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Original Research Paper

# The Relationship Between Diabetes and Hypertension and Mortality in Chronic Kidney Disease Patients in Indonesia

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**Abstract**

**Background:** Chronic kidney disease (CKD) is a major global health problem that significantly increases morbidity and mortality, mainly due to cardiovascular disease (CVD). In Indonesia, cardiovascular complications account for approximately 42% of deaths among CKD patients. This study aimed to analyze the relationship between diabetes and hypertension with mortality in CKD patients in Indonesia. **Objective:** To investigate the association between diabetes and hypertension and mortality among chronic kidney disease patients undergoing hemodialysis in Indonesia. **Methods:** A cross-sectional study was conducted at Dr. H. Abdul Moeloek Regional Hospital, Lampung, from March to May 2024. The study population consisted of end-stage CKD patients undergoing hemodialysis. Data were obtained from medical records and analyzed using the Chi-Square test, with a significance level set at $p < 0.05$. **Results:** Of 110 patients, 58% of those with diabetes and 55.1% of those with hypertension died. Both comorbidities showed a significant association with mortality in CKD patients ($p = 0.0031$ for diabetes, $p = 0.019$ for hypertension). **Conclusion:** Diabetes and hypertension significantly increase mortality risk among CKD patients. These findings underscore the importance of comprehensive management of comorbidities to improve survival outcomes in CKD populations.

**Keywords:** *Chronic Kidney Disease; Diabetes; Hypertension; Mortality; Comorbidities.*

## Introduction

Chronic kidney disease (CKD) is a progressive condition characterized by a gradual loss of kidney function and represents a major global health burden with profound implications for morbidity and mortality. The global prevalence of CKD is estimated at approximately 10–15% of the population, underscoring its public health significance [1]. CKD is strongly associated with increased morbidity and mortality, particularly from cardiovascular disease (CVD) [2]. Patients with CKD face not only the risk of progression to end-stage kidney disease (ESKD) but also a heightened risk of CVD and premature death[2,3]. Early detection and effective management strategies are therefore essential to slow disease progression, reduce cardiovascular complications, and improve overall patient outcomes.

Evidence has demonstrated that CKD is an independent predictor of both all-cause and cardiovascular mortality, highlighting the importance of early detection and management[3]. Patients with CKD frequently present with higher rates of comorbidities, including heart failure, which further worsens their prognosis [4]. Epidemiological studies have shown that CKD is linked to adverse outcomes such as hospitalization, long-term dialysis, and death [5]. Notably, many patients with CKD die

from cardiovascular or other causes before reaching the stage of ESKD [5].

In Indonesia, cardiovascular complications remain the leading cause of death among CKD patients, accounting for approximately 42% of cases [6]. The 2018 Indonesian Basic Health Research Survey reported that 0.38% of the population, equivalent to 739,208 individuals, were living with CKD [7]. Mortality rates are also disproportionately higher in CKD patients with comorbid conditions, particularly during the COVID-19 pandemic, where the crude mortality rate reached 44.6% in CKD patients with COVID-19, compared to 4.7% among those without COVID-19 [8].

Among the multiple risk factors associated with mortality in CKD patients, traditional cardiovascular risk factors such as diabetes mellitus, hypertension, and dyslipidemia are highly prevalent and contribute significantly to adverse outcomes [9]. CKD itself amplifies the risk of all-cause and cardiovascular mortality, particularly in patients with advanced disease who frequently harbor multiple cardiovascular risk factors [10, 11]. Diabetes and hypertension, in particular, are the most common comorbidities observed in CKD patients and are consistently linked to worse prognosis and higher mortality risk[12]. Both conditions accelerate the progression of renal dysfunction, thereby compounding disease burden [5].

Given the substantial morbidity and mortality associated with CKD and the critical role of comorbidities such as diabetes and hypertension, this study aims to analyze the association between these comorbidities and mortality among CKD patients undergoing hemodialysis in Indonesia. While previous studies have examined the impact of diabetes and hypertension on CKD outcomes, limited research has specifically addressed their relationship with mortality in Indonesian hemodialysis populations. The novelty of this study lies in its focus on a local Indonesian cohort, which is expected to generate contextually relevant data to guide more tailored management strategies aimed at reducing mortality and improving quality of life among CKD patients in Indonesia.

## Materials and Methods

### *Study Design*

This study employed a descriptive-analytic design with a cross-sectional approach to analyze the association between comorbidities and mortality among patients with end-stage chronic kidney disease (CKD) undergoing hemodialysis at Dr. H. Abdul Moeloek Regional Hospital, Lampung Province, Indonesia. Data were extracted from patient medical records at a single point in time without additional interventions. The study was conducted from March to May 2024. Cross-sectional designs are widely applied in epidemiological research to evaluate associations between exposures and outcomes.

### *Sampling*

The study population consisted of patients diagnosed with end-stage CKD undergoing routine hemodialysis at the hospital. A purposive sampling technique was applied, in which participants were selected based on predefined eligibility criteria until the required sample size was reached. Inclusion criteria were: (1) patients aged ≥18 years, (2) diagnosis of end-stage CKD undergoing hemodialysis, and (3) complete medical records documenting demographic characteristics, comorbidities, and mortality status. Patients with incomplete records or missing information on comorbidities were excluded. Purposive sampling is an appropriate method for clinical studies focusing on specific populations.

The independent variables were the presence of comorbidities, specifically diabetes mellitus and hypertension. The dependent variable was mortality in patients with end-

stage CKD undergoing hemodialysis. Demographic information, comorbidity status, and survival outcomes were obtained from patient medical records. Diabetes and hypertension are among the most prevalent comorbidities in CKD patients and have been strongly associated with increased mortality risk.

### *Data Collection Technique*

Data were collected retrospectively from patient medical records that fulfilled the inclusion criteria. The extracted data included age, sex, comorbidity status (diabetes and hypertension), and mortality outcomes. Medical record review is a widely used and reliable approach for obtaining clinical information in CKD epidemiological studies. All data were anonymized prior to analysis to ensure patient confidentiality and compliance with ethical research standards.

### *Data Analysis Technique*

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 26.0 for Windows (IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize demographic characteristics and comorbidity prevalence using frequency distributions and percentages. Bivariate analysis was conducted to evaluate the association between comorbidities (independent variables) and mortality (dependent variable). The Chi-Square test was employed to assess statistical associations, with Fisher's Exact Test used as an alternative when Chi-Square assumptions were not met. A significance level of $p < 0.05$ was applied. Statistical approaches such as Chi-Square testing are commonly used for categorical variables in medical research.

### *Ethical Considerations*

The study was approved by the Ethics Committee of Dr. H. Abdul Moeloek Regional Hospital, Lampung Province, Indonesia. All data were collected from secondary medical records, and patient confidentiality was maintained by anonymizing identifying information. Ethical approval ensures compliance with research standards and protection of patient rights.

## Results

This study examined the relationship between comorbidities, particularly diabetes and hypertension, and mortality among patients with chronic kidney disease (CKD). Data were collected from 110 patients at Dr. H. Abdul Moeloek Regional General Hospital. The results are presented in two main tables that describe the demographic and clinical characteristics of the study population and the statistical associations between comorbidities and mortality outcomes.

**Table 1**. Characteristics of the study sample

| Characteristics | Frequency | Percentage (%) |
|---|---|---|
| **Age** | | |
| <65 years | 64 | 58.2 |
| ≥65 years | 46 | 41.8 |
| **Sex** | | |
| Male | 59 | 53.6 |
| Female | 51 | 46.4 |
| **Diabetes** | | |
| Positive | 50 | 45.5 |
| Negative | 60 | 54.5 |
| **Hypertension** | | |
| Positive | 49 | 44.5 |
| Negative | 61 | 55.5 |
| **Mortality** | | |
| Positive | 47 | 42.7 |
| Negative | 63 | 57.3 |

Table 1 summarizes the demographic and clinical characteristics of the sample. A total of 58.2% of patients were younger than 65 years, while 41.8% were 65 years or older. The sex distribution was relatively balanced, with 53.6% male and 46.4% female. Regarding comorbidities, 45.5% of patients had diabetes and 44.5% had hypertension. Overall, 42.7% of

patients died during the study period, while 57.3% survived.

The age distribution indicates a slightly higher prevalence of CKD in patients younger than 65 years, which may reflect the rising incidence of CKD at younger ages due to lifestyle-related risk factors. The balanced sex distribution suggests that the findings are generalizable across genders. The presence of diabetes and hypertension in nearly half of the sample highlights the high prevalence of these comorbidities among individuals with CKD, consistent with prior reports.

**Table 2**. Association of diabetes and hypertension with mortality in CKD patients

| Variable | Mortality Positive | Mortality Negative | Total | p-value |
|---|---|---|---|---|
| **Diabetes** | | | | |
| Positive | 29 (58%) | 21 (42%) | 50 | 0.0031 |
| Negative | 18 (30%) | 42 (70%) | 60 | |
| **Hypertension** | | | | |
| Positive | 27 (55.1%) | 22 (44.9%) | 49 | 0.019 |
| Negative | 20 (32.8%) | 41 (67.2%) | 61 | |

Table 2 explores the relationship between diabetes, hypertension, and mortality among CKD patients. Among patients with diabetes, 58% died compared with 30% of those without diabetes. A chi-square analysis yielded a p-value of 0.0031, indicating a statistically significant association between diabetes and increased mortality risk.

Hypertension was also significantly associated with mortality. A total of 55.1% of hypertensive patients died, compared with 32.8% of non-hypertensive patients. The chi-square analysis yielded a p-value of 0.019, further confirming the significant correlation between hypertension and mortality risk in CKD patients. These findings align with existing literature showing that diabetes and hypertension are major contributors to adverse outcomes in CKD. This highlights the critical importance of comprehensive blood pressure control as an integral component of CKD management to reduce mortality and improve long term prognosis

## Discussion

Chronic kidney disease (CKD) is a major global health problem characterized by a persistent decline in kidney function for more than three months, affecting nearly 500 million individuals worldwide, with a particularly high prevalence in developing countries[13]. Epidemiological studies consistently show that CKD is closely associated with multiple comorbidities, particularly cardiovascular disease (CVD), which remains the leading cause of death in this population. Patients with CKD have an 8–10 fold higher risk of cardiovascular mortality compared with the general population, and this risk is further amplified by the presence of hypertension and diabetes, two highly prevalent comorbidities among CKD patients [14].

The multifactorial nature of CKD-related mortality is well established. Cardiovascular events are the major contributors, especially in those with reduced estimated glomerular filtration rate (eGFR), who are at increased risk for acute cardiovascular events and long-term mortality [15]. In addition, CKD is associated with anemia, mineral and bone disorders, and higher susceptibility to infections, all of which further worsen outcomes[13,16]. Infectious diseases, particularly pneumonia and sepsis, are also significant causes of death, as CKD has been identified as an independent risk factor for these conditions [17]. Moreover, CKD patients have an elevated risk of malignancies, such as urinary tract and lung cancers, which further contribute to mortality [18].

Our findings align with previous studies that identified diabetes as a key risk factor for poor outcomes in CKD [2,12]. Pathophysiological mechanisms such as hyperglycemia-induced nephropathy contribute to CKD progression and increased mortality risk. The significant p-

values in our analysis emphasize the need for strict diabetes management in CKD to improve survival. Diabetes mellitus, particularly type 2 diabetes, is a global health concern due to its strong association with premature death. Both microvascular complications (e.g., diabetic nephropathy and retinopathy) and macrovascular complications (e.g., CVD) drive this risk[19,20]. Furthermore, psychosocial factors, such as comorbid depression, worsen prognosis, highlighting the importance of integrated care addressing both physical and mental health [21].

The duration and severity of diabetes-related complications strongly influence mortality risk. Studies show that higher burden of complications, measured for example by the Diabetes Complications Severity Index (DCSI), is directly correlated with mortality in both type 1 and type 2 diabetes [22, 23]. Obesity further complicates outcomes, with body mass index (BMI) demonstrating a U-shaped relationship with mortality in diabetes, where both underweight and obese individuals are at increased risk [24]. Emerging biomarkers, such as shorter telomere length, may also provide prognostic information, being linked with increased cardiovascular mortality among patients with diabetes [25].

Consistent evidence confirms that diabetes remains a significant predictor of mortality among CKD patients, even at advanced stages[26]. The World Health Organization has identified CKD and diabetes as the most common risk factors for severe COVID-19, reinforcing their clinical importance [27]. Type 2 diabetes, the leading cause of CKD, is associated with increased all-cause mortality, frequent infections, and higher cardiovascular events[28,29,30]. The synergistic effect of diabetes and CKD doubles the mortality risk compared to diabetes alone [31, 32].

Hypertension, another highly prevalent comorbidity, emerged as a significant predictor of mortality in our study. Prior research consistently shows hypertension accelerates CKD progression and increases CVD risk [33-37]. Hypertension is the second leading cause of CKD and is strongly associated with vascular damage, glomerulosclerosis, and higher risk of cardiovascular events[38,39]. Severe or uncontrolled hypertension is linked with all-cause and cardiovascular mortality [40,41], and resistant hypertension is particularly concerning in CKD, requiring aggressive management [42,43,44,45].

The bidirectional relationship between CKD and hypertension creates a vicious cycle where each condition exacerbates the other, further elevating mortality risk [46]. Our findings reinforce previous reports that hypertensive CKD patients face markedly higher cardiovascular mortality, especially in advanced stages [47]. In addition, comorbid diabetes, CKD, and hypertension form a “high-risk triad” associated with adverse clinical outcomes and high mortality [48,49,50,51].

Taken together, our results highlight that both diabetes and hypertension independently and synergistically increase mortality risk in CKD patients. Effective management requires a comprehensive approach encompassing glycemic control, blood pressure management, early detection and treatment of complications, and integrated care for psychosocial factors. Future research should further elucidate biological pathways, such as oxidative stress and endothelial dysfunction, to develop more targeted interventions that may reduce mortality among this high-risk population.

## Conclusion

Diabetes mellitus and hypertension were found to be significant predictors of mortality among patients with end stage chronic kidney disease (CKD) undergoing hemodialysis. These findings are consistent with previous studies reporting that both diabetes and hypertension

accelerate vascular complications and increase the risk of adverse outcomes in CKD patients. Effective management of diabetes and hypertension is therefore essential to improve therapeutic outcomes and reduce mortality rates in this population [4,5]. Future studies with larger cohorts and prospective designs are recommended to validate these results and explore additional modifiable risk factors.

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