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The Effect of Breakfast With Low Glycemic Index on Cognitive Ability in Indonesian High School Students By Taufiqur Rahman

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[Simon B. Cooper, Stephan Bandelow, Maria L. Nute, John G. Morris, Mary E. Nevill. "Breakfast glycaemic index and cognitive function in adolescent school children", British Journal of Nutrition, 2011](#)

Food and Nutrition Downloaded from <http://journals.lww.com/nutritiontodayonline> by DGixsy1y+oajEKKd971ZXjsUVUvFbcXz3j4v0jTPKzP28tihnlFRZeilqh7+9tF1AJjDcRcStt3Z/lqS64JZE4xgpUI7l3qMU/rG39Xb4HAWEr/VLK9BwY+54CS on 11/25/2020 [The Effect of Breakfast With Low Glycemic Index on Cognitive Ability in Indonesian High School Students A Pilot Study of Locally Based Foods Approach](#) Mochammad Rizal, SGz Taufiqurrahman, SKM, MPH Nuning Marina Pengge, SKM, MKes Numerous studies have investigated the importance of low-glycemic-index (GI) breakfast on cognitive performance. However, until recently, none has used rice and noodles, which are staple foods in Indonesia. This pilot study examined the effect of a low-GI breakfast on cognitive ability of an arithmetic task using locally based food approach. This randomized, crossover study involved 64 high school students (32 male and 32 female students) aged 12 to 15 years. They were provided with a low-GI breakfast or placebo with high GI, which were matched by $\pm 10\%$ for energy amount, serving size, and macronutrient composition. The arithmetic ability Uchida-Kraepelin test was performed 2 hours after breakfast. Paired t test was used to analyze the difference between meals on the outcome. Students consuming the low-GI breakfast had higher scores than those on the high-GI breakfast (80.7 ± 15.9 vs 73.7 ± 17.1), a significant difference ($P = .008$). The low-GI breakfast was beneficial on these scores, suggesting that further investigations are warranted and that locally based food sources with lower GIs at breakfast might be in order. More tests of cognitive Mochammad Rizal, SGz, graduated bachelor of nutritional science degree from the Universitas Airlangga and received diploma of nutrition from the Politeknik Kesehatan Kemenkes Surabaya. Taufiqurrahman, SKM, MPH, graduated master of public health from the Universitas Gadjah Mada; graduated bachelor of public health from the Universitas Airlangga; received diploma of nutrition from the Politeknik Kesehatan Kemenkes Mataram. Taufiqurrahman is currently a lecturer at Politeknik Kesehatan Kemenkes Surabaya. Nuning Marina Pengge, SKM, MKes, graduated Master of Public Health from the Universitas Airlangga, graduated bachelor of public health from the Universitas Airlangga, and received diploma of nutrition from the Politeknik Kesehatan Kemenkes Kendari. N.M.P. is currently a lecturer at Politeknik Kesehatan Kemenkes Surabaya. Partial financial support was provided for this study from the internal, competitive-based program (student creativity program), Politeknik Kesehatan Kemenkes Surabaya. The authors have no conflicts of interest to disclose. Correspondence: Mochammad Rizal, SGz, Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Jl. Mulyorejo Kampus C, Surabaya 60115, Indonesia (mochammad.rizal-2016@fkm.unair.ac.id), Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved. DOI: 10.1097/NT.0000000000000446 ability are needed to ensure findings are valid, with careful consideration on the issues appearing in this study. Nutr Today. 2020;55(6):328-332 Breakfast is recognized as the most important meal of the day for many reasons. Among schoolchildren, there is evidence of its beneficial effect on cognitive and academic performance. 1-4 Breakfast supplies energy and essential nutrients, which are needed by the brain to function at full capacity. Despite the many benefits of breakfast, an Indonesian national health survey in 2015 reported that 39% of male and 50% of female high school students did not eat it. 5 Indonesian students still lag behind other countries (ranked 62 out of 70) in terms of average math, science, and reading scores in the International Student Assessment Program 2015, 6 and the results also showed positive relationship between breakfast and students' science performance across countries. Boys and girls who ate breakfast scored, respectively, 10 and 6 points higher than those skipping it. 7 The effects of breakfast on cognitive development are ongoing, but it is clear that the nutritional characteristics of breakfast fed may affect outcomes. Some studies found that adequate energy intake, 8,9 and macronutrient composition, 10,11 of breakfast have effects on cognition and academic output. Other studies suggested an effect of low-GI breakfast on cognitive ability. 12-14 Cereal, cornflakes, and oatmeal were predominantly used in aforementioned studies, but these foods are unfamiliar to Indonesians. Therefore, it seems to be impractical to implement because Indonesian staple foods are rice and noodles (98% and 23% of population, respectively). 15 This pilot study examined the effect of low-GI breakfast on cognitive performance of an arithmetic task, using locally based foods. MATERIALS AND METHODS Participants Sixty-four high school students (32 male and 32 female students) aged 12 to 15 years (mean, 13.6 ± 0.7 years) were used. FIGURE 1. Study design. They were recruited from Pondok Pesantren Tebuireng (an Islamic Boarding School) and SMPN 1 Ploso (a high school) in Jombang. The inclusion criteria were students who rank between 1 and 10 in their latest semester report in each class. Participants with diabetes, anemia, and food allergies were excluded. The study was approved by the Health Research Ethics Committee of Politeknik Kesehatan Kemenkes Surabaya (002/S/KEPK/VI/2016) and conducted in accordance with the Declaration of Helsinki. The procedures were registered at Thai Clinical Trials Registry as TCTR20200425002. Informed consent had been signed by both students and parents prior to the commencement of the study. Treatment and Design The study used a randomized, crossover design (Figure 1). Therefore, participants acted as their own controls so that the effect of the different breakfast could be evaluated. They were randomly assigned into 2 groups to receive low GI or placebo (high GI) breakfast. All participants in both groups received both meals within a predetermined schedule at 7-day interval. Blinding was not possible because the menu variation was clearly obvious. However, participants were not informed about the purpose of the different meals to limit any potential bias. Both menus were calorically matched and had similar serving size, as well as macronutrient component (protein, fat, and carbohydrate) with a 10% tolerance. The energy and nutrient contents were analyzed using Nutrisurvey 2007 (EBISpro). The low-GI breakfast value was 46 and consisted of 150 g noodles, 30 g caisims, 25 g chicken sausage, 60 g fried eggs, and 25 g shredded chicken (Table 1). The high-GI breakfast value was 86 and consisted of 175 g rice, 25 g carrots, 25 g beans, 25 g

tempeh, 10 g soy sauce, 25 g fried chicken, and cooking oil (Table 2). The total energy values of the low and high GI were 508 and 481 kcal, respectively. The GIs of food items were obtained from the international glycemic index table and glycemic load values.¹⁶ In addition, GI estimation of mixed meals was calculated using the formula¹⁷ shown in Figure 2. Procedure The sequence of GI breakfasts was provided in a random manner. All participants ate both GI breakfasts and performed the arithmetic test twice, separated by 7 days. Half of the participants received the low-GI breakfast first, whereas the other half had a high-GI breakfast first. Participants were instructed not to eat after 10:00 PM the night before intervention and to go to school on the test day without breakfast. In the morning at 7:00 AM, they were asked to eat the entire administered meal within 10 minutes. Additional food consumption such as snacks or sugary drinks was not permitted except ad libitum mineral water. The arithmetic tasks were measured 2 hours after eating breakfast (9:00 AM). Assessment Test The Uchida-Kraepelin test is a shortened, 30-minute modification of Kraepelin's arithmetic test¹⁸ containing 25 column lines of 115 random and single-digit number. Participants were instructed to sum each sequence of 2 overlapping vertical numbers, with the second of each pair becoming the first of the next pair. Only the answer unit is written down in a space between the pair. They were asked to change to a new line each minute following the examiner's signal regardless of their current line position. The test was taken for 15 minutes for the first 15 lines and rest for 5 minutes, followed by 10 minutes to work on the remaining 10 lines. Because the test was performed twice for each participant, the final score analyzed was the average of those 2 scores. Statistical Analysis Statistical analyses were performed using SPSS statistics 20 (IBM Corp, Armonk, New York), and values were reported as mean \pm SD. [Paired t test was used to analyze the arithmetic test scores difference between the low and high GI groups.](#) The statistical significance level was determined at $P < .05$. RESULTS Figure 3 illustrates that students achieved higher average arithmetic test scores after consuming the low-GI breakfast (80.7 ± 15.9) compared with those who ate the high-GI breakfast (73.7 ± 17.1). In addition, Table 3 reveals that better scores consistently persisted in the low-GI-breakfast group, regardless of the GI breakfast sequence. Furthermore, Table 4 shows a statistically significant difference in the arithmetic test scores between interventions ($P = .008$). DISCUSSION These preliminary findings indicated [that a low-GI breakfast enhanced cognitive performance of an arithmetic task, as opposed to a high-GI breakfast. A low-GI breakfast has also been reported to be associated with attention in a positive manner.](#)¹⁹ In the present study, rice and noodles were used for high- and low-GI breakfast interventions, respectively, which are the main staple for Indonesians. To the best of our knowledge, there have been no experimental studies using rice and noodles, staple Indonesian breakfast foods, providing such interventions until recently. Compared with earlier studies across countries in 3 systematic reviews, it was found that most breakfast comprised cereals, comflakes, and bread, as well as oatmeal, and none of the studies used rice or noodles as interventions.^{1,19,20} The 2 supplied menus [were matched by \$\pm 10\%\$ for energy amount, serving size, and macronutrient composition. The total energy was equated to prevent any potential limitations as performed by previous investigations.](#)^{21,22} The amount of energy accounted for 20% to 25% of total intake according to recommended dietary allowance (Indonesia),²³ regardless of individual needs variance. It is also in accordance with an earlier study that reported better reasoning scores for children having adequate breakfast $\geq 20\%$ of daily energy, compared with those eating inadequate breakfast.⁸ Furthermore, it is also important to note that compositional differences may influence cognitive performance.^{10,11} Hence, the provided meals were matched in terms of macronutrient contents aiming to minimize the possibility of nutritional component differences impact on the outcome.¹² There are important limitations to be considered. First, it was unclear whether participants had similar characteristics (such as body mass index, socioeconomic, and psychological) because it was not investigated. Because portion size was held constant for all volunteers, it is possible that cognitive processes of students who were bigger or had higher energy requirements being attributed to glycemic index may partially reflect differential energy content of the high- and low-GI portions. Also, the breakfast manipulations were equal rather than ad libitum, meaning that the participants did not eat at a certain portion size based on individual preferences. Third, baseline measurement of the arithmetic test was not performed; therefore, it was not understood whether breakfast caused an improvement or a decline on the outcome. Another issue is that the arithmetic test was only one of many aspects of cognitive processes, preventing the generalizability of the results. Furthermore, food cost and palatability of the 2 breakfasts provided were not explored; thus, the affordability and practicality of the meals in real-life conditions are still questionable. Additionally, overestimation on the GI values might occur because the measurements were based only on published values and math formula. Considering the aforementioned limitations, suggestions for further research need to be followed up before findings can be translated into action. First, participants' characteristics (such as body mass index, socioeconomic, and psychological) need to be investigated to confirm whether significant results persisted, and adjustment of confounders did not attenuate the observed GI effect. It is also suggested that ad libitum meals should be provided to better reflect participants' habitual breakfast consumption rather than fixed serving. Third, more tests of cognitive function are needed (such as memory and attention), and baseline measurement should be taken into consideration. In addition, exploration of food cost and palatability are proposed in order to ensure that the meals are accessible and practical. Because the formula overestimated the GI of mixed meals, it is essential to measure continuous blood glucose during the tests to monitor postprandial glycemic responses more accurately. In conclusion, the present pilot study found [that locally based Indonesian breakfast food sources with lower GI might be beneficial for cognitive performance on an arithmetic score, just as other GI studies have found for other types of foods. Additional investigations of cognitive ability with locally based foods are needed with careful consideration of the issues noted in this study to ensure findings are valid prior to implementation in Indonesian schools.](#) Acknowledgments The authors are grateful to all of the participants, Pondok Pesantren Tebuireng, and SMPN 1 Ploso for their support. REFERENCES 1. 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;22:220-243. doi.org/10.1017/S0954422409990175. 2. Adolphus K, Lawton CL, Dye L. The effects of breakfast on behavior and academic performance in children and adolescents. *Front Hum Neurosci.* 2013;7:425. doi.org/10.3389/fnhum.2013.00425. 3. Yao J, Liu Y, Zhou S. Effect of eating breakfast on cognitive development of elementary and middle school students: an empirical study using large-scale provincial survey data. *Med Sci Monit.* 2019;25:8843-8853. doi:10.12659/MSM.920459. 4. Jeong E. The influence of breakfast on the academic performance of school-age adolescents: systematic review. *J Nutr Health.* 2019; 52(2):119-128. doi.org/10.4163/jnh.2019.52.2.119. 5. Kusumawardani N, Rachmalina, Wiryawan Y, et al. Perilaku Berisiko Kesehatan Pada Pelajar SMP Dan SMA Di Indonesia; Jakarta: Kementerian Kesehatan RI; 2015. 6. OECD. PISA 2015 Results in Focus; 2018. 7. OECD. PISA 2015 Results (Volume III): Students' Well-being. Vol. III. Paris; 2017. doi.org/10.1787/9789264266490-en. 8. López-Sobaler AM, Ortega RM, Quintas ME, Navia B, Requejo AM. Relationship between habitual breakfast and intellectual performance (logical reasoning) in well-nourished schoolchildren of Madrid (Spain). *Eur J Clin Nutr.* 2003;57(suppl 1):S49-S53. doi.org/10.1038/sj.ejcn.1601815. 9. Muthayya S, Thomas T,

Srinivasan K, et al. Consumption of a mid-morning snack improves memory but not attention in school children. *Physiol Behav.* 2007;90:142–150. doi.org/10.1016/j.physbeh.2006.09.025. 10. Mahoney CR, Taylor HA, Kanarek RB, Samuel P. Effect of break- fast composition on cognitive processes in elementary school children. *Physiol Behav.* 2005;85:635–645. doi.org/10.1016/j.physbeh.2005.06.023. 11. Amiri F, Amani R, Khajemogahi N, Rashidkhani B, Saxby B, Wesnes KA. Assessing the effects of two breakfasts (high- carbohydrate vs high-protein) on cognitive function, mood and satiety status of 9-11 year-old primary school children with a new technology in Iran. *Brain Inj.* 2014;28:754–755. 12. Ingwersen J, Defeyter MA, Kennedy DO, Wesnes KA, Scholey AB. A low glycaemic index breakfast cereal preferentially pre- vents children's cognitive performance from declining through- out the morning. *Appetite.* 2007;49:240–244. doi.org/10.1016/j.appet.2006.06.009. 13. Cooper SB, Bandelow S, Nute ML, Morris JG, Nevill ME. Breakfast glycaemic index and cognitive function in adolescent school children. *Br J Nutr.* 2012;107:1823–1832. doi.org/10.1017/S0007114511005022. 14. Nilsson A, Radeborg K, Björck I. Effects on cognitive performance of modulating the postprandial blood glucose profile at breakfast. *Eur J Clin Nutr.* 2012;66:1039–1043. doi.org/10.1038/ejcn.2012.80. 15. Siswanto, Permaesih D, Lamid A, et al. *Studi Diet Total: Survei Konsumsi Makanan Individu Indonesia 2014.* Jakarta, Indonesia: Kementerian Kesehatan RI; 2014. 16. Foster-Powell K, Holt SHA, Brand-Miller JC. International table of glycemic index and glycemic load values: 2002. *Am J Clin Nutr.* 2002;76(1):5–56. doi.org/10.1093/ajcn/76.1.5. 17. Dodd H, Williams S, Brown R, Venn B. Calculating meal glycaemic index by using measured and published food values compared with directly measured meal glycaemic index. *Am J Clin Nutr.* 2011;94:992–996. doi.org/10.3945/ajcn.111.012138.992. 18. Sugimoto K, Kanai A, Shoji N. The effectiveness of the Uchida- Kraepelin test for psychological stress: an analysis of plasma and salivary stress substances. *Biopsychosoc Med.* 2009;3:5. doi:10.1186/1751-0759-3-5. 19. Adolphus K, Lawton CL, Champ CL, Dye L. The effects of break- fast and breakfast composition on cognition in children and ado- lescents: a systematic review. *Adv Nutr.* 2016;7(3):590S–612S. doi.org/10.3945/an.115.010256. 20. Edefonti V, Rosato V, Parpinel M, et al. The effect of breakfast composition and energy contribution on cognitive and academic performance: a systematic review. *Am J Clin Nutr.* 2014;100(2):626–656. doi.org/10.3945/ajcn.114.083683. 21. Micha R, Rogers PJ, Nelson M. The glycaemic potency of break- fast and cognitive function in school children. *Eur J Clin Nutr.* 2010;64(9):948–957. doi.org/10.1038/ejcn.2010.96. 22. Micha R, Rogers PJ, Nelson M. Glycaemic index and glycaemic load of breakfast predict cognitive function and mood in school children: a randomised controlled trial. *Br J Nutr.* 2011;106:1552–1561. doi.org/10.1017/S0007114511002303. 23. Kemenkes RI. *Angka Kecukupan Gizi Yang Dianjurkan Untuk Masyarakat Indonesia.* Jakarta; Kemenkes RI;2019. 328 Nutrition Today® Volume 55, Number 6, November/December 2020 Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved. Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved. 330 Nutrition Today® Volume 55, Number 6, November/December 2020 Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved. Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved. 332 Nutrition Today® Volume 55, Number 6, November/December 2020 Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.