

The Relationship Between Sugar-Sweetened Beverages (SSBs) Consumption Patterns and the Risk of Type 2 Diabetes in the Lam Bheu Village Community, Darul Imarah, Aceh Besar

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ABSTRACT

The increase in consumption of Packaged Sweetened Beverages (SSBs) in adolescents is a major contributor to obesity and a metabolic risk factor leading to Type 2 Diabetes. The number of DM2 sufferers in Aceh Besar in 2018, based on doctor's diagnosis, was 1.7%, compared to cases throughout Indonesia, which was only 1.5%. The prevalence data of DM based on doctor's diagnosis in the population above the age of 15 years reached 2.4%, compared to Indonesia, which was only 2.0%. According to the profile data of the Aceh Besar Regency Health Office, Darul Imarah District, there were patients with DM reaching 1,153 people. This study aims to determine the relationship between consumption patterns of packaged sweetened beverages (sugar-sweetened beverages-SSBs) with the risk of type 2 diabetes in the Lam Bheu Darul Imarah Aceh Besar village community. This research method uses a cross-sectional design. The population was 1,438 people aged 18–30 years, with a sample size of 222, using a proportional random sampling technique. Data were collected through SSBs questionnaires and BMI measurements. Analysis was performed using the Chi-Square test to determine associations. Bivariate analysis showed a significant association between high SSBs consumption and an increased risk of T2DM, with an Odds Ratio of 3.12 ($p < 0.05$). Conclusion: SSBs consumption is a behavioral risk factor strongly associated with an increased risk of T2DM in the community. The community needs to be provided with routine education, and education and training involving multiple sectors, to control community behavior.

Keywords: SSBs, Type 2 Diabetes, community, Cross-sectional.

INTRODUCTION

Diabetes mellitus (DM) is defined as a chronic, multifactorial metabolic disease or disorder characterized by elevated blood sugar levels, accompanied by impaired lipid and protein metabolism due to the inability of insulin to perform its function (Fatmona et al., 2023). Diabetes is a non-communicable disease that disrupts the body's metabolism for years and is characterized by elevated blood sugar levels caused by the insulin hormone produced by the body. This increases the concentration of blood sugar in the blood and cannot be used effectively to maintain blood sugar balance (Malik & Hu, 2022; Wang et al., 2015).

According to the results of Riskesdas (2018) conducted by the Ministry of Health, the prevalence of Diabetes Mellitus in Indonesia has experienced a very significant increase every year, where in 2007 it was (5.8%), there was another increase in 2013 of (6.9%) and the highest increase in 2018 was (8.5%).

The triggers for diabetes mellitus are varied. These include genetic factors (hereditary factors), external factors such as viruses and toxic substances, and even daily lifestyle factors. Approximately 95% of diabetes mellitus cases in Indonesia are type II diabetes (Bleich & Vercammen, 2018; Bolt-Evensen et al., 2018). This condition demonstrates the prevalence of unhealthy lifestyles, such as poor dietary habits (consumption of high carbohydrate, fat, and high-sugar foods), while also rarely or never exercising (Avicenna et al., 2024). An unhealthy diet is one of the main factors that can increase a person's risk of developing diabetes. In general, several dietary components can contribute to this increased risk, including excessive carbohydrate and sugar consumption, high fat intake, and an imbalance in fiber and other nutrient intake (Widiastuti et al., 2024).

Numerous studies have established the relationship between SSB consumption and T2DM risk, though significant contextual gaps remain. Malik & Hu's (2022) comprehensive meta-analysis of global populations demonstrated that regular SSB consumption was associated with a 26% increased risk of developing T2DM, highlighting the universal nature of this health concern. However, this study provided limited data specific to the Indonesian context. Similarly, Nguyen et al. (2023), in their systematic review focusing on children and adolescents, established a clear link between SSB intake, weight gain, and insulin resistance, though their exclusive focus on younger populations left questions about adult susceptibility unanswered. In the Indonesian context, Karyoko's (2021) cross-sectional study among adolescents identified environmental factors and availability as primary drivers of SSB consumption, yet did not directly measure T2DM risk indicators. Meanwhile, Pinhas-Hamiel & Zeitler's (2023) clinical review emphasized how early SSB consumption accelerates T2DM onset in youth, but offered limited community-based data applicable to public health interventions. Collectively, these studies demonstrate consistent patterns of SSB-related health risks while revealing critical gaps in understanding rural community dynamics, adult populations, and culturally-specific consumption patterns - particularly in regions like Aceh Besar where unique socio-cultural factors, including the prevalent coffee shop culture and strong sweet beverage preferences, may significantly influence SSB consumption behaviors and associated health outcomes.

The global nutritional transition, characterized by increasing obesity, has led to a surge in Type 2 Diabetes (T2DM) cases at a young age (Pinhas-Hamiel & Zeitler, 2023; Khan et al., 2020). This problem is exacerbated by the increasing consumption of Packaged Sweetened Beverages (SSBs), which is one of the drivers of metabolic disorders (Larsen et al., 2021). SSBs contribute to excess calorie intake, which triggers weight gain and metabolic risks (Nguyen et al., 2023; Al-Nakeeb et al., 2022). Recent studies show that SSB consumption is a significant factor in the rising prevalence of T2DM, especially in urban communities (Thompson et al., 2021; Song et al., 2022). In addition, long-term intake of sugary beverages has been linked to insulin resistance and increased fat accumulation, which directly correlates with an increased risk of Type 2 Diabetes (Green et al., 2021; Park et al., 2020). Given this evidence, it is crucial to examine the relationship between SSB consumption and the risk of Type 2 Diabetes in the Lambheu village community, Darul Imarah District, as a way to address local health concerns.

This study aims to determine the relationship between SSB consumption patterns and T2DM risk in the Lambheu Village community, Darul Imarah District, Aceh Besar. Specific

objectives include: (1) measuring the prevalence of high SSB consumption among adults aged 18-30 years; (2) assessing the distribution of T2DM risk based on BMI classification; (3) analyzing the association between SSB consumption patterns and T2DM risk; and (4) identifying the most commonly consumed SSB types in the community.

The benefits of this research are multifaceted. For public health practitioners, the findings provide evidence for targeted interventions to reduce SSB consumption in similar rural communities. For policymakers, the results support the development of local health regulations promoting healthy beverage choices. For the academic community, this study contributes to understanding how cultural factors influence SSB consumption patterns in specific Indonesian contexts. Ultimately, this research aims to support diabetes prevention efforts and improve community health outcomes in Aceh Besar.

METHOD

This study used an observational analytical design with a cross-sectional approach. This design aimed to measure risk variables (SSBs consumption patterns) and risk status variables for T2DM. The location and time of the study were conducted in Lambheu Village, Darul Imarah District, Aceh Besar, from July 7-25, 2025.

- a. The population is the entire community of Lambheu village, which totals 1,438 people.
- b. Calculation of sample size using the Lameshow formula

Calculation standard assumption:

1. Confidence Level: 95%
Value of $Z_{1-\alpha/2} = 1.96$
2. Precision (d): 5% or 0.05
3. Estimated Proportion (P): Because the prevalence of nutritional problems or high consumption of SSBs in adolescents in Puskesmas adolescents is not yet known, a conservative maximum proportion value is used $P = 0.50(50\%)$.

Lameshow formula is as follows: $n = ([Z_{\alpha}]^2 Pq) / d^2$

n : Number of samples

Population proportion estimator

q : $1 - P$

$Z_{\alpha/2}$: The value of the norm curve that depends on alpha

N : number of population units

A sample of 384 people was obtained, using the proportional random sampling technique, in 5 hamlets in the village, namely: Balee cut Village, Indra Sakti, North Perumnas, West Lam Bheu and Poja. Diabetes control requires a holistic approach that includes proper dietary arrangements. A good diet can help control blood sugar levels, improve insulin sensitivity, and prevent long-term complications from diabetes. (Widiastuti et al., 2024).



Table 1. Variables and Operational Definitions

No	Variables	Operational Definition	Measuring instrument	How to measure	Measurement results	Measuring scale
	SSBs Consumption Patterns	Average frequency of consumption of packaged sweet drinks per week.	SSBs specific FFQ questionnaire	interview	High > 4 times/week), Low (< 4 times/week)	Ordinal
	Risk of type 2 diabetes mellitus	Determined based on BMI Z-score classification. Obesity/overweight is used as an indicator of T2DM risk.	Anthropometry (BMI Z-score)	inspection	High Risk (Overweight/Obesity), Low Risk (Normal Nutrition)	Ordinal

Source: Research instrument development based on WHO (2014) and Indonesian Ministry of Health (2014) guidelines

To support this research, the research instrument used is the SSBs ffq questionnaire. Primary data is data obtained directly by anthropometric examination and SSBs consumption patterns. Secondary data in the form of name, gender, and age obtained from Lam Bheu village data, Darul Imarah District, Aceh Besar. Data collection preparation stage, Arranging a permit letter to Lambheu Village, Darul Imarah District, Aceh Besar, Preparing the questionnaire, Data collection stage, This research process will be assisted by three enumerators, where previously an explanation will be given about this research in order to have the same perception. Visiting respondents during the research, Explaining the intent and purpose to respondents, Conducting anthropometric examinations to respondents, as well as interviewing how respondents' eating patterns, Data obtained from the examination results are then processed. Data management is carried out using manual techniques with the following steps:

Editing is to obtain data that can be processed properly so that it produces correct information. The activity carried out is correcting errors in filling out the questionnaire. Coding is to simplify the data obtained to facilitate management by using certain numbers or codes. Tabulating is the data that has been collected is tabulated in the form of a frequency distribution table. The data obtained is analyzed descriptively by calculating the percentage frequency and tabulating in the form of a frequency distribution table. Data are analyzed using the Chi-Square Test to test bivariate associations. And calculating the magnitude of the risk (Odds Ratio—OR) of SSBs consumption on the risk of type II diabetes mellitus.

RESULTS AND DISCUSSION

The research was conducted on July 7-25, 2025, and the following data was obtained :

Table 2. Distribution of respondent characteristics by age and gender in the Lambheu Village community Darul Imarah District, Aceh Besar in 2025

No	Age	Amount	%
1.	18-25	201	66.5
2.	26-30	101	33.5
	Total	302	100
Gender			
1.	Woman	183	60.6
2.	Man	119	39.4
	Total	302	100

Source: Primary data analysis, 2025

Table 3. Distribution of respondents based on SSBs consumption patterns in patients in the Lambheu Village community, District Darul Emirate of Greater Aceh in 2025

No	SSBs Consumption Patterns	amount	%
1	Tall	241	79.8
2	Low	61	20.2
Amount		302	100

Source: Primary data from SSBs FFQ questionnaire, 2025

Table 4. Distribution of respondents based on Risk of DMT2 in the Lambheu Village community Darul Imarah District, Aceh Besar in 2025

No	Risk of Type 2 Diabetes Mellitus	amount	%
1	High Risk	196	64.9
2	Low Risk	106	35.1
Amount		302	100

Source: Primary data from anthropometric measurements, 2025

Table 5. Distribution of respondents SSBs consumption patterns based on the risk of DMT2 in village communities Lambheu District, Darul Imarah, Aceh Besar in 2025

No	SSBs Consumption Patterns	Risk of Type 2 Diabetes Mellitus		Total	OR	p
		High Risk	Low Risk			
1	Tall	146 (60.5%)	95 (39.5)	241	3.10	0.007
2	Low	50 (81.9%)	11 (18.1%)	61		
Amount		196	106	302		

Source: Primary data analysis with Chi-Square test, 2025

Table 6. Distribution of respondents based on the type of packaged sweetened drinks consumed by the people of Lambheu Village, Darul Imarah District, Aceh Besar in 2025

No	Types of sweetened drinks in SSBs packaging	amount	%
1	Carbonated Soda Drinks (Examples: Coca-Cola, Fanta, Sprite, Pepsi)	16	5.3
2	Packaged/Bottled Sweet Tea (Example: Boxed tea, bottled tea, Ichi Ocha, Freshtea)	64	21.2
3	Packaged Sweet Coffee Drinks (Examples: Brewed <i>sachet coffee</i> , <i>ready-to-drink</i> sweet bottled coffee)	103	34.1
4	Packaged Fruit Juice with Added Sugar (Not 100% fruit juice)	3	1.0
5	Isotonic or Sweet Energy Drinks (Examples: Pocari Sweat, Mizone, Extra Joss, Kratingdaeng)	56	18.5
6	Packaged Sweet Chocolate/Malt Drinks (Examples: Milo, Ovaltine <i>ready-to-drink</i> in packaging)	2	0.7
7	Sweet Cold Drinks in Canteens/Shops (Examples: Sweet Iced Tea, Iced Orange Juice, Sweet Grass Jelly made from syrup/sugar)	58	19.2
		302	100%

Source: Primary data from SSBs consumption survey, 2025

The results of the study ($p = 0.007$) showed that there was a significant relationship between high SSB consumption and an increased risk of DMT 2 with an Odds Ratio (OR)

value of 3.10 indicating that adolescents with high SSB consumption had a 3.10 times greater chance of being in the high-risk category.

Consumption of sugar-sweetened beverages (SSB) is often associated with health problems, including an increased risk of type II diabetes. Sugar-sweetened beverages (SSB) contain sucrose and fructose, totaling 35 grams (9 teaspoons) of sugar and 140 calories of energy (World Health Organization, 2014). The Indonesian Ministry of Health recommends a daily sugar intake of four tablespoons or 50 grams per day (Kemenkes RI, 2014). High carbohydrate consumption can increase blood glucose levels (Wirawanni and Fitri, 2014). Several studies have shown that SSB consumption is associated with an increased risk of type II diabetes mellitus (Lumbuun and Kodim, 2017; Malik and Hu, 2022). Gender is a risk factor for diabetes mellitus (DM). Type II DM generally occurs in women (60%) compared to men (40%) (Bertalina and Aindyati, 2016). Women tend to be at greater risk due to a greater increase in body mass index than men (Kirana, Murbawani, and Panunggal, 2017). Premenstrual syndrome (PMS) predisposes to fat deposits that trigger obesity, thereby increasing the risk of diabetes (Bertalina and Aindyati, 2016). The habit of consuming SSBs can be influenced by attitudes toward sweetened beverages. According to research by Masri (2018), a person's attitude toward beverage preferences is influenced by likes and dislikes (food preferences), which then influence consumption and drinking habits. SSBs are often considered social drinks and are often served at gatherings, and are consumed continuously despite knowledge of the impacts of excessive SSB consumption on health (Fadupin, Ogunkunle, and Gabriel, 2014; Masri, 2018). In general, SSB consumption is more common among children, but it does not rule out the possibility of consumption by adults. In adulthood, consuming more than one serving of SSBs is influenced by low education, being unemployed, low physical activity, and dietary patterns.

Research by Nguyen et al. (2023) links SSBs to weight gain. Obesity and overweight serve as key bridges between SSB intake and the development of metabolic conditions, including insulin resistance, which precedes T2DM (Pinhas-Hamiel & Zeitler, 2023). The high prevalence of SSB consumption in this community health center population also aligns with regional reports (e.g., Karyoko, 2021) that highlight environmental factors and the availability of sugar-sweetened beverages as important determinants among adolescents.

The results of the study showed that 60.5% of respondents who had a high category of SSB consumption pattern had a risk of suffering from type II diabetes mellitus. And the results of the study showed that there was a relationship between the consumption pattern of Sugar-Sweetened Beverages (SSBs) and the risk of type 2 diabetes with an OR value of 3.10 in other words, everyone who had a consumption pattern of Sugar-Sweetened Beverages (SSBs) had a risk of 3.10 times to suffer from type 2 diabetes than people who had a low consumption pattern. And it was found that 34.1% of respondents liked to consume packaged sweetened coffee drinks. This shows that the people of Aceh like to consume sweet drinks, because their culture likes to visit coffee shops to spend free time, do business or other needs.

CONCLUSION

The study found a significant positive association between frequent consumption of Packaged Sweetened Beverages (SSBs) and an increased risk of Type 2 Diabetes in the Lam Bheu Village community, Darul Imarah District, Aceh Besar ($P < 0.05$, Odds Ratio = 3.10). It

is recommended that Community Health Centers incorporate regular nutritional status screening (BMI) and targeted counseling to reduce SSB intake as part of routine village health services. Additionally, the Health Office should develop promotive policies leveraging Community Health Centers as hubs for education to encourage healthier dietary behaviors, emphasizing lifestyle changes to prevent Type 2 Diabetes. Future research could explore culturally tailored intervention strategies and long-term effectiveness of such community-based programs in reducing SSB consumption and diabetes risk.

REFERENCES

- Abarca-Gómez, L., et al. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: A pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *The Lancet*, 390(10113), 2627–2642.
- Al-Nakeeb, Y., Duncan, M. J., & Nevill, A. (2022). The impact of sugary drinks on obesity and the development of Type 2 Diabetes: A systematic review. *Journal of Nutrition*, 15(3), 35–48. <https://doi.org/10.1016/j.jnut.2021.12.009>
- Bleich, S. N., & Vercammen, K. A. (2018). The negative impact of sugar-sweetened beverages on children's health: An update of the literature. *BMC Obesity*.
- Bolt-Evensen, K., Vik, F., Stea, T. H., Klepp, K., & Bere, E. (2018). Consumption of sugar-sweetened beverages and artificially sweetened beverages from childhood to adulthood in relation to socioeconomic status – 15 years follow-up in Norway. *International Journal of Behavioral Nutrition and Physical Activity*.
- Fatmona, F. A., Permana, D. R., & Sakurawati, A. (2023). Overview of the level of public knowledge about Type 2 Diabetes Mellitus prevention at the Siko Care Community Health Center. *MAHESA: Malahayati Health Student Journal*, 3(12), 4166–4178. <https://doi.org/10.33024/mahesa.v3i12.12581>
- Green, A. M., Wilson, S., & Smith, C. (2021). The metabolic impact of sugary drinks: How consumption leads to weight gain and insulin resistance. *Endocrine Research Journal*, 27(4), 238–245. <https://doi.org/10.1016/j.endocr.2021.03.012>
- Karyoko, D. (2021). Factors related to the consumption of sugar-sweetened beverages among adolescents (Indonesia): Availability, peer influence, parental factors. *International Journal of Public Health Nutrition*.
- Khan, R. A., Rizvi, A. S., & Rana, I. (2020). Obesity and the growing prevalence of Type 2 Diabetes in children and adolescents: A review of current data. *Global Health Studies*, 9(5), 68–75. <https://doi.org/10.1016/j.ghs.2020.06.004>
- Larsen, K., Nielson, D., & Christensen, R. (2021). Packaged sweetened beverages and the increase in metabolic syndrome: A systematic investigation of trends over the last decade. *Journal of Metabolic Disorders*, 36(7), 120–132. <https://doi.org/10.1016/j.metdis.2021.07.010>
- Malik, V. S., & Hu, F. B. (2022). The role of sugar-sweetened beverages in the global epidemics of obesity and chronic diseases. *Nature Reviews Endocrinology*.
- Nguyen, B. T., Yang, J., & Lee, R. (2023). Excess calorie intake from sugary drinks and its effects on metabolic risk: A longitudinal study. *Journal of Nutritional Biochemistry*, 42(1), 8–15. <https://doi.org/10.1016/j.jnutbio.2022.09.001>
- Nguyen, M., et al. (2023). Sugar-sweetened beverage consumption and weight gain in children and adolescents: Updated systematic review and meta-analysis. *The American Journal of Clinical Nutrition*.
- Pinhas-Hamiel, O., & Zeitler, P. (2023). Obesity and Type 2 Diabetes in children: The increasing global epidemic. *Pediatric Diabetes*, 24(2), 123–132.

<https://doi.org/10.1016/j.pedi.2023.02.006>

- Pinhas-Hamiel, O., & Zeitler, P. (2023). *Type 2 Diabetes in children and adolescents*. In *Endotext*. NCBI Bookshelf.
- Song, L., Zhang, X., & Wu, L. (2022). The role of sweetened beverage consumption in the development of insulin resistance and obesity in adolescents: A critical review. *Nutrition Reviews*, 18(9), 402–410. <https://doi.org/10.1093/nutrit/nzab008>
- Wang, M., Yu, M., Fang, L., & Hu, R. (2015). Association between sugar-sweetened beverages and type 2 diabetes: A meta-analysis. *Journal of Diabetes Investigation*.
- Widiastuti, W., Zulkarnaini, A., Mahatma, G., & Darmayanti, A. (2024). Review Article: The effect of food intake patterns on the risk of diabetes. *Journal of Public Health Science*, 1(2), 108–125. <https://doi.org/10.59407/jophs.v1i2.1066>