

RESEARCH ARTICLE

Correlation Between Predictor Factors (Hemoglobin, Leukocytes, Platelets, LDL, HbA1c, D-dimer, Albumin) and Length of Stay in Patients with Diabetic Ulcers at Dr. Pirngadi General Hospital Medan, 2022–2023

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ABSTRACT

Background : Uncontrolled diabetes causes chronic complications, both microangiopathies and angiopathies. Diabetic ulcers are one of the chronic complications of diabetes, caused by macroangiopathy resulting in vascular insufficiency and neuropathy. Ulcers are a concern which will lead to a level of disability that will prolong the patient's treatment period. Factors that affect the length of care in diabetic ulcer patients are metabolic control (poor blood sugar, hba1c, albumin, hemoglobin, LDL, LDL), infection control (elevated leukocytes), vascular control (increased d-dimer coagulation). The length of treatment of diabetic ulcer patients will burden both the patient and the state. **Research:** To analyze the relationship of predictor factors (hemoglobin, leukocytes, platelets, LDL, HbA1c, D-dimer, Albumin) to the length of treatment of diabetic ulcer patients at Dr. Pirngadi Hospital Medan City. **Methods:** This study is an analytic observational study with a research design using a cross-sectional study. **Results:** Based on the results of the proportion test with the Chi-square correlation test there is a relationship between hemoglobin (p-value of 0.008), the relationship between leukocytes (p-value of 0.010), the relationship between platelets (p-value of 0.010), the relationship between LDL (p-value of 0.047), the relationship between HbA1C (p-value of 0.046), the relationship between D-dimer (p-value of 0.025), the relationship between albumin (p-value of 0.041) with the length of treatment of diabetic ulcer patients. In multivariate results, the factor that most influences the length of treatment is leukocytes. **Conclusion:** Hemoglobin, leukocyte, platelet, LDL, HbA1c, D-dimer, Albumin levels are factors associated with the length of treatment of diabetic ulcer patients at Rsud Dr. Pirngadi Medan City in 2022-2023 and leukocytes are the most influential factor.

Keywords: diabetes, diabetic ulcer, length of stay

INTRODUCTION

Currently, Indonesia ranks fifth in the world for the highest number of Diabetes Mellitus sufferers. This is a global public health issue characterized by a higher risk due to vascular consequences from various conditions, including metabolic, cellular, and hematological abnormalities.¹

According to the International Diabetes Federation (IDF), 537 million people worldwide aged 20 to 79 suffered from diabetes mellitus (DM) in 2021.² Meanwhile, according to the WHO, the global prevalence of DM is highest in the age group over 30, reaching 10.8%. The risk of amputation in DM patients is 15–46 times higher than in those without DM, with a post-amputation mortality rate of 15.89% and a prevalence of diabetic ulcers reaching 9.4%.³

Uncontrolled DM leads to chronic complications, including both microangiopathy and macroangiopathy.⁴ Diabetic ulcers are a chronic complication of diabetes, caused by macroangiopathy resulting in vascular insufficiency and neuropathy. Diabetic ulcers are prone to infection due to the presence of germs or bacteria, as high blood glucose levels create ideal conditions for microbial growth.⁵

The prevalence of diabetic ulcers in Indonesia is approximately 15%, with an amputation rate of 30% and a one-year post-amputation mortality rate of 14.8%. Data from Riskesdas (2018) indicates an increase in the number of diabetic ulcer patients, evidenced by an 11% rise in prevalence.⁷

Ulcers require serious attention as they lead to disability, limb amputation, and death. Lower limb amputation is considered a therapeutic failure. Factors influencing the length of stay for diabetic ulcer patients include metabolic control (poor blood glucose, HbA1c, albumin, hemoglobin, and LDL levels), infection control (elevated leukocyte counts), and vascular control (increased coagulation indicated by D-dimer). Prolonged hospitalization for diabetic ulcer patients imposes a burden on both the patients and the state.⁸

Inas, in her research, demonstrated that the majority of diabetic foot ulcer patients have low hemoglobin and albumin levels, which are associated with an extended length of stay. Low albumin levels in diabetic ulcer patients are caused by infection, wound depth, wound size, and inflammatory mediator levels. In this condition, a shift occurs in albumin distribution between the intravascular and extravascular compartments. Albumin concentrations decrease and do not increase again until the recovery phase. Meanwhile, low hemoglobin levels occur because hemoglobin synthesis requires an adequate supply of protein to form amino acids.⁹ Similarly, a study by Akirov in Israel concluded that a decrease in albumin values significantly affects the length of stay for diabetic ulcer patients.¹⁰

Consistent with Inas, Khanbhai concluded that low hemoglobin levels and leukocytosis lead to a poor prognosis in patients with diabetic foot disease.¹¹ Kuanxin, in his study, noted a significant increase in platelet counts among patients with diabetic ulcers, which positively correlated with wound grade. This may serve as a valuable marker for early diagnosis and assessment of wound severity, which in turn extends the length of hospitalization.¹²

In his research, Kenos found a relationship between HbA1c values and the duration of treatment in DM patients; specifically, if the HbA1c value exceeds 7%, the duration of treatment is prolonged, leading to an extended length of stay.¹³

MATERIALS AND METHODS

This study employs an observational analytic method with a cross-sectional design. The data used are secondary data obtained from the Medical Records Department at Dr. Pirngadi General Hospital, Medan. This research utilizes a quantitative methodology with an observational analytic cross-sectional approach. The sampling technique employed is total sampling, resulting in a total of 84 research samples consisting of patients with diabetic ulcers.

The length of stay for diabetic ulcer patients serves as the dependent variable, while the independent factors include Hemoglobin (Hb), Leukocytes,

Platelets, LDL, HbA1c, D-dimer, and Albumin. Data analysis was conducted using the Chi-square statistical test within the SPSS (Statistical Product and Service Solutions) software. For the statistical decision-making in this study, a significance level of 5% ($p < 0.05$) was adopted to determine meaningful and significant results.

RESULTS AND DISCUSSION

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1. The Correlation Between Hemoglobin Levels and the Length of Stay in Patients with Diabetic Ulcers

Hemoglobin	Lama Rawatan						P Value
	< 5 hari		> 5 hari		Total		
	F	%	F	%	F	%	
Rendah	42	50.0	21	25.0	63	75.0	0.008
Normal	3	3.6	11	13.1	14	16.7	
Tinggi	4	4.7	3	3.6	7	8.3	
Total	49	58.3	35	41.7	84	100.0%	

Based on the table, it can be observed that among the 49 individuals (58.3%) with a length of stay of < 5 days, 42 (50%) had low hemoglobin levels, 3 (3.6%) had normal hemoglobin levels, and the remaining 4 (4.7%) had high hemoglobin levels.

Regarding patients with a length of stay of > 5 days, 21 individuals (25%) had low hemoglobin levels, 11 (13.1%) had normal hemoglobin levels, and the remaining 3 (3.6%) had high hemoglobin levels.

The results of the Chi-square statistical test

Trombosit	Lama Rawatan						P Value
	< 5 hari		> 5 hari		Total		
	F	%	F	%	F	%	
Rendah	6	7.1	13	15.5	19	22.6	0.010
Normal	23	27.3	16	19.1	39	46.4	
Tinggi	20	23.9	6	7.1	26	31.0	
Total	49	58.3	35	41.7	84	100.0%	

yielded a p-value of 0.008, indicating a significant correlation between hemoglobin levels and the length of stay for diabetic ulcer patients at Dr.

Leukosit	Lama Rawatan						P Value
	< 5 hari		> 5 hari		Total		
	F	%	F	%	F	%	
Rendah	7	8.3	4	4.7	11	13.0	0.010
Normal	11	13.1	19	22.7	30	35.8	
Tinggi	31	36.9	12	14.3	43	51.2	
Total	49	58.3	35	41.7	84	100.0%	

Pirngadi General Hospital, Medan, during the 2022–2023 period.

2. The Correlation Between Leukocyte Counts and the Length of Stay in Patients with Diabetic Ulcers

Based on the table, it can be observed that among the 49 individuals (58.3%) with a length of stay of < 5 days, 7 (8.3%) had low leukocyte counts, 11 (13.1%) had normal leukocyte counts, and the remaining 31 (36.9%) had high leukocyte counts.

Meanwhile, among the 35 individuals (41.7%) with a length of stay of > 5 days, 4 (4.7%) had low leukocyte counts, 19 (22.7%) had normal leukocyte counts, and the remaining 12 (14.3%) had high leukocyte counts.

The results of the Chi-square statistical test yielded a p-value of 0.010, indicating a significant correlation between leukocyte counts and the length of stay for diabetic ulcer patients at Dr. Pirngadi General Hospital, Medan, during the 2022–2023 period.

3. The Correlation Between Platelet Counts and the Length of Stay in Patients with Diabetic Ulcers

Based on the data, it can be observed that among the 49 individuals (58.3%) with a length of stay of < 5 days, 6 (7.1%) had low platelet counts, 23 (27.4%) had normal platelet counts, and the remaining 20 (23.8%) had high platelet counts.

Meanwhile, among the 35 individuals (41.7%) with a length of stay of > 5 days, 13 (15.5%) had low platelet counts, 16 (19.0%) had normal platelet counts, and the remaining 6 (7.1%) had high platelet counts.

The results of the Chi-square statistical test yielded a p-value of 0.010, indicating a significant correlation between platelet counts and the length of stay for diabetic ulcer patients at Dr. Pirngadi General Hospital, Medan, during the 2022–2023 period.

4. The Correlation Between LDL Cholesterol Levels and the Length of Stay in Patients with Diabetic Ulcers

LDL	Lama Rawatan						P Value
	<5 hari		>5 hari		Total		
	F	%	F	%	F	%	
Normal	16	19.0	19	22.7	35	41.2	0.047
Meningkat	33	39.3	16	19.0	49	58.3	
Total	49	58.3	35	41.7	84	100.0%	

Based on the data, it can be observed that among the 49 individuals (58.3%) with a length of stay of < 5 days, 16 (19%) had normal LDL levels, and the remaining 33 (39.3%) had elevated LDL levels.

Meanwhile, among the 35 individuals (41.7%) with a length of stay of > 5 days, 19 (22.7%) had normal LDL levels, and the remaining 16 (19%) had elevated LDL levels.

The results of the Chi-square statistical test yielded a p-value of 0.047, indicating a significant correlation between LDL levels and the length of stay for diabetic ulcer patients at Dr. Pirngadi General Hospital, Medan, during the 2022–2023 period.

5. The Correlation Between HbA1c Levels and the Length of Stay in Patients with Diabetic Ulcers

Table 4 presents the results of the Erythrocyte Sedimentation Rate (ESR) examinations. The data reveals a predominant tendency toward elevated ESR levels, observed in 60 patients (55%), followed by normal ESR values in 49 patients (45%). Consequently, the majority of pediatric typhoid fever patients exhibited increased ESR levels, while a smaller proportion maintained normal levels.

Table 5. Frequency and Percentage of Platelet

HbA1C	Lama Rawatan						P Value
	<5 hari		>5 hari		Total		
	F	%	F	%	F	%	
Terkontrol baik	18	21.4	10	11.9	28	33.3	0.046
Terkontrol sedang	14	16.6	19	22.7	33	39.3	
Terkontrol buruk	17	20.3	6	7.1	23	27.4	
Total	49	58.3	35	41.7	84	100.0%	

Counts in Pediatric Patients with Typhoid Fever

CONCLUSION

1) Conclusion of Statistical Analysis

Based on the Chi-square statistical analysis of diabetic ulcer patients, significant correlations were found between several factors and the length of stay: hemoglobin levels (p=0.008), leukocyte counts (p=0.010), platelet counts (p=0.010), LDL levels (p=0.047), HbA1c levels (p=0.046), D-dimer levels (p=0.025), and albumin levels (p=0.041). These results indicate that each of these variables has a statistically significant relationship with the length of stay for diabetic ulcer patients at Dr. Pirngadi General Hospital, Medan, during the 2022–2023

period.

2) Multivariate Analysis Results

Based on the multivariate analysis, the primary factor influencing the length of stay in diabetic ulcer patients is the leukocyte count, with an Odds Ratio (OR) of 3.405.

3) Clinical Management of Diabetes

There are five pillars in the management of diabetes control: metabolic control (hemoglobin, platelets, LDL, HbA1c, and albumin), infection control (leukocytes), vascular control (D-dimer), pressure control, and education control. Poor results in metabolic, infection, and vascular controls directly contribute to a longer duration of hospitalization. Therefore, rigorous pressure control (blood pressure) and education are essential.

Based on the research findings regarding the association of Erythrocyte Sedimentation Rate (ESR) and platelet count with fever levels in pediatric typhoid fever patients at RSU Methodist Medan in 2023, it can be concluded that:

1. There is a statistically significant association between ESR values and the severity of fever.
2. There is no statistically significant association between the platelet count and the level of fever.

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