Breakfast Habits Relationship With Blood Sugar Levels And School Performance In Healthy Children In Yayasan Bali Kuna Santi, Karangasem, Bali

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Article Info	ABSTRACT
Keywords: Breakfast habits, Blood sugar level, School Performance, Healthy Children.	Background: These days, an increasing number of young people skip breakfast for a variety of reasons. Skipping breakfast is a behavior that raises the risk of metabolic disorders such as diabetes and cardiovascular disease, decreased sleep quality, as well as reduced concentration and creativity. This behavior is said to be increased glycemic responses that associated with increased blood sugar levels. Skipping breakfast also associated with decreased of concentration, creativity, and school performance. This research was conducted to examine whether there is a significant relationship between breakfast habits and blood sugar levels as well as school performance in healthy children. Methods: A cross-sectional design with 43 healthy children aged 8 months to 15 years as research participants. Participants were assessed for weight, height, body mass index (BMI), breakfast habits, school performance, and blood sugar levels. The SPSS software's One-Way ANOVA test were used to examine the exam outcomes. Results: A One-Way ANOVA analysis produced p value of 0.353 (>0.05) for blood sugar levels and p value of 0.003 (<0.05) for school performance. Conclusion: While there is no statistically significant relationship between breakfast habits and blood sugar levels in healthy children, there is statistically significant relationship between breakfast habits and school performance. These results may be attributed to several factors that can be considered for further research.
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INTRODUCTION

Breakfast is defined as the first meal of the say, eaten before or at the start of daily activities (such as working, travelling, errands), usually within the first two hours after waking up, before 10 a.m. It is recommended that breakfast provide between 2.000 – 3.500 calories, or 20 to 35% of the total daily energy needed (Timlin & Pereira, 2007). Omitting breakfast is defined as not having breakfast more than three times a week (Shashirekha et al., 2023). These days, an increasing number of young people skip breakfast for variety of reason, including in a rush, feeling unable to eat in the morning, or purposefully skipping breakfast

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because they believe it can help them to lose weight. Skipping breakfast is a behavior that raises the risk of metabolic disorders like diabetes and cardiovascular diseases, decreased sleep quality, as well as reduced concentration and creativity (Timlin & Pereira, 2007) (Rampersaud et al., 2005). In adults, skipping breakfast is associated with a higher risk of overweight and obesity. Meanwhile, in young adults, it is associated with an increased risk of metabolic syndrome (Donin et al., 2014).

A study states that there is a relationship between breakfast consumption and better sleep quality at night. Breakfast with sufficient tryptophan content will produce serotonin, a potent antidepressant, and help maintain the diurnal rhythm in the morning. Hormone melatonin, which is produced at night and induces sleepiness, is synthesized by neurotransmitter serotonin in the pineal gland during the night, leading to better sleep quality (Shashirekha et al., 2023). The results of this study also found that individuals who have a habit of eating breakfast have better memory, problem-solving skills, and focus compared to those who do not eat breakfast. A potential mechanism is that the glucose obtained during breakfast helps in the production of neurotransmitters such as acetylcholine and dopamine. These neurotransmitters enhances mental processes, including focus, memory, and creativity (Shashirekha et al., 2023).

In addition to the frequency of breakfast, the quality of breakfast is also said to have an impact on daily energy, weight changes, and the risk of chronic metabolic diseases. Breakfast with high-fiber contain foods are preferable to those high in fat or cholesterol. Compared to foods high in fat and cholesterol, foods high in fiber provide a longer-lasting sense of fullness and satisfaction (Pasman et al., 2003) (Pai et al., 2005). This may be due to the activity of digestive hormones like cholecystokinin and other incretin hormones that can reduce glucose output in the liver and serum free fatty acids (FFA), as we as stimulate the secretion of glucagon-like peptide I, which regulates insulin sensitivity and secretion patterns, resulting in a feeling of fullness and reducing the risk of type 2 diabetes mellitus (Thorburn et al., 1993) (Venter et al., 1990) (Reimer et al., 1997) (Reimer & McBurney, 1996).

Most previous researches on the relationship between breakfast habits and the risk of metabolic diseases had been conducted on adults. A study by Astbury et al found higher glycemic responses in individuals who skipped breakfast and were given liquid preload and lunch (Astbury et al., 2011). Research on patients with type 2 diabetes mellitus by Jakubowicz et al showed higher glycemic responses in individuals who skipped breakfast after lunch and dinner without consuming extra calories compare to those who had breakfast (Jakubowicz et al., 2015). Currently, there is an increasing number of researches on this topic involving children and adolescents. Donin et al conducted a study on children aged 9 to 10 years old found lower fasting insulin levels and insulin resistance in participants who had breakfast with high-fiber cereal compared to those who had breakfast with low-fiber cereal, bread and biscuit-based breakfasts, and other types of foods (Donin et al., 2014). This research was conducted to examine whether there is a significant relationship between breakfast habits and blood sugar levels in healthy children.

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METHODS

This research conducted using a cross-sectional study design. The participants in this study are children that came for health check-ups at the Bakti Sosial event organized by Yayasan Bali Kuna Santi in Desa Selat, Karangasem, Bali. Total of 43 children who came were measured for weight, height, BMI, blood pressure, and blood sugar levels. Participants data collected including names, dates of birth, ages, participants education, parents occupations, school performance (whether they placing in the top three at school), and breakfast habits that divided into three categories always (having breakfast 7 times a week), sometimes (having breakfast 1 to 6 times a week), and never (not having breakfast at all a week). The inclusion criteria for this study are children participants (under the age of 18), consent from participants and parents to have their blood sugar levels checked with a glucometer, participants not suffering from chronic illnesses, and not being in a state of any illness at the time of examination. Data analysis was conducted using the SPSS program with a One-Way ANOVA test to examine the relationship between breakfast habits and blood sugar levels of the research participants. A p value <0.05 is considered statistically significant, whereas a p value >0.05 is considered not statistically significant.

RESULTS AND DISCUSSION

The characteristics of the participants in this study include a total of 43 children, with the youngest being 8 months old and the oldest 15 years old. In addition to blood sugar levels, baseline data was also collected (name, date of birth, age, participants education, parents education, parents occupation, and school performance), weight, height, breakfast habits, and blood pressure. All participants did not suffer from chronic diseases, congenital diseases, and were not ill at the time of the examination.

Table 1. Research Participants Characteristics

Characteristics		Total (N=43)	Percentage (%)
Child Sex	Boy	7	16.3
	Girl	36	83.7
Age	8 months – 10 years	22	51.2
	11 years – 15 years	21	48.8
Parents Education	SD	14	32.6
	SMP	7	16.3
	SMA and SMK	13	30.2
	D2 and S1	9	20.9
Participants BMI	Low (<18.5 kg/m^2)	26	63.4
	Normal (18.5 – 25 kg/m^2)	14	34.1
	High (>25 kg/m^2)	1	2.3

From a total of 43 children showed that there were more females (36 individuals, 83.7%) than males (7 individuals, 16.3%). The participants ages varied from 8 months to 15 years and were divided into two groups based on their age ranges: 8 months to 10 years and

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11 years to 15 years. According to the age characteristics of the participants, there were 22 individuals aged 8 months – 10 years (51.2%) and 21 individuals aged 11 years – 15 years (48.8%). The education level of the participants parents is classified into 4 categories: elementary school (14 people, 32.6%), junior high school (7 people, 16.3%), senior high school and vocational school (13 people, 30.2%), and associate degree and bachelor's degree (9 people, 20.9%). These findings indicate that elementary school is the most prevalent educational level among parents. The participants BMI findings were split into three groups: low BMI (26 individuals, 63.4%), normal BMI (14 individuals, 43.1%), and high BMI (1 individuals, 2.3%). Low BMI is the most prevalent group among the participants BMIs, which may be related to the parents educational level, leading to inadequate nutrition for the children due to the parents limited knowledge about nutrition. However, to confirm this hypothesis, further research must be conducted.

Table 2. SPSS Analysis Results

Factor	Always (7x a week)	Sometimes (3-6x a week)	Never (0x a week)	Sig.
Blood Sugar Levels	28 (65.1%)	10 (23.3%)	5 (11.6%)	.353
School Performance (Good)	14 (32.6%)	0	0	.003*
School Performance (Bad)	14 (32.6%)	10 (23.3%)	5 (11.6%)	

*p<0.05, SPSS ver. 29

The independent variable, which is the breakfast habit, is divided into 3 categories: Always (7 times a week), Sometimes (3-6 times a week), and Never (less than 3 times a week). The dependent variable is blood sugar levels measured on a numerical scale, while school performance is divided into 2 categories: Good (ranking in the top 3 at school) and Bad (not get ranking). The relationship between breakfast habits and blood sugar levels as well as school performance was analyzed using the One-Way ANOVA test in SPSS version 29. The homogeneity test yielded a p value of 0.859, indicating that the data distribution is homogeneous. The analysis continued with the One-Way ANOVA test, resulting in a p value for blood sugar levels of .353 (>0.05), which means there is a statistically significant relationship between breakfast habits and blood sugar levels. Meanwhile, the p value for school performance was .003 (<0.05), indicating a statistically significant relationship between breakfast habits and school performance.

The results of this research analysis found no statistically significant relationship between breakfast habits and blood sugar levels in healthy children. These findings are consistent with a study conducted on Taiwanese children, which also found no significant relationship between breakfast frequency and fasting blood sugar levels and triglyceride levels. this insignificant difference may be due to a compensatory response from insulin and other hormones to the increase in blood sugar levels (Ho et al., 2015). In addition, the likelihood of insulin resistance increases during adolescence instead of younger age, this may be the reason of this research results (Goran & Gower, 2001). The findings of this research are in contrast to the study conducted by Voronova et al. that found a significant relationship

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between the habit of skipping breakfast and disturbances in fasting blood sugar levels in healthy young adults individuals (Voronova et al., 2012). A prospective study in Sweden that predicted metabolic syndrome with central obesity and high fasting blood sugar levels found a correlation between poor breakfast habits in adolescence and metabolic syndrome in adulthood after a 27-year follow-up (Wennberg et al., 2015). Another study by Junior et al. found no significant relationship between skipping breakfast and obesity, but this result may be due to study participants were only consist of obese adolescents (Freitas Júnior et al., 2012). Research by Miyamura et al. found a significant relationship between skipping breakfast and prediabetes in adolescents, with the association being stronger in overweight adolescents (Miyamura et al., 2023).

The effect of skipping breakfast on glucose metabolism is greater in obese children because this condition increases insulin resistance and the risk of glucose intolerance (Verma). In a prolonged fasting state, energy sources come not only from gluconeogenesis and glycogen degradation but also from lipolysis, which increases the levels of free fatty acids (FFA) (Soeters et al., 2012). This increase affects glucose metabolism by disrupting insulin receptor signaling in skeletal muscles and liver, thereby increasing the likelihood of insulin resistance (Shulman). Another potential mechanism is disruption of the circadian rhythm. The hormones and enzymes involved in the metabolism of glucose are controlled by the circadian rhythm. The central circadian clock is located in the suprachiasmatic nucleus of the hypothalamus and is influenced by external light-dark cycles (Perelis et al., 2015), while peripheral circadian clock are found in pancreatic beta cells, muscles, adipose tissue, and liver, are influenced by meal timing and composition. Synchronization of central and peripheral circadian rhythms is associated with a decrease in insulin and glucagon-like peptide 1 (GLP-1) secretion, insulin resistance, beta cell proliferation, and beta cell apoptosis (Marcheva et al., 2010) (Brubaker & Gil-Lozano, 2016). To maintain normoglycemia, insulin resistance condition leads to hyperinsulinemia. Insulin resistance and hypersecretion compensation will strain the pancreatic beta cells if this condition develops gradually and over time. This will ultimately leading to beta cell failure, prediabetes, and eventually diabetes mellitus (Kalupahana et al., 2012).

The results indicated that there was a statistically significant relationship between breakfast habits and school performance. This suggests that those who eat breakfast on a daily basis more likely to perform better than those who skip it. This finding is consistent with the study conducted by Shashirekha et al., which found that individuals who regularly have breakfast exhibit better memory, problem-solving abilities, focus, and alertness compared to those who skip breakfast (Shashirekha et al., 2023). A study in Bekasi also found that students who have good breakfast habit achieve better academic performance (Said et al., 2024). Furthermore, research by Gajre et al. showed that compared to individuals who rarely or never have breakfast, those who regularly eat breakfast have better concentration, memory, and academic performance (Gajre et al., 2008).

The results of several different studies align with the findings of this research, in accordance with the limitations of the study. First, given that insulin resistance usually begins

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at an older age, one reason for the discrepancies in the results could be the paticipants age, which is younger than that of adolescents. Second, the lack of participants with an overweight BMI in this study prevented a comparison between normal dan overweight BMI, as conducted by Miyamura et al. Third, other metabolic syndrome parameters such as central obesity, fasting blood sugar levels, triglycerides levels, HbA1c levels, and insulin levels were not examined in this study. Fourth, the research participants breakfast components data were not collected, so we could not analyzed based on breakfast quality. Fifth, because the design of this study is cross-sectional, it is not possible to assess causal relationship between breakfast habits and blood sugar levels. Lastly, sixth, a small sample size cannot reflect a larger population.

CONCLUSION

The analysis of this study's data found no significant relationship between breakfast habits and blood sugar levels in healthy children. Meanwhile, the relationship between breakfast habits and school performance is statistically significant. These results may caused by several factors that should be considered for further research. Further studies with a larger sample size, experimental research design, and examination of more parameters are needed to validate the hypothesis of this research.

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