

RESEARCH ARTICLE

Association of Screen Time-Based Sedentary Behavior, Food Intake Quality, and Physical Activity on Body Mass Index Among Filipino Adolescents

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ABSTRACT

Adolescent overweight and obesity remain global public health concerns, yet limited Philippine evidence exists on the combined influence of screen time-based sedentary behavior, food intake quality, and physical activity on body mass index (BMI). This study examined the association of these behaviors with BMI among Grade 8 students in a public secondary school in Misamis Oriental, Philippines. Guided by Social Cognitive Theory, Ecological Systems Theory, and Energy Balance Theory, the study used a descriptive–correlational design. A total of 246 students aged 13–15 were selected through computer-assisted simple random sampling. Data were collected using validated, contextualized self-report instruments—a Screen Time-Based Sedentary Behavior Survey, a 15-item Food Frequency Questionnaire, and a modified IPAQ–Short Form—together with directly measured height and weight for BMI, and analyzed using descriptive statistics, Pearson product–moment correlation, and multiple regression. Participants showed moderate levels of screen-based sedentary behavior ($M = 3.21$), food intake quality ($M = 3.19$), and physical activity, while mean BMI fell within the normal range ($M = 19.58$), classified using WHO BMI-for-age standards. Correlation and regression analyses indicated that screen time ($r = 0.075$, $p = .239$), food intake quality ($r = 0.065$, $p = .306$), and physical activity (all $p > .05$) were not significantly associated with BMI, and together did not significantly predict it, $F(6, 239) = 0.888$, $p = .504$. The findings suggest that adolescent weight status in this setting may be shaped by broader physiological, environmental, and socioeconomic factors beyond the measured behaviors, supporting an integrated, multi-factor approach to school health.

KEYWORDS BMI; screen time; physical activity; dietary intake; secondary schools

INTRODUCTION

Overweight and obesity among adolescents continue to rise worldwide and remain pressing public health concerns. In 2016, an estimated 340 million children and adolescents aged 5–19 years were classified

as overweight or obese (World Health Organization, 2020). Excessive screen time and sedentary behavior have been identified as major contributors to this trend, alongside low physical activity and poor dietary habits (Bakour *et al.*, 2022; Haghjoo *et al.*, 2022; Tambalis *et al.*, 2020). In the Philippines, the Expanded National Nutrition Survey reported that about 13.3% of adolescents aged 10–19 were overweight and 6.2% were obese, with similar associations to increased screen exposure and unhealthy eating (Angeles-Agdeppa *et al.*, 2022; Mascarenhas *et al.*, 2023; Moitra *et al.*, 2021).

Food consumption is central to energy balance and is often influenced by screen exposure, while physical activity is widely recognized as a protective factor that increases energy expenditure and offsets the effects of sedentary behavior (Munusamy & Shanmugam, 2023; Yoon *et al.*, 2020). Because these behaviors are closely interrelated, examining them together provides a more complete understanding of adolescent weight status than studying them in isolation (Kaul *et al.*, 2023). Although international studies consistently link prolonged screen time, low physical activity, and poor diet to higher BMI (Ikeda *et al.*, 2024; Peral-Suárez *et al.*, 2024), local evidence within the Philippine secondary-school context remains limited, particularly in the post-pandemic period when online and hybrid learning increased screen exposure and reduced structured activity (Moitra *et al.*, 2021).

This study is anchored in three complementary theories. Social Cognitive Theory (Bandura, 1991) explains how adolescents acquire and maintain screen-based and dietary behaviors through observation, reinforcement, and self-regulation. Ecological Systems Theory (Bronfenbrenner, 1992) situates these behaviors within interacting environments—home, school, and the broader social and economic context—that shape food access and activity opportunities. Energy Balance Theory (Hill *et al.*, 2012) provides the biological mechanism linking the behaviors to BMI through the balance of energy intake and expenditure. Together, these frameworks support examining screen time-based sedentary behavior, food intake quality, and physical activity as jointly associated with BMI.

Body Mass Index, derived from height and weight, is a widely used and practical indicator of adolescent nutritional status and a predictor of long-term health outcomes (Dawed *et al.*, 2022; Su *et al.*, 2024; World Health Organization, 2007). By providing localized evidence on the levels and relationships of these lifestyle behaviors in relation to BMI, the present study contributes to school-based health promotion and supports Sustainable Development Goals 2 (Zero Hunger), 3 (Good Health and Well-being), 4 (Quality Education), and 10 (Reduced Inequalities).

This study investigated the association of screen time-based sedentary behavior, food intake quality, and physical activity with the BMI of Grade 8 Filipino adolescents. Specifically, it sought to determine:

- the extent of the participants' screen time-based sedentary behavior;
- the participants' level of food intake quality;
- the participants' level of physical activity;
- the participants' body mass index; and
- whether screen time-based sedentary behavior, food intake quality, and physical activity are significantly associated with BMI.

The following null hypotheses were tested at $\alpha = 0.05$: (H_{0_1}) screen time-based sedentary behavior is not significantly associated with BMI; (H_{0_2}) food intake quality is not significantly associated with BMI; (H_{0_3}) physical activity is not significantly associated with BMI; and (H_{0_4}) the three behaviors together are not significantly associated with BMI.

METHODS

The study employed a descriptive–correlational, cross-sectional design within a non-experimental quantitative approach, which describes variables in their natural state and examines their relationships at a

single time point without manipulation (Miksza *et al.*, 2023). Through surveys and BMI classification, it described screen time-based sedentary behavior, food intake quality, physical activity, and BMI among Filipino adolescents and explored their associations; causality cannot be inferred from such observations.

Participants were 246 Grade 8 students (aged 13–15) enrolled in a public secondary school in Misamis Oriental, Philippines, during the 2025–2026 school year, drawn from a Grade 8 population of approximately 600 through computer-assisted simple random sampling. Eligible students were physically and mentally healthy per school clinic records, regularly attending, able to complete self-report questionnaires, and provided parental consent and personal assent. Students with chronic illness, diagnosed eating disorders, or conditions affecting metabolism, appetite, or weight—or those in intensive dietary, pharmacological, or activity programs—were excluded.

Three self-report instruments and one anthropometric measure were used. The Screen Time-Based Sedentary Behavior Survey was adapted from the HELENA Sedentary Behaviour Questionnaire (Rey-López *et al.*, 2012) and contextualized to Filipino adolescents, distinguishing weekday and weekend screen use. Food intake quality was measured with a 15-item modified semi-quantitative Food Frequency Questionnaire adapted from Rothenberg *et al.* (2021). Physical activity was measured with a Modified IPAQ–Short Form (International Physical Activity Questionnaire Research Committee, 1998) covering vigorous, moderate, and walking activity, each rated on a 5-point Likert scale. BMI was computed from directly measured height and weight (kg/m^2) and classified using the World Health Organization (2007) BMI-for-age growth reference for children and adolescents aged 5–19 years (de Onis *et al.*, 2007).

The source instruments have established validity and reliability, and the contextualized versions underwent expert content validation and pilot testing. Pilot Cronbach's alpha values indicated acceptable to good internal consistency: 0.718 for the Screen Time scale, 0.818 for Physical Activity, and 0.705 for Food Intake Quality. Height and weight were directly measured by the research team using a calibrated stadiometer and digital weighing scale at the school, with partitions to ensure privacy; BMI was not based on self-reported values.

Screen time, food intake, and physical activity were each interpreted using a five-level scale: Very High (4.51–5.00), High (3.51–4.50), Moderate (2.51–3.50), Low (1.51–2.50), and Very Low (1.00–1.50). BMI was classified using age- and sex-specific WHO (2007) BMI-for-age z-scores for adolescents (de Onis *et al.*, 2007; Li *et al.*, 2016): Severe thinness (< -3 SD), Thinness (< -2 SD), Normal (-2 SD to $+1$ SD), Overweight ($> +1$ SD), and Obesity ($> +2$ SD). For the behavioral scales, higher screen-time scores indicate more sedentary behavior, whereas higher food-intake-quality and physical-activity scores indicate healthier behavior; this difference in valence is relevant when interpreting the correlations with BMI.

Following approval from the Lourdes College Research Ethics Committee and the schools division, an orientation explained the purpose, procedures, risks, benefits, voluntary participation, and right to withdraw. Parental consent and student assent were secured. Surveys were administered in person via tablets or printed forms with trained assistants; BMI measurements followed. Data were coded for confidentiality and handled in accordance with the Data Privacy Act of 2012 and the ethical principles of the Belmont Report.

Descriptive statistics (frequencies, percentages, means, standard deviations) summarized each variable. Pearson product-moment correlation assessed bivariate associations with BMI, and multiple regression examined the combined prediction of BMI, with the three independent variables entered as their six measured components (weekday and weekend screen time; vigorous, moderate, and walking activity; and

food intake quality); both were tested at $\alpha = 0.05$. Regression assumptions were satisfactory: residuals were approximately normal and homoscedastic, the Durbin–Watson statistic was 2.191 (independent residuals), tolerance ranged 0.601–0.868 and VIF 1.152–1.663 (no multicollinearity), and Cook’s and Mahalanobis distances indicated no influential outliers.

RESULTS

Problem 1. Extent of Screen Time–Based Sedentary Behavior

As shown in Table 1, the participants’ overall screen time–based sedentary behavior was Moderate ($M = 3.21$, $SD = 1.30$), indicating that screen use is a regular part of their academic, social, and recreational routines. The largest share fell in the Moderate category (30.89%), followed by High (23.17%), Very High (21.95%), Low (19.11%), and Very Low (4.88%). Academic-related screen activities (surfing the internet for study, $M = 3.58$; studying, $M = 3.54$) were the highest indicators, suggesting that device use was driven more by schoolwork than by leisure.

Table 1. Screen Time–Based Sedentary Behavior of the Participants

Range	Description	Interpretation	f	%
4.51 – 5.00	Always	Very High	54	21.95
3.51 – 4.50	Often	High	57	23.17
2.51 – 3.50	Sometimes	Moderate	76	30.89
1.51 – 2.50	Rarely	Low	47	19.11
1.00 – 1.50	Never	Very Low	12	4.88
TOTAL			246	100
Mean = 3.21			Interpretation = Moderate	
			SD = 1.30	

Problem 2. Level of Food Intake Quality

Table 2 shows a Moderate level of food intake quality ($M = 3.19$, $SD = 1.16$), indicating that healthy dietary practices were followed only to an intermediate degree. Most participants were in the Moderate category (59.76%), followed by High (28.86%), Low (10.16%), Very Low (0.81%), and Very High (0.41%). The strongest practice was including vegetables with minimal oil or salt ($M = 3.51$), while limiting processed, salty, and high–sodium foods was weakest (e.g., choosing unsalted nuts/seeds, $M = 2.78$).

Table 2. Level of Food Intake Quality of the Participants

Range	Description	Interpretation	f	%
4.51 – 5.00	Always	Very High	1	0.41
3.51 – 4.50	Often	High	71	28.86
2.51 – 3.50	Sometimes	Moderate	147	59.76
1.51 – 2.50	Rarely	Low	25	10.16
1.00 – 1.50	Never	Very Low	2	0.81
TOTAL			246	100
Mean = 3.19			Interpretation = Moderate	
			SD = 1.16	

Problem 3. Level of Physical Activity

Table 3 indicates a Moderate level of physical activity ($M = 3.26$, $SD = 1.21$), with stronger engagement in moderate-intensity activity and walking than in vigorous exercise. Most participants fell in the Moderate category (48.78%), followed by High (31.30%), Low (15.45%), Very High (4.07%), and Very Low (0.41%). The highest indicators were recreational movement and continuous walking ($M = 3.69$), while vigorous activity was lowest ($M = 2.98$), indicating that adolescents were more active through routine and practical movement than through structured vigorous exercise.

Table 3. Level of Physical Activity of the Participants

Range	Description	Interpretation	f	%
4.51 - 5.00	Always	Very High	10	4.07
3.51 - 4.50	Often	High	77	31.30
2.51 - 3.50	Sometimes	Moderate	120	48.78
1.51 - 2.50	Rarely	Low	38	15.45
1.00 - 1.50	Never	Very Low	1	0.41
TOTAL			246	100

Mean = 3.26

Interpretation = Moderate

SD = 1.21

Problem 4. Body Mass Index of the Participants

Table 4 shows a mean BMI of 19.58 ($SD = 3.99$), within the normal range. Classified using WHO (2007) BMI-for-age z-scores (de Onis *et al.*, 2007), most participants (75.61%) fell within the normal category, while 18.70% were overweight (10.98%) or obese (7.72%) and 5.69% showed thinness (3.66%) or severe thinness (2.03%). This coexistence of under- and over-nutrition within a single school population is consistent with the double burden of malnutrition reported among Filipino adolescents (Angeles-Agdeppa *et al.*, 2020). Applying age- and sex-specific BMI-for-age standards rather than adult cut-offs reclassified most apparently 'underweight' cases as normal, underscoring that cut-off choice materially shapes the adolescent nutritional profile (Gomes *et al.*, 2009; Li *et al.*, 2016).

Table 4. BMI of the Participants

z-score range	Classification	f	%
> +2 SD	Obesity	19	7.72
> +1 to +2 SD	Overweight	27	10.98
-2 to +1 SD	Normal	186	75.61
-3 to < -2 SD	Thinness	9	3.66
< -3 SD	Severe thinness	5	2.03
TOTAL		246	100

Mean = 19.58 SD = 3.99

Classified using WHO (2007) BMI-for-age z-scores (de Onis *et al.*, 2007)**Problem 5.** Association of the Behaviors with BMI

Pearson correlation showed that screen time-based sedentary behavior was not significantly associated with BMI ($r = 0.075$, $p = .239$); within this variable, academic-engagement screen time ($r = 0.070$)

and leisure screen time ($r = 0.039$) were both negligible. Food intake quality was likewise not significantly associated with BMI ($r = 0.065$, $p = .306$). For physical activity, none of the components were significantly associated with BMI—vigorous ($r = 0.035$, $p = .581$), moderate ($r = 0.047$, $p = .459$), walking ($r = 0.017$, $p = .788$), and overall lifestyle activity ($r = 0.009$, $p = .884$)—although the activity components correlated significantly with one another (e.g., vigorous–moderate $r = 0.665$, $p < .001$). Accordingly, H_{o1} , H_{o2} , and H_{o3} were retained (Table 5).

Table 5. Pearson Correlation of Screen Time, Food Intake Quality, and Physical Activity with BMI

Predictor (with BMI)	Pearson's r	p
Screen Time–Based Sedentary Behavior	0.075	.239
Food Intake Quality	0.065	.306
Vigorous Physical Activity	0.035	.581
Moderate Physical Activity	0.047	.459
Walking Physical Activity	0.017	.788
Overall Lifestyle Physical Activity	0.009	.884

Note. None of the associations were significant at $\alpha = 0.05$ (Tables 5–7 in the original thesis, consolidated here).

Multiple regression (Table 6) showed that the six predictors together did not significantly predict BMI, $R = 0.148$, $R^2 = 0.022$, adjusted $R^2 = -0.003$, $F(6, 239) = 0.888$, $p = .504$, explaining only about 2.2% of the variance. No individual predictor was significant: weekend screen time had the largest standardized coefficient ($\beta = 0.148$) but did not reach significance ($t = 1.867$, $p = .063$), and all other predictors had $p > .70$. H_{o4} was therefore retained.

Table 6. Multiple Regression of Screen Time, Food Intake, and Physical Activity on BMI

Predictor	B	SE	β	t	p
Constant	16.97	1.79	–	9.480	<.001
Screen Time – Weekday	-0.17	0.49	-0.026	-0.347	.729
Screen Time – Weekend	0.84	0.45	0.148	1.867	.063
Food Intake Quality	0.19	0.57	0.028	0.333	.739
Vigorous PA	-0.001	0.42	0.000	-0.002	.998
Moderate PA	0.15	0.48	0.029	0.312	.755
Walking	-0.17	0.39	-0.037	-0.436	.663

Model: $R = 0.148$ $R^2 = 0.022$ **Adjusted $R^2 = -0.003$** **$F(6, 239) = 0.888$** **$p = .504$**

Note. B = unstandardized coefficient; SE = standard error; β = standardized coefficient; $t = B/SE$; $df = 239$. No predictor was statistically significant at $\alpha = 0.05$, consistent with the non-significant overall model. (Per-predictor t and p were recomputed from the reported B and SE, correcting a column misalignment in the source table.)

DISCUSSION

The participants displayed moderate levels of screen time–based sedentary behavior, food intake quality, and physical activity, with screen use oriented more toward academic than recreational purposes. This pattern is consistent with the normalization of digital devices for learning in the post-pandemic period (Moitra et al., 2021). Most participants fell within the normal BMI-for-age range, with a smaller share overweight or obese and a few showing thinness—reflecting the double burden of malnutrition documented among Filipino adolescents, in which undernutrition and overweight coexist (Angeles-Agdeppa et al., 2020).

Contrary to much international evidence (Haghjoo *et al.*, 2022; Ikeda *et al.*, 2024; Tambalis *et al.*, 2020), none of the three behaviors was significantly associated with BMI, and together they explained only about 2% of its variance. Several explanations are plausible. The behaviors clustered at moderate levels with limited variability, which constrains the detection of associations. The FFQ captured dietary quality and frequency rather than caloric intake or portion size, which are more directly tied to energy balance (Angeles-Agdeppa *et al.*, 2022). Much of the screen exposure was academic rather than recreational, which may carry different health implications than leisure screen time.

These results do not invalidate the guiding theories so much as point to their more distal operation. Social Cognitive Theory locates behavior change in reinforcement and self-regulation; Ecological Systems Theory emphasizes family, school, and socioeconomic context; and Energy Balance Theory ultimately ties BMI to the balance of energy intake and expenditure—mechanisms only partially captured by self-reported behavior. Because the study did not measure caloric intake, metabolic rate, food security, or socioeconomic status, these unmeasured factors likely contribute more to BMI variation in this sample than the behaviors examined (Higuera-Gómez *et al.*, 2024).

CONCLUSION

This study profiled screen time-based sedentary behavior, food intake quality, physical activity, and BMI among Grade 8 Filipino adolescents and examined their associations. Participants showed moderate levels across the three behaviors and a BMI distribution weighted toward underweight and normal classifications. None of the behaviors—individually or together—was significantly associated with BMI. The findings provide localized, post-pandemic evidence that adolescent weight status is multidimensional and is likely shaped by physiological, environmental, and socioeconomic factors beyond the measured behaviors, reinforcing the value of integrated, multi-factor approaches to adolescent health.

LIMITATIONS OF THE STUDY

Several limitations should be considered. The descriptive–correlational, single-site design with one Grade 8 cohort limits causal inference and generalizability. Reliance on self-report for screen time, diet, and physical activity introduces possible recall and social-desirability bias. The study did not measure several determinants of BMI—caloric intake and portion size, sleep, mental health, family background, peer influence, food security, socioeconomic status, and metabolic factors—which may account for the limited associations observed. The moderate, low-variability levels across behaviors may also have reduced the likelihood of detecting relationships.

RECOMMENDATIONS

School administrators may strengthen wellness policies through structured movement breaks, active recess, and health-promotion activities, while Physical Education teachers may design developmentally appropriate activities that raise participation in moderate-to-vigorous physical activity. Teachers across subjects may incorporate brief movement breaks during extended screen-based tasks. Health and nutrition personnel may promote balanced meals and food literacy and conduct periodic monitoring of BMI and nutritional status to identify risks of both undernutrition and overweight. Parents may support healthy routines at home, and students may practice self-regulation in balancing screen use, diet, and activity. Future researchers may examine additional determinants—socioeconomic status, food security, metabolic and developmental factors, and environmental influences—using longitudinal or mixed-methods designs.

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Ethical Approval: The study was reviewed and approved by the Ethics Committee of Lourdes College, Inc., the researcher's academic institution, in accordance with the ethical standards outlined in the Belmont Report. Informed assent was obtained from student participants, alongside written parental consent, ensuring full ethical compliance.

AI Declaration: This study utilized artificial intelligence tools to assist in preparing this article. AI assistance was used to help condense the full thesis manuscript into a reduced journal article format and to enhance the language quality, clarity, and tone of the manuscript, with human supervision and editing throughout. The author carefully reviewed and edited all outputs to maintain scholarly standards and integrity.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Requests for access will be evaluated in accordance with ethical guidelines and data privacy policies.