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Relationship Between Patients with Hypertension Stage 2 and Chronic Kidney Disease (CKD) at Harapan Keluarga Hospital

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Abstract: Hypertension and chronic kidney disease (CKD) are interrelated global health challenges with rising prevalence, particularly in low-resource settings such as Indonesia. This retrospective cohort study aimed to investigate the association between hypertension stage 2 and CKD among 65 patients treated at Harapan Keluarga Hospital between 2023 and 2024. Data were obtained through medical record reviews, and statistical analysis was conducted using Chi-square testing and odds ratio (OR) calculations. A significant association was found between stage 2 hypertension and CKD ($p = 0.001$), although the OR value of 0.888 (95% CI: 0.821–0.920) suggests a negative correlation, potentially influenced by variations in treatment adherence, demographic characteristics, or other confounding factors. Differences in BMI and blood pressure between male and female patients were also observed, highlighting the role of sex-specific physiological and lifestyle variables in disease progression. The findings emphasize the importance of tailored clinical management strategies for hypertensive patients to prevent CKD progression, particularly in healthcare settings with limited diagnostic and therapeutic resources.

Keywords: Chronic Kidney Disease (CKD), disease progression, hypertension stage 2, risk factor.

Introduction

Hypertension and chronic kidney disease (CKD) are two critical health issues that are interconnected and significantly affect global public health. Hypertension is acknowledged as the most common modifiable risk factor for cardiovascular disease and disability (Kulkarni *et al*., 2023). In contrast, CKD is characterized by the progressive decline in kidney function, which frequently culminates in the requirement for renal replacement therapy, particularly hemodialysis (Hustrini, 2023). Hypertension is a significant global health concern, affecting more than one billion individuals and resulting in approximately 10 million deaths annually (Franco *et al*., 2022; Lu *et al*., 2022). Concurrently, CKD affects 10-15% of the worldwide population, with its prevalence continuing to rise (Pugh *et al*., 2019). In Indonesia, the increasing prevalence of both diseases is exacerbated by limited access to health services, which hinders effective chronic disease management. The relationship between hypertension and CKD shows the importance of an integrated approach in the prevention and management of both conditions.

It is important to know how these two conditions are clinically defined, to understand the relationship between hypertension and CKD. Hypertension is a condition when systolic blood pressure is ≥140 mmHg or diastolic blood pressure reaches ≥90 mmHg (Jafarnejad *et al*., 2020). Based on the Heart Association guidelines in 2017, hypertension is classified into several levels, ranging from normal blood pressure, increased blood pressure, hypertension stage 1, to hypertension stage 2 (Yu *et al*., 2021). Conversely, CKD is defined as a progressive condition characterized by the gradual loss of nephrons, which ultimately leads to the failure of renal compensation mechanisms. This condition

is characterized by a glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m², or a situation where the GFR is elevated in the presence of urinary tract abnormalities, including albuminuria and proteinuria (Teo *et al*., 2021). Understanding this definition is an important basis for assessing the pathophysiology interaction between the two diseases.

Hypertension and CKD have a complex and mutually influencing correlation. The pathophysiology of hypertension is multifaceted, involving gradual nephron dysfunction, sodium retention leading to volume expansion, heightened sympathetic nervous system activity, renin-angiotensin-aldosterone system (RAAS) dysregulation, and endothelial impairment. Hypertension can accelerate the progression of CKD by causing structural changes in the renal arteries, increasing intraglomerular pressure, and heightening oxidative stress, which eventually leads to renal fibrosis. Conversely, CKD can exacerbate hypertension through the accumulation of uremic toxins, endothelial dysfunction, and a reduction in nephron function. This reduction can trigger excessive sympathetic nervous system and RAAS activity, further worsening hypertension (de Bhailis & Kalra, 2022).

Although the relationship between hypertension and CKD has been extensively studied, epidemiological data on CKD in Indonesia remain limited. This is reflected in the high incidence of hypertension reported in Asia and Indonesia, with prevalence rates of 27% and 34.1%, respectively (Oktamianti *et al*., 2022; Soenarta *et al*., 2020). In comparison, CKD prevalence data in Southeast Asia are available from five countries, representing approximately 72% of the region's adult population. However, data specific to Indonesia report a CKD prevalence of only 0.38%, suggesting possible underreporting and highlighting the need for more comprehensive documentation (Liyanage *et al*., 2022). Moreover, studies investigating the correlation between hypertension stage 2 and the early onset of CKD, particularly among patient populations in regional healthcare settings such as Harapan Keluarga Hospital, are still scarce.

This study aims to address existing gaps in the literature by analyzing the relationship between the incidence of hypertension stage 2 and CKD among patients at Harapan Keluarga Hospital. The research will evaluate the impact of hypertension stage 2 on the progression of CKD in treated patients. Additionally, this study seeks to identify the factors that contribute to the interaction between these two conditions. By understanding the pattern of the relationship between hypertension stage 2 and CKD within a specific clinical context, the findings are expected to serve as a foundation for developing more effective prevention and management strategies for hypertension and CKD at the hospital level.

Material and Methods

This study is a quantitative research with a retrospective cohort design, conducted at Harapan Keluarga Hospital during the period of 2023 to 2024. Subjects were selected using purposive sampling based on predefined inclusion and exclusion criteria, with a total sample of 65 patients. The target population in this study was all patients who underwent medical examinations at Harapan Keluarga Hospital during the study period. The selected samples were patients diagnosed with hypertension stage 2 and had complete data in accordance with the study requirements. The independent variable in this study was the status of hypertension stage 2, while the dependent variable was the occurrence of chronic kidney disease (CKD). Data were obtained through the review of medical records, including diagnoses by internal medicine specialists and complete laboratory test results. Data analysis was performed using SPSS software. Univariate analysis was used to describe the characteristics of respondents based on age, sex, body mass index (BMI), as well as systolic and diastolic blood pressure. Bivariate analysis using the Chi-square test was conducted to assess the relationship between hypertension stage 2 and the occurrence of CKD. The strength of the association was expressed in terms of odds ratio (OR) with a 95% confidence interval (CI), and the level of statistical significance was set at $p < 0.05$.

Results and Discussion

Characteristic Data

The characteristics data of hypertension

stage 2 patients with CKD were classified based on sex and characterized by age, BMI, systolic blood pressure, and diastolic blood pressure. These data are presented in Table 1, which shows the mean, maximum (Max), minimum (Min), and standard deviation (SD) values for each observed characteristic.

Tabel 1. Characteristic Data of Hypertension Stage 2 Patients Experiencing CDK

Variabel	Mean	Min	Max	SD
Male				
Age	41.47	19.00	41.74	14.69
BMI	22.50	12.38	51.38	3.38
Systolic	131.56	85.67	236.00	18.93
Diastolic	99.00	44.67	153.33	11.65
Female				
Age	41.85	19.00	101.00	13.89
BMI	24.68	10.85	68.76	4.79
Systolic	129.59	78.00	245.00	23.71
Diastolic	80.34	39.00	146.50	12.11

Analysis Data

Tabel 2. Analysis of the Relationship between Hypertension Stage 2 and CKD Patients

Variabel	OR (95% CI)	P value
CKD	Ref	0.001
Yes	0.888 (0.821-0.920)	
No		

Discussions

Relationship between Patients With Hypertension Stage 2 and CKD.

The findings of this study indicate a significant association between hypertension stage 2 and CKD ($p = 0.001 < 0.05$). This aligns with the results of Zhang *et al* (2019), who reported a statistically significant relationship between uncontrolled hypertension and early kidney damage. However, the OR of 0.888 (95% CI: 0.821–0.920), which reflects a negative association between the two conditions, appears to contradict this conclusion. Such a discrepancy may stem from differences in population characteristics or levels of treatment control among study subjects. Patient specific characteristics may also influence these outcomes.

According to Table 1, the average age of patients with hypertension stage 2 and CKD was similar for both males and females, approximately 41 years. However, there were differences in BMI, with female patients having a higher average BMI (24.68) compared to male patients (22.50). Increased BMI is independently known to correlate with a decline in GFR, which can ultimately contribute to CKD progression (Basolo *et al*., 2023; Kalantar-Zadeh *et al*., 2021). This correlation is influenced by the linear relationship between elevated systolic and diastolic blood pressure and increased BMI (Kreiner *et al*., 2023; Landi *et al*., 2018). Therefore, the difference in BMI values between men and women in this study may be a contributing factor in the severity of hypertension and the risk of CKD progression. Moreover, the study also revealed differences in blood pressure between male and female patients.

The mean systolic and diastolic blood pressure in male patients was 131.56 mmHg and 99.00 mmHg, respectively, whereas in female patients, the values were 129.59 mmHg and 80.34 mmHg. These findings indicate that male patients had higher systolic blood pressure than females, in line with the general pattern that men are at greater risk of hypertension. Elevated blood pressure in men contributes to a higher risk of kidney damage due to uncontrolled hypertension, thereby accelerating CKD progression compared to women (Minutolo *et al*., 2021). Furthermore, differences in blood pressure could be influenced by hormonal factors, lifestyle differences, or the use of antihypertensive medications, which may be more prevalent among male patients (Mallamaci & Tripepi, 2024).

Sex-based differences in blood pressure in the context of CKD may be attributed to biological factors, lifestyle patterns, and the treatment regimens. Hormonally, women have higher levels of estrogen, which confers protective effects on the cardiovascular system. In contrast, elevated testosterone levels in men affect vascular tone and endothelial function, increasing susceptibility to hypertension (Connelly *et al*., 2022). Moreover, lifestyle factors such as high sodium intake, low physical activity, alcohol consumption, and smoking habits also contribute to increased blood pressure (Ojangba *et al*., 2023; Sarfika *et al*., 2023).

Inconsistent use of medication, particularly among men, may lead to greater blood pressure variability, ultimately impacting kidney damage progression (Abalos *et al*., 2018; Ettehad *et al*., 2016). Consequently, biological differences, behavioral tendencies, and adherence to antihypertensive therapy should be considered when evaluating sex-related differences in CKD risk.

Although this study provides insights into the differences in blood pressure and CKD risk based on sex, it has several limitations. These include the lack of data on patient adherence to antihypertensive medication and hormonal status (e.g., reproductive phase in female patients), which limits more in-depth analysis of these factors. In addition, lifestyle variables such as sodium intake, physical activity, and smoking habits were not measured quantitatively, so the relationship between these factors and blood pressure can only be assumed based on previous literature. These limitations should be considered in the interpretation of the results and are important considerations for the design of future longitudinal studies with more comprehensive variable measurements.

Conclusion

This study demonstrated a statistically significant association between hypertension stage 2 and the incidence of chronic kidney disease (CKD) among patients at Harapan Keluarga Hospital, with a *p*-value of 0.001. However, the odds ratio (OR) of 0.888 (95% CI: 0.821–0.920) indicated a negative association, which may be influenced by various factors including population characteristics, treatment adherence, lifestyle differences, and hormonal status. The observed variations in blood pressure and body mass index (BMI) between male and female patients suggest that sex-specific physiological and behavioral factors may play a role in CKD progression. These findings highlight the need for comprehensive and individualized management strategies in hypertensive patients to prevent or slow CKD development. Further research incorporating detailed measurements of lifestyle factors, medication adherence, and hormonal profiles is warranted to better understand the complexities of this association.

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