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Research Article

Nutritional Insights into Adolescence: The Influence of Breakfast Habits on Health and Performance

Divya Jain[1]* and Kiran Grover[2]

[1]*Krishi Viyan Kendra (Ferozepur), Punjab Agricultural University, Ludhiana*

[2]*Department of Food and Nutrition, Punjab Agricultural University, Ludhiana*

***Corresponding Author:** Divya Jain, Krishi Viyan Kendra (Ferozepur), Punjab Agricultural University, Ludhiana.

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Abstract

Breakfast is essential for adolescent growth and development, yet many adolescents frequently skip this critical meal. This cross-sectional study assessed the impact of breakfast consumption frequency on nutritional intake, physical fitness, and academic performance among 90 schoolgirls (aged 16-18) from Ludhiana, Punjab. Participants were grouped into Regular (RBC), Occasional (OBC), and Never (NBC) breakfast consumers (n = 30 each). Dietary intake was recorded using a 3-day 24-hour recall. Physical performance was measured through timed tasks (running, jumping, toe-touching) and cardiovascular responses, while academic performance was assessed using school scores and attendance. Data were analyzed using ANOVA and Chi-square tests ($p \leq 0.05$). Results showed RBCs had significantly higher energy and nutrient intakes, with breakfast contributing 20% of total energy. They also demonstrated better physical performance and lower heart rate elevations post-activity. Academically, RBCs scored higher and had fewer absences than OBCs and NBCs. These findings highlight that regular breakfast consumption positively influences both physical and academic outcomes. Promoting consistent breakfast intake through school-based nutrition programs could support improved health and learning in adolescents.

Keywords: Adolescent Nutrition; Breakfast Frequency; Physical Performance; Academic Achievement; Dietary Intake; School-Based Intervention

Introduction

Adolescence represents a critical period of growth and development marked by significant physiological, psychological, and behavioral changes. Adequate nutrition during this stage is essential to support the increased demands of physical activity, cognitive functioning, and academic performance. Among daily meals, breakfast is widely recognized as the most important, as it breaks the overnight fast and replenishes glucose stores necessary for optimal brain and muscle function.

Breakfast is typically defined as the first meal of the day, consumed before the onset of daily activities, and should contribute at least 10% of the Recommended Dietary Allowance (RDA) for energy. Nutritionally adequate breakfasts generally include foods from at least two major food groups-such as cereals and pulses, dairy products, fruits, or protein sources-to provide a balanced intake of macronutrients and essential micronutrients [1]. Empirical evidence suggests that breakfast contributes approximately 20-30% of total daily energy intake [2,3].

Regular breakfast consumption has been associated with numerous health benefits, including improved weight regulation, better dietary quality, and enhanced mental alertness [4,5]. Several studies have examined the role of breakfast in promoting cognitive and physical performance among children and adolescents [6-9]. However, relatively few studies have specifically focused on adolescent girls, who are uniquely vulnerable to nutritional inadequacies due to menstruation, body image concerns, and academic stress.

Skipping breakfast has also been linked to decreased physical activity, increased fatigue, and poor dietary quality-all of which may impair academic performance and physical efficiency. As diet and physical activity are two modifiable lifestyle factors that influence adolescent health, understanding their relationship with breakfast habits is essential for effective public health planning [10].

Given the rising prevalence of breakfast skipping among Indian adolescents, particularly girls, this study aims to generate insights into how the frequency of breakfast consumption influences both physical fitness and academic achievement. By investigating dietary intake patterns alongside objective measures of physical and academic performance, this study contributes to a more holistic understanding of adolescent health and underscores the importance of promoting regular breakfast habits as part of school-based nutrition interventions.

Materials and Methods

Study population and participant selection

An initial sample of 500 adolescent girls aged 16-18 years was randomly selected from government schools situated in both rural and urban areas of Ludhiana district, Punjab, India, to assess their breakfast consumption patterns. Based on this preliminary screening, a subsample of 90 girls was purposively selected and categorized into three groups (n = 30 each) according to the frequency of breakfast consumption: Regular Breakfast Consumers (RBC), Occasional Breakfast Consumers (OBC), and Never Breakfast Consumers (NBC). Data on participants' age, socio-economic status, and demographic background were collected through a structured interview schedule.

The study protocol was reviewed by the Institutional Review Ethics Board (IREB) of Punjab Agricultural University, Ludhiana, India. As the study involved no invasive procedures, no biological sample collection, and only the use of non-identifiable data, it was exempted from full ethical review in accordance with national ethical guidelines (National Statement on Ethical Conduct in Human Research, Chapter 2.1, Paragraph 2.1.7). Written informed consent was obtained from the parents or legal guardians of all participating minors.

Dietary intake assessment

Dietary intake was assessed using the 24-hour dietary recall method conducted over three consecutive days. Data were analyzed using DietCal software [11], which provided estimates of average daily energy and nutrient intake. Additionally, the contribution of breakfast to total daily nutrient intake was specifically calculated.

Assessment of physical performance

Physical performance was evaluated using three school-based activities:

- Running (100 meters)
- Jumping (25 repetitions)
- Toe-touching (25 repetitions)

For each activity, the following physiological parameters were recorded

- **Time Taken:** Measured using a digital stopwatch to determine the duration required to complete each activity.
- **Heart Rate:** Assessed pre- and post-activity using a wireless heart rate monitor. The device, consisting of a chest-worn transmitter and a wristwatch receiver, recorded heart rate in beats per minute (bpm).
- **Blood Pressure:** Systolic and diastolic blood pressure readings were recorded before and after each physical activity using a standard mercury sphygmomanometer, under the supervision of a licensed physician.

Pulse pressure was calculated using the formula:

As given: Pulse pressure = Systolic pressure - Diastolic pressure (mmHg)

Assessment of academic performance

Academic performance was assessed using two variables

- Percentage of aggregate marks obtained in the most recent academic session.
- Percentage of school absenteeism, calculated from attendance records across 280 school days. The number of absences was documented from official school registers. The percentage of absence was computed, and participants were classified accordingly.

Statistical analysis

Descriptive statistics, including means, standard deviations, and percentage distributions, were computed for all major variables. One-way Analysis of Variance (ANOVA) was applied to evaluate the statistical significance of differences in dietary intake and physical performance across the three breakfast consumption groups. Additionally, the Chi-square test (χ^2) was employed to examine the association between breakfast consumption patterns and physical performance outcomes. All statistical analyses were conducted at a 5% significance level ($p \leq 0.05$).

Results and Discussion

General profile of respondents

The background characteristics of the adolescent girls are summarized. A majority of regular breakfast consumers (RBC; 70%) belonged to the 16-17-year age group. The mean ages were 16.75 years for RBCs, 17.32 years for occasional breakfast consumers (OBCs), and 17.60 years for never breakfast consumers (NBCs). These figures indicate a trend of increased breakfast skipping with advancing age.

This pattern is consistent with previous research indicating that older adolescents are more likely to skip meals due to growing academic pressure, peer influence, and lifestyle changes [13,14]. As adolescents gain autonomy, their dietary behaviors often shift, leading to irregular meal patterns, including breakfast skipping.

Maternal education showed a strong influence on breakfast habits: 53.3% of NBCs had illiterate mothers, compared to 33.3% in OBCs and only 26.47% in RBCs. Similarly, the mean monthly family income was ₹17,383.33 ± 5665.22 for RBCs, ₹13,050 ± 6990.88 for OBCs, and ₹12,173.33 ± 10047.30 for NBCs.

These results underscore the role of socioeconomic and maternal educational status in shaping children's dietary patterns. Educated mothers are more likely to prioritize and ensure regular meals, while higher income allows greater access to varied and nutritious food options. This highlights that both knowledge and resources are key drivers of consistent breakfast consumption.

Dietary intake analysis

Nutrient intake was assessed using a 24-hour dietary recall over three consecutive days. The average daily energy intake was highest among RBCs (1799 ± 323 kcal), followed by OBCs (1406 ± 307 kcal), with breakfast contributing 20% and 18% of daily energy, respectively.

Protein intake was also higher in RBCs (42.61 ± 9.14 g/day) compared to OBCs (34.5 ± 7.15 g/day), with breakfast accounting for 26% and 24% of total intake, respectively. For calcium, RBCs consumed an average of 361.3 ± 52.2 mg/day, of which 207 mg (57%) was derived from breakfast. OBCs consumed 305 ± 129.22 mg/day with 145 mg (47%) from breakfast. Iron intake in RBCs was 12.16 ± 3.71 mg/day (24% from breakfast), while in OBCs it was 10 ± 2.98 mg/day (19% from breakfast).

The results clearly demonstrate that regular breakfast consumption substantially contributes to daily nutrient adequacy, particularly for critical growth-related nutrients like protein, calcium, and iron. Despite all groups falling short of RDA values, RBCs were closer to meeting nutritional targets, indicating the nutritional value of a consistent breakfast routine. These findings are supported by studies [15,16] that show breakfast as a key determinant of dietary quality in adolescents. Breakfast skippers not only consume less energy overall but also miss out on micronutrients essential for growth, cognition, and bone development.

Physical performance

The present study investigated the influence of breakfast consumption frequency on physical performance and cardiovascular responses among adolescent girls (n = 90), categorized into three groups: regular (n = 30), occasional (n = 30), and never (n = 30) breakfast consumers. Physical tasks included jumping, running, and toe-touching exercises, with parameters such as time taken, heart rate, blood pressure, and pulse pressure recorded before and after each activity.

Jumping performance

As presented, the time taken to complete the jumping task was significantly lower among regular breakfast consumers (12.07 ± 2.12 sec) compared to occasional (13.69 ± 0.58 sec) and never (14.80 ± 70.80 sec) consumers. The observed difference was statistically significant (CD = 0.54), indicating superior physical performance among those who regularly consumed breakfast.

Pre- and post-test heart rates showed no significant variation across groups, but systolic blood pressure and pulse pressure differed significantly. The regular breakfast group exhibited lower systolic BP both before (106.60 ± 11.32 mm Hg) and after (112.70 ± 10.40 mm Hg) the test compared to the other groups. Additionally, the rise in systolic BP and pulse pressure was significantly lower in regular consumers, suggesting better cardiovascular efficiency and reduced exertional stress.

These findings are consistent with the physiological role of breakfast in replenishing glucose stores after overnight fasting. Regular intake of a morning meal provides immediate energy for muscular work and supports optimal vascular tone, thereby minimizing stress-induced fluctuations in cardiovascular parameters.

Running performance

As shown, the running performance followed a similar pattern. Regular breakfast consumers completed the task significantly faster (18.38 ± 1.15 sec) than occasional (20.62 ± 1.33 sec) and never (22.69 ± 1.01 sec) consumers (CD = 0.32). Although heart rate and blood pressure values before and after exercise were not significantly different, the pulse pressure post-exercise was markedly higher in the occasional (54.4 mm Hg) and never (51.43 mm Hg) groups compared to the regular group (44.96 mm Hg). The rise in pulse pressure was also significantly greater in the non-regular groups (CD = 3.86), reflecting higher cardiovascular strain.

Running is a high-intensity activity that depends heavily on rapid and sustained energy release. Skipping breakfast may result in inadequate glycogen availability, forcing the body to rely on slower fat oxidation, which compromises physical output and increases fatigue. Moreover, the elevated post-exercise pulse pressure among breakfast skippers suggests compromised arterial compliance or autonomic regulation.

Touching toes performance

Flexibility performance, as assessed through the toe-touching task, also demonstrated significant differences across breakfast consumption categories. Regular breakfast consumers took significantly less time (17.11 ± 0.58 sec) than occasional (19.04 ± 1.02 sec) and never (20.59 ± 19.11 sec) consumers (CD = 0.36). While the changes in heart rate and diastolic BP were not statistically significant, systolic BP and pulse pressure values were again significantly lower in the regular breakfast group both before and after the activity.

Interestingly, despite being a low-intensity task, touching toes still elicited a measurable cardiovascular response. Regular breakfast consumers displayed a minimal rise in systolic BP (8.56%) and pulse pressure (5.57%), in contrast to higher elevations in the other groups. These results suggest that habitual breakfast consumption aids not only in physical strength but also in energy management and cardiovascular resilience, even during flexibility-based exercises.

The study findings clearly establish that regular breakfast consumption is associated with significantly better physical performance and more favorable cardiovascular responses among adolescent girls. Across all physical tasks-jumping, running, and touching toes-those who ate breakfast regularly completed tasks faster and exhibited lower rises in systolic blood pressure and pulse pressure post-exercise. These outcomes highlight the crucial role of breakfast in providing immediate energy, supporting cardiovascular efficiency, and enhancing overall physical capability.

From a physiological perspective, breakfast helps maintain blood glucose levels, reduces fatigue, and enhances muscle efficiency and autonomic regulation. In contrast, skipping breakfast prolongs the fasting period, leads to energy depletion, impairs performance, and places additional strain on the cardiovascular system.

These results reinforce existing dietary guidelines that emphasize the importance of a nutritious breakfast, particularly for adolescents undergoing critical stages of physical growth and development. Implementing school-based and community interventions to promote daily breakfast consumption may therefore contribute to improved health and functional fitness in this population.

Physical performance, assessed through jumping, running, and flexibility tasks, was also significantly better among regular breakfast consumers. These individuals completed tasks in shorter times and showed more stable cardiovascular responses post-exercise, including lower systolic blood pressure and pulse pressure elevations. This supports the physiological basis that breakfast replenishes glycogen stores, providing the necessary energy for muscular and cardiovascular function. In contrast, those who skipped breakfast experienced higher physical strain, possibly due to energy deficits and impaired circulatory regulation. These findings are in agreement with previous research [17,18] demonstrating that breakfast consumption contributes to enhanced athletic performance and endurance.

Academic performance

Academic performance was assessed through percentage scores and school attendance. RBCs had the highest mean academic scores (80.06 ± 10.73%), significantly higher than OBCs (66.91 ± 13.53%) and NBCs (65.88 ± 12.98%) (CD = 4.49). School absenteeism was lowest in RBCs (14.19 ± 9.74%), compared to OBCs (33.81 ± 6.6%) and NBCs (23.81 ± 12.59%) (CD = 3.76).

The higher academic achievement and lower absenteeism among RBCs can be attributed to improved cognitive performance linked to regular breakfast intake. Breakfast provides a steady supply of glucose, which is essential for brain functions such as memory, attention, and concentration. Previous studies [19,20] have shown that breakfast consumption enhances academic engagement and reduces mental fatigue. The reduced absenteeism in RBCs may reflect better overall well-being and readiness to attend school consistently.

Association of breakfast consumption with physical and academic performance in adolescent girls

The data summarized reveals a clear association between breakfast consumption and both physical and academic performance among adolescent girls. The findings from this study highlight a clear association between breakfast consumption and both physical and academic performance among adolescent girls. A significant difference was observed in physical performance, with regular breakfast consumers (RBC) completing tasks such as jumping, running, and touching toes more quickly than never breakfast consumers (NBC). Specifically, 24.44% of NBC participants took longer to complete the jumping task, 33.33% took longer for running, and 11.11% for touching toes, while the RBC group had only 2.22% taking longer for each of these activities. These differences were statistically significant ($p \leq 0.05$), suggesting that regular breakfast consumption directly enhances physical performance. Regular breakfast consumption provides the necessary glucose for both brain and muscle function, which is crucial for physical tasks requiring energy, speed, and coordination [21,22]. In contrast, skipping breakfast may result in lower energy levels, leading to slower performance, particularly in tasks that demand high energy and focus, such as jumping, running, and flexibility exercises. This supports the observation that NBC participants exhibited slower performance times, likely due to energy depletion and impaired cardiovascular regulation.

Furthermore, the RBC group also performed significantly better in terms of academic achievement compared to the occasional and NBC groups. In particular, 21.11% of RBC participants obtained high marks, compared to 7.78% of occasional and 5.56% of NBC participants. Additionally, the RBC group had the lowest proportion of participants obtaining low marks (1.11%), whereas 13.33%

of occasional and 12.22% of NBC participants scored low marks. These differences were statistically significant ($p \leq 0.05$), reinforcing the positive correlation between breakfast consumption and academic success. Breakfast plays a critical role in cognitive function, as it replenishes glucose levels in the brain, facilitating better concentration, memory, and problem-solving ability [23]. Skipping breakfast can lead to cognitive fatigue, decreased attention, and reduced retention of information. This may explain why RBC participants demonstrated improved academic performance compared to their occasional and NBC counterparts. In addition to glucose, breakfast often provides essential nutrients like vitamins and minerals, which support brain health and cognitive processes. The findings suggest that regular breakfast consumption is vital for optimal cognitive functioning, particularly during critical stages of brain development in adolescence.

Another noteworthy finding in this study was the impact of breakfast consumption on school absenteeism. Regular breakfast consumers had the lowest percentage of absences (3.33%), while a striking 28.89% of both occasional and NBC participants were absent more frequently. The relationship between breakfast consumption and reduced absenteeism can be attributed to the physical and cognitive benefits of breakfast. Skipping breakfast can result in low energy levels, reduced alertness, and difficulty focusing, which can diminish motivation to attend school [24]. These findings highlight the importance of breakfast in promoting not only physical and cognitive performance but also school attendance, which is closely linked to academic achievement.

In summary, the results of this study provide strong evidence for the positive impact of regular breakfast consumption on both physical and academic performance among adolescent girls. Those who consumed breakfast regularly completed physical tasks more quickly, demonstrated better academic outcomes, and had lower rates of absenteeism. These results underscore the physiological benefits of breakfast in terms of glucose availability for both brain and muscle function. Moreover, they highlight the importance of breakfast in supporting cognitive function, reducing fatigue, and promoting regular school attendance. This study adds to the growing body of evidence suggesting that regular breakfast consumption is essential for optimal health and academic success during adolescence.

Conclusion

This study concludes that the frequency of breakfast consumption is a significant determinant of nutritional adequacy, physical fitness, and academic performance in adolescent girls. Regular breakfast consumption was positively associated with improved nutrient intake, better execution of physical tasks, favorable cardiovascular responses, and superior academic achievement. In contrast, breakfast skipping was linked with lower nutritional status, delayed physical task completion, and poorer school performance. Additionally, maternal education and household income were identified as key socioeconomic factors influencing breakfast habits. These findings highlight the need for targeted interventions that consider both behavioral and contextual factors affecting adolescent nutrition.

Given the multidimensional impact of breakfast habits on adolescent health and performance, this study strongly advocates for the integration of nutrition-focused education in school curricula. School-based initiatives such as breakfast awareness campaigns and the establishment of nutrition clubs could serve as effective platforms to educate students, parents, and school staff about the health and academic benefits of a regular, balanced breakfast. Such measures are essential to fostering lifelong healthy eating behaviors and optimizing developmental outcomes during adolescence.

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Conflict of Interest

The authors declare no conflict of interest related to this study.

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