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Original article

Salivary glucose levels and estimation of food intake in type 2 diabetes mellitus patients

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ABSTRACT

Background: *Saliva, an easily collectible organic fluid, offers a noninvasive means for multiple samplings to determine salivary glucose levels, comparable to blood and potentially helpful in diagnosing and monitoring type 2 diabetes mellitus.* ***Purpose:*** *This research was carried out to determine the value of salivary glucose levels and food intake in patients with type 2 diabetes mellitus.* ***Methods:*** *This research utilized a descriptive quantitative method with a cross-sectional approach. The study population comprised type 2 diabetes mellitus patients in Bandung and Jatinangor. The samples, consisting of 27 individuals from each group—type 2 diabetes mellitus patients and healthy participants—were collected through purposive sampling. Saliva was collected using the spitting method and measured to determine salivary glucose levels (mg/dL). Food intake per day (in grams) was assessed using a semi-quantitative food frequency questionnaire and converted using NutriSurvey 2007.* ***Results:*** *Among the 27 participants with type 2 diabetes mellitus, salivary glucose levels were found to be ≥2 mg/dL (mean 23.47 mg/dL), whereas in the healthy group, 5 participants (18.5%) exhibited salivary glucose levels <2 mg/dL (mean 8.29 mg/dL). Most type 2 diabetes mellitus patients and healthy participants reported food intake below the Indonesian dietary recommendations.* ***Conclusion:*** *In our limited sample, salivary glucose levels in type 2 diabetes mellitus patients were higher compared to healthy participants. Energy intake in both groups showed similar results. Salivary glucose levels and BMI exhibited a correlation, though notably weak in this study.*

Keywords: *food intake; salivary glucose levels; type 2 diabetes mellitus*
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INTRODUCTION

Diabetes mellitus is a chronic condition that requires continuous health maintenance by mitigating multifactorial risks in addition to glucose control.[1] According to estimates provided by the International Diabetes Federation (IDF), there were 536.6 million people aged 20–79 years worldwide with diabetes in 2021, corresponding to a prevalence rate of 10.5% of the total population in the same age group. Based on IDF data, Indonesia ranks fifth in terms of the highest number of diabetes cases globally, with 19.5 million people.[2] Basic Health Research (RISKESDAS) collected data on people with diabetes mellitus in Indonesia in 2018, obtaining a prevalence of 2% based on a doctor's diagnosis.[3] This figure shows an increase compared to the 2013 RISKESDAS findings, which reported a 1.5% prevalence among the population aged ≥15 years.[4] The prevalence in West Java Province also increased, from 1.3% in 2013 to 1.7% in 2018.[3–5]

Diabetes mellitus is a metabolic disorder commonly characterized by elevated blood glucose levels that exceed normal limits, a condition known as hyperglycemia. Chronic hyperglycemia in diabetes is associated with organ dysfunction, impaired salivary gland function, and persistent damage that causes alterations in salivary composition.[6] Diabetes may also lead to changes in oral conditions, such as xerostomia.[7] Saliva is an organic fluid that is easy to collect in a noninvasive way, allowing for multiple samplings to assess salivary glucose levels.[8] It is an exocrine fluid containing water, electrolytes, and various proteins such as enzymes, immunoglobulins, albumin, polypeptides, and biomarkers suitable for rapid tests. Saliva is functionally comparable to blood and reflects the body's physiological status, making it a potential

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indicator for diagnosing and monitoring type 2 diabetes mellitus.[8,9]

Type 2 diabetes mellitus is caused by a decrease in insulin secretion by the pancreas, resulting in elevated blood glucose.[10] Other contributing factors include genetics and lifestyle.[3] Lifestyle factors include diet, age, obesity, insulin resistance, physical activity, and unhealthy habits. Unhealthy lifestyles, such as the consumption of sugary foods and drinks and excessive food intake, can lead to uncontrolled calorie intake, which quickly contributes to obesity. Being overweight or obese increases the risk of developing diabetes. Food intake is one of the modifiable risk factors for type 2 diabetes mellitus and affects obesity, postprandial glucose levels, and insulin resistance.[11] Macronutrients that influence postprandial glucose levels include carbohydrates, protein, fat, and fiber. Therefore, every diabetes patient needs to follow an appropriate diet.[12,13]

Increased blood glucose levels can lead to elevated salivary glucose levels.[14] Glucose levels in saliva are considered one of the noninvasive diagnostic methods for diabetes mellitus. Salivary glucose levels can also be used for general screening to identify prediabetes and undiagnosed diabetes.[15]

Proper food composition and selection can help control blood glucose levels, which show a positive correlation with salivary glucose in diabetes patients. Hence, they have a beneficial impact on long-term health.[13] Diabetes patients tend to have higher salivary and blood glucose levels due to biochemical changes.[16] Although numerous studies have explored salivary glucose levels, blood glucose levels, and food intake in individuals with type 2 diabetes, there is limited research specifically addressing the relationship between salivary glucose levels and food intake. Therefore, this study was conducted to determine the value of salivary glucose levels and food intake in type 2 diabetes mellitus patients, and to assess the correlation between salivary glucose levels and food intake.

MATERIALS AND METHODS

This quantitative study uses a descriptive observational design with a cross-sectional approach. The population consisted of type 2 diabetes mellitus patients in the Bandung and Jatinangor areas. The sampling method was purposive sampling, based on the criteria of outpatients diagnosed with type 2 diabetes mellitus by doctors at the research site and who had received education regarding the condition. The minimum sample size required for the study was determined using the sample size formula for estimating a population mean. The research sample included 27 patients with type 2 diabetes mellitus and 27 healthy participants who met the predetermined inclusion and exclusion criteria.

The inclusion criteria for type 2 diabetes mellitus patients were individuals aged 20–65 years. The exclusion criteria were a history of other systemic diseases (such as hypertension or HIV), smoking, a salivary flow rate below 0.1 ml/min, and receiving insulin injections. For healthy participants, the inclusion criteria were age 20–40 years, and the exclusion criteria were the same as for the diabetes group: history of systemic diseases (hypertension and HIV), smoking, and salivary flow rate below 0.1 ml/min.

The study was conducted in December 2023 at the Puter Public Health Center, Ibrahim Adjie Public Health Center, and Mitra Sehati Clinics. The data collected included salivary glucose levels and food intake. Type 2 diabetes patients and healthy participants were asked to come to the clinic or public health center in the morning. The procedure began with obtaining informed consent, followed by an interview on food intake, physical and systemic examination—including body weight and height for BMI calculation—and blood pressure measurement. Saliva and blood samples were also collected. Blood samples were drawn by an experienced nurse for the purpose of HbA1c testing.

Saliva, obtained using the spitting method, was collected every 1 minute for 5 minutes into a centrifugation tube.[6] Salivary glucose levels were then measured using the O-Toluidine reagent method and spectrophotometry at a wavelength of 630 nm.

Participants were interviewed regarding their intake of carbohydrates, protein, fat, and energy using a semi-quantitative food frequency questionnaire. This questionnaire included 30 types of Indonesian food items, with questions about how frequently they were consumed per day, week, or month, in line with nutritional targets for the Indonesian population. Based on these food types, participants estimated their meal portions using standard household sizes, which were then converted into grams using the 2007 version of NutriSurvey software to determine nutritional intake.

The data from the study were analyzed descriptively and using Pearson's correlation test, presented in tabular form. The Universitas Padjadjaran Research Ethics Committee approved this research under number 1437/UN6.KEP/EC/2023.

RESULTS

Table 1 shows that there were more female than male participants among both the diabetes mellitus and healthy groups. Based on age, it can be seen that among all type 2 diabetes mellitus patients aged 20–69 years, participants aged 60–69 years (48.2%) had the largest percentage, followed by those aged 40–49 years (29.6%). The largest number of healthy participants were in the 20–29 age range, with 26 participants (96.3%).

Based on the physical characteristics presented in Table 2, it can be seen that most type 2 diabetes mellitus patients had a normal Body Mass Index (BMI) (44.4%) or were overweight (37.0%). Regarding systemic characteristics in type 2 diabetes mellitus patients based on the duration

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of illness, participants with less than 5 years of diabetes (51.9%) showed the largest percentage. Based on blood pressure parameters, most type 2 diabetes mellitus patients fell into the hypertension stage 1 category (77.8%), whereas the healthy participants showed the highest percentage in the normal category (55.6%). Most type 2 diabetes mellitus patients had HbA1c levels in the diabetes category (88.9%). In comparison, the largest percentage of healthy participants belonged to the normal category (55.6%), followed by the prediabetes category (44.4%).

According to the data presented in Table 3, all type 2 diabetes mellitus patients had salivary glucose levels ≥ 2 mg/dL. In comparison, a greater percentage of healthy participants had salivary glucose levels ≥ 2 mg/dL (81.5%) than < 2 mg/dL (18.5%). The results indicate that both groups recorded lower quantities of total carbohydrate, protein, fat, and energy intake.

Table 4 shows the correlation of salivary glucose levels with BMI and energy intake in type 2 diabetes mellitus and healthy participants. Statistical analysis showed that

Table 1. Frequency distribution of demographic data of research participants

Variable	Category	Type 2 Diabetes Mellitus n = 27	Healthy Participant n = 27
Sex	Male	6 (22.2%)	9 (33.3%)
	Female	21 (77.8%)	18 (66.7%)
Age (years)	20–29	0 (0%)	26 (96.3%)
	30–39	0 (0%)	1 (3.7%)
	40–49	8 (29.6%)	0 (0%)
	50–59	6 (22.2%)	0 (0%)
	60–69	13 (48.2%)	0 (0%)

Table 2. Frequency distribution of physical and systemic characteristics of research participants

Variable	Category	Type 2 Diabetes Mellitus n = 27	Healthy Participant n = 27
Physical Characteristics			
BMI (kg/m^2)	Underweight	0 (0%)	4 (14.8%)
	Normal	12 (44.4%)	15 (55.6%)
	Overweight	10 (37.0%)	8 (29.6%)
	Obesity	5 (18.6%)	0 (0%)
Systemic Characteristics			
Long Suffering (years)	< 5	14 (51.9%)	
	5–10	8 (29.6%)	
	> 10	5 (18.5%)	
Blood Pressure (mmHg)	Normal	2 (7.4%)	15 (55.6%)
	Elevated	4 (14.8%)	9 (33.3%)
	Hypertension Stage 1	21 (77.8%)	3 (11.1%)
HbA1c (%)	Normal (< 5.7)	0 (0%)	15 (55.6%)
	Prediabetes (5.7–6.5)	3 (11.1%)	12 (44.4%)
	Diabetes (> 6.5)	24 (88.9%)	0 (0%)

Table 3. Salivary glucose levels and total daily food intake of research participants

Variable	Category	Type 2 Diabetes Mellitus n = 27	Healthy Participant n = 27
Salivary Glucose Levels (mg/dL)	< 2	0 (0%)	5 (18.5%)
	≥ 2	27 (100%)	22 (81.5%)
Carbohydrates (g)	Sufficient (≥ 315)	5 (18.5%)	1 (3.7%)
	Less (< 315)	22 (81.5%)	26 (96.3%)
Protein (g)	Sufficient (≥ 57)	12 (44.4%)	17 (63.0%)
	Less (< 57)	15 (55.6%)	10 (37.0%)
Fat (g)	Sufficient (≥ 46.67)	6 (22.2%)	13 (48.1%)
	Less (< 46.67)	21 (77.8%)	14 (51.9%)
Energy (kcal)	Sufficient (≥ 2100)	3 (11.1%)	3 (11.1%)
	Less (< 2100)	24 (88.9%)	24 (88.9%)

Table 4. Correlation of salivary glucose levels with BMI and energy intake

Correlation Variable	Type 2 Diabetes Mellitus (n = 27)		Healthy Participant (n = 27)	
	r	*p* value	*r*	*p* value
BMI (kg/m^2)	0.185	0.357	-0.148	0.460
Energy intake (kcal)	0.026	0.897	0.366	0.060

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the degree of correlation between salivary glucose levels and BMI, as well as between salivary glucose levels and energy intake in type 2 diabetes mellitus, was very weak. In healthy participants, a negative correlation was found between salivary glucose levels and BMI, whereas salivary glucose levels and energy intake showed a weak correlation.

DISCUSSION

The study of salivary glucose levels and food intake in patients with type 2 diabetes mellitus involved 27 people in each group—type 2 diabetes mellitus patients and healthy participants—stratified by sex and age. In this study, the number of female participants with type 2 diabetes mellitus was higher than that of male participants, which aligns with the 2018 RISKESDAS data that reported a higher prevalence of diabetes mellitus among females (12.7%) compared to males (9%).[10] Based on age, this study found that the highest proportion of type 2 diabetes mellitus occurred at 60–69 years, followed by 40–49 years. In concordance, previous studies also found a higher prevalence of diabetes in the 60–69 age group.[17]

The results report that the average body weight in the type 2 diabetes mellitus group was greater compared to the healthy participants. In contrast, the mean body height of the healthy participants was higher than that of type 2 diabetes mellitus patients. Based on BMI, this study found that obesity was only seen in patients with diabetes, which is supported by previous studies.[18]

This study also found that the majority of patients with type 2 diabetes mellitus had been diagnosed for less than 5 years and concurrently suffered from stage 1 hypertension. Diabetes patients have a higher risk of hypertension due to endothelial cell changes, which can lead to elevated blood pressure within a period of less than 5 years.[19] A total of 77.8% of the type 2 diabetes mellitus group had stage 1 hypertension, whereas the majority of the healthy participants, 55.6%, showed normal blood pressure. Type 2 diabetes mellitus is correlated with other systemic diseases; both diabetes and hypertension affect each other and often occur together.[20]

There were no research participants in the type 2 diabetes mellitus group with normal HbA1c values; 24 participants (88.9%) had HbA1c values ≥ 6.5% and were classified as diabetic. All 27 healthy participants (100%) had HbA1c values < 6.5% and were classified as normal or prediabetic.

This research showed that type 2 diabetes mellitus participants tended to suffer from hypertension. This supports the theory that type 2 diabetes mellitus is characterized by deficiencies in insulin secretion, leading to elevated blood glucose levels. Hypertension may develop as a complication of type 2 diabetes due to the adherence of glucose to blood vessel walls, initiating an inflammatory response. This process causes vascular damage, resulting in stiffening and narrowing of blood vessels, ultimately contributing to increased oxidative stress and hypertension.[19,21] Al-Hadi et al. stated that there are patients with type 2 diabetes mellitus who are also diagnosed with hypertension.[19] Putra et al.[22] also found that increasing blood glucose levels caused blood pressure to rise in type 2 diabetes mellitus patients.

Previous research states that salivary glucose in healthy nondiabetic individuals is less than 2 mg/dL.[23] Table 3 shows that in this study, there were no research participants in the type 2 diabetes mellitus group with salivary glucose levels < 2 mg/dL; the average result was 23.47 mg/dL, with a range of 2.24–178.26 mg/dL. The healthy participants had an average of 8.29 mg/dL, with a range of salivary glucose levels from 0.24 to 81.71 mg/dL; 18.5% of participants were classified as having normal salivary glucose values. These findings indicate that salivary glucose levels are directly proportional to HbA1c glucose levels. This aligns with previous studies that found salivary glucose increases proportionally with the rise in HbA1c glucose levels in diabetes mellitus patients.[15,24]

Most salivary glucose levels in both groups in this study were higher than 2 mg/dL. This may be influenced by differences in glucose test kits, methods, and absorbance wavelengths compared to previous studies. The samples in this study were tested directly at a maximum absorbance wavelength of 630 nm. Determining the maximum absorbance wavelength is intended to produce maximum sensitivity in absorbance measurements.[25] Centrifugation speed during the testing process may also have impacted the variation in salivary glucose results.[26]

This study reveals that healthy participants had lower average salivary glucose levels compared to the diabetes mellitus group, which is consistent with previous research.[24] Samkani et al. suggested that changes in the macronutrient composition of proper food intake can help control glucose levels in type 2 diabetes mellitus patients.[27] Dietary recommendations from the Indonesian Ministry of Health suggest a daily intake of 2,100 kcal energy, 315 g carbohydrates, 57 g protein, and 46.67 g fat.[28]

Table 3 shows that the total intake of carbohydrates, protein, fat, and energy in the type 2 diabetes mellitus group was more frequently in the "less" category than the "sufficient" category. Among healthy participants, intake of carbohydrates, fat, and energy was also more often in the "less" category. However, protein intake in healthy participants showed a higher percentage in the "sufficient" category (63.0%) than in the "less" category (37.0%). A total of 5 participants in the type 2 diabetes mellitus group and one healthy participant had sufficient carbohydrate intake. The type 2 diabetes mellitus group tended to consume more carbohydrates. This study showed that both groups frequently consumed white rice, which is high in carbohydrates, with 83.3% of all research participants consuming it two or more times per day. Rice is a staple food commonly consumed more than once a day by the Indonesian population.[29]

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Carbohydrates are rapidly absorbed through the digestive tract mucosa and broken down by enzymes into the disaccharide maltose and small glucose polymers. These are then further broken down by monosaccharide enzymes to produce monosaccharides that can be absorbed into the bloodstream, resulting in a rapid rise in blood glucose levels. Excessive carbohydrate consumption can disrupt carbohydrate metabolism, leading to increased blood glucose levels and a higher risk of developing diabetes mellitus.[29,30]

There were 12 participants in the type 2 diabetes mellitus group with sufficient protein intake, whereas the healthy participants included 17. A total of 6 participants in the type 2 diabetes mellitus group had sufficient fat intake, whereas 13 healthy participants met the same criterion. Based on the semi-quantitative food frequency questionnaire results, 74.1% of the healthy participants consumed beef with a frequency of ≥ 2 times per week. In contrast, among the type 2 diabetes mellitus group, only 14.8% of the research participants consumed beef with the same frequency. The higher protein and fat intake in the healthy participants was due to more frequent consumption of red meat, namely beef. In line with the sample of this study—outpatients diagnosed with type 2 diabetes mellitus and educated about their condition—it is possible that the research participants were aware of and avoided beef consumption, which is an animal protein containing fat that can contribute to insulin resistance.[31]

The total energy intake of type 2 diabetes mellitus and healthy participants showed the same percentage in the sufficient (11.1%) and less (88.9%) categories. Most research participants fell into the "less" energy intake category, possibly because not all consumed food portions aligned with proper Indonesian dietary recommendations. Many studies have stated that food intake can affect blood glucose levels, so considering the correct composition of carbohydrates, protein, and fat is necessary. Previous studies have also noted that salivary glucose levels can rise as blood glucose increases.[23]

In the diabetes patients, a linear correlation was observed between salivary glucose levels and BMI, whereas no such correlation was evident in the healthy participants. Table 2 data indicate a higher number of individuals in the overweight and obesity categories—15 participants—compared to the healthy participants, where the count was lower. The correlation between salivary glucose levels and energy intake was found to be very weak in type 2 diabetes mellitus and weak in healthy participants, with an equal number of respondents categorized as having less and sufficient intake. Consequently, it is not feasible to draw a definitive conclusion. Further research is needed, as saliva is a favorable biomarker and a noninvasive clinical diagnostic tool.

This study has limitations related to its technical implementation. Collecting food intake data relies on the memory of research participants, so it may not fully reflect actual intake. Further studies are recommended to utilize different methods for measuring food intake. The patients with type 2 diabetes mellitus were predominantly aged 60–69 years, whereas the healthy participants were primarily aged 20–29 years. It is possible that the comparison between the two groups would yield more balanced results if they had a similar frequency distribution and age range.

In conclusion, based on our limited number of patients, it was found that salivary glucose levels in type 2 diabetes mellitus were higher compared to healthy participants. The energy intake values in both groups showed similar results. This study found that salivary glucose levels were not influenced by energy intake, as the results revealed a non-significant correlation. Salivary glucose might be influenced by the duration of illness due to its impact on systemic conditions. A correlation between salivary glucose levels and BMI can be acknowledged, although the correlation observed in this study was notably very weak.

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REFERENCES

1. Situmorang PC, Zuhra CF, Lutfia A, Pasaribu KM, Hardiyanti R, Nugraha AP. Harnessing phytochemicals to combat diabetes: Insights into molecular pathways and therapeutic advances. J Funct Foods. 2025; 128: 106799.
2. Magliano DJ, Boyko EJ. IDF Diabetes atlas. 10th ed. Brussels: International Diabetes Federation; 2021.
3. Badan Penelitian dan Pengembangan Kesehatan. Riset kesehatan dasar 2018. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018. p. 127–41.
4. Badan Penelitian dan Pengembangan Kesehatan. Riset kesehatan dasar 2013. Jakarta: Kementerian Kesehatan Republik Indonesia; 2013. p. 89.
5. Betteng R, Pangemana D, Mayulu N. Analisis faktor resiko penyebab terjadinya diabetes melitus tipe 2 pada wanita usia produktif di Puskesmas Wawonasa. J e-Biomedik. 2014; 2(2): 404–12.
6. Ghadge KK, Shetty SK, Kulloli A, Martande S, Mehta V, Gopalakrishnan D, Mathur A, Fiorilla L. The effect of non-surgical periodontal therapy on glycemic control in Indian diabetics with periodontal disease – A systematic review and meta-analysis. Dent J. 2025; 58(2): 198–206.
7. Mulawarmanti D, Widyastuti W. Effect of oxygen hyperbaric therapy on malondialdehyde levels in saliva of periodontitis patients with type 2 diabetes mellitus. Dent J (Majalah Kedokt Gigi). 2008; 41(4): 151–4.
8. Narmada IB, Laksono V, Nugraha AP, Ernawati DS, Winias S, Prahasanti C, Dinaryanti A, Susilowati H, Hendrianto E, Ihsan IS, Rantam FA. Regeneration of salivary gland defects of diabetic Wistar rats post human dental pulp stem cells intraglandular transplantation on acinar cell vacuolization and interleukin-10 serum level. Pesqui Bras Odontopediatria Clin Integr. 2019; 19(1): 1–10.
9. Tiongco R, Bituin A, Arceo E, Rivera N, Singian E. Salivary glucose as a non-invasive biomarker of type 2 diabetes mellitus. J Clin Exp Dent. 2018; 10(9): e902-7.

DOI: 10.20473/j.djmkg.v58.i4.p336–341

10. Badan Penelitian dan Pengembangan Kesehatan. Hasil utama riset kesehatan dasar. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018. p. 123–6.
11. Olsson K, Ramne S, González-Padilla E, Ericson U, Sonestedt E. Associations of carbohydrates and carbohydrate-rich foods with incidence of type 2 diabetes. Br J Nutr. 2021; 126(7): 1065–75.
12. Bonsembiante L, Targher G, Maffeis C. Type 2 diabetes and dietary carbohydrate intake of adolescents and young adults: what is the impact of different choices? Nutrients. 2021; 13(10): 3344.
13. Park SH, Yao J, Chua XH, Chandran SR, Gardner DSL, Khoo CM, Müller-Riemenschneider F, Whitton C, van Dam RM. Diet and physical activity as determinants of continuously measured glucose levels in persons at high risk of type 2 diabetes. Nutrients. 2022; 14(2): 366.
14. Sumintarti S, Rahman F. Korelasi kadar glukosa saliva dengan kadar glukosa darah terhadap terjadinya kandidiasis oral pada penderita diabetes melitus (Correlation of salivary glucose level and blood glucose level with oral candidiasis in diabetes mellitus patient). J Dentomaxillofacial Sci. 2015; 14(1): 29–31.
15. Zhang W, Du Y, Wang ML. Noninvasive glucose monitoring using saliva nano-biosensor. Sens Bio-Sensing Res. 2015; 4: 23–9.
16. Pérez-Ros P, Navarro-Flores E, Julián-Rochina I, Martínez-Arnau FM, Cauli O. Changes in salivary amylase and glucose in diabetes: a scoping review. Diagnostics. 2021; 11(3): 453.
17. Subramani SK, Yadav D, Mishra M, Pakkirisamy U, Mathiyalagen P, Prasad G. Prevalence of type 2 diabetes and prediabetes in the Gwalior-Chambal Region of Central India. Int J Environ Res Public Health. 2019; 16(23): 4708.
18. Venkatachalam J, Muthukumar T, Muthu RE, Singh Z. BMI, physical activity and diabetes- a case control study in a rural area of Kancheepuram district of Tamil Nadu. J Compr Heal. 2020; 4(1): 49–56.
19. Al-Hadi H, Zurriyani Z, Saida SA. Prevalensi diabetes melitus tipe 2 dengan kejadian hipertensi di Poliklinik Penyakit Dalam RS Pertamedika Ummi Rosnati. J Med Malahayati. 2020; 4(4): 291–7.
20. Przezak A, Bielka W, Pawlik A. Hypertension and type 2 diabetes—the novel treatment possibilities. Int J Mol Sci. 2022; 23(12): 6500.
21. Haryati AI, Tyas TAW. Perbandingan kadar HbA1c pada pasien diabetes melitus tipe 2 yang disertai hipertensi dan tanpa hipertensi di Rumah Sakit Umum Daerah Duri, Mandau, Bengkalis, Riau. J Kedokt dan Kesehat. 2022; 18(1): 33–40.
22. Pratama Putra IDGI, Wirawati IAP, Mahartini NN. Hubungan kadar gula darah dengan hipertensi pada pasien diabetes mellitus tipe 2 di RSUP Sanglah. Intisari Sains Medis. 2019; 10(3): 797–800.
23. Gupta S, Nayak M, Sunitha J, Dawar G, Sinha N, Rallan N. Correlation of salivary glucose level with blood glucose level in diabetes mellitus. J Oral Maxillofac Pathol. 2017; 21(3): 334–9.
24. Choudhry AA, Kumar P, Prasad M, Mohapatra T, Sharma P. Validation of salivary glucose as a screening tool of diabetes mellitus. Rom J Intern Med. 2022; 60(3): 145–52.
25. Sukmawati, Sudewi S, Pontoh J. Optimasi dan validasi metode analisis dalam penentuan kandungan total flavonoid pada ekstrak daun gedi hijau (Abelmoschus manihot L.) yang diukur dengan spektrofotometer UV-VIS. Pharmacon. 2018; 7(3): 32–41.
26. Cui Y, Zhang H, Wang S, Lu J, He J, Liu L, Liu W. Obtaining a reliable diagnostic biomarker for diabetes mellitus by standardizing salivary glucose measurements. Biomolecules. 2022; 12(10): 1335.
27. Samkani A, Skytte MJ, Kandel D, Kjaer S, Astrup A, Deacon CF, Holst JJ, Madsbad S, Rehfeld JF, Haugaard SB, Krarup T. A carbohydrate-reduced high-protein diet acutely decreases postprandial and diurnal glucose excursions in type 2 diabetes patients. Br J Nutr. 2018; 119(8): 910–7.
28. Menteri Kesehatan Republik Indonesia. Peraturan menteri kesehatan nomor 28 tahun 2019 tentang angka kecukupan gizi yang dianjurkan untuk masyarakat Indonesia. 28 Indonesia; 2019 p. 33.
29. Suprapti D. Hubungan pola makan karbohidrat, protein, lemak, dengan diabetes mellitus pada lansia. J Borneo Cendekia. 2017; I(1): 8–12.
30. Haryono M, Handayani OWK. Analisis tingkat stres terkait kadar gula darah pada penderita diabetes melitus tipe II. Indones J Public Heal Nutr. 2021; 1(3): 657–65.
31. Nuraini P, Witjaksono FI, Lestari W. Analisis asupan makronutrien terhadap resistensi insulin. Prepotif J Kesehat Masy. 2022; 6(2): 1878–83.

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