The Relationship Between Random Blood Glucose Levels and The Incidence of Diabetic Foot Ulcers

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Abstract.

Diabetes mellitus is a global health challenge characterized by an ever-increasing number of cases annually. The most feared chronic complication of diabetes mellitus is diabetic foot ulcer (DFU), which significantly increases the risk of amputation and mortality rates. This study aims to analyze the relationship between random blood sugar (RBS) levels and the incidence of DFU in type 2 diabetes mellitus patients at Paragon Hospital, Citeureup 2026. The research method used is an analytical observational design with a cross-sectional approach. A total of 54 subjects meet the inclusion criteria out of 109 type 2 diabetes mellitus patients. Medical record data were statistically analyzed using the Chi-Square test. The results indicated that DFU patients were predominantly male (53.7%) and belonged to the 46-55 age group (38.9%). Clinical findings showed that the majority of research subjects (88.9%) had high random blood sugar levels (≥ 200 mg/dL). Statistical test results yielded a p-value of 0.000 ($p < 0.05$), indicating a significant relationship between high RBS levels and the incidence of DFU. Based on the result the concluded that uncontrolled RBS levels are a primary trigger for DFU. Chronic hyperglycemia triggers vascular and nerve damage, which inhibits the tissue healing process in the feet. Optimal control of RBS levels is essential as a preventive measure to avoid amputation complications in type 2 diabetes patients.

Keywords: *Diabetic foot ulcer; diabetes mellitus and random blood sugar levels.*

I. INTRODUCTION

Diabetes mellitus is a major global health challenge characterized by a continuous increase in prevalence worldwide [1]. According to the International Diabetes Federation (IDF), approximately 589 million adults were living with diabetes in 2025. Indonesia ranks fifth globally, with 20.4 million cases in 2024, and is projected to maintain this position until 2050, with an estimated increase to 28.6 million cases. This trend indicates that diabetes will remain a significant public health concern in the future [2]. One of the most serious chronic complications of diabetes mellitus is diabetic foot ulcer (DFU), which significantly reduces quality of life and increases mortality risk [3]. DFU is defined as a lesion involving damage to the epidermal and dermal layers of the foot, commonly occurring in areas subjected to repetitive pressure below the ankle [4]. If not properly managed, these ulcers can lead to infection, gangrene, amputation, physical disability, and even death [5].

Globally, the lifetime risk of developing DFU among diabetic patients ranges from 19% to 34%, with a recurrence rate of up to 65% and mortality reaching 50–70%. The incidence of lower extremity amputation is estimated at 20% [4]. The global prevalence of DFU is approximately 6.3%, with regional variations. North America has the highest prevalence at 13%, while Oceania has the lowest at 3%. In Asia, the prevalence is around 5.5% [4], [6]. In Indonesia, the lifetime prevalence of DFU among patients with diabetes mellitus is estimated at approximately 15% [7]. Data from Cipto Mangunkusumo National Hospital reported 158 DFU cases between 2020 and 2022 [8]. These findings highlight the clinical and epidemiological significance of DFU.The severity of DFU can be assessed using the Wagner classification system, which categorizes ulcers into six grades based on depth, extent, and presence of infection or gangrene. This classification plays an important role in determining prognosis and guiding treatment strategies [1].

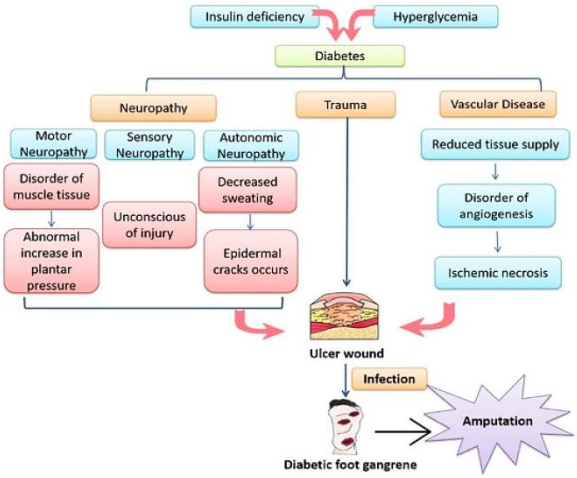

Fig 1. Patofisiologi diabetic foot ulcer

Hyperglycemia is a major contributing factor to the development of DFU. Elevated blood glucose levels cause endothelial dysfunction and atherosclerosis, leading to narrowing of blood vessels and reduced peripheral tissue perfusion [9]. This condition results in tissue ischemia, delayed wound healing, and increased susceptibility to infection [10]. Chronic hyperglycemia also triggers oxidative stress, formation of Advanced Glycation End Products (AGEs), and activation of inflammatory pathways, all of which contribute to tissue damage [11]. In addition, hyperglycemia contributes to diabetic neuropathy. Sensory neuropathy reduces pain perception, making patients unaware of minor injuries. Motor neuropathy leads to abnormal pressure distribution on the foot, while autonomic neuropathy causes dry and cracked skin. These combined factors significantly increase the risk of DFU development [11].Monitoring blood glucose levels is essential in diabetes management. Random blood glucose (RBG) testing is widely used in clinical practice due to its practicality, rapid results, and cost-effectiveness, without requiring fasting [12].

An RBG level ≥200 mg/dL indicates hyperglycemia [13]. Persistent elevation of RBG is a key risk factor for DFU, as it contributes to vascular damage and impaired tissue perfusion [11]. Despite extensive research on hyperglycemia and diabetic complications, studies specifically examining the relationship between random blood glucose levels and the occurrence of DFU at the healthcare facility level remain limited, particularly in the Citeureup region. Therefore, this study is important to provide empirical evidence relevant to local clinical settings. This study aims to analyze the relationship between random blood glucose levels and the incidence of diabetic foot ulcers among patients with type 2 diabetes mellitus at Paragon Hospital, Citeureup, in 2026. The findings are expected to support early detection and prevention of severe complications, including amputation. Based on this background, the research question is: how is the relationship between random blood glucose levels and the incidence of diabetic foot ulcers among patients with type 2 diabetes mellitus at Paragon Hospital, Citeureup, Bogor, in 2026?

II. METHODS

This study used an analytical observational design with a cross-sectional approach to examine the relationship between random blood glucose levels and the incidence of diabetic foot ulcers among patients with type 2 diabetes mellitus at Paragon Hospital, Citeureup, West Java, in 2026. The study applied a quantitative research method. The research was conducted in the medical records unit of Paragon Hospital, Citeureup, West Java. Data were obtained from patient medical records covering the period from 2023 to 2025.The study population consisted of all patients diagnosed with type 2 diabetes mellitus who were treated at Paragon Hospital during the study period. Subjects were selected based on predefined inclusion and exclusion criteria. The inclusion criteria included hospitalized patients with type 2 diabetes mellitus who had complete medical records, were aged between 36 and 75 years, were diagnosed with diabetic foot ulcers, and had complete data on random blood glucose levels. The exclusion criteria included incomplete medical records, patients with type 1 diabetes mellitus, patients aged below 36 years or above 75 years, patients with diabetic foot ulcers caused by non-diabetic trauma, and patients with incomplete random blood glucose data.

Data collection was carried out using secondary data obtained from medical records. The procedure involved obtaining research permission from the hospital management, accessing the medical records unit, identifying eligible patient records, and extracting relevant data.

The collected variables included random blood glucose levels and the presence of diabetic foot ulcers, along with patient demographic characteristics. In this study, random blood glucose level was defined as the measurement of blood glucose concentration that can be performed at any time without requiring fasting. The value was obtained from the average results of laboratory examinations recorded in the medical records. This variable was measured on a numerical scale and categorized into normal (<200 mg/dL) and high (≥200 mg/dL).Diabetic foot ulcer was defined as an open lesion on the foot of a patient with diabetes mellitus resulting from complications such as peripheral neuropathy or peripheral arterial disease. This variable was identified based on the documented medical diagnosis in the patient's medical record. It was measured on a nominal scale and classified into the presence or absence of diabetic foot ulcer.The collected data were analyzed using statistical software. Data analysis was conducted in two stages. Univariate analysis was used to describe patient characteristics, including age, sex, and random blood glucose levels. Bivariate analysis was performed to assess the relationship between random blood glucose levels as the independent variable and the incidence of diabetic foot ulcers as the dependent variable using the Chi-square test.

III. RESULT AND DISCUSSION

Result

A total of 54 subjects met the inclusion criteria in this study. The demographic characteristics of the subjects are presented in Table 1.

Table 1. Demographic Characteristics of Study Subjects

Variable	Category	n	%
Age	36–45 years	4	7.4
	46–55 years	21	38.9
	56–65 years	15	27.8
	66–75 years	14	25.9
Sex	Male	29	53.7
	Female	25	46.3

Based on Table 1, the majority of subjects were in the 46–55 years age group (38.9%), followed by 56–65 years (27.8%) and 66–75 years (25.9%). The lowest proportion was found in the 36–45 years group (7.4%). This distribution indicates that diabetic foot ulcer cases were more common in middle-aged to older adults. In terms of sex distribution, male subjects slightly predominated (53.7%) compared to females (46.3%). This finding suggests that male patients may have a higher tendency to develop diabetic foot ulcers compared to female patients.

Table 2. Distribution of Random Blood Glucose Levels in DFU Patients

RBG Category	n	%
Normal (<200 mg/dL)	6	11.1
High (≥200 mg/dL)	48	88.9
Total	**54**	**100**

Based on Table 2, most subjects with diabetic foot ulcer had high random blood glucose levels (88.9%), while only a small proportion had normal levels (11.1%). This finding indicates that the majority of DFU cases occurred in patients with hyperglycemic conditions. The dominance of high RBG levels among DFU patients suggests that poor glycemic control is a major clinical characteristic associated with the occurrence of diabetic foot ulcers.

Table 3. Association Between RBG Levels and DFU Incidence

RBG Category	DFU (n)	Non-DFU (n)	Total (n)	p-value
Normal	6	45	51	
High	48	10	58	0.000
Total	**54**	**55**	**109**	

Based on Table 3, among subjects with high random blood glucose levels, 48 out of 58 patients (82.8%) experienced diabetic foot ulcers, while only 10 patients (17.2%) did not. In contrast, among subjects with normal RBG levels, only 6 out of 51 patients (11.8%) experienced DFU, whereas the majority, 45 patients (88.2%), did not develop DFU.These findings show a clear difference in DFU incidence between patients with high and normal RBG levels. Patients with high RBG levels had a substantially higher proportion of DFU compared to those with normal levels. Statistical analysis using the Chi-square test showed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant association between random blood glucose levels and the incidence of diabetic foot ulcers. This result suggests that high random blood glucose levels are strongly associated with an increased risk of developing diabetic foot ulcers.

Discussion

This study found that the majority of subjects with diabetic foot ulcer were in the middle-aged group (46–55 years) and predominantly male. These findings are consistent with previous studies reporting that DFU is more common in middle-aged individuals due to longer disease duration and cumulative effects of chronic hyperglycemia [4], [14], [15]. Age is a significant risk factor because it is associated with declining physiological function, including reduced insulin secretion and impaired tissue regeneration. These changes contribute to microvascular complications and delayed wound healing, increasing the risk of ulcer formation [14].The predominance of male patients in this study aligns with previous findings that men have a higher risk of developing DFU [16], [17]. Behavioral factors such as smoking, poor foot care, and delayed health-seeking behavior contribute to this increased risk [6], [18]. Smoking, in particular, impairs insulin sensitivity, promotes inflammation, and reduces tissue oxygenation, thereby worsening vascular damage and delaying wound healing [19], [20].This study also showed that most patients with DFU had high random blood glucose levels. This finding indicates that hyperglycemia plays a central role in the development of diabetic foot ulcers. Similar results were reported in previous studies, where patients with DFU had poorly controlled blood glucose levels [21], [22].

Chronic hyperglycemia contributes to severe complications, including infection, sepsis, and increased risk of amputation.Pathophysiologically, prolonged hyperglycemia leads to neuropathy and peripheral vascular disease, both of which are key factors in DFU development [23]. Neuropathy reduces sensation, causing patients to overlook minor injuries, while vascular impairment limits oxygen and nutrient supply to tissues, delaying healing [24]. In addition, high glucose levels create a favorable environment for bacterial growth, particularly anaerobic bacteria, which can worsen infection and tissue damage [25]. Hyperglycemia also induces oxidative stress and the formation of Advanced Glycation End Products (AGEs), leading to endothelial dysfunction and ischemia [11]. These mechanisms collectively contribute to the progression of diabetic foot ulcers.The statistical analysis confirmed a significant relationship between random blood glucose levels and DFU incidence. Patients with high RBG levels had a substantially higher proportion of DFU (82.8%) compared to those with normal levels. This finding is consistent with previous studies demonstrating a strong association between uncontrolled blood glucose and diabetic wound severity [26], [27].These results emphasize that glycemic control is a critical factor in preventing diabetic foot ulcers. Effective management should include regular monitoring of blood glucose levels, adherence to diabetes medication, and lifestyle modifications [1]. Patient education on foot care, including daily inspection, proper footwear, and early wound management, is also essential to reduce the risk of complications [28].

IV. CONCLUSION

This study analyzed the relationship between random blood glucose levels and the incidence of diabetic foot ulcers among patients with type 2 diabetes mellitus at Paragon Hospital, Citeureup, during the period of 2023–2025. A total of 54 subjects met the inclusion criteria, with the majority being male and predominantly in the middle-aged group (46–55 years). These findings indicate that diabetic foot ulcers tend to occur more frequently in male patients and individuals in the middle-age category. Most subjects in this study were found to have elevated random blood glucose levels, indicating poor glycemic control. The high proportion of patients with uncontrolled blood glucose highlights the importance of monitoring glucose levels as a key component in diabetes management. Elevated glucose levels are known to contribute to

vascular damage, impaired tissue perfusion, and delayed wound healing, all of which are major factors in the development of diabetic foot ulcers.The statistical analysis using the Chi-square test demonstrated a significant association between random blood glucose levels and the incidence of diabetic foot ulcers ($p < 0.05$). Patients with high random blood glucose levels showed a substantially higher occurrence of diabetic foot ulcers compared to those with normal levels. This finding confirms that hyperglycemia is a major risk factor for the development of diabetic foot complications. In conclusion, poor glycemic control, as reflected by elevated random blood glucose levels, plays a critical role in the occurrence of diabetic foot ulcers in patients with type 2 diabetes mellitus. These findings emphasize the need for strict glycemic monitoring, early detection, and appropriate clinical management to prevent the progression of complications. Strengthening patient education, routine screening, and adherence to diabetes treatment are essential strategies to reduce the incidence and severity of diabetic foot ulcers..

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