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ASSOCIATION OF BREAKFAST SKIPPING WITH BODY MASS INDEX AND CONCENTRATION LEVELS AMONG ADOLESCENTS: A SCHOOL-BASED CROSS-SECTIONAL STUDY IN CHENNAI

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Abstract

Background:

Breakfast is a critical meal for adolescents, influencing both physical health and cognitive development. However, increasing trends of breakfast skipping, particularly in urban school populations, have raised concerns regarding its long-term health impacts.

Objectives:

To evaluate the association between breakfast skipping, body mass index (BMI), and concentration levels among adolescents in secondary schools in Chennai.

Methods:

A cross-sectional observational study was conducted among 360 adolescents aged 13–18 years, selected through stratified random sampling from three secondary schools in Chennai. Data were collected using a structured questionnaire, anthropometric measurements, and the d2 Test of Attention. Participants were categorized into regular eaters (≥5 days/week), occasional skippers (2–4 days/week), and frequent skippers (≤1 day/week). Statistical analysis included ANOVA, Pearson's correlation, and multiple linear regression adjusted for age, gender, SES, physical activity, screen time, and sleep duration.

Results:

The mean BMI increased significantly across breakfast skipping categories ($p < 0.001$), with frequent skippers showing the highest mean BMI (24.6 ± 3.4 kg/m²). Concentration scores declined progressively from regular eaters (317.5 ± 28.6) to frequent skippers (256.8 ± 35.7) ($p < 0.001$). Pearson's correlation showed a moderate negative association between breakfast frequency and BMI ($r = –0.38$) and a positive association with concentration ($r = +0.45$) (both $p < 0.001$). In multivariable regression, breakfast skipping independently predicted higher BMI ($\beta = +1.74$, $p < 0.001$) and lower concentration scores ($\beta = –27.8$, $p < 0.001$), even after adjusting for lifestyle factors.

Conclusion:

Breakfast skipping is significantly associated with increased BMI and decreased concentration levels among adolescents. These findings underscore the importance of regular breakfast consumption in promoting adolescent health and academic performance. School-based interventions and parental engagement strategies are recommended to address this modifiable behavior.

Keywords: Adolescents, Breakfast Skipping, BMI, Concentration, Cognitive Performance, Urban Schools, Nutrition, d2 Test

INTRODUCTION

Breakfast habits have been closely linked to nutritional status, body weight, and academic performance among children and adolescents. Adolescence, in particular, is a dynamic period marked by rapid physical growth, cognitive development, and evolving lifestyle behaviors. During this transitional stage, dietary patterns often undergo substantial change, influenced by peer dynamics, academic stressors, and growing independence. Among these dietary behaviors, breakfast consumption has garnered specific attention due to its potential impact on both physical well-being and cognitive outcomes (1).

Breakfast is considered essential for initiating metabolic processes, sustaining energy levels, and supporting optimal brain function. Despite this, skipping breakfast is a common behavior among adolescents, particularly in urban environments. Factors such as time constraints, irregular sleep patterns, lack of appetite, and body image concerns contribute to this trend(2,3).

Emerging research has linked breakfast skipping to adverse health outcomes. Studies indicate that adolescents who regularly skip breakfast are at a higher risk of developing overweight and obesity, likely due to disrupted energy balance and increased caloric intake later in the day (3,4).

Additionally, breakfast consumption has been positively associated with cognitive functions such as attention, memory, and academic performance. In contrast, skipping breakfast has been shown to impair these abilities, potentially hindering learning and concentration in school settings(5,6).

While global data highlight these associations, there is a relative paucity of evidence from the Indian context—particularly studies that explore the combined effect of breakfast habits on nutritional status and cognitive outcomes in adolescents. This gap is especially relevant in urban school populations, where lifestyle transitions are more pronounced.

This study was conducted to assess the association between breakfast skipping, body mass index (BMI), and concentration levels among adolescents attending secondary schools in Chennai. The findings aim to support the development of targeted school-based nutrition programs and promote healthier eating habits among Indian youth.

Methods

Study Design

This cross-sectional observational study aimed to assess the association between breakfast skipping, body mass index (BMI), and concentration levels among adolescents. The study design was selected to capture a snapshot of dietary behaviors and cognitive outcomes within a school-based adolescent population.

Study Setting and Duration

The study was conducted in three co-educational secondary schools (two public and one private) in Chennai, India. Data collection occurred over a period of three months from [start month] to [end month].

Study Population

The target population consisted of adolescents aged 13–18 years, enrolled in grades 8 through 12. Participants were selected using stratified random sampling to ensure representation across different grade levels, genders, and socioeconomic status (SES). This method aimed to enhance the generalizability of the findings to the broader adolescent population**.**

Sample Size

The sample size was calculated using Cochran's formula for cross-sectional studies. Assuming a 95% confidence level, a 5% margin of error, and an anticipated breakfast skipping prevalence of 30%, the required minimum sample size was 323. After accounting for a 10% non-response rate, the final sample size was adjusted to 360 participants.

Inclusion Criteria

- Adolescents aged 13–18 years.
- Enrollment in one of the participating schools.
- Parental consent and adolescent assent obtained.

Exclusion Criteria

- Adolescents with known metabolic or neurological disorders.
- Adolescents on medications known to affect appetite or cognitive function.
- Students absent on the day of assessment.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of [Institution Name]. Informed consent was obtained from parents or guardians, and assent was obtained from all participating adolescents prior to study inclusion. Participants were assured of confidentiality, and participation was voluntary, with the option to withdraw at any time.

Recruitment and Consent Process

After obtaining permission from the school administration, eligible students were briefed about the study objectives and procedures. Participant information sheets outlining the purpose and requirements were distributed to students along with the consent and assent forms. Recruitment commenced one week after document collection.

Data Collection Tools

Data were collected using the following tools:

1. Structured Questionnaire: A pre-tested, structured questionnaire was administered to gather information on:
    - Demographic details (age, sex, grade).
    - Socioeconomic status, determined using a modified Kuppuswamy scale.
    - Breakfast consumption habits (frequency, timing, reasons for skipping).
    - Lifestyle factors (physical activity, screen time, sleep duration).
2. Anthropometric Measurements:
    - Height: Measured using a portable stadiometer to the nearest 0.1 cm.
    - Weight: Measured using a calibrated digital scale to the nearest 0.1 kg.
    - BMI: Calculated as weight in kilograms divided by height in meters squared (kg/m²). BMI values were classified using WHO age- and sex-specific percentiles.
3. Concentration Assessment: The d2 Test of Attention, a standardized psychometric tool, was used to assess attention and processing speed, providing a concentration performance index. Testing was conducted in a quiet, distraction-free classroom under the supervision of a trained psychologist.

Breakfast Skipping Categories

Participants were classified into three categories based on their self-reported breakfast consumption frequency:

- Regular Breakfast Eaters: Consumed breakfast ≥5 days per week.
- Occasional Skippers: Consumed breakfast 2–4 days per week.
- Frequent Skippers: Consumed breakfast ≤1 day per week.

Data Collection Schedule

The data collection was organized as follows:

- Day 1: Administration of the demographic and lifestyle questionnaire.
- Day 2: Anthropometric measurements (height, weight, BMI).
- Day 3: Administration of the d2 Test of Attention, conducted in groups of 10–15 students.

Quality Control

To ensure the accuracy and reliability of data:

- All field investigators underwent thorough training on data collection procedures.
- Instruments were calibrated daily before use.
- A random 10% of data entries were re-checked for consistency and accuracy to minimize errors in data entry.

Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. The following statistical methods were used:

1. Descriptive Statistics: Mean, standard deviation, frequency, and percentage were calculated to summarize the characteristics of the participants.
2. Comparative Analysis:
    - ANOVA was used to assess differences in BMI and concentration scores across breakfast consumption categories (regular eaters, occasional skippers, frequent skippers).
3. Correlation Analysis: Pearson correlation was used to evaluate the relationship between breakfast frequency and both BMI and concentration scores.
4. Multiple Linear Regression: Adjusted for confounding variables (age, gender, physical activity, and socioeconomic status), multiple linear regression models were used to assess the independent associations between breakfast skipping and the outcomes (BMI and concentration).

Statistical Significance

A p-value of < 0.05 was considered statistically significant for all analyses.

RESULTS

Table 1: Demographic Characteristics of Study Participants (N = 360)

Variable	Frequency (n)	Percentage (%)
Age (years)		
13–14	96	26.7
15–16	142	39.4
17–18	122	33.9
Gender		
Male	188	52.2
Female	172	47.8
Socioeconomic Status		
Upper	60	16.7
Middle	210	58.3
Lower	90	25.0

This table 1 summarizes the demographic profile of the 360 adolescent participants. The mean age was 15.5 years (SD ± 1.7), with the majority falling in the 15–16-year age range (39.4%). Gender distribution was nearly balanced, with a slight male predominance (52.2%). Regarding socioeconomic status (SES), over half the participants (58.3%) belonged to the middle-income group based on the modified Kuppuswamy scale, while 16.7% and 25% were from upper and lower SES, respectively. These findings ensure a diverse sample that enhances the generalizability of the study outcomes to urban adolescent populations.

Table 2: Distribution of Participants Based on Breakfast Consumption Pattern

Breakfast Category	Frequency (n)	Percentage (%)
Regular (≥5 days/week)	152	42.2
Occasional (2–4 days/week)	128	35.6
Frequent Skippers (≤1 day/week)	80	22.2

Table 2 shows Among the adolescents surveyed, 42.2% were classified as regular breakfast consumers (≥5 days/week), 35.6% were occasional skippers (2–4 days/week), and 22.2% were frequent skippers (≤1 day/week). These results indicate that over half of the adolescents had irregular breakfast habits, aligning with global trends of declining breakfast frequency among school-aged youth. This distribution allows for meaningful group comparisons across breakfast consumption patterns in relation to BMI and concentration.

Table 3: Mean BMI According to Breakfast Consumption Pattern

Breakfast Category	Mean BMI (kg/m²)	SD	p-value (ANOVA)
Regular eaters	21.4	2.8	
Occasional skippers	23.2	3.0	
Frequent skippers	24.6	3.4	< **0.001**

Table 3 shows the analysis that revealed a statistically significant increase in mean BMI across breakfast categories ($p < 0.001$, ANOVA). Regular eaters had the lowest mean BMI (21.4 ± 2.8 kg/m²), followed by occasional skippers (23.2 ± 3.0 kg/m²), and the highest mean BMI was observed in frequent skippers (24.6 ± 3.4 kg/m²). The increasing trend in BMI with higher frequency of breakfast skipping suggests a potential role of regular breakfast consumption in maintaining healthy weight in adolescents. These findings support existing literature that associates meal skipping with unhealthy weight gain, possibly due to compensatory overeating or poor metabolic regulation.

Table 4: Concentration Scores (d2 Test) by Breakfast Pattern

Breakfast Category	Mean Concentration Score	SD	p-value (ANOVA)
Regular eaters	317.5	28.6	
Occasional skippers	289.4	32.2	
Frequent skippers	256.8	35.7	< **0.001**

Cognitive performance, as measured by the d2 Test of Attention, showed a statistically significant decline with increasing frequency of breakfast skipping ($p < 0.001$, ANOVA). Regular breakfast consumers achieved the highest mean concentration score (317.5 ± 28.6), compared to 289.4 ± 32.2 in occasional skippers, and 256.8 ± 35.7 in frequent skippers. This inverse relationship suggests that breakfast intake may enhance attention and processing speed, likely through stabilization of glucose metabolism and improved neural efficiency in

cognitive domains. The findings corroborate evidence from neurocognitive studies linking breakfast with short-term memory, vigilance, and mental performance in children and adolescents.

Table 5: Correlation Between Breakfast Frequency and Outcome Variables

Variable	Pearson's r	p-value
Breakfast frequency vs BMI	-0.38	< 0.001
Breakfast frequency vs Concentration Score	+0.45	< 0.001

Table 5 shows Pearson correlation analysis demonstrated a moderate, statistically significant negative correlation between breakfast frequency and BMI ($r = -0.38$, $p < 0.001$), and a positive correlation between breakfast frequency and concentration score ($r = +0.45$, $p < 0.001$). These coefficients suggest that adolescents who skipped breakfast more frequently were not only more likely to have a higher BMI but also demonstrated lower concentration ability. The strength and direction of these correlations reinforce the protective role of regular breakfast consumption in both physiological and cognitive health domains.

Table 6: Multivariable Regression Analysis Adjusted for Age, Gender, SES

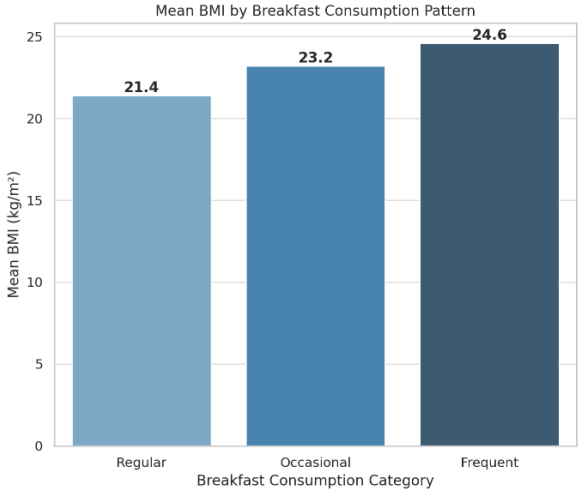
Dependent Variable	Predictor	β Coefficient	95% CI	p-value
BMI	Breakfast Skipping	+1.74	1.18–2.30	< 0.001
	Physical Inactivity	+0.97	0.41–1.53	0.001
	Sleep < 6 hours/day	+0.89	0.22–1.56	0.010
Concentration	Breakfast Skipping	-27.8	-35.1 to -20.4	< 0.001
	Screen Time > 4 hrs/day	-14.3	-21.5 to -7.1	< 0.001
	Sleep < 6 hours/day	-9.8	-17.1 to -2.5	0.008

Regression models were developed to assess the independent effects of breakfast skipping on BMI and concentration, adjusting for confounding variables such as age, gender, socioeconomic status, physical activity, screen time, and sleep duration.

- **For BMI**, breakfast skipping emerged as a significant predictor ($\beta = +1.74$, 95% CI: 1.18–2.30, $p < 0.001$), alongside physical inactivity ($\beta = +0.97$, $p = 0.001$) and short sleep duration ($\beta = +0.89$, $p = 0.010$).
- **For concentration**, breakfast skipping ($\beta = -27.8$, 95% CI: -35.1 to -20.4, $p < 0.001$) and high screen time ($\beta = -14.3$, $p < 0.001$) significantly predicted lower scores.

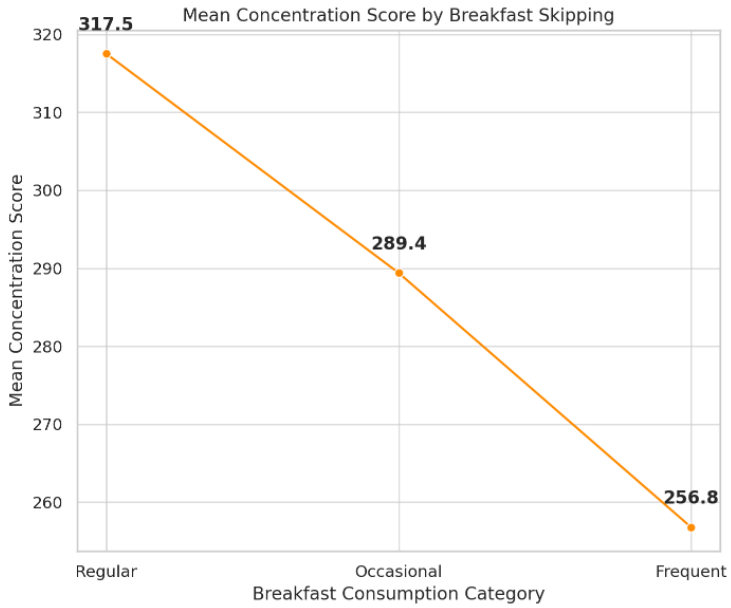
These results indicate that even after adjusting for lifestyle factors, breakfast skipping remains a strong independent determinant of adverse BMI and cognitive outcomes. The strength of associations underscores the multifactorial nature of adolescent health behaviors.

Figure 1



This bar chart visually illustrates the progressive increase in mean BMI from regular to frequent breakfast skippers. The lowest BMI (21.4 kg/m²) was observed among regular eaters, while the highest (24.6 kg/m²) was seen in those skipping breakfast most frequently. Data labels enhance interpretability and confirm the statistical significance observed in Table 3. The linear trend strongly suggests a dose-response effect, where reduced frequency of breakfast consumption correlates with higher body mass index. This graph supports dietary interventions aimed at improving breakfast habits to mitigate adolescent obesity.

Figure 2:



This line graph presents a clear downward trajectory in concentration performance with increasing breakfast skipping. Regular eaters scored a mean of 317.5, compared to 256.8 among frequent skippers—a 19.1% decline. The consistent decline shown in the line plot, combined with data labels, accentuates the cognitive disadvantage associated with irregular breakfast intake. The visualization echoes the findings in Table 4 and provides a compelling case for promoting morning meals as a cognitive enhancer in school settings.

DISCUSSION

This cross-sectional study evaluated the association between breakfast consumption frequency, body mass index (BMI), and cognitive performance among adolescents attending secondary schools in Chennai. The results demonstrate significant and clinically meaningful relationships, supporting the hypothesis that regular breakfast consumption is beneficial to both physical health and attention-related cognitive performance during adolescence.

Breakfast Skipping and BMI

Our study revealed a statistically significant upward trend in BMI with decreasing breakfast frequency ($p < 0.001$), with regular eaters having the lowest mean BMI (21.4 ± 2.8 kg/m²), and frequent skippers the highest (24.6 ± 3.4 kg/m²). This gradient suggests a dose-response relationship, echoing findings from a 2023 meta-analysis of 40 studies involving 323,244 participants, which showed increased odds of both overweight (OR = 1.37) and obesity (OR = 1.51) among breakfast skippers (7). Another systematic review encompassing 43 studies confirmed that breakfast skipping is independently associated with greater adiposity and cardiometabolic risk, regardless of total caloric intake or physical activity levels (3).

Our multivariable regression analysis supports these findings by identifying breakfast skipping as an independent predictor of increased BMI ($\beta = +1.74$, 95% CI: 1.18–2.30; $p < 0.001$), even after adjusting for confounders such as age, gender, socioeconomic status (SES), physical inactivity, and sleep duration. These results reinforce the notion that breakfast is not only a marker of a healthier dietary pattern but may also play a physiological role in regulating energy balance and metabolic function.

Breakfast Consumption and Cognitive Performance

The cognitive benefits of breakfast were also evident in our study, with attention scores (measured by the d2 Test) declining significantly across breakfast categories ($p < 0.001$). Regular breakfast consumers had a mean concentration score of 317.5, whereas frequent skippers scored just 256.8—a reduction of 19.1%. A 2021 study from Chile similarly found that adolescents who regularly consumed breakfast, especially before cognitive tasks, performed significantly better in domains such as attention and memory. This association was particularly pronounced among overweight/obese adolescents(8).

Moreover, multivariable regression analysis in our cohort showed that breakfast skipping independently reduced concentration scores by an average of 27.8 points (95% CI: -35.1 to -20.4; $p < 0.001$), after adjusting for other cognitive-affecting variables like screen time and sleep deprivation. These findings align with broader literature

demonstrating that regular breakfast intake is associated with improved academic achievement, better school attendance, and enhanced classroom engagement(9,10).

Correlation and Direction of Associations

Pearson's correlation analysis in our study revealed a moderate inverse association between breakfast frequency and BMI ($r = -0.38$, $p < 0.001$), and a moderate positive association with concentration scores ($r = +0.45$, $p < 0.001$). These bidirectional correlations are consistent with earlier reports showing that regular breakfast consumption is positively linked to healthier body weight and better cognitive outcomes(7,8,10).

Public Health Implications

In our cohort, more than half of the adolescents reported skipping breakfast at least occasionally (57.8%), reflecting global patterns. The CDC's 2023 Youth Risk Behavior Survey in the United States reported that 72.6% of high school students missed breakfast at least once in the past week, and nearly 18% skipped breakfast daily. Notably, breakfast skipping was associated not only with lower academic performance but also with adverse mental health indicators such as increased sadness or hopelessness (11). The prevalence of this behavior is often higher in urban areas and among adolescents from lower socioeconomic backgrounds(12).

In India, similar patterns have been observed, with a high frequency of breakfast skipping reported among hostel-dwelling and late-sleeping adolescents. This behavior has been linked to both higher BMI and reduced cognitive scores, underscoring the dual risk posed by meal skipping (9). These findings emphasize the urgent need for school-based nutrition promotion strategies and parental awareness campaigns, particularly in urban settings where lifestyle disruptions are more common.

Strengths and Limitations

A key strength of this study is its relatively large and socio-demographically diverse sample of 360 adolescents, allowing for greater generalizability within urban populations. The use of standardized tools like the d2 Test and multivariable models adjusted for relevant confounders adds robustness to the findings.

However, several limitations should be acknowledged. The cross-sectional design limits the ability to infer causality. Breakfast frequency was self-reported and may be prone to recall bias. Although adjustments were made for major lifestyle confounders such as sleep and screen time, residual confounding cannot be entirely ruled out.

CONCLUSION

This study highlights the significant associations between breakfast consumption patterns, body mass index (BMI), and cognitive performance among urban adolescents. Regular breakfast intake was associated with healthier BMI levels and improved concentration scores, while skipping breakfast emerged as a strong independent predictor of both increased adiposity and reduced cognitive function. These findings reinforce the dual role of breakfast in supporting physiological and neurocognitive health during adolescence.

Given the high prevalence of breakfast skipping observed, particularly in urban and high-stress academic settings, there is an urgent need for targeted school-based nutritional interventions. Promoting consistent and nutritious morning meals—alongside addressing modifiable lifestyle factors such as sleep hygiene and screen time—can serve as an effective strategy to improve adolescent health outcomes. Future longitudinal and interventional studies are warranted to establish causal relationships and to evaluate the long-term impact of breakfast-focused health promotion programs.

REFERENCES

1. Rampersaud GC, Pereira MA, Girard BL, Adams J, Metzl JD. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. J Am Diet Assoc. 2005 May;105(5):743–60; quiz 761–2.
2. Wang K, Niu Y, Lu Z, Duo B, Effah CY, Guan L. The effect of breakfast on childhood obesity: a systematic review and meta-analysis. Front Nutr. 2023 Sep 6;10:1222536.
3. Souza MR, Neves MEA, Gorgulho BM, Souza AM, Nogueira PS, Ferreira MG, et al. Breakfast skipping and cardiometabolic risk factors in adolescents: Systematic review. Rev Saúde Pública. 2021 Dec 1;55:107.
4. Nuru H, Mamang F. Impact of breakfast skipping toward children health: a review. Int J Community Med Public Health. 2015;2(3):201–9.
5. Ayoub DS, Kaur DG, Sharma DV, Shazia D. EFFECT OF SKIPPING BREAKFAST ON DIFFERENT DOMAINS OF COGNITIVE FUNCTION AMONG UNDERGRADUATE MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY.
6. Peña-Jorquera H, Campos-Núñez V, Sadarangani KP, Ferrari G, Jorquera-Aguilera C, Cristi-Montero C. Breakfast: A Crucial Meal for Adolescents' Cognitive Performance According to Their Nutritional Status. The Cogni-Action Project. Nutrients. 2021 Apr 16;13(4):1320.

7. Wang K, Niu Y, Lu Z, Duo B, Effah CY, Guan L. The effect of breakfast on childhood obesity: a systematic review and meta-analysis. Front Nutr. 2023 Sep 6;10:1222536.
8. Peña-Jorquera H, Campos-Núñez V, Sadarangani KP, Ferrari G, Jorquera-Aguilera C, Cristi-Montero C. Breakfast: A Crucial Meal for Adolescents' Cognitive Performance According to Their Nutritional Status. The Cogni-Action Project. Nutrients. 2021 Apr 16;13(4):1320.
9. Khurshid R, Mahmood M, Chaudhry F, Paracha HM, Haq MF. Factors associated with skipping breakfast among Day scholarsand Boarding Adolescent and their effects on their academic performance.
10. Adolphus K, Lawton CL, Dye L. The effects of breakfast on behavior and academic performance in children and adolescents. Front Hum Neurosci [Internet]. 2013 Aug 8 [cited 2025 May 29];7. Available from: https://www.frontiersin.org/journals/human-neuroscience/articles/10.3389/fnhum.2013.00425/full
11. Sliwa SA. Skipping Breakfast and Academic Grades, Persistent Feelings of Sadness or Hopelessness, and School Connectedness Among High School Students — Youth Risk Behavior Survey, United States, 2023. MMWR Suppl [Internet]. 2024 [cited 2025 May 29];73. Available from: https://www.cdc.gov/mmwr/volumes/73/su/su7304a10.htm
12. Lundqvist M, Vogel NE, Levin LÅ. Effects of eating breakfast on children and adolescents: A systematic review of potentially relevant outcomes in economic evaluations. Food Nutr Res. 2019 Sep 12;63:10.29219/fnr.v63.1618.