Journal of Health and Nutrition Research
Vol. 5, No. 1, 2026, pg. 353-362, https://doi.org/10.56303/jhnresearch.v5i1.883
Journal homepage: https://journalmpci.com/index.php/jhnr/index

e-ISSN: **2829-9760**

The Association of Breakfast Consumption with Blood Glucose Levels and Short-Term Memory in Primary School Children: A Cross-Sectional Study

Arfah Husna[1,2], Hardinsyah[1]*, Cesilia Meti Dwiriani[1], Lilik Kustiyah[1]

[1] Nutrition Study Program, Faculty of Medicine and Nutrition, IPB University, Indonesia
[2] Public Health Study Program, Faculty of Health Sciences, Teuku Umar University, Aceh, Indonesia

Corresponding Author Email: hardinsyah2010@gmail.com

ORIGINAL ARTICLES

Submitted: 24 September 2025

Accepted: 26 November 2025

Keywords:
Breakfast, Blood Glucose, Primary School Student, Short-Term Memory

ABSTRACT

Breakfast is an essential component of a healthy diet for school-aged children, yet it is often neglected. This study aimed to analyze the association between breakfast intake, blood glucose levels, and short-term memory among elementary school students in Nagan Raya Regency. This study employed a cross-sectional design involving 150 students from grades IV, V, and VI across three primary schools in Nagan Raya District with a purposive sampling technique. Short-term memory was assessed at 08:30 a.m. using a picture recognition memory test, and blood glucose levels were measured at 09:00 a.m. using the finger-prick method. Breakfast intake was measured using the recall method. Data on student characteristics (gender, daily allowance, and mother's education) and nutritional status were sourced from the 2023 GENIUS program (Nutrition education and snacks program for school children). The statistical tests used were the Mann–Whitney U test and the Spearman rank correlation test. The results showed that breakfast energy intake was positively and significantly associated with blood glucose levels, and blood glucose levels were positively and significantly associated with short-term memory. Consuming a complete breakfast plays an important role in maintaining stable blood glucose levels and supporting of short-term memory among primary school students.

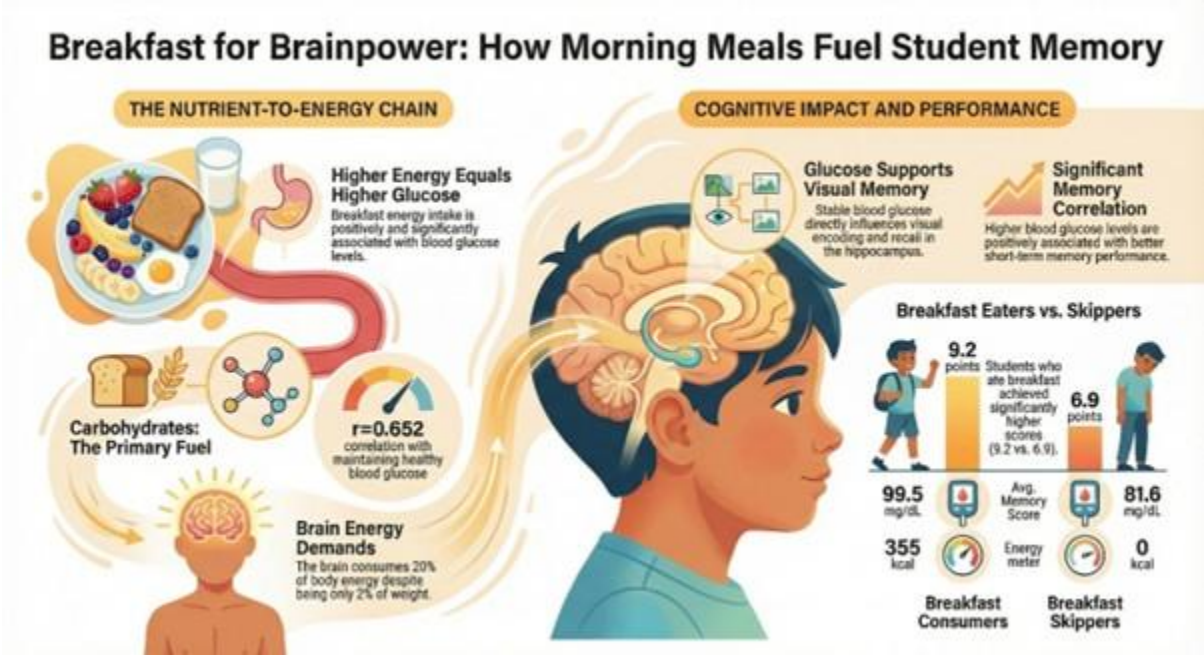
Key Messages:

- A regular breakfast supports stable blood glucose in primary school children.
- Adequate breakfast energy enhances short-term memory and cognitive function.
- Breakfast contributes relatively little to daily energy needs, requiring careful menu planning.
- Nutrition education is crucial to establishing healthy breakfast habits early.

Access this article online

Quick Response Code

GRAPHICAL ABSTRACT



INTRODUCTION

Breakfast is an important component of a healthy diet for school-aged children, as it helps meet daily energy and nutrient requirements (1). Children at this age are in a period of rapid cognitive development, so their ability to concentrate and short-term memory capacity greatly influence their learning readiness and academic achievement (2). Physiologically, breakfast is the first meal of the day, providing energy and helping maintain stable blood glucose levels after an overnight fast (3)

Data from the 2018 Basic Health Research (Riskesdas) reported that approximately 26.1% of children aged 7–12 years do not eat breakfast daily (4). This finding is further supported by a literature review indicating that approximately 41.2% to 54.5% of Indonesian school-aged children skip breakfast (5). Common reasons for this behavior include rushing to school, lack of appetite, or the unavailability of ready-to-eat food at home (6). This condition has the potential to affect children's cognitive performance, particularly in the aspects of concentration and short-term memory (7).

Physiologically, breakfast serves as the first meal of the day, providing essential energy and nutrients to maintain stable blood glucose levels following an overnight fast (3). Glucose plays a crucial role as the primary energy source for the brain and is indispensable for cognitive functions requiring high metabolic activity, including short-term memory (8). Insufficient or unstable glucose supply can lead to significant cognitive impairment, particularly in attention, information retention, and problem-solving abilities(9). Conversely, regular breakfast consumption is associated with better cognitive function, healthier dietary patterns, optimal nutritional status, and higher academic achievement among school-aged children (10,11). Skipping breakfast has been shown to result in decreased memory and concentration due to limited energy supply to the brain during morning hours (12).

Although scientific evidence demonstrates the important role of breakfast in children's cognitive function, the majority of previous studies have primarily focused on academic achievement, learning concentration, or general cognitive function. Research specifically analyzing the correlation between breakfast consumption, blood glucose levels, and short-term memory among elementary school students in Indonesia remains limited. Based on this background, the present study was conducted among fourth-, fifth-, and sixth-grade students at three public elementary schools participating in the 2023 GENIUS Program in Nagan Raya Regency, Aceh Province. GENIUS (Nutrition Education and Snacks Program for School Children) is a school-based nutrition intervention program launched in Nagan Raya, Aceh Province,

https://doi.org/10.56303/jhnresearch.v5i1.883

that provides nutritious morning snacks to improve children's nutritional status and cognitive performance. This study aims to analyze the relationships between breakfast consumption and blood glucose levels and between blood glucose levels and short-term memory among elementary school students.

METHODS

Study Design and Setting

This study utilized a cross-sectional design and was conducted from September to December 2023 at three elementary schools participating in the 2023 GENIUS Program in Nagan Raya Regency, Aceh Province: SDN 2 Arongan, SDN Cot Mee, and SDN Kuala Baro.

Sample Selection

The minimum sample size was calculated using the formula by Lemeshow et al. (1990), resulting in a requirement of 150 students. This study employed a purposive sampling technique, targeting all students in grades 4, 5, and 6 across three elementary schools in Nagan Raya Regency, Aceh Province. Participants in the study met specific inclusion and exclusion criteria. The established inclusion criteria were students in grades 4, 5, and 6 who could read and write well and were willing to have their blood drawn for glucose testing. The exclusion criteria for this study included students who were ill or absent from school on the day of data collection, as well as students who did not complete all research procedures, including blood glucose measurement and the short-term memory test.

Data Collection Tools and Procedures

The collected data consist of both primary and secondary sources. Primary data include blood glucose levels, short-term memory scores, and breakfast intake on the day of measurement. Blood glucose levels were measured using a FamilyDr glucometer (Family Dr, Taiwan) via the finger-prick method, approximately two hours after breakfast (at 09:00 WIB). Short-term memory was assessed at 08:30 WIB using a recognition method with visual media; students were instructed to observe an image for 45 seconds and subsequently record as many details as they could remember. Breakfast intake was evaluated using a meal-specific dietary assessment approach, following standard food consumption assessment protocols for specific eating occasions. Students were asked to provide a detailed report of the food and beverages consumed during breakfast on the day of data collection, including the types of food, estimated portion sizes, and time of consumption. These assessments were conducted through structured interviews by trained enumerators. Secondary data were retrieved from the 2023 GENIUS program database, which provided student characteristics (gender, pocket money, and maternal education) and nutritional status based on BMI-for-age (BMI/U).

Data Analysis

Collected data were processed using Microsoft Excel for Windows and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0 for Windows. Descriptive analyses were performed to obtain means, standard deviations, and percentages for student characteristics, energy and nutrient intake at breakfast, blood glucose levels, and short-term memory scores. Inferential analysis was conducted using the Mann–Whitney test and Spearman's rank correlation. The Mann–Whitney test was used to compare blood glucose levels and short-term memory scores. In contrast, Spearman correlation was used to analyze the relationship between breakfast intake and blood glucose levels, and between blood glucose levels and short-term memory among students. The adequacy of breakfast nutrient intake was processed and analyzed using the NutriSurvey application.

CODE OF HEALTH ETHICS

This study received ethical approval from the Health Research Ethics Committee, Faculty of Nursing and Health Sciences, Universitas Muhammadiyah Semarang (Approval No. 250/KE/10/2023). Before the study, all students and their parents/guardians were informed about its objectives, benefits, and

https://doi.org/10.56303/jhnresearch.v5i1.883

procedures, and written informed consent was provided.

RESULTS

Student Characteristics

Student characteristics included gender, maternal education, and daily pocket money. The characteristics in the present study are presented in Table I. Descriptive analysis showed that, out of 150 students, 109 (72.6%) consumed breakfast on the day of the study, while 41 (27.3%) did not.

Regarding maternal education, students who skipped breakfast had a relatively balanced distribution across junior high school (SMP), senior high school (SMA), and undergraduate (S1) levels, each accounting for 29.3%. Meanwhile, among students who ate breakfast, the highest proportions were mothers with SMA (32.1%) and S1 (30.3%) education levels. Nutritional status among students who skipped breakfast and those who ate breakfast showed a relatively balanced distribution, with the majority classified as normal (58.5% and 54.1%, respectively). In both groups, the largest proportion of students' daily pocket money was less than IDR 5,000, accounting for 48.8% in the non-breakfast group and 39.4% in the breakfast group.

Statistical analysis showed no significant difference in gender between the breakfast and non-breakfast groups ($p = 0.804$). This finding aligns with Khan et al. (2021), who reported no significant difference in breakfast frequency between male and female elementary school students. Pocket money was also not significantly associated with breakfast status ($p = 0.288$), consistent with the study by Rosyidah and Andrias (2015), which found that having pocket money does not necessarily correlate positively with breakfast habits, as many students use their money to buy snacks rather than a main morning meal**.** In the present study, maternal education did not differ significantly between the breakfast and non-breakfast groups ($p = 0.935$).

Table 1. Distribution of Student Characteristics and Nutritional Status by Breakfast Status

Variable	No Breakfast (n= 41)		Breakfast (n=109)		p-value
	n	%	n	%	
Gender					
Male	22	53.7	56	51.4	0.804
Female	19	46.3	53	48.6	
Mother's Education					
Elementary School	5	12.2	13	11.9	0.935
Junior high school	12	29.3	28	25.7	
Senior High School	12	29.3	35	32.1	
Bachelor's Degree	12	29.3	33	30.3	
Pocket Money (IDR)					
No pocket money	11	26.8	36	33.0	0.288
< 5.000	20	48.8	43	39.4	
5000-10.000	10	24.4	23	21.1	
>10.000			7	6.4	

*Chi-square test; significant at $p < 0.05$

Energy and Nutrient Intake, Short-Term Memory, and Students' Blood Glucose Levels

Based on the analysis presented in Table 2, of the total 150 students, 109 (72.6%) had breakfast on the day of the study, with an average energy contribution of 18% of the daily Recommended Dietary Allowance. In contrast, 41 students (27.3%) did not eat breakfast and therefore did not obtain any energy or nutrient intake in the morning. Statistical tests showed $p < 0.001$ for all intake variables (energy, carbohydrates, protein, and fat), indicating significant differences in nutrient intake between students who ate breakfast and those who did not.

The results of the Mann–Whitney test presented in Table 3 indicate that there was a significant difference in students' picture-based short-term memory scores between those who ate breakfast and those who did not ($p < 0.001$). Students who had breakfast had higher short-term memory scores for pictures (9.2 points) than those who skipped breakfast (6.9 points). The results of this study also showed a significant difference in blood glucose levels between students who ate breakfast and those who did not

https://doi.org/10.56303/jhnresearch.v5i1.883

($p < 0.001$). Students who had breakfast had higher blood glucose levels (mean 99.5 mg/dL) than those who skipped breakfast (81.6 mg/dL).

Table 2. Mean energy and nutrient intake of breakfast and non-breakfast consumers

Variable	Breakfast (n=109)		Non-Breakfast (n=41)		P-value
	Mean ± SD	Mean ± SD (%)	Mean ± SD	Mean ± SD (%)	
Energy (kcal)	355 ± 145	18 ± 7	0.0 ± 0.0	0.0 ± 0.0	0.000*
Carbohydrates (g)	52.8 ± 24.9	18.2 ± 8.5	0.0 ± 0.0	0.0 ± 0.0	0.000*
Protein (g)	12.8 ± 6.6	24.5 ± 12.8	0.0 ± 0.0 0.0	0.0 ± 0.0	0.000*
Fat (g)	12.5± 7.7	21.1 ± 13.5	± 0.0	0.0 ± 0.0	0.000*

p-values were obtained using the Mann–Whitney U test; significant at $p < 0.05$

Table 3. Blood glucose levels and short-term memory scores based on breakfast status

Variable	Breakfast (n= 109)	Non-Breakfast (n=41)	Total	p-value
Blood Glucose Levels (mg/dL)				
Mean ± SD	99.5 ± 8.5	81.6 ± 4.3	94.6 ± 11.0	0.000*
Median (max-min)	100 (85-120)	82.0 (69-90)	94.0	
Short-term Memory Score				
Mean ± SD	9.2 ± 2.3	6.9 ± 2.0	8.6 ± 2.4	0.000*
Median (max-min)	8 (5-15)	8 (1-11)	8	

*Mann–Whitney test. Significant at $p < 0.05$.

Relationship Between Energy And Nutrient Intake At Breakfast And Blood Glucose Levels

Based on the Spearman correlation analysis presented in Table 4, there was a significant positive relationship between breakfast energy and nutrient intake and students' blood glucose levels ($p < 0.001$). The correlation coefficients indicated that carbohydrate intake had the strongest significant positive correlation ($r = 0.652$), followed by energy intake ($r = 0.621$), protein intake ($r = 0.514$), and fat intake ($r = 0.493$). These findings indicate that higher energy and nutrient intake (carbohydrates, protein, and fat) at breakfast is associated with higher blood glucose levels among students.

Table 4. Relationship Between Breakfast Energy and Nutrient Intake and Students' Blood Glucose Levels

Variable	Blood Glucose Levels	
	r	*p*
Energy Intake	0.621	0.000*
Carbohydrate Intake	0.652	0.000*
Protein Intake	0.514	0.000*
Fat Intake	0.493	0.000*

Relationship Between Blood Glucose Levels and Students' Short-Term Memory

The analysis showed a positive, significant relationship between blood glucose levels and students' picture-based short-term memory scores ($r = 0.291$; $p < 0.001$). The direction of this relationship indicates that higher blood glucose levels within the physiological range are associated with better short-term memory performance (Table 5).

Table 5. Relationship Between Blood Glucose Levels and Short-term Memory in Students

Variable	Blood Glucose Levels	
	r	*p*
Blood Glucose Levels	0.291	0.000*

DISCUSSION

Student Characteristics and Breakfast Status

The descriptive analysis showed that most students consumed breakfast on the day of the study, although a considerable proportion (27.3%) skipped breakfast. This finding reflects a persistent public health concern regarding breakfast habits among school-aged children. National data from the 2018 Basic Health Research indicate that a substantial number of Indonesian children still skip breakfast (4). Similar

https://doi.org/10.56303/jhnresearch.v5i1.883

findings have also been reported in previous studies showing that breakfast skipping remains common among elementary school students (5). International evidence further confirms this pattern; for example, a study in Morocco reported that nearly 60% of students did not consume breakfast before school (13). Several factors may contribute to this behavior, including rushing to school, lack of morning appetite, and the unavailability of prepared food at home (6).

In the present study, a higher proportion of boys skipped breakfast compared to girls, although the difference was not statistically significant. Previous research suggests that boys tend to skip breakfast more frequently due to irregular sleep patterns, late-night eating, time constraints in the morning, and social influences (14,15). In contrast, girls are generally more likely to maintain regular breakfast (16). However, the absence of a significant association between gender and breakfast status in this study is consistent with findings reported by (16), who observed no significant gender differences in breakfast frequency among elementary school students.

Maternal education and students' daily pocket money were also not significantly associated with breakfast habits. Although maternal education is often linked to healthier dietary patterns and structured family meal routines (17), previous research has shown that children's breakfast behavior is strongly influenced by daily household routines rather than education level alone (18). Similarly, the availability of pocket money does not necessarily encourage breakfast consumption, as students may use it primarily to purchase snacks rather than a complete meal (18)These findings suggest that environmental and behavioral factors may play a more important role than socioeconomic characteristics in shaping children's breakfast habits.

Breakfast Energy and Nutrient Intake

Breakfast plays a critical role in meeting morning energy and nutrient requirements, preventing hypoglycemia, and maintaining stable blood glucose levels after overnight fasting (11). In this study, students who consumed breakfast obtained an average of 355 kcal, equivalent to approximately 18% of the daily Recommended Dietary Allowance. This proportion falls within the recommended range of 15–30% of daily energy intake suggested for breakfast (19); (20).

Statistical analysis revealed significant differences in energy and macronutrient intake between students who consumed breakfast and those who did not. Students who skipped breakfast did not obtain any energy or nutrient intake during the morning hours, thereby missing an important opportunity to replenish energy reserves after overnight fasting. These findings are consistent with previous research indicating that breakfast contributes significantly to daily energy and macronutrient intake and plays an important role in maintaining metabolic balance (21).

Carbohydrates consumed at breakfast function as the primary source of glucose for nerve cells and are essential for supporting optimal neuronal activity (22). Protein intake also plays an important role in cognitive processes through its involvement in neurotransmitter synthesis (23). In addition, adequate fat intake helps maintain a stable energy supply and contributes to sustained metabolic balance. Conversely, students who skip breakfast may experience insufficient morning energy intake, which may negatively affect cognitive performance and emotional stability during school activities (7).

Energy and Nutrient Intake, Short-Term Memory, and Students' Blood Glucose Levels

The findings of this study showed that students who consumed breakfast had significantly higher blood glucose levels compared to those who skipped breakfast. Blood glucose was measured approximately two hours after breakfast, reflecting postprandial glucose conditions. These results are consistent with previous studies indicating that breakfast consumption significantly increases blood glucose levels in school-aged children (24,25).

After overnight fasting, liver glycogen stores decline and blood glucose levels decrease. Breakfast functions to restore circulating glucose and replenish glycogen reserves, thereby ensuring adequate energy supply for the brain (3). In children, this process is particularly important because their brains have high metabolic demands to support growth and neural development. In addition to physiological differences, this study also found a significant difference in short-term memory scores between students who

https://doi.org/10.56303/jhnresearch.v5i1.883

consumed breakfast and those who skipped it. Students who ate breakfast achieved higher picture-based short-term memory scores than those who did not.

These findings are consistent with previous research showing that breakfast consumption is associated with better cognitive performance and academic outcomes among school-aged children (26,27). Several studies have also demonstrated that children who eat breakfast exhibit better working memory, attention, and learning capacity compared with those who skip breakfast (28,29). Short-term memory is a key component of cognitive function that plays an essential role in learning processes, including information encoding, storage, and retrieval. These processes depend heavily on adequate energy supply to the brain, particularly glucose, which serves as the primary metabolic substrate for neuronal activity (Yin et al., 2023).

Relationship Between Breakfast Intake and Blood Glucose Levels

Correlation analysis demonstrated significant positive associations between breakfast energy and nutrient intake and students' blood glucose levels. Among the macronutrients, carbohydrate intake showed the strongest correlation with blood glucose levels, followed by total energy intake, protein intake, and fat intake. These results indicate that higher breakfast intake contributes to higher circulating glucose levels in the bloodstream.

Carbohydrates play a direct role in increasing blood glucose levels because they are digested into monosaccharides, primarily glucose, which are absorbed in the small intestine and enter the bloodstream (30). Total energy intake also correlates with blood glucose levels because it represents the combined contribution of carbohydrates, protein, and fat. During sleep, the body undergoes a fasting period of approximately 8–10 hours, which reduces liver glycogen stores. Breakfast replenishes these stores and restores circulating glucose levels needed to support metabolic processes, particularly brain function (3).

Protein and fat intake also contribute to blood glucose regulation through different mechanisms. Protein can increase glucose production through gluconeogenesis from amino acids when carbohydrate intake is limited (31). Meanwhile, dietary fat slows gastric emptying and glucose absorption, resulting in a more gradual and stable rise in blood glucose levels until the next meal (32). Together, these macronutrients help maintain energy stability throughout the morning.

Relationship Between Blood Glucose Levels and Short-Term Memory

The study also demonstrated a positive and significant relationship between blood glucose levels and students' picture-based short-term memory scores. This finding suggests that higher blood glucose levels within the physiological range are associated with better short-term memory performance. Glucose is the primary energy source for the brain and supports neuronal activity, synaptic transmission, and metabolic processes underlying cognitive functions such as attention, working memory, and short-term memory (33,34). Although the brain accounts for only about 2% of body weight, it consumes approximately 20% of the body's total energy supply. Because the brain has limited capacity to store energy reserves, it depends heavily on a continuous supply of glucose from the bloodstream (35).

Glucose enters neurons through glucose transporters across the blood–brain barrier and is metabolized via glycolysis and the tricarboxylic acid cycle to produce adenosine triphosphate (ATP), which supports synaptic activity and neural signaling (36). Insufficient glucose supply may reduce ATP production, impair synaptic transmission, and ultimately decrease cognitive performance. Picture-based short-term memory tasks involve several cognitive processes, including encoding visual information, temporary storage, and recall. These processes rely on neural networks in the visual cortex and hippocampus, which are highly sensitive to changes in energy availability (37).

When blood glucose levels are within an optimal range, synaptic transmission and neuronal signaling occur more efficiently, thereby supporting better short-term memory performance. Conversely, low blood glucose levels may impair central nervous system efficiency and lead to decreased concentration and memory performance. Overall, these findings highlight the critical role of adequate breakfast consumption in maintaining optimal blood glucose levels and supporting cognitive performance among elementary school students.

https://doi.org/10.56303/jhnresearch.v5i1.883

CONCLUSION

Among school-aged children with blood glucose levels of 85–120 mg/dL, higher breakfast energy intake was associated with higher blood glucose levels. Furthermore, higher blood glucose levels were associated with better short-term memory performance among students. Therefore, students are recommended to consume a complete breakfast consisting of staple foods and side dishes to help maintain higher blood glucose levels and support optimal short-term memory.

FUNDING

This study was funded by the Indonesian Education Scholarship (Beasiswa Pendidikan Indonesia, BPI) through the Indonesia Endowment Fund for Education (Lembaga Pengelola Dana Pendidikan, LPDP), Ministry of Finance of the Republic of Indonesia.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia (Kemdiktisaintek) for funding this research. The authors also extend their appreciation to the Association of Indonesian Nutrition Higher Education Institutions (AIPGI) and the National Food Agency (BAPANAS), as the organizers of the GENIUS Program, for providing access to the GENIUS Program data used in this study.

CONFLICTS OF INTEREST

All authors declare no conflict of interest in the preparation of this article.

REFERENCES

1. Kustiyah L, Kusprasetia M. Children with Better Breakfast Habit and Family Socioeconomic Status Tended to Have Better Academic Achievment. Int J Med Heal Sci. 2018;03(02):14–21.
2. Baddeley A. The episodic buffer: a new component of working memory? Trends Cogn Sci. 2000 Nov;4(11):417–23.
3. Monzani A, Ricotti R, Caputo M, Solito A, Archero F, Bellone S, et al. A Systematic Review of the Association of Skipping Breakfast with Weight and Cardiometabolic Risk Factors in Children and Adolescents. What Should We Better Investigate in the Future? Nutrients. 2019 Feb;11(2).
4. Kemenkes RI. Laporan Nasional Riskesdas 2018. Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan; 2018.
5. Putri SK. Hubungan Kebiasaan Sarapan Pagi dengan Konsentrasi Belajar pada Anak Sekolah Dasar : Literature Review: The Relationship Between Habits and Learning Concentration in Elementary School : Literature Review. Media Publ Promosi Kesehat Indones. 2023 Aug 2;6(8 SE-Review Article):1538–44.
6. Godin KM, Patte KA, Leatherdale ST. Examining Predictors of Breakfast Skipping and Breakfast Program Use Among Secondary School Students in the COMPASS Study. J Sch Health. 2018 Feb;88(2):150–8.
7. Kawabata M, Lee K, Choo H cheng, Burns SF. Breakfast and Exercise Improve Academic and Cognitive Performance in Adolescents. 2021;
8. Gillespie KM, White MJ, Kemps E, Moore H, Dymond A, Bartlett SE. The Impact of Free and Added Sugars on Cognitive Function : A Systematic Review and Meta-Analysis. 2024;1–31.
9. Chen Y, Joo J, Man J, Chu T, Chuen R, Chang C, et al. Downregulation of the glucose transporter GLUT 1 in the cerebral microvasculature contributes to postoperative neurocognitive disorders in aged mice. J Neuroinflammation. 2023;1–18.
10. Raut S, KC D, Singh DR, Dhungana RR, Pradhan PMS, Sunuwar DR. Effect of nutrition education intervention on nutrition knowledge, attitude, and diet quality among school-going adolescents: a quasi-experimental study. BMC Nutr. 2024;10(1).
11. Gibson-Moore H, Spiro A, Stanner S. No food for thought–How important is breakfast to the health, educational attainment and wellbeing of school-aged children and young people? Nutr Bull.

https://doi.org/10.56303/jhnresearch.v5i1.883

2023;48(4):458–81.
12. Rani R, Dharaiya CN, Singh B. Importance of not skipping breakfast: a review. Int J Food Sci Technol. 2021;56(1):28–38.
13. Elkhatir M, Ghaffouli C, Louasté B, Loukili A, Aboussaleh Y. Dietary habits and cognitive performance in primary school students : a cross-sectional study in Khemisset region in Morocco. 2025;(October):1–11.
14. Alshdifat E, Alkhawaldeh A, Albashtawy M, Ta'an W, Mohammad K, Al-Rawashdeh S, et al. Breakfast Skipping and Associated Factors Among Jordanian University Students. Iran J Nurs Midwifery Res. 2024;29(1).
15. Hovdenak IM, Helleve A, Wolden IE, Bere E. Socioeconomic inequality in breakfast skipping among Norwegian adolescents. Nutr J. 2024;23(1):94.
16. Kawalec A, Pawlas K. Breakfast Frequency and Composition in a Group of Polish Children Aged 7–10 Years. 2021;
17. Luque V, Mucarzel F, Hertogs A, Seed PT, Flynn AC, Poston L, et al. Associations between maternal diet, family eating habits and preschool children's dietary patterns: insights from the UPBEAT trial. Nutr J. 2024;23(1):115.
18. Rosyidah Z, Andrias DR. Jumlah Uang Saku dan Kebiasaan Melewatkan Sarapan Berhubungan dengan Status Gizi Lebih Anak UsiaSekolah Dasar. Media Gizi Indones. 2015 May 20;10(1):1–6.
19. Kemenkes RI. Angka Kecukupan Gizi. 2019;(956).
20. Hardinsyah H, Aries M. Jenis Pangan Sarapan dan Perannya dalam Asupan Gizi Harian Anak Usia 6-12 Tahun dI Indonesia. J Gizi dan Pangan. 2016;7:89.
21. Álvarez-Bueno C, Martínez-Vizcaíno V, López EJ, Visier-Alfonso ME, Redondo-Tébar A, Cavero-Redondo I. Comparative Effect of Low-Glycemic Index versus High-Glycemic Index Breakfasts on Cognitive Function: A Systematic Review and Meta-Analysis. Nutrients. 2019 Jul;11(8).
22. Mergenthaler P, Lindauer U, Dienel GA, Meisel A. Sugar for the brain: the role of glucose in physiological and pathological brain function. Trends Neurosci. 2013 Oct;36(10):587–97.
23. Nagao K. Cognition and nutrition: the role of dietary protein and amino acids in cognitive health. Curr Opin Clin Nutr Metab Care. 2024 Jan;27(1):40–6.
24. Nurul-Fadhilah A, Teo PS, Huybrechts I, Foo LH. Infrequent breakfast consumption is associated with higher body adiposity and abdominal obesity in Malaysian school-aged adolescents. PLoS One. 2013;8(3):e59297.
25. Kustiya L, Carissa C, Anwar F. Relationship between Breakfast Types and Blood Glucose Level and Short-Term Memory of Elementary School Children in Bogor, Indonesia. Malaysian J Med Heal Sci. 2020;16(13).
26. Wylie GR, Genova HM, Yao B, Chiaravalloti N, Román CAF, Sandroff BM, et al. Evaluating the effects of brain injury, disease and tasks on cognitive fatigue. Sci Rep. 2023 Jun 20;13(1):20166.
27. Adolphus K, Hoyland A, Walton J, Quadt F, Lawton CL, Dye L. Ready-to-eat cereal and milk for breakfast compared with no breakfast has a positive acute effect on cognitive function and subjective state in 11–13-year-olds: a school-based, randomised, controlled, parallel groups trial. Eur J Nutr. 2021;60(6):3325–42.
28. Mahoney CR, Taylor HA, Kanarek RB, Samuel P. Effect of breakfast composition on cognitive processes in elementary school children. Physiol Behav. 2005;85(5):635–45.
29. Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. Nutr Res Rev. 2009 Dec;22(2):220–43.
30. Holesh JE, Aslam S, Martin A. Physiology, Carbohydrates. Treasure Island (FL): StatPearls Publishing; 2023.
31. Hall, E. J. Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021.
32. Gropper SS, Smith JL, Carr TP. Advanced Nutrition and Human Metabolism [Internet]. Cengage Learning; 2021. Available from: https://books.google.co.id/books?id=vggVEAAAQBAJ
33. Melzer TM, Manosso LM, Yau S yu, Gil-Mohapel J, Brocardo PS. In Pursuit of Healthy Aging: Effects of Nutrition on Brain Function. Vol. 22, International Journal of Molecular Sciences. 2021. p. 5026.

https://doi.org/10.56303/jhnresearch.v5i1.883

34. Ekstrand B, Scheers N, Rasmussen MK, Young JF, Ross AB, Landberg R. Brain foods - the role of diet in brain performance and health. Nutr Rev. 2021 May;79(6):693–708.
35. Arshad MT, Maqsood S, Altalhi R, Shamlan G, Mohamed Ahmed IA, Ikram A, et al. Role of Dietary Carbohydrates in Cognitive Function: A Review. Food Sci Nutr. 2025 Jul;13(7):e70516.
36. Nimgampalle M, Chakravarthy H, Devanathan V. Chapter 8 - Glucose metabolism in the brain: An update. In: Viswanath B, editor. Recent Developments in Applied Microbiology and Biochemistry. Academic Press; 2021. p. 77–88.
37. McNay EC, Pearson-Leary J. GluT4: A central player in hippocampal memory and brain insulin resistance. Exp Neurol. 2020 Jan;323:113076.

https://doi.org/10.56303/jhnresearch.v5i1.883