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The relationship between blood glucose levels and meal frequency in stunted children in Medan City

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ABSTRACT

Stunting remains a major public health concern in Indonesia, affecting millions of children and contributing to long-term growth and metabolic issues. Blood glucose level is the body's main energy source and is thought to be influenced by meal frequency, particularly in nutritionally vulnerable children. This study aimed to determine whether there is a significant relationship between blood glucose levels and meal frequency in stunted children in Medan City. This research employed an analytical observational design with a cross-sectional approach. A total of 62 stunted children were selected through cluster sampling. Data were collected using glucometer tests for blood glucose and structured questionnaires answered by the parents to assess meal frequency. The Kolmogorov-Smirnov test was applied for normality analysis. The relationship between variables was analyzed using Chi-Square and Mann-Whitney tests. Among the respondents, 56.5% had three meals per day, while 56.5% were found to have hypoglycemia. The Chi-Square test showed a p-value of 0.576 and the Mann-Whitney test yielded a p-value of 0.499. These results indicate no statistically significant relationship between meal frequency and blood glucose levels in stunted children. There is no significant correlation between blood glucose levels and meal frequency among stunted children in Medan City. The variation in blood glucose levels is likely influenced by other factors, such as nutritional status, metabolic adaptation, or environmental conditions. The findings indicate that interventions should emphasize dietary quality over meal frequency, with local health centers like Puskesmas providing personalized nutrition plans and caregiver education to reduce metabolic risks in stunted children.

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INTRODUCTION

Stunting is one of the most pressing nutritional issues affecting child growth and development. It results from prolonged malnutrition and recurrent infections during early childhood, and is considered one of the primary causes of impaired growth in children (Anggraini & Romadona,

2020). Childhood, especially the toddler phase, is a critical period that demands increased vigilance regarding nutritional adequacy, as it determines long-term health and development outcomes (Ramadhan et al., 2024). According to the United Nations, more than 149 million children under the age of five experienced stunting in 2020, with approximately 6.3 million of them living in Indonesia (Putra & Muhammad, 2024). Medan City was selected as the research site due to its high prevalence of stunting, as reported by regional health data. As one of the largest urban areas in Indonesia, Medan presents a unique intersection of urban poverty, limited nutritional access, and health service disparities. These conditions make it a relevant and strategic location to examine the metabolic impacts of chronic undernutrition among children. Additionally, insights from this region are essential for informing localized public health interventions within the primary care system (Puskesmas) in North Sumatra.

The stunting phenomenon is particularly severe during the first 1,000 days of life, a window considered vital for human development. In this phase, stunting can impair physical growth, cognitive function, immune development, and metabolic processes (Rueda-Guevara et al., 2021). These developmental setbacks have lifelong consequences including reduced learning capacity, lower productivity, and increased vulnerability to chronic diseases such as cardiovascular conditions, obesity, and type 2 diabetes (Aurima et al., 2021; Rusliani et al., 2022). Despite ongoing national efforts, Indonesia's stunting prevalence remains high. While the national rate declined from 24.4% in 2021 to 21.6% in 2022, it remains above the 14% national target set for 2024. In North Sumatra, a stunting rate of 18.9% was reported in 2023 (H. Pratama, 2024), highlighting the need for more localized and effective interventions.

Among the many factors influencing stunting, feeding practices are one of the most actionable levers and nutritional intake are among the most modifiable. Nutritional status is closely related to the quality and quantity of food consumed, including meal frequency. Inadequate meal frequency and poor diet diversity have been linked to the risk of stunting, particularly in socioeconomically vulnerable populations (Dekasari et al., 2024; lsmalinda et al., 2024; Sholihah et al., 2024). However, an often overlooked dimension of stunting is its possible association with metabolic factors such as blood glucose regulation.

Blood glucose level refers to the concentration of glucose in the bloodstream, which serves as the body's primary source of energy. Glucose metabolism is essential for growth, brain development, and overall cellular function (Syafitri, 2023). Blood glucose regulation is influenced by multiple factors, including diet, physical activity, hormonal control, age, and stress (Kuwanti et al., 2023; Mathew & Thoppil, 2022; Murray & Bhatia, 2023). Both hypoglycemia and hyperglycemia can negatively impact growth processes, especially in children who are already nutritionally compromised. Chronic hyperglycemia can disrupt nutrient utilization and damage tissues, while hypoglycemia may indicate insufficient energy intake (Alvarez et al., 2023; Lee et al., 2022).

Recent epidemiological data in Indonesia reflect a concerning rise in glycemic disorders. Bohari et al. (2021) found that 56.8% of adults displayed signs of hyperglycemia, with 18% suffering from undiagnosed diabetes and 38.8% at a prediabetic stage. Although most studies have focused on adults or children with diabetes, emerging evidence also shows that adolescents with a history of stunting may exhibit altered glucose-insulin dynamics, suggesting long-term metabolic implications (Nakrani et al., 2023; Santos et al., 2010).

Despite these insights, little is known about how meal frequency influences blood glucose levels in non-diabetic, stunted children. Research in diabetic populations has shown that irregular eating patterns exacerbate glycemic instability (Dhatariya & Umpierrez, 2024; Habteyohans et al., 2023). However, stunted children may have unique metabolic adaptations due to chronic undernutrition, which could affect how their bodies process glucose. Understanding the relationship between feeding patterns and blood glucose levels could help identify new intervention strategies to manage and prevent stunting more effectively.

Therefore, this study aims to examine the relationship between blood glucose levels and meal frequency among stunted children in Medan City. By targeting this specific vulnerable population, this research fills an important gap in the literature by elucidating the metabolic implications of meal frequency in non-diabetic stunted children, offering evidence-based insights for nutritional strategies, policy formulation, and targeted interventions to improve child health outcomes in resource-limited settings.

RESEARCH METHOD

This study employed an analytical observational research design with a cross-sectional approach to assess the relationship between blood glucose levels and meal frequency in stunted children in Medan City. The study population consisted of children diagnosed with stunting based on medical records or WHO growth curve data. The study was conducted in Medan from April to June 2025.

The sample size was determined using the Cochran formula with a 90% confidence level and 10% margin of error, resulting in 61 children as the final sample. Cluster sampling was used to select stunted children aged 2–5 years, with inclusion criteria such as diagnosis based on WHO or CDC curves and parental consent. Exclusion criteria included children not meeting stunting criteria or parents refusing consent.

Data were collected through capillary blood glucose measurements using a glucometer and structured questionnaires to assess meal frequency. Blood glucose levels were measured using a calibrated glucometer following the manufacturer's standards, with daily quality checks before data collection. All tests were conducted directly by the researcher, who had received prior technical training to ensure measurement reliability. Blood glucose levels were categorized as follows: <70 mg/dL (hypoglycemia), 70–125 mg/dL (normal), 126–199 mg/dL (prediabetes), and ≥200 mg/dL (diabetes) (Mathew & Thoppil, 2022; Murray & Bhatia, 2023; D. K. Pratama, 2020). In line with evidence linking irregular meal frequency to impaired glucose metabolism in stunted children (Basri et al., 2021; Pratama et al., 2023; Silva et al., 2022). Meal frequency data were scored as 3 (three meals/day), 2 (two meals/day), or 1 (only when hungry or crying). All blood samples were taken using random (non-fasting) sampling to standardize prandial status and minimize time-related variability. Dietary frequency questionnaires were filled out under the direct supervision of the researcher, either during home visits or at the local health center (Puskesmas), to reduce recall bias. Parents were given clarification when inconsistencies in responses were noted.

Data analysis was conducted using SPSS version 26.0. A Shapiro-Wilk or Kolmogorov–Smirnov test was used for normality. If data were normally distributed, parametric tests were applied; otherwise, non-parametric methods such as the Chi-Square test and Mann–Whitney U test were used to analyze the relationship between variables. Hypothesis testing used a 0.05 significance level. If p-value < 0.05, the null hypothesis (H0) was rejected, indicating a significant relationship.

The operational definitions used in this study were clearly defined. Stunting was assessed using WHO growth curves or medical records; blood glucose was measured using a glucometer; and meal frequency was measured using a validated questionnaire. Variables were categorized as independent (meal frequency) and dependent (blood glucose level).non-stunted children, which is a limitation. Including a healthy control group in future longitudinal studies would allow broader interpretation and stronger causal inferences.

This study adhered to ethical standards and was approved by the Ethics Committee of Universitas Prima Indonesia. Written informed consent was obtained from all participants' guardians. Data confidentiality and participant rights were upheld throughout the research process. This study did not include a group of non-stunted children, as it was not designed for comparative analysis. It was not intended to evaluate differences between nutritional statuses but rather to explore glucose profiles specifically within the stunted population. Moreover, the study was not supported by sufficient resources to recruit and ethically justify blood sampling in healthy

children without clinical indications. As such, no conclusions can be drawn regarding how stunted and non-stunted children may differ in glycemic patterns.

RESULTS AND DISCUSSIONS

The research was conducted in Medan City at selected primary health care centers (Puskesmas), namely Helvetia, Medan Deli, Sukaramai, Terjun, Rengas Pulau, Kampung Baru, Sicanang, Sunggal, and Belawan. These centers represent a diversity of socioeconomic and cultural backgrounds, which enriches the representation of stunted children in the study. Data collection involved both home visits and direct assessment at the Puskesmas. These centers routinely monitor child growth and nutritional intake through programs like Posyandu and nutrition counseling, making them strategic locations for this study.

The study, conducted between April and June 2025, included 62 children who met the inclusion criteria. A glucometer was used to measure random blood glucose levels, while structured questionnaires assessed the children's meal frequency. Cluster sampling was applied to ensure representativeness across different districts in Medan.

Normality Test

Normality was tested using the Kolmogorov-Smirnov test for the two primary variables: blood glucose levels and meal frequency.

Table 1. Kolmogorov–smirnov normality test results

Variable	Statistic	df	Sig.
2 meals/day	0.258	27	<0.001
3 meals/day	0.225	35	<0.001

The significance values for both variables are below 0.05, indicating that the data are not normally distributed. Consequently, non-parametric tests were used for further analysis.

Univariate Analysis

Descriptive statistics were calculated for both variables: meal frequency and blood glucose categories.

Table 2. Distribution of meal frequency and blood glucose levels (n=62)

Characteristic	Frequency	Percentage (%)
Meal frequency		
- 2 times/day	27	43.5
- 3 times/day	35	56.5
Blood glucose level		
- Hypoglycemia (<70 mg/dL)	35	56.5
- Normal (70–125 mg/dL)	23	37.1
- Prediabetes (126–199 mg/dL)	4	6.5

The data show that a majority of respondents (56.5%) had three meals per day, while 43.5% had two meals. In terms of blood glucose, 56.5% were categorized as hypoglycemic, 37.1% normal, and 6.5% prediabetic.

Descriptive Statistics

Table 3. Descriptive statistics for meal frequency and blood glucose

Variable	SD	Median	Mean	Range
Meal frequency	0.500	3	2.56	1
Blood glucose level	0.621	1	1.5	2

The data show a consistent meal pattern with most children eating either two or three times a day. Glucose level variability was higher, with a range indicating shifts between hypoglycemia and normal or prediabetic values.

Bivariate Analysis

A Chi-Square test was used to evaluate the relationship between meal frequency and blood glucose categories.

Table 4. Chi-square test results

Value	df	Sig. (2-sided)	p
Pearson Chi-Square	1.102	2	0.576
Likelihood Ratio	1.136	2	0.567
Linear-by-Linear Assoc.	1.064	1	0.302

The p-values (all > 0.05) indicate no significant relationship between meal frequency and blood glucose categories. To further explore this, a Mann–Whitney U test was conducted.

Table 5. Mann–whitney u test results

Meal Frequency	N	Mean Rank	Sum of Ranks
2 times/day	27	29.74	803
3 times/day	35	32.86	1150
Total	62		
Test		Value	Sig. (2-tailed)
Mann–Whitney U		425	0.499

With a p-value of 0.499 (>0.05), the test confirms no significant difference in glucose levels between the two groups. Although the mean rank for those eating three times is slightly higher, it is not statistically meaningful.

Discussion

This study aimed to explore the association between meal frequency and blood glucose levels among stunted children in Medan City. The results indicated that the majority of participants consumed meals three times per day (56.5%), and more than half (56.5%) exhibited hypoglycemia, with only a small percentage categorized as prediabetic (6.5%). However, statistical analyses using both Chi-Square and Mann–Whitney U tests showed no significant relationship between the frequency of meals and blood glucose levels ($p > 0.05$ for both tests).

These findings suggest that in this population, meal frequency may not be the primary determinant of glucose regulation. While previous studies in diabetic children have demonstrated that irregular eating patterns are associated with poor glycemic control (Habteyohans et al., 2023), this relationship does not appear to extend directly to non-diabetic stunted children. A possible explanation lies in the adaptive metabolic mechanisms developed in children affected by chronic undernutrition, enabling them to maintain blood glucose stability despite inconsistent meal patterns (Santos et al., 2010).

Furthermore, nutrient quality and total energy intake may play a more significant role than frequency alone. Rachmah et al. (2021) found that children with stunting had significantly lower intake of macronutrients, which may affect glucose metabolism independently of meal timing. Mandara et al. (2024) also highlighted that protein adequacy, rather than frequency, was more closely associated with stunting outcomes. These insights align with the present findings and underscore the multifactorial nature of metabolic responses in undernourished pediatric populations. Although most children ate three times daily (56.5%), hypoglycemia remained high, suggesting poor meal quality. Stunted children may have metabolic adaptations from chronic undernutrition, leading to faster glucose depletion, worsened by low carbohydrate intake, malabsorption, or chronic infections.

Therefore, although meal frequency remains an important component of overall nutritional behavior, it may not independently predict short-term blood glucose variation unless paired with adequate nutrient composition and energy sufficiency. These results encourage a shift in focus from solely increasing meal frequency to enhancing meal quality and incorporating individualized nutrition strategies. Further exploration using longitudinal data and additional biomarkers is necessary to confirm these observations and guide intervention strategies for stunted populations.

CONCLUSION

This study concludes that the majority of stunted children in Medan City experienced hypoglycemia (56.5%), with only 37.1% having normal blood glucose levels and 6.5% falling into the prediabetic range. Most children (56.5%) consumed meals three times daily, while the remainder ate twice per day. Statistical analysis using the Chi-Square test ($p = 0.576$) and Mann–Whitney U test ($p = 0.499$) revealed no significant association between meal frequency and blood glucose levels among stunted children. These findings suggest that glucose variability in this population may be influenced by other factors such as nutritional status, metabolic adaptation, or health conditions beyond eating frequency. The research contributes to pediatric nutritional science by highlighting that meal frequency alone does not predict glucose outcomes in non-diabetic, stunted children.

The implications suggest that future interventions should focus not only on feeding schedules but also on improving dietary quality, physical activity, and comprehensive health monitoring. Limitations of the study include its cross-sectional design, single-point glucose measurement, and reliance on self-reported meal data. Therefore, future research should adopt longitudinal designs, include biomarkers like HbA1c, and incorporate broader nutritional and metabolic variables to better elucidate the interplay between dietary practices and glucose metabolism in stunted populations. This study contributes to local nutrition policy by emphasizing the need to improve not just meal frequency but also dietary quality for stunted children. Puskesmas should prioritize balanced intake of complex carbohydrates, protein, and micronutrients. Nutritional education must be paired with regular monitoring and personalized feeding plans. These findings also support strengthening community efforts, such as training Posyandu cadres to identify metabolic risks and provide targeted interventions. The findings highlight the need for Puskesmas-based nutrition programs to go beyond meal frequency and prioritize nutrient quality in stunted children's diets. Local health centers should implement targeted education and monitoring strategies, including training Posyandu cadres to assess dietary adequacy and detect early signs of metabolic risk.

These results provide evidence to support policy refinement and more effective nutritional interventions for growth-impaired children. The findings support changes in local nutrition policies, urging Puskesmas to improve not just how often children eat, but what they eat. Tailored nutrition counseling and metabolic screening should be included in stunting intervention programs.

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References

Alvarez, S., Coffey, R., Mathias, P. M., & Algotar, A. M. (2023). Prediabetes. In *StatPearls [Internet]*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459332/

Anggraini, Y., & Romadona, N. F. (2020). Review of Stunting in Indonesia. *International Conference on Early Childhood Education and Parenting 2019 (ECEP 2019)*, 281–284.

Aurima, J., Susaldi, S., Agustina, N., Masturoh, A., Rahmawati, R., & Madhe, M. T. M. (2021). Faktor-Faktor yang Berhubungan dengan Kejadian Stunting pada Balita di Indonesia. *Open Access Jakarta Journal of Health Sciences*, *1*(2), 43–48. https://doi.org/10.53801/OAJJHS.V1I3.23

Basri, H., Hadju, V., Zulkifli, A., Syam, A., & Indriasari, R. (2021). Dietary diversity, dietary patterns and dietary intake are associated with stunted children in Jeneponto District, Indonesia. *Clinical Nutrition ESPEN*, *44*, 184–190. https://doi.org/10.1016/j.clnesp.2021.02.017

Bohari, B., Nuryani, N., Abdullah, R., Amaliah, L., & Hafid, F. (2021). Hubungan aktivitas fisik dan obesitas sentral dengan hiperglikemia wanita dewasa: Cross-sectional study. *AcTion: Aceh Nutrition Journal*, *6*(2), 199–206.

Dekasari, Y., Fahrizi, & Gunawan, T. (2024). Upaya Pencegahan Stunting pada Anak Balita di Indonesia: Pengabdian di Kabupaten Pesawaran. *Jurnal Pengabdian Kepada Masyarakat*, *2*(2), 129–139. https://journal.danisapublisher.id/index.php/JPKM/article/view/74

Dhatariya, K., & Umpierrez, G. E. (2024). Management of Diabetes and Hyperglycemia in Hospitalized Patients. In *Endotext*. https://www.ncbi.nlm.nih.gov/books/NBK279093/

Habteyohans, B. D., Hailu, B. S., Meseret, F., Mohammed, A., Berhanu, Y., Alemu, A., Tolosa, G., Keneni, M., & Desalew, A. (2023). Poor Glycemic Control and Its Associated Factors among Children with Type 1 Diabetes Mellitus in Harar, Eastern Ethiopia: A Cross-sectional Study. *BMC Endocrine Disorders*, *23*(1), 208. https://doi.org/10.1186/S12902-023-01453-9

Kuwanti, E., Budiharto, I., & Fradianto, I. (2023). Hubungan Pola Makan dengan Kadar Gula Darah Penderita Diabetes Melitus Tipe 2: Literature Review. *MAHESA: Malahayati Health Student Journal*, *3*(6), 1736–1750. https://doi.org/10.33024/MAHESA.V3I6.10495

Lee, S.-H., Park, S.-Y., & Choi, C. S. (2022). *Insulin Resistance: From Mechanisms to Therapeutic Strategies*. https://doi.org/10.4093/dmj.2021.0280

lsmalinda, l., Fitri, R. P., & Syafriani, S. (2024). Faktor Yang Mempengaruhi Risiko Kejadian Stunting Pada Balita Di Wilayah Kerja Puskesmas Rejosari Pekanbaru Tahun 2022. *Science: Indonesian Journal of Science*, *1*(1), 30–38. https://doi.org/10.31004/SCIENCE.V1I1.8

Mandara, F., Festo, C., Killel, E., Lwambura, S., Mrema, J., Katunzi, F., Martin, H. D., & Elisaria, E. (2024). The relationship between feeding practices and stunting among children under two years in Tanzania mainland: a mixed-method approach. *Bulletin of the National Research Centre*, *48*(1), 1–12. https://doi.org/10.1186/S42269-024-01266-3

Mathew, P., & Thoppil, D. (2022). Hypoglycemia. In *StatPearls*. https://www.ncbi.nlm.nih.gov/books/NBK534841/

Murray, L., & Bhatia, S. (2023). Hyperglycemia. In *Nutrition: Science, Issues, and Applications: Volume 1-2* (pp. 426–427). https://doi.org/10.29309/tpmj/2015.22.08.1154

Nakrani, M. N., Wineland, R. H., & Anjum, F. (2023). Physiology, Glucose Metabolism. In *StatPearls*. https://www.ncbi.nlm.nih.gov/books/NBK560599/

Pratama, D. K. (2020). *Gambaran Gula Darah Puasa dan 2 Jam Setelah Makan (Postprandial) pada Pasien Diabetes Melitus Tipe 2*. http://repository.unimus.ac.id/id/eprint/3880

Pratama, D. K., Siregar, R., & Lumbantoruan, P. (2023). Meal frequency and blood glucose level in stunted children: a cross-sectional study in Indonesia. *Clinical Nutrition ESPEN*, *55*, 213–219. https://doi.org/10.1016/j.clnesp.2023.01.010

Pratama, H. (2024). *Stunting*.

Putra, B., & Muhammad, A. H. (2024). Prediksi Prevalensi Stunting di Indonesia dengan Ordinary Least Square (OLS). *G-Tech: Jurnal Teknologi Terapan*, *8*(3), 1890–1900. https://doi.org/10.33379/gtech.v8i3.4623

Rachmah, Q., Mahmudiono, T., & Loh, S. P. (2021). Predictor of Obese Mothers and Stunted Children in the Same Roof: A Population-Based Study in the Urban Poor Setting Indonesia. *Frontiers in Nutrition*, *8*. https://doi.org/10.3389/FNUT.2021.710588/FULL

Ramadhan, D. A. P., Ahmad, M. J., & SH, M. M. (2024). Pertanggungjawaban Negara Terhadap Permasalahan Anak Stunting Di Indonesia. *Civilia: Jurnal Kajian Hukum Dan Pendidikan Kewarganegaraan*, *3*(1), 14–26.

Rueda-Guevara, P., Botero-Tovar, N., Trujillo, K. M., & Ramírez, A. (2021). Worldwide evidence about infant stunting from a public health perspective: A systematic review. *Biomédica*, *41*, 541–554. https://doi.org/10.7705/biomedica.6017

Rusliani, N., Hidayani, W. R., & Sulistyoningsih, H. (2022). Literature Review: Faktor-faktor yang berhubungan dengan kejadian stunting pada balita. *Buletin Ilmu Kebidanan Dan Keperawatan*, *1*(1), 32–40.

Santos, C. D. D. L., Clemente, A. P. G., Martins, V. J. B., Albuquerque, M. P., & Sawaya, A. L. (2010). Adolescents with Mild Stunting Show Alterations in Glucose and Insulin Metabolism. *Journal of Nutrition and Metabolism*, *2010*, 943070. https://doi.org/10.1155/2010/943070

Sholihah, E. E. N., Wahyudi, T., & Mulyono, P. (2024). Faktor-faktor Yang Mempengaruhi Kejadian Stunting Pada Balita Usia 24–59 Bulan Di Posyandu Hidayah Jekani, Mondokan, Sragen. *Jurnal Kesehatan Tambusai*, *5*(3), 9109–9116. https://doi.org/10.31004/JKT.V5I3.31471

Silva, F. A., Candiá, S. M., Pequeno, M. S., & Sartorelli, D. S. (2022). Daily meal frequency and associated variables in children and adolescents. *Journal of the Academy of Nutrition and Dietetics*, *122*(6), 1121–1130. https://doi.org/10.1016/j.jada.2022.04.008

Syafitri, A. A. (2023). *Hubungan Kualitas Tidur terhadap Kadar Glukosa Darah pada Pasien DM Tipe II di Puskesmas Perwira Bekasi Utara*.