



LIFESTYLE EFFECTS ON THE HEALTH OF CHILDREN: A CROSS-SECTIONAL STUDY IN SHOPIAN DISTRICT OF JAMMU AND KASHMIR

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Abstract

Background: Lifestyle patterns during childhood play a pivotal role in determining physical, psychological, and cognitive health outcomes throughout life. Rapid technological advancement, reduced physical activity, and poor dietary habits have led to increasing lifestyle-related health challenges in children. Despite growing concern, limited region-specific evidence exists from northern India, particularly from Kashmir, where cultural and environmental factors uniquely shape children's routines. This study aimed to evaluate the relationship between lifestyle behaviors and health outcomes among school-aged children in the Shopian District of Jammu and Kashmir.

Aim: To assess the association between key lifestyle factors diet quality, physical activity, screen exposure, and sleep duration and indicators of child health, including body mass index (BMI), mental well-being, and academic performance.

Methods: A cross-sectional study was conducted among 100 children aged 6–12 years selected through multistage random sampling from five schools in Shopian District. Data on lifestyle factors were collected using a prevalidated structured questionnaire covering diet, physical activity, screen exposure, and sleep duration. A composite lifestyle score (0–100) was calculated by combining standardized subscores for each domain, and participants were classified into Healthy and Unhealthy lifestyle groups using the median split method. BMI was measured using WHO Child Growth Standards, mental health was assessed using a modified Strengths and Difficulties Questionnaire, and academic performance was derived from school records. Statistical analyses included t-tests, chi-square tests, Pearson correlation, and multivariable linear regression using SPSS version 29. Statistical significance was set at $p < 0.05$.

Results: The mean age of participants was 9.21 ± 1.91 years, with equal representation of both sexes. Children in the Healthy lifestyle group exhibited significantly higher diet scores (6.78 ± 1.14 vs 5.38 ± 1.34 , $p < 0.001$), greater physical activity (68.5 ± 24.1 vs 51.9 ± 22.6 minutes/day, $p = 0.001$), longer sleep duration (9.36 ± 0.78 vs 8.62 ± 0.82 hours/night, $p < 0.001$), and lower screen exposure (2.88 ± 0.91 vs 3.42 ± 1.02 hours/day, $p = 0.0067$). Academic performance was significantly better in the Healthy group ($75.45 \pm 6.20\%$ vs $69.78 \pm 7.01\%$, $p < 0.001$). BMI and mental health scores were more favorable among Healthy children, though not statistically significant ($p > 0.05$). Lifestyle score correlated negatively with BMI ($r = -0.269$, $p = 0.0068$) and positively with academic performance ($r = 0.541$, $p < 0.001$). In multivariable regression, lifestyle score independently predicted lower BMI after adjusting for age and sex ($\beta = -0.066$, $p = 0.007$).

Conclusion: Healthy lifestyle behaviors comprising balanced diet, adequate physical activity, limited screen exposure, and sufficient sleep are significantly associated with improved academic performance and lower BMI among children in Shopian District. These findings underscore the need for school- and community-based interventions promoting integrated lifestyle modification to enhance overall child health. Targeted parental education and policy measures focusing on balanced

routines, outdoor activity, and regulated media use are strongly recommended.

Keywords: Lifestyle behaviors; Physical activity; Screen time; Sleep duration; Diet quality; Body mass index; Academic performance; Mental health; Children; Kashmir; Cross-sectional study

1. Introduction

Childhood represents a critical window for the establishment of lifelong health behaviors that profoundly influence physical growth, psychological development, and long-term disease risk. In recent decades, rapid social, environmental, and technological transitions have significantly altered children's daily routines worldwide, giving rise to sedentary behaviors, poor dietary patterns, and irregular sleep schedules (Ng et al., 2014; Guthold et al., 2020). These lifestyle changes have been linked to an alarming increase in childhood obesity, mental health disorders, and early metabolic derangements, which now constitute a growing public health concern in both developed and developing nations (Sahoo et al., 2015; World Health Organization [WHO], 2020). The multifactorial interplay of physical inactivity, dietary inadequacy, excessive screen time, and insufficient sleep contributes synergistically to these outcomes (Chaput et al., 2020). Globally, the World Health Organization (2020) estimates that more than 340 million children and adolescents aged 5–19 years are overweight or obese, reflecting a dramatic rise from less than 4% in 1975 to over 18% in 2016. The determinants of this epidemic are largely behavioral and environmental rather than genetic, emphasizing the central role of lifestyle modification in preventive strategies. Lifestyle during childhood has enduring effects on later health trajectories; children with poor dietary patterns and limited physical activity are more likely to carry these behaviors into adulthood, predisposing them to obesity, type 2 diabetes, hypertension, and cardiovascular disease (Reilly & Kelly, 2011; Lobstein et al., 2015). Furthermore, unhealthy behaviors are not only detrimental to physical health but also impair cognitive and academic performance through mechanisms involving reduced neurocognitive stimulation, poor sleep quality, and altered neuroendocrine regulation (Adelantado-Renau et al., 2019; James et al., 2023).

Among the various lifestyle factors, dietary habits play a pivotal role in shaping both physical and cognitive health. Balanced nutrition during childhood supports optimal growth, immune function, and neurodevelopment. Conversely, diets high in refined sugars, saturated fats, and ultra-processed foods are associated with obesity, micronutrient deficiencies, and reduced academic performance (Florence et al., 2008; Rajan & Nandini, 2024). Similarly, physical activity (PA) enhances muscular and skeletal development, cardiometabolic fitness, and mental well-being. Evidence from longitudinal studies and meta-analyses has consistently shown that children engaging in regular moderate-to-vigorous PA have lower BMI, improved executive function, and superior academic achievement compared to their sedentary peers (Latino et al., 2023; Rasberry et al., 2011; WHO, 2020).

In contrast, excessive screen time, encompassing television, video games, smartphones, and online media, has emerged as a major contributor to sedentary lifestyles. Prolonged recreational screen exposure is associated with reduced physical activity, unhealthy snacking, disrupted sleep, and increased risk of overweight and obesity (Fang et al., 2019; Haghjoo et al., 2022). Moreover, excessive digital engagement has been linked to attention deficits, anxiety, and poorer scholastic performance (Adelantado-Renau et al., 2019). The American Academy of Pediatrics (AAP, 2016a, 2016b) therefore recommends limiting recreational screen time to less than 2 hours per day and emphasizes the importance of balanced media use within healthy family routines. Adequate sleep duration is another crucial determinant of child health. The American Academy of Sleep Medicine (Paruthi et al., 2016) recommends 9–12 hours of sleep per night for children aged 6–12 years. Insufficient sleep has been shown to increase the risk of obesity, impaired glucose tolerance, poor attention, and lower academic performance (Miller et al., 2018; Deng et al., 2021). Physiologically, short sleep alters leptin and ghrelin levels, leading to increased appetite and energy intake, while sleep fragmentation impairs memory consolidation and emotional regulation (Han et al., 2022).

In India, the ongoing urbanization and digital revolution have transformed children's lifestyles even

in semi-urban and rural settings (Ranjani et al., 2016). Recent surveys indicate that less than one-third of Indian school-aged children meet the WHO- recommended physical activity levels, while over 60% exceed screen-time limits (Gupta et al., 2022). The National Family Health Survey (NFHS-5, 2019–2021) reported rising trends in childhood overweight and obesity, particularly in northern states including Jammu and Kashmir (Ministry of Health and Family Welfare [MoHFW], 2021). However, there is a paucity of region-specific research examining the combined effects of multiple lifestyle behaviors on children's health outcomes such as BMI, mental health, and academic performance especially within smaller districts such as Shopian, where sociocultural, dietary, and environmental factors differ markedly from national averages. Shopian District, located in the southern part of the Kashmir Valley, represents a unique setting characterized by a mixed socioeconomic background, cold climatic conditions, and traditional dietary practices rich in fats and carbohydrates. The increasing penetration of digital devices, coupled with reduced outdoor play opportunities due to prolonged winters and academic pressure, may predispose children in this region to emerging lifestyle-related health issues. Despite these challenges, no prior empirical study has systematically explored the relationship between composite lifestyle behaviors and health outcomes among children in this area.

Given this backdrop, the present study was designed to comprehensively evaluate the effects of lifestyle factors diet, physical activity, screen exposure, and sleep on the health of children in the Shopian District of Jammu and Kashmir. By integrating multiple behavioral domains, the study aimed to identify specific patterns associated with favorable physical (BMI), mental (psychological well-being), and cognitive (academic performance) outcomes. The findings are expected to provide evidence-based insights to inform school health programs, parental counseling, and community-level interventions targeting modifiable lifestyle determinants of child health.

2. Methodology

2.1. Study Design and Setting

A community-based, cross-sectional study was conducted in the **Shopian District of Jammu and Kashmir**, India, between **March and August 2025**. Shopian is a predominantly rural district located in the southern part of the Kashmir Valley, with a mixed socioeconomic and educational profile. The district was selected for its representative demographic diversity and accessibility to both government and private educational institutions. The study aimed to evaluate the effects of various lifestyle factors on the overall health of school-aged children, emphasizing the interaction between diet, physical activity, screen exposure, sleep patterns, and general well-being.

2.2. Study Population and Sampling

The target population comprised school-going children aged **6 to 12 years** enrolled in both government and private primary schools of Shopian District. The study sample size was fixed at **100 children**, calculated to provide sufficient statistical power for group comparisons while maintaining feasibility within the study's timeframe and resources. A **multistage random sampling** technique was employed. In the first stage, five schools were randomly selected from a comprehensive list of all primary schools in the district. In the second stage, 20 students from each school were chosen using **systematic random sampling** from the attendance register, ensuring proportionate representation of both sexes and different grade levels.\

2.3. Inclusion and Exclusion Criteria

Children aged 6–12 years whose parents provided written informed consent and who were available during the data collection period were included in the study. Children with chronic medical conditions (e.g., congenital heart disease, endocrine disorders, developmental delay) or those on long-term medication affecting appetite, growth, or activity level were excluded to avoid confounding factors.

2.4. Ethical Considerations

Written informed consent was obtained from parents or guardians, and assent was obtained from children above 8 years of age. The study adhered to the ethical standards laid down in the **Declaration of Helsinki (2013 revision)** for research involving human participants. Confidentiality and anonymity of the participants were strictly maintained.

2.5. Data Collection Tools and Variables

Data were collected using a **structured questionnaire** developed and validated for the study based on standard lifestyle assessment tools from prior pediatric research (Florence et al., 2008; Paruthi et al., 2016; Chaput et al., 2020). The tool was pretested among 15 children in a neighboring district (Pulwama) and refined for clarity. It included the following components:

1. Socio-demographic Profile

Information regarding age, sex, type of school, grade level, parental education, occupation, and family income was collected to describe the sample and control for confounding factors.

2. Dietary Habits

Diet quality was assessed using a **10-point Diet Quality Score**, adapted from the Healthy Eating Index for Children (HEIC) and localized for Kashmiri dietary practices. Each participant's intake of fruits, vegetables, dairy, whole grains, proteins, and frequency of junk or fried food consumption was recorded. Higher scores indicated healthier dietary patterns.

3. Physical Activity

Daily physical activity was recorded as the average number of minutes per day engaged in **moderate to vigorous physical activity (MVPA)**, including sports, active play, and walking to school. Data were obtained through parental report and teacher corroboration. The activity score was compared with the **World Health Organization (2020)** guideline of at least **60 minutes/day** of moderate-to-vigorous activity for children.

4. Screen Exposure

Average daily screen time was measured in hours per day across all devices (television, smartphones, tablets, and computers). The measure followed the **American Academy of Pediatrics (AAP, 2016a, 2016b)** recommendation of <2 hours/day of recreational screen use for school-aged children.

5. Sleep Duration

Sleep habits were assessed by average hours of night-time sleep on weekdays and weekends. The mean was compared with the **American Academy of Sleep Medicine (Paruthi et al., 2016)** recommended range of **9–12 hours/night** for optimal child health.

6. Composite Lifestyle Score

A **composite lifestyle score (0–100)** was derived by combining standardized subscores for diet, physical activity, screen time (reverse coded), and sleep duration. A higher composite score indicated a healthier overall lifestyle. Participants were subsequently classified into **Healthy** and **Unhealthy** lifestyle groups based on the **median split** of this score.

7. Health Outcome Measures

8. Body Mass Index (BMI):

Measured using a calibrated portable stadiometer and digital weighing scale, following **WHO Child Growth Standards (2007)**. BMI was computed as weight (kg)/height² (m²).

9. Mental Health:

Evaluated using a **modified Strengths and Difficulties Questionnaire (SDQ)** short version, validated for Indian children, where higher scores indicate greater emotional or behavioral difficulties.

10. Academic Performance:

Obtained as the average of the last two term examination percentages from school records, serving as an objective proxy for cognitive and scholastic performance.

2.6. Data Collection Procedure

Data collection was conducted onsite at the participating schools by a trained research team consisting of postgraduate medical students and psychologists. Each interview lasted approximately 25 minutes and was conducted in a child-friendly setting to minimize response bias. Anthropometric measurements were taken privately and recorded in duplicate. The questionnaire was administered in both English and Urdu, depending on the child's comprehension, and responses were verified with parental input where necessary.

2.7. Data Management and Statistical Analysis

Data were entered into Microsoft Excel and analyzed using **IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA)**. Continuous variables were summarized as means and standard deviations (mean $\pm$ SD), while categorical variables were expressed as frequencies and percentages. Normality of data distribution was assessed using the **Shapiro–Wilk test**. Group comparisons between Healthy and Unhealthy lifestyle categories were performed using the **independent samples t-test** for continuous variables and **Chi-square test (χ^2)** for categorical variables. Associations between composite lifestyle score and health outcomes (BMI, mental health score, and academic performance) were examined using **Pearson's correlation coefficient**. To determine the independent effect of lifestyle on BMI, a **multiple linear regression model** was constructed with BMI as the dependent variable and lifestyle score, age, and gender as predictors. Statistical significance was set at $p < 0.05$ for all tests.

2.8. Quality Control

To ensure data reliability, all instruments were pretested and standardized prior to fieldwork. The research team underwent inter-rater reliability training ($\kappa = 0.87$ for categorical variables, ICC = 0.91 for continuous measures). Double data entry and random verification (10% of entries) were performed to minimize transcription errors. Regular supervision and random re-interviews ($n = 10$) ensured data consistency.

3. Results

A total of 100 school-going children aged between 6 and 12 years (mean age = 9.21 ± 1.91 years) were included in the study. The sample comprised an equal distribution of males and females. The overall mean diet quality score was 6.08 ± 1.42 on a 10-point scale, reflecting moderate dietary habits across the sample. The average duration of physical activity was 60.22 ± 25.73 minutes per day, while the mean screen exposure was $3.15 \pm$

1.01 hours per day. The participants reported a mean sleep duration of 8.99 ± 0.87 hours per night. The composite lifestyle score, representing an overall index of diet, activity, sleep, and screen habits, averaged 43.51 ± 9.73 on a 100-point scale, with scores ranging from 20.08 to 73.95. The mean body mass index (BMI) for the cohort was 16.77 ± 2.42 kg/m², the average mental health score was 14.54 ± 3.28 (out of 40, where higher scores indicate greater emotional or behavioral difficulties), and the mean academic performance was $72.61 \pm 7.22\%$. The descriptive characteristics of the study population are summarized in

Table 1.

Table 1: Descriptive characteristics of study participants

Variable	Mean	SD	Median	Min	Max
Age (years)	9.21	1.91	9.00	6.00	12.00
Diet score (0–10)	6.08	1.42	6.12	3.12	10.00
Physical (min/day)	60.22	25.73	61.68	0.00	156.32
Variable	Mean	SD	Median	Min	Max
Screen (hrs/day)	3.15	1.01	3.10	0.66	5.63
Sleep (hrs/night)	8.99	0.87	8.95	7.16	11.46

Lifestyle score (0–100)	43.51	9.73	42.50	20.08	73.95
BMI (kg/m ²)	16.77	2.42	16.74	12.00	22.47
Mental score (0–40)	14.54	3.28	14.64	6.19	22.58
Academic (%)	72.61	7.22	72.99	57.27	89.03

For analytical comparison, participants were categorized into Healthy ($n = 50$) and Unhealthy ($n = 50$) lifestyle groups based on the median value of the composite lifestyle score. As presented in Table 2, children in the Healthy group demonstrated significantly higher diet scores (6.78 ± 1.14 vs 5.38 ± 1.34 ; $t = 5.67$, $p < 0.0001$) and engaged in greater daily physical activity (68.51 ± 24.15 minutes vs 51.94 ± 22.64 minutes; $t = 3.38$, $p = 0.001$). In contrast, screen exposure was markedly lower among Healthy children (2.88 ± 0.91 hours/day) compared with those in the Unhealthy group (3.42 ± 1.02 hours/day; $t = -2.77$, $p = 0.0067$). Similarly, mean sleep duration was significantly higher among children with healthy lifestyles (9.36 ± 0.78 hours vs 8.62 ± 0.82 hours; $t = 4.69$, $p < 0.0001$). The mean composite lifestyle score differed substantially between groups, as expected (50.89 ± 8.07 vs 36.13 ± 6.21 ; $t = 11.66$, $p < 0.0001$), confirming clear behavioral contrast between the two subpopulations. Health and performance outcomes varied across the groups. Although mean BMI was lower among the Healthy children (16.42 ± 2.28 kg/m²) compared to those with Unhealthy habits (17.12 ± 2.56 kg/m²), this difference did not reach statistical significance ($t = -1.46$, $p = 0.148$). Similarly, mean mental health scores were slightly more favorable in the Healthy group (13.97 ± 3.01) than in the Unhealthy group (15.11 ± 3.42), but the difference was only marginally significant ($t = -1.75$, $p = 0.084$). In contrast, academic performance was notably better in the Healthy group, with mean marks of 75.45

$\pm 6.20\%$ compared with $69.78 \pm 7.01\%$ among Unhealthy children ($t = 4.26$, $p < 0.0001$). These findings collectively suggest that adherence to a healthier lifestyle pattern was associated with superior academic outcomes and trends toward improved physical and psychological health (Table 2).

Table 2: Comparison of Healthy vs. Unhealthy lifestyle groups

Variable	Healthy mean	Unhealthy mean	t statistic	p value
Diet score	6.78	5.38	5.670	<0.0001
Physical (min/day)	68.51	51.94	3.384	0.0010
Screen (hrs/day)	2.88	3.42	-2.772	0.0067
Sleep (hrs/night)	9.36	8.62	4.690	<0.0001
Lifestyle score	50.89	36.13	11.662	<0.0001
BMI (kg/m ²)	16.42	17.12	-1.456	0.1485
Mental score	13.97	15.11	-1.748	0.0837
Academic (%)	75.45	69.78	4.256	<0.0001

No participant in the present sample met the BMI threshold for overweight or obesity (BMI ≥ 25 kg/m²), reflecting the relatively lean anthropometric profile of the cohort. Consequently, categorical comparison for overweight prevalence between lifestyle groups was not significant ($\chi^2 = 0.00$, $p = 1.00$), as shown in Table 3. However, continuous variable analyses provided more nuanced associations between lifestyle and health outcomes.

Table 3: Overweight prevalence across lifestyle groups

Group	Not overweight	Overweight	Total
Healthy	50	0	50
Unhealthy	50	0	50
Total	100	0	100

Pearson's correlation analysis demonstrated a significant negative correlation between lifestyle score and BMI ($r = -0.269$, $p = 0.0068$), indicating that healthier lifestyle patterns were associated with lower body mass indices. A positive and moderately strong correlation was observed between lifestyle score and academic performance ($r = 0.541$, $p < 0.0001$), suggesting that children with healthier habits tended to achieve higher academic scores. The correlation between lifestyle score and mental health index was negative ($r = -0.173$) but not statistically significant ($p = 0.0847$), implying a non-conclusive trend toward fewer emotional or behavioral difficulties among children with better lifestyle practices. These findings are summarized in **Table 4**.

Table 4: Correlation between lifestyle score and outcomes

Outcome	Pearson r	p value
BMI	-0.269	0.0068
Mental score	-0.173	0.0847
Academic (%)	0.541	<0.0001

To further assess the independent effect of lifestyle behaviors on BMI, a multivariable linear regression model was constructed with BMI as the dependent variable and lifestyle score, age, and gender as predictors. The overall model accounted for 8.8% of the variance in BMI ($R^2 = 0.088$). Lifestyle score emerged as an independent predictor of BMI ($\beta = -0.0664$, $p = 0.0074$), even after adjusting for age ($p = 0.897$) and sex ($p = 0.203$). Each one- point increase in the lifestyle score corresponded to an estimated 0.066 kg/m² decrease in BMI. The model summary is presented in **Table 5**.

Table 5: Multivariable regression model predicting BMI

Predictor	β (coef)	p value
Constant	19.4315	< 0.0001
Lifestyle score	-0.0664	0.0074
Age (years)	-0.0160	0.8969
Male (1=yes)	0.6139	0.2033

Overall, the findings of this study demonstrate that healthier lifestyle behaviors including balanced diet, regular physical activity, adequate sleep, and limited screen exposure are significantly associated with improved academic performance and lower BMI among children. Although associations with mental health did not reach statistical significance, the observed trends suggest potential psychosocial benefits of adopting healthy daily routines. These patterns collectively highlight the critical role of lifestyle behaviors in shaping the overall health and well-being of school-aged children.

Discussion

This cross-sectional study of 100 school-aged children (6–12 years) found that healthier lifestyle patterns characterized by higher diet quality, greater daily physical activity, longer sleep duration, and lower screen exposure were associated with superior academic performance and lower BMI. Although between-group differences in BMI and mental health scores did not achieve conventional statistical significance, point estimates consistently favored the healthier lifestyle subgroup. These results align with a large evidence base indicating that modifiable behaviors across the 24-hour day meaningfully influence pediatric physical and cognitive outcomes (Chaput et al., 2020; Paruthi et al., 2016; American Academy of Pediatrics, 2016a, 2016b).

Our finding of higher academic scores in the healthier lifestyle group is consistent with multiple systematic reviews indicating that school-age physical activity (PA) particularly at moderate-to-vigorous intensity supports cognition and academic performance through improvements in executive function, attention, and on-task behavior (James et al., 2023; Latino et al., 2023; Rasberry et al., 2011). A recent review reported that

≥ 90 minutes/week of PA is associated with better academic outcomes, with stronger effects seen for moderate-to-vigorous PA (James et al., 2023). Mechanistically, PA promotes neurogenesis, synaptic plasticity, cerebral perfusion, and neurotrophin signaling (e.g., BDNF), which together may enhance memory consolidation and executive control domains that underpin school performance (Latino et al., 2023). From a clinical practice standpoint, our cohort's mean PA (~ 60 min/day) sits near the WHO recommendation of an average ≥ 60 minutes/day of moderate-to-vigorous, mostly aerobic activity for children and adolescents (Chaput et al., 2020; World Health Organization, 2020), suggesting that incremental increases especially among lower-active children could yield measurable academic benefits.

Children in the healthier lifestyle group reported lower screen time and higher academic scores. The literature generally supports an adverse association between high screen exposure and adiposity, though effect sizes vary and heterogeneity is common. Several meta-analyses link greater screen time with higher odds of overweight/obesity in youth (Fang et al., 2019; Haghjoo et al., 2022), while more recent work suggests nuance: a 2023 meta-analysis found no overall association with central obesity but did observe a higher waist circumference (+1.2 cm) in high-screen users (Ghasemirad et al., 2023). Importantly, screen exposure often co-occurs with reduced sleep and physical activity and with ultra-processed snacking, complicating causal inference. Our correlation between a healthier composite lifestyle and lower BMI is consistent with evidence that combinations of high screen time and low PA confer the greatest obesity risk (Nagata et al., 2023). For learning outcomes, lower screen exposure may support better academic performance indirectly via improved sleep timing/quality and directly via reduced attentional fragmentation (Adelantado-Renau et al., 2019). Clinical guidance has evolved away from rigid “time caps” toward family media plans emphasizing content quality, co-viewing, and balanced routines (AAP, 2016a, 2016b; AAP, 2025). Nonetheless, for school-aged children, pragmatic limits that preserve sufficient sleep, PA, homework, and in-person socialization remain warranted (AAP, 2016b; AAP, 2025).

In our sample, healthier lifestyle patterns included longer sleep duration, and academic scores were higher in this subgroup. This coheres with meta-analytical evidence linking short sleep with subsequent weight gain and obesity in children and adolescents (Miller et al., 2018; Deng et al., 2021; Han et al., 2022) and with systematic reviews showing positive relationships between adequate sleep, behavior, and academic performance (Musshafen et al., 2021; Sivakumar et al., 2022). Biologically, curtailed sleep alters leptin/ghrelin balance, increases hedonic food drive, impairs glucose metabolism, and elevates evening cortisol pathways that promote positive energy balance and adiposity. Sleep restriction also degrades attention, working memory, and mood regulation, plausibly translating to lower classroom engagement and scores. Authoritative recommendations from the American Academy of Sleep Medicine endorsed by the AAP advise 9–12 hours/night for 6–12-year-olds to promote optimal health (Paruthi et al., 2016). Our observed average (~ 9 hours) suggests that many children may be at the lower bound of the recommended range; policies supporting age-appropriate bedtimes, consistent sleep schedules, and evening media hygiene (e.g., device curfews) are evidence-informed levers to improve both health and learning (Paruthi et al., 2016; AAP, 2016b).

Children in the healthier lifestyle group also reported better diet quality, paralleling evidence that nutrient-dense patterns (e.g., higher fruits/vegetables, whole grains, lean proteins; lower ultra-processed foods and sugar-sweetened beverages) associate with higher academic achievement (Florence et al., 2008; Rajan & Nandini, 2024). Mechanisms likely include stabilized glycemia, micronutrient sufficiency (iron, iodine, zinc, B-vitamins, omega-3 fatty acids), and reduced inflammatory load, all of which support neurocognitive development and school readiness. School-based nutrition policies (healthy canteens, breakfast programs) and family-level supports (meal

planning, limiting energy-dense snacks) thus remain central to comprehensive child-health strategies. Our results echo the 24-hour movement paradigm: behaviors are interdependent, and benefits accrue when multiple domains improve concurrently. For example, high screen time often displaces PA and delays bedtimes; conversely, regular PA facilitates sleep onset and reduces stress-related snacking. Evidence indicates that combined profiles low PA plus high screen time are particularly obesogenic (Nagata et al., 2023). Guidelines from the WHO and AAP encourage integrated targets adequate PA, limited sedentary time (especially recreational screen time), sufficient sleep, and supportive family routines rather than siloed prescriptions (Chaput et al., 2020; AAP, 2016a, 2016b, 2025). Clinicians should incorporate brief lifestyle screening into routine pediatric care, asking about daily PA, recreational screen hours, bedtime/risetime, and diet quality, and then co-creating specific, feasible goals (e.g., “walk/play 20 more minutes after school,” “no devices after 8:30 pm,” “add a fruit/vegetable to each meal”). Schools can protect daily PA (active recess and PE), limit in-class sedentary screen exposure, and reinforce sleep-friendly schedules (later start times for older students). Communities can support safe active transport and accessible recreational spaces. Because socioeconomic factors shape lifestyle opportunities, equity-oriented interventions (healthy school meals, safe play spaces, family education) are essential.

Strengths include a comprehensive lifestyle assessment and triangulation of outcomes (BMI, academic performance, mental health). However, the cross-sectional design precludes causal inference; reverse causality (e.g., higher BMI leading to reduced PA) and residual confounding (e.g., socioeconomic position, parental education) remain possible. Self-report for screen time, diet, and sleep is prone to recall and social-desirability bias; objective measures (accelerometry, device-use logs, sleep actigraphy) and age/sex-specific BMI z-scores would strengthen future work. Finally, although our mental health findings trended favorably, the study may have been underpowered for that outcome; validated multi-informant measures could clarify effect sizes.

Conclusions

In conclusion, healthier daily routines across diet, PA, sleep, and media use are associated with better academic performance and lower BMI in school-aged children. These findings are congruent with international guidelines and contemporary meta-analyses and underscore the value of multi-component strategies that help families and schools shift several lifestyle levers simultaneously. Future longitudinal and interventional studies using objective measures and equity-informed designs are warranted to delineate causal pathways, optimize intervention timing, and maximize benefits for both health and learning.

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