The Association Between Breakfast Habits, Nutritional Status, and Anemia on Working Memory Capacity in Teenage Girls at Madrasah Tsanawiyah of Al Fatah

Afiska Prima Dewi[1][a], Ritma Dewanti[1][b], Hernianti[1][c], Syamsopyan[1][d], Suherman[1][e]
[1]IAdila College of Health Sciences, Soekarno Hatta Street No.110, Bandar Lampung City, Indonesia
{f_author, s_author} afiska.pd@gmail.com, ritmadewanti08@gmail.com

Keywords: Working Memory, Breakfast Habits, Nutritional Status, Anemia

Abstract: Working memory capacity is a cognitive aspect that can affect student learning achievement. Working memory capacity is a limited capacity system that stores and manipulates information temporarily and plays a very important role in the student learning process. This study aims to analyze the association between breakfast habits, nutritional status, and anemia on working memory capacity in teenage girls. The research design was cross-sectional, conducted on students girls in Madrasah Tsanawiyah of Al Fatah, July 2024. The sample used purposive sampling following the inclusion and exclusion criteria provisions. The sample consisted of 30 students. Data collection on characteristics and breakfast habits used a questionnaire that the respondents themselves filled in. Nutritional status data was collected using anthropometric measurements and determined based on BMI (Body Mass Index) for Age. Anemia data was obtained through hemoglobin level measurements. Working memory data was collected using digit span test measurements. Data was analyzed using the Gamma correlation test. The results showed that there was a association ($p<0,05$) between breakfast habits and anemia on working memory capacity, while nutritional status had no association with working memory capacity ($p>0,05$). In conclusion, breakfast habits and anemia have association with working memory capacity..

.

1 INTRODUCTION

Learning is a human need to be able to increase knowledge or learn things that have not been mastered or understood. Learning is a process that can result in behavioral changes due to entering new information, the results of which can be seen from behavioral development. As a process, learning is influenced by many factors, one of which is working memory (Walgito, 2010).

Working memory is a cognitive process that has the main function of facilitating and increasing the capacity of coding, storage, and search functions that are important for learning at the information processing level (Kuswana, 2011). Working memory is related to various cognitive processes during school learning, from reasoning tasks for verbal understanding to mathematical abilities (Alloway & Capello, 2013). Working memory capacity is a limited capacity system that stores and manipulates information temporarily and plays a very important role in the student learning process, such as thinking, reasoning, remembering, and solving problems in counting, speaking, and reading comprehension activities (Santrock, 2011; Bailey et. al, 2008); following instructions, concentrating (focusing) and completing academic tasks (Cockcroft, 2015); and a complex construct in the storage process that is verbal, spatial, and visual (Baddeley, 2003).

Working memory capacity is a cognitive aspect that can affect student learning achievement. One of the factors that causes children's difficulties in remembering, calculating, and reading is the low capacity to remember temporary information in working memory. (Alloway, TP, & Alloway, RG, 2010). The size of working memory capacity affects the ability to learn learning materials and the ability to work on questions (Alloway, TP & Elsworth, M.,

[a] https://orcid.org/0000-0002-8117-3573
[b] https://orcid.org/0009-0003-6987-0952
[c] https://orcid.org/0009-0008-1966-2828
[d] https://orcid.org/0000-0002-3617-8105
[e] https://orcid.org/0000-0002-3772-2547

2012). Several studies have shown a association between working memory and student learning achievement. Haydar's (2013) study showed a positive association between working memory and student learning achievement at SDN Kleco I Surakarta (r = 0.442; p = 0.008) (Haydar, 2013). Another study by Puspitasari (2018) showed a significant positive association between working memory and mathematics learning achievement (p <0.05) (Puspitasari, 2018).

Several factors that influence students' working memory include internal factors, namely interest, motivation, gender, and age, as well as external factors, namely physical activity and exercise, stress, environment, and nutrition. As part of cognition, working memory is greatly influenced by nutrition (Burhaein E. 2017; Bryan, J. et al, 2004). Several aspects that can affect working memory and are to be studied in this study are breakfast habits, nutritional status, and anemia status.

Nutritional status affects students' working memory using anthropometric standards with BMI/U (Body Mass Index by Age) indicators (Ministry of Health of the Republic of Indonesia, 2020). The association between nutritional status and short-term memory (including working memory) has been studied by previous researchers, namely Winarsih (2021) where the study showed that there was a association between nutritional status and short-term memory with a p value of 0.004. In this study, short-term memory was measured using a digit span test which is also a measuring tool to measure working memory. Children with good nutritional status will have normal short-term memory (working memory). Conversely, poor nutritional status causes poor short-term memory or working memory (Winarsih, 2021). Nutritional status is a reflection of a person's intake balance where if a person's nutritional intake is good, the person's nutritional status will be good (Par'i, H.M, 2017). If a person's nutritional status is good, body cells, especially the brain, have enough energy to process metabolism and organ function properly. This affects the broadcasting of information processes in the brain, thus affecting brain performance including a person's cognitive abilities and working memory (Bogale, A, et a. 2011).

Blood hemoglobin levels have a positive association with working memory. The association between hemoglobin (Hb) levels and working memory has been studied by previous researchers, namely Nadira (2023) where there was a association between Hb levels and working memory in SMA Negeri 1 Samudera students with a p value of 0.000. Most students who have high and normal Hb levels will have good working memory. Conversely, if students have low Hb levels, then working memory will be lacking. Low memory ability in anemia patients can be caused by low iron levels in certain parts of the brain. Low iron levels in the brain can change the function of neurotransmitters and slow down the myelination process which plays a role in cognitive, socio-emotional, and motor functions. In addition, low Hb levels (anemia) cause the oxygen transported by Hb to also be reduced from normal conditions. Limited oxygen to the brain will affect students' thinking processes so that memory will decrease (Nadira, CS et al, 2023; Astina J, 2012).

Diet and nutrient intake have a positive correlation with working memory. Nutrition is one of the factors that affect brain development including cognitive and working memory. Nutrition can affect the brain's macrostructure (development of regional brain areas such as the hippocampus), microstructure (neuron myelination), and neurotransmitter levels and operations (dopamine levels or number receptors) all of which can have an impact on cognitive development. Some nutrients related to cognitive development including working memory are protein, omega 3 fats, vitamins A, C, and the minerals iron, zinc, iodine, and selenium (Scholey, 2013; Bellisle, 2004; Bryan, 2004). Some of these nutrients are found in animal foods, vegetables, and fruits (Ministry of Health of the Republic of Indonesia, 2018).

2 METHOD

The research design was cross-sectional, conducted on students girls in Madrasah Tsanawiyah of Al Fatah in July 2024. The sample used purposive sampling. The sample consisted of 30 students. Data collection on characteristics and breakfast habits used a questionnaire that the respondents filled in by themselves. Nutritional status was collected using anthropometric measurements and determined based on BMI (Body Mass Index) for Age. Anemia was obtained through hemoglobin level measurements. Working memory capacity was collected by using digit span test measurements. Data was analyzed using the Gamma correlation test.

3 RESULT

Respondent Characteristics

The respondents' age were dominated by 13 years old. Both respondent father's and mother's education were dominated by senior high school. Most of respondents' fathers' jobs were private sector employees, while most of respondents' mothers did not work.

Table 1: Respondent Characteristics

Respondent Characteristics	n	%
Respondent Age		
12 Tahun	5	16,7
13 Tahun	23	76,7
14 Tahun	2	6,7
Father's Education		
Elementary School	1	3,3
Junior High School	5	16,7
Senior High School	19	63,3
College	5	16,7
Mother's Education		
Elementary School	1	3,3
Junior High School	4	13,3
Senior High School	15	50,0
College	10	33,3
Father's Occupation		
Civil Servants/Military/Police	1	3,3
Private Sector Employee	14	46,7
Farmer/Livestockman	8	26,7
Entrepreneur/Trader	7	23,3
Doesn't Work	0	0
Mother's Occupation		
Civil Servants/Military/Police	4	13,3
Private Sector Employee	6	20,0
Farmer/Livestockman	2	6,7
Entrepreneur/Trader	8	26,7
Doesn't Work	10	33,3

Distribution of Breakfast Habits, Nutritional Status, Anemia Status, and Working Memory Capacity

Respondents who used to eat breakfast were 2 persons, while respondents who used to not eat breakfast were 16 persons. Most respondents had normal nutritional status, but there were respondents who thinness (2 persons), overweight (5 persons), and obese (4 persons). Most of respondents had normal hemoglobin levels, but there were 6 persons of respondents who had anemia. Working memory capacity was dominated by the average score, there were only 8 respondents who had good score. average score, there were only 8 respondents who had good score.

Table 2: Distribution of Breakfast Habits, Nutritional Status, Anemia, and Working Memory

Variable	n	%
Breakfast Habits		
Always Have Breakfast Every Day	2	6,7
Eat Breakfast Often (4-6x/Week)	6	20,0
Rarely Eat Breakfast (1-3x/Week)	6	20,0
Never Eat Breakfast	16	53,3
Nutritional Status		
Severely Thinness	0	0
Thinness	2	6,7
Normal	19	63,3
Overweight	5	16,7
Obese	4	13,3
Anemia Status		
Anemia	6	20,0
Normal	24	80,0
Working Memory Capacity		
Very Less	0	0
Less	0	0
Average	22	73,3
Good	8	26,7
Very Good	0	0

Association of Breakfast Habits, Nutritional Status, and Anemia to Working Memory Capacity

The results stated that there was a association (p value <0,05) between breakfast habits and anemia on working memory capacity, while Mid Upper Arm Curcumference (MUAC) had no association with working memory capacity. From the study, breakfast habits had strong association on working memory capacity (r value in range of 0.6 – 0,8), while anemia had very strong association on working memory capacity (r value in range of 0,8 – 1,0).

Table 3: Association of Breakfast Habits, Nutritional Status, and Anemia to Working Memory Capacity

Variables	Working Memory				*r*	*p value*
	Average		Good			
	n	%	n	%		
Breakfast Habits						
Never	2	6,7	0	0	0,630	0,027
Rarely	6	20,0	0	0		
Often	4	13,3	2	6,7		
Always	10	30,0	6	20,0		
Nutritional Status						
Very Thinness	0	0	0	0	0,466	0,165
Thinness	1	3,3	1	3,3		
Normal	17	56,6	2	6,7		
Overweight	2	6,7	3	10,0		
Obese	2	6,7	2	6,7		
Anemia Status						
Anemia	6	20,0	0	0	1,000	0,012
Normal	16	53,3	8	26,7		

4 DISCUSSIONS

Association between Breakfast Habits and Working Memory Capacity

The results of this study indicate that there is a significant association between breakfast habits and working memory capacity as indicated by a p value of 0.027 (p value <0.05). The strength of the association between the two variables is strong as indicated by an r value of 0.630 (r value between 0.6–0.8). The form of a positive association where the better the student's breakfast habits, the better the working memory capacity.

Working memory is part of the executive function that occurs in the prefrontal cortex. This cognitive function is very important for regulating students' behavior, academic achievement, and language performance. Adequate or sufficient nutritional intake is one of the important factors for optimal human brain growth and performance. Students' brains require higher levels of brain glucose metabolism than adults, so they need more 'fuel' to feed their brains and therefore need more glucose than adults. The findings of this study support the assumption that breakfast consumption can have a positive effect on working memory capacity.

Association between Anemia Status and Working Memory Capacity

This study shows that hemoglobin levels have a significant association with working memory with a p value of 0.000 (<0.05). The strength of the association between the two variables is strong as indicated by an r value of 0.753 (r value between 0.6–0.8). The form of a positive association where the higher the hemoglobin level, the better the working memory score.

Students who have high or normal hemoglobin (Hb) levels will have good working memory capacity. Conversely, if a student's hemoglobin level is low or anemic, working memory will not be optimal. This can be caused by low iron levels in certain parts of the brain. Low iron levels in the brain can change the function of neurotransmitters and slow down the myelination process which plays a role in cognitive, socioemotional, and motor functions. In addition, low Hb levels (anemia) can cause the oxygen transported by Hb to be reduced from normal conditions. Limited oxygen to the brain will affect students' thinking processes so that memory will decrease. The findings of this study support the hypothesis that anemia status can affect students' working memory capacity.

5 CONCLUSIONS

Based on the results of this study, it can be concluded that there is a association between breakfast habits and hemoglobin levels with working memory capacity, but there is no association between nutritional status and body fat percentage with working memory capacity in MTs Al Fatah students. Regular breakfast and having good hemoglobin levels will make working memory capacity better than skipping breakfast and experiencing anemia..

.

6 ACKNOWLEDGEMENTS

We would like to express our deepest appreciation to all the respondents who were willing to support this study.

REFERENCES

Alloway, T. P.,& Alloway, R. G. 2010. Investigating the predictive roles of working memory and IQ in academic attainment. Journal of Experimental Child Psychology, 106, 20-29. doi: 10.1016/j.jecp.2009.11.003

Alloway, T. P.,& Capello, E. 2013. Working Memory: The What, the Why, and the How. The Australian Educational and Developmental Psychologist, Volume 30, Issue 2, 2013, p105–118, doi 10.1017/edp.2013.13

Aryadi, I., Ariawati, K., & Suwarba, I. G. N. M. 2019. Hubungan antara Kebiasaan Sarapan dengan Tingkat Memori pada Siswa Sekolah Dasar Negeri di Kota Denpasar. Media Penelitian dan Pengembangan Kesehatan, 29(3), 197-204

Astina J, Tanziha I. Pengaruh Status Gizi dan Status Anemia Terhadap Daya Ingat Sesaat Siswa di SDN Pasanggrahan 1 Kabupaten Purwakarta. J Gizi dan Pangan. 2012;7(2):103

Barr SI, DiFrancesco L, Fulgoni VL. 2014. Breakfast Consumption is Positively Associated with Nutrient Adequacy in Canadian Children and Adolescents. Br J Nutr., 112(8):1373–83

Bellisle, France. 2004. Effects of diet on behaviour and cognition in children. British Journal of Nutrition, 92 (2), 227–S232. doi: 10.1079/BJN20041171

Bogale, A, et al. 2011 Nutritional status and cognitive performance of mother–child pairs in Sidama, Southern Ethiopia. Maternal and Child Nutrition,

Vol 9, Issue 2, p 274-284 doi:10.1111/j.1740-8709.2011.00345.x

Bryan, Janet et al. 2004. Nutrients for Cognitive Development in School-aged Children. Nutrition Reviews. Vol. 62, No. 8. p 295–306

Cockcroft, K. 2015. The role of working memory in childhood education: Five questions and answers. South African Journal of Early Children Education, 5(1), 1-21.

Dauncey MJ. 2014. Nutrition, The Brain and Cognitive Decline: Insights from Epigenetics. Eur J Clin Nutr, 68(11) : 1179–85

Haydar, M. Handayani, S., Sumardiyono. 2013. Hubungan Kapasitas Memori Kerja Dengan Prestasi Belajar Pada Siswa Kelas V Sekolah Dasar Negeri Kleco I Surakarta. Fakultas Kedokteran Universitas Sebelas Maret (Skripsi)

Kementerian Kesehatan Republik Indonesia. 2020. Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2020 tentang Standar Antropometri Anak

Morris N, Sarll P. 2010. Drinking Glucose Improves Listening Span in Students Who Miss Breakfast. Educ Res., 43(2) : 201–7

Nadira, C.S., Rahayu,M.S., Maulina, N., Muhammad, O., Akbar, R. 2023. Penilaian Hubungan Kadar Hemoglobin Darah terhadap Working Memory pada Siswa SMA. Jurnal Ilmiah Manusia dan Kesehatan, Vol. 6 No. 1 p 44-50

Passer, Michael & Smith, Ronald. 2003. Psychology: The science of mind and behavior, 2nd ed. McGraw-Hill Companies, Incorporated

Puspitasari, Widya. 2018. Hubungan Antara Working Memory dengan Prestasi Belajar Matematika pada Anak Usia 10 Tahun di Semarang. Unika Soegijapranata (Thesis)

Widyanti PA, Sidiartha IGL. Breakfast Habit and Academic Performance among Suburban Elementary School Children. J Ilm Kedokt. 2013;56:3–7