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Survival Analysis of Chronic Kidney Failure Patients with Comorbid Diabetes Mellitus in the Hemodialysis Room

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Abstract

Chronic kidney disease has been the leading cause of death at Bahteramas Regional General Hospital in Southeast Sulawesi for the past three years. This disease is often caused by non-communicable diseases such as diabetes mellitus, which is recognized by the WHO as a priority condition. Diabetes mellitus causes damage to the blood vessels in the kidneys, reducing their blood filtration function. This condition triggers the leakage of albumin protein into the urine, known as albuminuria, and can potentially lead to kidney failure. If not properly treated, kidney failure can be fatal. The survival of hemodialysis patients is influenced by the presence of diabetes mellitus as a comorbidity. The purpose of this study was to determine the survival analysis of patients with chronic kidney failure and comorbid diabetes mellitus in the Hemodialysis Room of the Bahteramas Regional General Hospital in Southeast Sulawesi Province using a historical medical record cohort design. The analysis used the Kaplan-Meier and log-rank tests as well as modeling with Cox proportional hazards regression. The results showed that patients with diabetes had a mean survival time of 458 days (CI 303–586), and the log-rank test produced a p-value of 0.016, indicating a significant effect of diabetes on patient survival. Cox proportional hazards regression showed a hazard ratio of 3.617, indicating that the risk of death in diabetic patients was 3.617 times higher than in non-diabetic patients. These findings emphasize the importance of strict diabetes management in kidney failure patients undergoing hemodialysis to improve their life expectancy.

Keywords: Survival Rate; Diabetes Mellitus; Chronic Kidney Disease; Kaplan-Meier; Comorbidity

1. Introduction

Chronic kidney disease (CKD) is a serious health problem with an increasing incidence worldwide. This disease, also known as chronic kidney disease (CKD), is a condition of kidney dysfunction that lasts for more than three months. It is characterized by abnormalities in the structure or function of the kidneys, with or without a decrease in glomerular filtration rate (eGFR <60 mL/1.73 m^2), based on the presence of kidney damage detected through pathological examination, blood composition, urine, or laboratory tests. Symptoms of CKD develop gradually and are only noticeable when kidney function has significantly declined [1]. Common complaints among patients include fatigue, itching, swelling of the hands or feet, shortness of breath, difficulty sleeping, and loss of appetite, which certainly have an impact on daily activities [2].

According to data from the Center for Disease Control and Prevention (2023), nearly 808,000 people in the United States, or about 2 in every 1,000 residents, have chronic kidney disease. The main causes of end-stage kidney disease in the United States include diabetes, high blood pressure, glomerulonephritis, and other unknown causes [3]. According to international consensus data (2024), it is estimated that approximately 850 million people worldwide suffer from kidney disease, with the majority residing in low- and lower-middle-income countries. In the United States, chronic

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kidney disease (CKD) is estimated to affect 35.5 million people. Projections from indicate that by 2040, chronic kidney failure will be the fifth leading cause of death globally [4].

The Ministry of Health states that kidney failure is one of the diseases with the highest mortality rate in Indonesia. In 2022, the incidence of chronic kidney failure reached 0.38% or around 713.783 people, and 19.33% of these patients underwent hemodialysis, which is around 2.850 people. Meanwhile, in 2023, the results of the Indonesian Health Survey (SKI) showed a prevalence of chronic kidney failure cases of 638.178 or 0.18% of the total population, with 1.259 patients undergoing hemodialysis [5]. The total number of deaths due to chronic kidney disease in 2023 reached over 42.000 people [6].

For data on chronic kidney failure deaths at Bahteramas Regional General Hospital in 2022, it ranked first among the top 10 causes of death with 77 cases. in 2023 it remained in first place with 123 cases, and in 2024 it still ranked first with 164 cases. In 2025 (January-June), there were 76 patients [7].

Chronic kidney disease (CKD) is usually caused by pre-existing major noncommunicable diseases, such as diabetes, which has been recognized by the WHO as a priority condition, or by common risk factors associated with heart disease and stroke, such as hypertension. According to a WHO report, deaths from kidney disease are caused by diabetic kidney disease [4]. About one in three people with diabetes and one in five people with high blood pressure suffer from kidney disease. Other risk factors that can increase the likelihood of kidney disease include heart disease and a family history of kidney failure [8].

Data from the Indonesian Renal Registry (IRR) in 2020 shows that the most common chronic kidney disease causing patients to undergo dialysis is kidney disease due to hypertension, followed by diabetic nephropathy, and then glomerulopathy [1].

Diabetes mellitus increases the risk of chronic kidney failure by up to 4.1 times compared to patients who do not have diabetes mellitus risk factors [9]. Diabetes can damage blood vessels in the kidneys, thereby impairing the kidneys' ability to filter blood. This condition causes protein, particularly albumin, to leak into the urine (albuminuria), which can ultimately lead to kidney failure. If this condition is not addressed and continues, the damage can result in death [10].

The survival rate of hemodialysis patients is influenced by the presence of comorbidities [11]. Several factors that play a role in the survival rate of hemodialysis patients include hypertension, diabetes mellitus, glomerulonephritis, treatment, comorbidities, nutritional status, and socioeconomic factors. Based on research (12], the survival rate of chronic kidney failure patients undergoing hemodialysis for ≤ 1 year is around 84.41%, while those undergoing ≥ 5 years is around 63.32%. Death in hemodialysis patients is not entirely caused by the hemodialysis procedure itself, but is influenced by various factors, especially comorbidities [11].

Research conducted by Betiru et al., (2023) Regarding survival analysis and its predictors in hemodialysis patients at Saint Paul Hospital, Millennium Medical College, and Myungsung Christian Medical Center in Addis Ababa, Ethiopia in 2021 showed that the median survival time of patients was 65 months. The most common comorbidity was a combination of diabetes mellitus and hypertension, accounting for 42% [13].

Based on this background, the author was motivated to conduct research on "Survival Analysis of Chronic Kidney Failure Patients with Comorbid Diabetes Mellitus in the Hemodialysis Room".

2. Material and methods

This study is a quantitative study using analytical observation methods. The design used is a historical (retrospective) cohort study with secondary data from patient medical records and daily reports from the hemodialysis unit at Bahteramas Regional General Hospital. The study population consisted of new chronic renal failure patients undergoing hemodialysis at Bahteramas Regional General Hospital. A sample of 94 people was taken using a simple random sampling method. The tool used in this study was an observation sheet. The data collection technique involved observation or examination of medical records (MR) and daily reports from the hemodialysis unit of new chronic kidney failure patients undergoing hemodialysis during the period September 2023 to September 2025 at Bahteramas Regional General Hospital. The observation sheet was one of the data instruments used by researchers as an aid in indirect data collection.

The independent variable is diabetes mellitus comorbidity, while the dependent variable is patient survival time, calculated from the start of hemodialysis until the occurrence of death or censoring. Data analysis was performed using survival analysis with SPSS, namely Kaplan-Meier with log-rank test to see the probability of survival, and Cox regression to estimate the Hazard Ratio (HR), test the HR hypothesis, and determine the confidence interval, assuming proportional hazards.

3. Results and discussion

3.1. Univariate Analysis

Univariate analysis in this study describes the variables studied, including survival and diabetes mellitus comorbidity.

3.1.1. Survival

Survival (life expectancy) as defined in this study is the length of time (in days) from when a patient with chronic renal failure began hemodialysis until the occurrence of an "event" (death) or the end of the observation period (censored). The distribution according to survival is presented in the following table:

Table 1 Distribution According to Survival in Patients with Chronic Kidney Failure Undergoing Hemodialysis at Bahteramas Regional General Hospital, Southeast Sulawesi Province 2023-2025

No	Survival	f	%
1.	Death (Event)	42	44.7
2.	No death (*Censored*)	52	55.3
Total		94	100

Source: Secondary Data 2025

The table above shows that out of 94 people, most did not die (censored), namely 52 people (55.3%), while the lowest number died (event), namely 42 people (44.7%).

3.1.2. Diabetes Mellitus Comorbidity

Diabetes mellitus referred to in this study is the history/comorbidity of diabetes mellitus in patients with renal failure undergoing routine hemodialysis. The distribution according to diabetes mellitus comorbidity is presented in the following table:

Table 2 Distribution According to Diabetes Mellitus Comorbidity in Patients with Chronic Kidney Failure Undergoing Hemodialysis at Bahteramas Regional General Hospital, Southeast Sulawesi Province 2023-2025

No.	Diabetes Mellitus Comorbidity	Death (Event)	%	No Death (Censored)	%	Total	%
1.	Diabetes	12	12.8	35	37.2	47	50.0
2.	No Diabetes Mellitus	30	31.9	17	18.1	47	50.0
Total		42	44.7	52	55.3	94	100

Source: Secondary Data 2025

The table above shows that out of 94 people, the number of people with diabetes mellitus and without diabetes mellitus is the same, namely 47 people (50.0%) each.

3.2. Kaplan Meier Survival Curve and Log Rank Test

The comorbidity status of diabetes mellitus is also thought to affect the survival time of patients with renal failure undergoing hemodialysis. In this study, the comorbidity status of diabetes mellitus was categorized into two groups: those with diabetes mellitus comorbidity and those without diabetes mellitus comorbidity.

Table 3 Average Survival Time of Chronic Kidney Failure Patients Undergoing Hemodialysis Based on Diabetes Mellitus Comorbidity Status at Bahteramas Regional General Hospital, Southeast Sulawesi Province 2023-2025

Diabetes Mellitus Comorbidity Status	Mean	Min	Max
Present	458	330	586
None	288	205	371
Total	365	294	437

Source: Secondary Data 2025

The table above shows that kidney failure patients with diabetes mellitus comorbidity have a mean survival time of 458 days (CI 303-586 days), while those without diabetes mellitus comorbidity have a mean survival time of 288 days (CI 205-371 days).

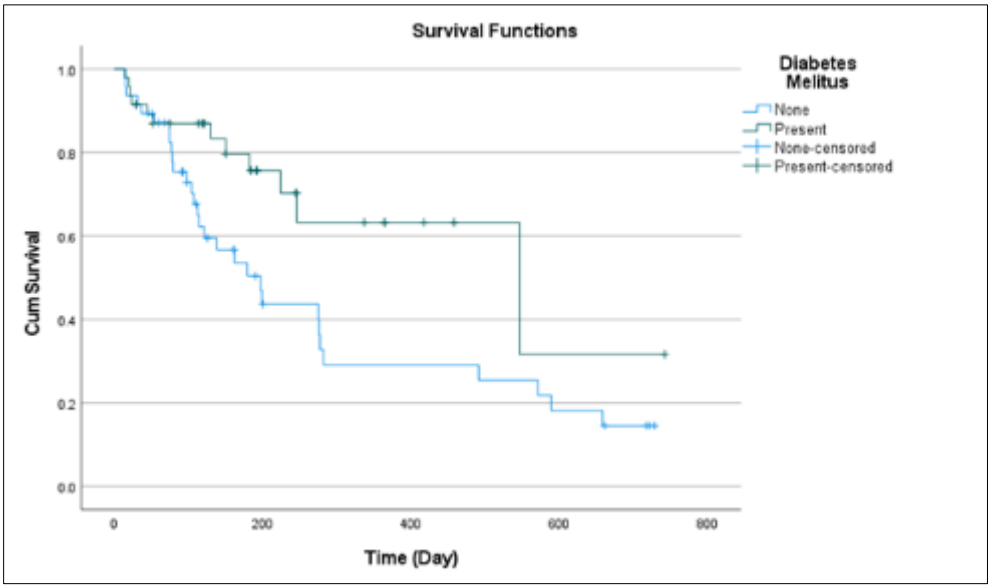

Figure 1 Kaplan Meier Survival Curve Based on diabetes mellitus comorbidity status

In the figure above, the green line indicates the presence of diabetes mellitus comorbidity, while the blue line indicates the absence of diabetes mellitus comorbidity. The X-axis represents time in days, and the Y-axis represents cumulative survival probability from 0 to 1. The curve for the group without diabetes (blue) shows a higher probability of survival compared to the group with diabetes (green). In the initial observation, the second group had a survival probability close to 1, but over time, the survival of diabetic patients declined more rapidly. The survival of patients with diabetes mellitus declined more rapidly and was lower than that of patients without diabetes, indicating that diabetes mellitus has a negative effect on survival. Overall, this curve shows a significant difference in survival between patients with and without diabetes mellitus, with diabetic patients having a worse prognosis in the observed period. To further determine whether there is a difference in survival between the two groups in the curve, a log-rank test was performed.

Table 4 Log Rank Test Variable status of diabetes mellitus comorbidity

Log Rank	df	P-Value
5.813	1	0.016

Source: Secondary Data 2025

In the table above, the results of the Kaplan-Meier Log Rank test for the variable of diabetes mellitus comorbidity status show a Log Rank statistical value of 3.878 with a degree of freedom (df) of 1 and a P-Value of 0.016. The p-value is smaller than α (0.05), resulting in a decision to reject H0. This means that there is a significant difference between diabetes mellitus comorbidity status and survival time. Thus, analytically, diabetes mellitus comorbidity status is a

significant factor influencing the survival of kidney failure patients undergoing hemodialysis at Bahteramas Regional General Hospital in Southeast Sulawesi Province.

3.3. Survival Analysis of Renal Failure Patients using Cox Proportional Hazard Regression

Table 5 Survival Analysis with Cox Regression Test

Variable	β	ρ	Exp(B)	Confident Interval	
				Lower	Upper
Diabetes melitus	1.286	0.019	3.617	1.241	10.544

Source: Secondary Data 2025

In the table above, it can be seen that the sig value or p-value of the diabetes mellitus variable is smaller than the significance level (0.05). This means that the diabetes mellitus variable has a significant effect on the survival time of chronic kidney failure patients.

Next, we can see the Exp(B) column, which shows the Hazard Ratio (HR). If we look at the Hazard Ratio value for the significant variable, namely diabetes mellitus, with a Hazard Ratio of 3.617. An HR value of 3.617 indicates that patients with diabetes mellitus comorbidity have a 3.617 times higher risk of experiencing an event (death) compared to the group without diabetes mellitus comorbidity.

High glucose levels cause glycosylation of proteins in the basement membrane, resulting in thickening of the membrane. In addition, glycoprotein-like substances accumulate in the mesangium, causing compression of the glomerular capillaries. This condition disrupts blood flow, which can ultimately lead to glomerulosclerosis and nephron enlargement, causing diabetic nephropathy. Diabetic nephropathy causes changes in capillaries and arteries, including thickening of the endothelial membrane and thrombosis, which are characteristics of diabetic microangiopathy that appear after one to two years of diabetes mellitus. Tissue hypoxia and ischemia can occur as a result of microangiopathy, especially in the retina and kidneys. In the kidneys, the manifestation of microangiopathy is diabetic nephropathy, which causes impaired kidney function, ultimately leading to chronic kidney failure in patients with diabetes mellitus who have had the disease for a long time [14].

Complications of nephropathy cause cellular damage to the kidneys. Analysis of the difference in survival between the diabetes mellitus group and the non-diabetes mellitus group using Cox regression showed a p-value of 0.001 with a significance level of α=0.05. The non-diabetes mellitus group had a survival rate 2.3 times higher than the diabetes mellitus group, as well as a longer survival time [9].

Research conducted by Marlina Rajagukguk (2019) shows that patients with renal failure and diabetic nephropathy have a mortality risk 6.714 times higher than patients with renal failure without diabetic nephropathy. This condition causes the prognosis for survival of patients with diabetic nephropathy to be worse than that of patients without this complication. Progressively, this disease begins with the leakage of albumin protein into the urine (albuminuria), which then develops to the point of reducing kidney filtration function. This decline in function results in the accumulation of metabolic waste in the body. If not treated quickly and appropriately, this condition can lead to death [15].

4. Conclusion

Of the 94 patients with renal failure undergoing hemodialysis, the number with and without comorbid diabetes mellitus was the same, namely 47 people (50%). Patients with diabetes mellitus comorbidity had a mean survival time of 458 days (CI 303-586). The Log Rank test showed a statistical value of 5.813 with p = 0.016, indicating that diabetes mellitus comorbidity had a significant effect on survival. Cox Regression analysis showed a hazard ratio (HR) of 3.617, meaning that patients with diabetes mellitus had a 3.617 times higher risk of death compared to those without diabetes. Therefore, this study can serve as a basis for improving the clinical management of patients with renal failure and diabetes mellitus comorbidity, assisting medical personnel and families in making treatment decisions and planning long-term care. By understanding the higher risk, more intensive and targeted interventions can be implemented to extend patient survival and conduct further research with larger samples and prospective designs to confirm findings and explore other risk factors for mortality.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest in this research

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