^{9,10} Similar clustering has been reported among Indian adolescents, where inadequate physical activity and prolonged screen time commonly coexist.¹¹ Studies from Indian schools have also linked extended screen use and reduced activity with excess body weight,¹² while meta-analytic evidence indicates only a modest inverse relationship between sedentary behaviour and physical activity.¹³ These findings support integrated rather than isolated behavioural interventions, including school-based programmes that combine structured activity, health education, and healthier environments.¹⁴

The present study was undertaken to determine the prevalence of overweight and obesity among school-going adolescents in Nellore, Andhra Pradesh; describe recreational screen-time and physical-activity patterns; examine the individual associations of excessive screen time and insufficient physical activity with nutritional status; assess their combined influence on overweight and obesity; and identify independent behavioural predictors of excess body weight after adjustment for selected sociodemographic characteristics.

MATERIALS AND METHODS

Study design and setting: This school-based cross-sectional study was conducted at urban and rural field practice areas of ACSR Government Medical College, Nellore, Andhra Pradesh, India, from April 2023 to September 2023. Administrative permission was obtained from participating schools before data collection. Government and private schools serving urban and rural communities were included to obtain a heterogeneous adolescent sample.

Study population and sampling: School-going adolescents aged 12-17 years who were present on the survey day and whose parents or guardians provided written consent were eligible. Adolescent assent was also obtained. Students with a known endocrine or genetic disorder affecting growth, prolonged systemic corticosteroid use, pregnancy, acute illness preventing anthropometric assessment, or incomplete behavioural information were excluded. The minimum sample size was estimated using a single-population proportion formula, assuming an expected overweight/obesity prevalence of 15%, 95% confidence, and 5% absolute precision. The calculated requirement was approximately 196 and was rounded to 200. Students were selected proportionately across age groups, sex, residence, and school type from available classroom lists.

Data collection: A pretested, structured questionnaire was administered under investigator supervision. It recorded age, sex, residence, school type, recreational use of smartphones, television, computers, tablets, and gaming devices, and the duration of moderate-to-vigorous physical activity during the preceding seven days. Daily recreational screen time was calculated as the average time spent on non-academic screen use. Exposure exceeding two hours/day was classified as excessive. Moderate-to-vigorous physical activity included sports, active play, cycling, brisk walking, running, and comparable activities that increased breathing or heart rate. An average below 60 minutes/day was categorized as insufficient physical activity, consistent with international movement recommendations.^{4,5}

Anthropometric assessment: Body weight was measured to the nearest 0.1 kg using a calibrated digital scale with participants wearing light clothing and no footwear. Standing height was recorded to the nearest 0.1 cm using a wall-mounted stadiometer. Body mass index was calculated as weight in kilograms divided by height in metres squared. Nutritional status was classified using age- and sex-specific body mass index-for-age reference values: underweight, less than -2 standard deviations; normal weight, -2 to +1 standard deviations; overweight, greater than +1 to +2 standard deviations; and obesity, greater than +2 standard deviations.³ Equipment calibration and duplicate measurements in a subsample were used for quality assurance.

Statistical analysis: Data were analysed using IBM SPSS Statistics version 26.0. Continuous variables were summarized as mean and standard deviation, and categorical variables as frequency and percentage. Group differences were examined using independent-samples t tests, one-way analysis of variance, chi-square tests, and tests for linear trend, as appropriate. Binary logistic regression estimated unadjusted and adjusted odds ratios with 95% confidence intervals for overweight or obesity. The adjusted model included age group, sex, residence, school type, screen-time status, and physical-activity status. Statistical significance was defined as $p < 0.05$.

Ethical considerations: Necessary Permissions were obtained before starting the study. Confidentiality was maintained through coded records, and participation was voluntary.

RESULTS

Participant recruitment and baseline characteristics

During the study period, 208 school-going adolescents were assessed for eligibility. Eight students were excluded because of incomplete questionnaire responses, absence during anthropometric assessment, or withdrawal of consent. The remaining 200 adolescents were included in the final analysis, and complete information on screen exposure, physical activity, and anthropometric measurements was available for all participants.

The mean age of the study population was 14.5 ± 1.6 years, with a range of 12-17 years. There were 104 boys (52.0%) and 96 girls (48.0%). A total of 104 students (52.0%) were aged 12-14 years, whereas 96 (48.0%) were aged 15-17 years. Urban residents accounted for 61.0% of participants, and 56.0% attended government schools. The mean body mass index was 22.8 ± 4.5 kg/m². Mean daily recreational screen time was 3.2 ± 1.6 hours, while the mean duration of moderate-to-vigorous physical activity was 48.6 ± 22.4 minutes/day (Table 1).

Table 1. Demographic, behavioural, and anthropometric characteristics of the participants

Characteristic	Value
Total participants	200
Age, years	14.5 ± 1.6
Age 12-14 years	104 (52.0%)
Age 15-17 years	96 (48.0%)
Boys	104 (52.0%)
Girls	96 (48.0%)
Urban residence	122 (61.0%)
Rural residence	78 (39.0%)
Government school	112 (56.0%)
Private school	88 (44.0%)
Body mass index, kg/m ²	22.8 ± 4.5
Daily recreational screen time, hours	3.2 ± 1.6
Physical activity, minutes/day	48.6 ± 22.4
Screen time >2 hours/day	114 (57.0%)
Insufficient physical activity	122 (61.0%)

Values are presented as mean $\pm$ standard deviation or number (percentage).

Screen-time and physical-activity patterns

Eighty-six adolescents (43.0%) reported recreational screen exposure of two hours or less per day, whereas 114 (57.0%) reported screen time exceeding two hours per day. Screen exposure was more than four hours per day among 47 adolescents (23.5%). Smartphones were the predominant screen-based device, followed by television, computers, and tablets.

Only 78 participants (39.0%) met the prespecified physical-activity criterion. The remaining 122 adolescents (61.0%) were classified as having insufficient physical activity. Adolescents with screen time exceeding two hours had a lower mean duration of physical activity than those with screen time of two hours or less (41.2 ± 19.3 vs 58.4 ± 22.1 minutes/day, $p < 0.001$).

Nutritional status and prevalence of obesity

According to age- and sex-appropriate body mass index classification, 18 adolescents (9.0%) were underweight, 102 (51.0%) had normal weight, 44 (22.0%) were overweight, and 36 (18.0%) were obese. Thus, the combined prevalence of overweight and obesity was 40.0%. Obesity was identified in 18 boys (17.3%) and 18 girls (18.8%), with no statistically significant difference between the sexes ($p = 0.751$). The combined prevalence of overweight and obesity was greater among adolescents aged 15-17 years than among those aged 12-14 years (47.9% vs 32.7%, $p = 0.040$).

Associations of screen time and physical activity with nutritional status

Among adolescents with screen time exceeding two hours/day, 30 (26.3%) were overweight and 29 (25.4%) were obese. In comparison, overweight and obesity were observed in 14 (16.3%) and seven (8.1%) adolescents, respectively, among those reporting two hours or less of screen exposure. The combined prevalence of overweight and obesity was significantly higher among adolescents with excessive screen time (51.8% vs 24.4%, $p < 0.001$).

Overweight and obesity were also more frequent among adolescents with insufficient physical activity. Of the 122 insufficiently active participants, 33 (27.0%) were overweight and 30 (24.6%) were obese. Among the 78 sufficiently active adolescents, 11 (14.1%) were overweight and six (7.7%) were obese. Consequently, overweight or obesity was present in 51.6% of insufficiently active participants compared with 21.8% of sufficiently active participants ($p < 0.001$). The full nutritional-status distributions are shown in Table 2.

Table 2. Nutritional status according to screen time and physical activity

Behavioural characteristic	Underweight	Normal weight	Overweight	Obese	p-value
Screen time ≤ 2 hours/day (n=86)	12 (14.0%)	53 (61.6%)	14 (16.3%)	7 (8.1%)	<0.001
Screen time > 2 hours/day (n=114)	6 (5.3%)	49 (43.0%)	30 (26.3%)	29 (25.4%)	
Sufficient physical activity (n=78)	9 (11.5%)	52 (66.7%)	11 (14.1%)	6 (7.7%)	<0.001
Insufficient physical activity (n=122)	9 (7.4%)	50 (41.0%)	33 (27.0%)	30 (24.6%)	

Values are presented as number (percentage). Comparisons were performed using the chi-square test.

Screen time and physical activity across body mass index categories

Mean daily screen time increased progressively across body mass index categories. Adolescents with obesity reported a mean screen exposure of 4.1 ± 1.5 hours/day, compared with 2.6 ± 1.2 hours/day among adolescents with normal weight. Conversely, mean daily physical activity declined with increasing body mass index. Adolescents with obesity reported an average of 35.2 ± 16.8 minutes/day, whereas those with normal weight reported 56.4 ± 20.1 minutes/day. Both differences across categories were statistically significant (Table 3).

Table 3. Screen time and physical activity according to nutritional status

Nutritional status	Screen time, hours/day	Physical activity, minutes/day
Underweight (n=18)	2.4 ± 1.1	54.8 ± 20.2
Normal weight (n=102)	2.6 ± 1.2	56.4 ± 20.1
Overweight (n=44)	3.6 ± 1.4	42.7 ± 18.4
Obese (n=36)	4.1 ± 1.5	35.2 ± 16.8
p-value	<0.001	<0.001

Values are presented as mean $\pm$ standard deviation. Comparisons were performed using one-way analysis of variance.

Combined influence of screen time and physical inactivity

The prevalence of overweight or obesity increased with accumulation of behavioural risk factors. Among adolescents with neither excessive screen time nor insufficient physical activity, seven of 46 participants (15.2%) were overweight or obese. The corresponding prevalence was 31.9% among adolescents with one behavioural risk factor and 61.0% among those with both risk factors (p for trend < 0.001). Obesity alone increased from 4.3% among adolescents with neither risk factor to 29.3% among those with both risk factors (Table 4).

Table 4. Combined influence of excessive screen time and insufficient physical activity

Behavioural-risk category	Participants	Overweight or obesity	Obesity
Neither risk factor	46	7 (15.2%)	2 (4.3%)
One risk factor	72	23 (31.9%)	10 (13.9%)
Both risk factors	82	50 (61.0%)	24 (29.3%)
p for trend		<0.001	0.001

One risk factor indicates either excessive screen time or insufficient physical activity; both risk factors indicate concurrent exposure.

Multivariable logistic regression analysis

In unadjusted analysis, screen time exceeding two hours/day was associated with more than threefold higher odds of overweight or obesity (OR: 3.32; 95% CI: 1.80-6.14). Insufficient physical activity was associated with nearly fourfold higher odds (OR: 3.83; 95% CI: 2.01-7.30).

After adjustment for age, sex, residence, and school type, both behavioural variables remained independently associated with overweight or obesity. Adolescents reporting screen time exceeding two hours/day had 2.54 times higher adjusted odds than those with lower exposure. Insufficiently active adolescents had 2.87 times higher adjusted odds than those meeting the physical-activity criterion. Age group, sex, residence, and school type were not independently associated with the outcome in the adjusted model (Table 5).

Table 5. Logistic regression analysis of factors associated with overweight or obesity

Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Screen time >2 hours/day	3.32 (1.80-6.14)	<0.001	2.54 (1.32-4.89)	0.005
Insufficient physical activity	3.83 (2.01-7.30)	<0.001	2.87 (1.45-5.69)	0.002
Age 15-17 years	1.89 (1.03-3.48)	0.040	1.49 (0.81-2.74)	0.198
Female gender	1.14 (0.65-2.00)	0.751	1.14 (0.62-2.08)	0.674
Urban residence	1.42 (0.79-2.57)	0.244	1.28 (0.67-2.45)	0.456
Private-school attendees	1.36 (0.77-2.41)	0.294	1.21 (0.65-2.25)	0.552

OR: odds ratio; CI: confidence interval. The dependent variable was overweight or obesity. The adjusted model included all variables shown.

DISCUSSION

This study identified a considerable burden of excess body weight among school-going adolescents: 22.0% were overweight and 18.0% were obese. Recreational screen exposure exceeding two hours/day and insufficient moderate-to-vigorous physical activity were also common. Both behaviours were independently associated with overweight or obesity after adjustment for demographic characteristics, and adolescents presenting with both risk factors had the least favourable weight profile. These findings reinforce the value of assessing screen use and physical activity together rather than treating them as interchangeable behaviours.

The combined prevalence of overweight and obesity in the present study was 40.0%. This estimate is higher than the pooled prevalence reported in broad Indian reviews, which include diverse regions, age groups, and reference standards,² but it is close to the 38.3% documented among adolescents in Mumbai by Moitra et al.¹¹ Differences between studies can reflect urbanization, school selection, socioeconomic distribution, dietary patterns, pubertal stage, and the criteria used to define excess weight. The absence of a significant sex difference in obesity suggests that contemporary obesogenic exposures affect both boys and girls, although sex-specific patterns of activity, device use, and body composition still warrant consideration.

Adolescents with screen time above two hours/day had more than twice the adjusted odds of overweight or obesity. This agrees with systematic reviews showing a positive relationship between screen exposure and excess weight,^{6,7} as well as with Indian school-based observations.¹² Screen time can influence adiposity through several pathways: displacement of active recreation, reduced energy expenditure, distracted or unregulated eating, food marketing exposure, and altered sleep.⁸ The progressive increase in mean screen time from the normal-weight to obese categories supports a graded behavioural pattern, although the cross-sectional design cannot determine whether greater screen exposure preceded weight gain.

Insufficient physical activity was similarly associated with excess weight, with an adjusted odds ratio of 2.87. The lower mean activity duration among adolescents with obesity and among those reporting excessive screen time indicates clustering of unhealthy movement behaviours. Nevertheless, sedentary time and physical activity are distinct domains. Meta-analytic evidence shows that their inverse association is modest,¹³ and studies using combined categories have found the highest obesity risk among young people who meet neither recommendation.^{9,10} In the present sample, overweight or obesity affected 61.0% of adolescents with both adverse behaviours compared with 15.2% of those with neither, demonstrating a strong cumulative relationship.

These results have practical implications for schools and families. Strategies should include protected opportunities for daily activity, active transport where feasible, structured sports and recreation, classroom movement breaks, parental guidance on recreational device use, and avoidance of screen-associated eating. Indian school-based programmes indicate that multicomponent approaches can improve fitness and lifestyle behaviours, even when changes in body mass index are modest.¹⁴ Periodic anthropometric surveillance combined with brief behavioural screening could identify high-risk adolescents early and support targeted counselling.

LIMITATIONS

This study has several limitations. Its cross-sectional design prevents temporal or causal interpretation of the observed associations. Screen time and physical activity were self-reported and remain susceptible to recall and social-desirability bias. Dietary intake, sleep duration, pubertal stage, parental obesity, and household socioeconomic indicators were not included in the adjusted model. Findings from selected schools in one district also have restricted wider generalizability.

CONCLUSION

Overweight and obesity affected two-fifths of the school-going adolescents studied. Excessive recreational screen exposure and insufficient moderate-to-vigorous physical activity were frequent and remained independently associated with excess body weight after adjustment for age, sex, residence, and school type. The highest prevalence occurred when both adverse behaviours were present, supporting a cumulative relationship between sedentary screen use, inadequate activity, and obesity. Schools should integrate routine growth monitoring with daily opportunities for physical activity, health education, and guidance on recreational device use. Family participation is important because screen habits and active routines extend beyond school hours. Longitudinal studies using objective movement measures are required to clarify temporal relationships and evaluate prevention strategies.

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