ANALYSIS OF FACTORS INFLUENCING BLOOD GLUCOSE LEVELS AND PERIODONTAL DISEASE IN PATIENTS WITH DIABETES MELLITUS

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Abstract

Diabetes mellitus is a chronic disease that shortens life expectancy by about ten years, mainly due to cardiovascular complications such as ischemic heart disease and stroke. According to the International Diabetes Federation and WHO, the number of people with diabetes in Indonesia is expected to rise from 8.4 million in 2000 to 21.3 million by 2030. Data from the 2018 National Basic Health Research reported an increase in prevalence from 6.9% in 2013 to 8.5% in 2018. Prevalence was higher in urban areas compared to rural areas. South Kalimantan ranks second nationally in periodontal disease prevalence, which is closely associated with diabetes. If left untreated, periodontal disease in diabetic patients may lead to severe infections and even mortality. This study aimed to analyze factors influencing blood glucose levels and periodontal disease among diabetic patients. An observational analytic study with a cross-sectional approach was conducted on 30 respondents. Bivariate analysis revealed significant associations between stress levels (p = 0.013) and periodontal disease (p = 0.004) with blood glucose levels (p < 0.05). The study concludes that stress and periodontal disease are significantly related to blood glucose control, highlighting the importance of non-pharmacological interventions such diabetes exercise, and proper tooth-brushing education.

Background

Diabetes mellitus is a chronic, incurable disease that shortens life expectancy by approximately 10 years due to cardiovascular complications such as ischemic heart disease and stroke. Patients face a 20-fold higher risk of amputation and increased hospitalization rates. Type 2 diabetes is the leading cause of non-traumatic blindness, kidney failure, cognitive dysfunction, and dementia, including Alzheimer's disease and vascular dementia. In 2015, the International Diabetes Federation reported that 415 million people worldwide were living with diabetes, 98% of whom had type 2 diabetes. The World Health Organization projected that the number of people with diabetes in Indonesia would rise from 8.4 million in 2000 to 21.3 million in 2030 .

Data from the 2018 Basic Health Research (Riskesdas) indicated that the prevalenc e of diabetes in Indonesia increased from 6.9% in 2013 to 8.5% in 2018, with higher rates in urban (2.0%) than rural (1.0%) populations, and a trend of rising prevalence with age up to 65 years. Beyond its systemic complications, diabetes mellitus also affects oral health, including neuropathy and periodontal disease, making blood glucose control and oral health maintenance essential.

Studies in the United States and the United Kingdom have confirmed a strong association between diabetes and oral health, particularly periodontal disease, which affects up to 75% of diabetic patients. In Indonesia, the prevalence of periodontal disease across all age groups reaches 96.58%, with South Kalimantan ranking second after South Sulawesi in oral health problems above the national average. Diabetes mellitus is a significant risk factor for periodontal disease, and untreated cases can progress to severe bacterial infections and even death .

Based on this evidence, it is necessary to analyze the factors influencing blood glucose levels and periodontal disease among patients with diabetes mellitus in Banjarbaru City in 2024.

Method
The research design employed in this study was observational analytic with a cross-sectional approach. In this cross-sectional study, the independent variables consisted of factors influencing blood glucose levels and periodontal disease, while the dependent variables were blood glucose levels and periodontal status of patients with diabetes mellitus. Both independent (risk factors) and dependent variables (outcomes) were measured and collected simultaneously at a single point in time, allowing the relationship between the studied factors and the patients' condition to be analyzed without long-term follow-up. The sampling technique used in this study was accidental sampling, in which research subjects were selected based on individuals who were encountered by chance during the data collection process. Data collection methods included the use of a stress questionnaire (Perceived Stress Scale) to assess stress levels, the International Physical Activity Questionnaire (IPAQ) to evaluate physical activity, and the Community Periodontal Index of Treatment Needs (CPITN), which was examined using a standard dental set, to assess periodontal disease status. Measurement of blood glucose levels was carried out using a glucose check device by performing a random blood glucose test at the time of data collection. Prior to the implementation of this study, ethical approval had been obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Banjarmasin, ensuring that the research was conducted in accordance with ethical standards.

Result and Discussion

Based on the study carried out by the research team involving Prolanis participants diagnosed with diabetes mellitus at Banjarbaru Selatan Primary Health Center, and analysed using bivariate statistical methods through cross-tabulation with subsequent Chi-Square testing, the following findings were recorded:

Table 1. Statistical Analysis

Variabel	Blood Glucose Level						Total		P Value	R
	Hypoglycemic		Normal		Hyperglycemia					
	n	%	n	%	n	%	n	%		
Gender									0,777	0,129
Man	-	-	2	6,67	6	20	30	100		
Woman	1	3,33	4	13,33	17	56,67				
Age (Year)									0,004	0,580
38-44	1	3,33	2	6,67	0	0	30	100		
45-59	-	-	3	10	17	56,67				
60+	-	-	1	3,33	6	20				
CPITN									0,004	0,623
0	-	-	-	-	-	-	30	100		
1	1	3,33	-	-	1	3,33				
2	-	-	1	3,33	1	3,33				
3	-	-	2	6,67	13	43,33				
4	-	-	2	6,67	9	30				
Level of Physical Activity									0,15	0,539
Low	1	3,33	2	6,67	6	20	30	10		
Moderate	-	-	1	3,33	16	53,33				
High	-	-	3	10	1	3,33				

Stress Level							0,013	0,545
Low	1	3,33	4	13,33	2	6,67	30	10
Moderate	-	-	2	6,67	16	53,33		
High	-	-	-	-	5	16,67		

The Statistical analysis revealed significant associations between stress levels (p = 0.013) and periodontal disease (p = 0.004) with blood glucose levels (p < 0.05). which indicate that stress and periodontal disease are significantly related to blood glucose control. Diabetes mellitus is a chronic and progressive metabolic disorder that often coexists with numerous comorbidities, further complicating the health status of affected individuals. These comorbidities can accelerate disease progression and worsen the overall prognosis. According to Leni (2023), uncontrolled diabetes mellitus shows a significant relationship with the severity of periodontal tissue damage (1). This finding emphasizes the strong bidirectional link between systemic metabolic dysregulation and oral health.

Periodontal disease itself is characterized as a chronic, cumulative, and progressive degeneration of the soft tissues and supporting alveolar bone surrounding the teeth. The condition develops slowly but steadily, often without obvious symptoms in the early stages. Etiological factors contributing to periodontal disease include bacterial plaque, calculus, materia alba, and food debris that accumulate along the gingival margin. If left unmanaged, these factors initiate an inflammatory response that eventually destroys periodontal tissues. Furthermore, systemic diseases such as diabetes mellitus weaken host immune responses, thereby lowering the ability to resist bacterial invasion and accelerating periodontal breakdown (2).

Patients with diabetes mellitus have consistently shown a higher prevalence of periodontal disease compared to non-diabetic individuals. The degree of tissue damage is often more severe when oral hygiene practices are poor. A lack of awareness, insufficient knowledge about oral health, and poor behavioral habits such as irregular tooth brushing or ignoring bleeding gums contribute significantly to worsening periodontal status (3). On the other hand, adequate knowledge and consistent oral hygiene practices—such as proper brushing techniques, routine dental check-ups, and plaque control—can substantially reduce or even prevent the adverse oral manifestations associated with diabetes mellitus (2,4–6). Thus, oral health education plays a crucial role in the overall management of diabetic patients.

Considering the growing number of individuals diagnosed with diabetes mellitus worldwide, and in Indonesia specifically, the issue of oral health among diabetic patients has become an increasingly urgent public health concern. Periodontal health is not only essential for preserving oral function and aesthetics but also plays a key role in systemic health outcomes. In Indonesia, where the prevalence of periodontal disease is remarkably high, the interplay between diabetes and oral health requires special attention and targeted interventions .

In addition to periodontal complications, the development and progression of diabetes mellitus are influenced by several risk factors. These include genetic predisposition (family history), environmental factors, advancing age, ethnicity, hypertension, unhealthy lifestyle behaviors, and psychological factors such as stress and depression . Each of these risk factors contributes differently to the pathophysiology of diabetes, yet their combined effects can be profound. For example, an unhealthy diet and sedentary lifestyle can promote obesity and insulin resistance, while psychosocial stress can exacerbate metabolic dysregulation.

Stress, in particular, plays a central role in the worsening of diabetes mellitus. It is generally defined as an unpleasant state in which the demands of a situation are perceived as exceeding one's coping resources. Stress does not only impact psychological well-being but also has systemic

consequences, influencing physical, intellectual, emotional, spiritual, and social aspects of health. Prolonged stress can therefore disrupt homeostasis and place significant strain on multiple organ systems (1–6).

Physiologically, stress activates the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system, leading to the secretion of stress hormones such as cortisol and epinephrine. These hormones are known to antagonize insulin activity by reducing glucose uptake into peripheral tissues and enhancing hepatic glucose production. In diabetic patients, this process intensifies gluconeogenesis, resulting in persistent hyperglycemia and poor glycemic control (7). The correlation is well documented: the higher the stress level, the worse the glycemic outcomes. Chronic stress also contributes to hormonal imbalances involving growth hormone, glucocorticoids, catecholamines, glucagon, and β-endorphins, which further impair glucose metabolism. Cortisol, in particular, exerts a direct hyperglycemic effect by decreasing tissue sensitivity to insulin and blocking glucose transport into cells. Over time, sustained elevations in cortisol not only increase blood glucose levels but also impair pancreatic β-cell function. As a result, the pancreas becomes less effective in regulating insulin production, further aggravating hyperglycemia. This mechanism underscores how stress can transform from a temporary physiological response into a long-term metabolic burden (8).

Moreover, prolonged stress is associated with behavioral changes that indirectly worsen diabetes outcomes. Patients under chronic stress may engage in unhealthy coping strategies such as overeating, consuming high-sugar foods, smoking, or avoiding medical appointments. These behaviors amplify insulin resistance and contribute to further metabolic deterioration. When combined with inadequate oral hygiene practices, stress may also worsen periodontal inflammation, creating a vicious cycle between psychological stress, metabolic dysregulation, and oral health deterioration.

Ultimately, failure of the pancreas to produce adequate insulin—whether due to genetic, lifestyle, or stress-related factors—remains a hallmark of diabetes mellitus. This impaired insulin secretion, together with insulin resistance, constitutes the pathophysiological foundation of diabetes mellitus, one of the most prevalent metabolic diseases globally (9)

Conclusion
The study concludes that stress level and periodontal disease are significantly related to blood glucose control in diabetic patients

Recomendation
It is recommended to provide greater attention through curative efforts, including non-pharmacological therapies such as relaxation techniques, diabetes exercise programs, and proper tooth-brushing education for patients with diabetes mellitus

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