

The Relationship Between Duration of Hypertension and Serum Creatinine, Urea, and Estimated Glomerular Filtration Rate (EGFR) in Hypertensive Patients

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Abstract

Hypertension, defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, affects 34.1% of Indonesia's population according to the Indonesian Basic Health Research. Uncontrolled and long-standing high blood pressure can damage the glomerular structure, leading to decreased kidney function characterized by increased urea and creatinine levels, as well as a reduced glomerular filtration rate (eGFR), which is the main indicator for staging chronic kidney disease. The purpose of the study is to analyze the relationship between the duration of hypertension and kidney function biomarkers, namely creatinine, urea, and estimated glomerular filtration rate (eGFR), in hypertensive patients. This research method uses an observational analytical design with a purposive sampling technique, involving a total of 30 patients with grade 1 and grade 2 hypertension. The results of the examination of kidney function biomarkers (creatinine, urea, and eGFR) in relation to the duration of hypertension, based on the nonparametric Kendall's tau correlation test, showed no significant relationship between creatinine values and duration of hypertension ($p = 0.061$, $p > 0.05$), nor between urea values and duration of hypertension ($p = 0.198$, $p > 0.05$); however, a significant relationship was found between eGFR and duration of hypertension ($p = 0.006$, $p < 0.05$). Thus, it can be concluded that eGFR is a potential biomarker in laboratory examinations for assessing the risk of kidney damage complications in hypertensive patients. It is recommended that people with hypertension undergo regular kidney function checks in order to reduce the risk of long-term complications.

INTRODUCTION

Hypertension is an increase in systolic blood pressure (TDS) ≥ 140 mm Hg and/or diastolic blood pressure (TDD) ≥ 90 mm Hg after repeated examinations (Unger et al., 2020). The disease is categorized as *the silent disease* Because people do not know they have hypertension before checking their blood pressure, it develops without obvious symptoms and can cause serious complications without the sufferer realizing it (Salsabila et al., 2025).

Hypertension causes the death of about 8 million people each year, of which 1.5 million deaths occur in Southeast Asia. In Indonesia, Basic Health Research (Riskesdas) in 2018 showed that the increase in the prevalence of hypertension in Indonesia with a population of around 260 million was 34.1% compared to 25.8% in Riskesdas in 2013. It is estimated that only a quarter of hypertension cases in Indonesia are diagnosed, and data shows that only 0.7% of diagnosed hypertensive patients take antihypertensive drugs (Kemenkes RI, 2021). The incidence rate of hypertension in Indonesia reaches 36%. From the Indonesian Basic Health Research, the prevalence of hypertension incidence is 34.1% (Kemenkes RI, 2023).

Uncontrolled hypertension is a major risk factor for heart attack, stroke, chronic kidney disease, and dementia (WHO, 2025). Various complications that may arise are very serious diseases and have an impact on the patient's psychology because of their low quality of life, especially in cases of stroke, kidney failure, and heart failure (Restia et al., 2023).

Chronic kidney disease can occur due to progressive damage due to high pressure in the capillaries of the kidneys and glomerulus. Glomerular damage will result in blood flowing to the functional units of the kidneys, so the nephrons will be disrupted and continue into hypoxia and kidney death (Ameer, 2022). Renal hypoxia and decreased blood flow to the kidneys cause LFG to decrease, resulting in an increase in renin regulation of the renin angiotensin aldosterone system which promotes salt and water retention. Salt and water retention will lead to the development of hypertension (Franzen et al., 2021). Uncontrolled high blood pressure can damage the glomerular structure and decrease the kidneys' ability to filter waste substances such as urea and creatinine and excess fluid from the blood. The disease is characterized by a decrease in kidney function which will clinically be seen as an increase in urea and creatinine (Sinta et al., 2022), in addition to being able to assess through glomerular filtration rate (LFG), which is the main indicator in determining the stage of chronic kidney disease (Salsabila et al., 2025).

Long-standing hypertension was significantly associated with a decrease in eGFR in adult patients with hypertension, suggesting that patients who had hypertension for more than 10 years experienced a greater percentage of decrease in eGFR (37%) compared to those with hypertension for less than 10 years (28%). This may be due to the fact that over time, high blood pressure can damage blood vessels throughout the kidneys and reduce the blood supply to the kidneys, leading to renal vascular nephropathy, which slowly leads to a decrease in the rate of glomerular filtration (Maiserer et al., 2024).

Several previous studies have examined the relationship between hypertension and biomarkers of kidney function. Research by Sinta et al., (2022) It shows an increase in urea and creatinine levels in stage 1 hypertension and stage 2 hypertension. Research Barends et al., (2026) It was found that there was no significant relationship between blood creatinine levels and blood pressure in patients with chronic kidney disease with hypertension. Research by Salsabila et al., (2025) reports that Lama suffering from hypertension has a significant association with LFG. Research Maiseri et al., (2024) reports that long-lasting hypertension is significantly associated with a decrease in eGFR in adult patients. The findings that have been obtained confirm that hypertension has a major contribution to impaired kidney function.

Various studies have discussed the relationship between hypertension and kidney function biomarkers, there are still some limitations, namely most previous studies focused more on the relationship between blood pressure and kidney function biomarkers without considering the length of time suffering from hypertension. In addition, some studies use only one biomarker of kidney function that is associated with long-term hypertension, such as eGFR, so it does not provide a complete picture of kidney function in people with hypertension. Based on these limitations, there are research *gaps* that need to be filled. There have not been many studies that have evaluated the effect of hypertension duration on various parameters of kidney function simultaneously. The combination of creatinine, urea, and eGFR tests can provide a more comprehensive picture of the kidney function status of hypertensive patients (Gupta et al., 2024; Hocher & Adamski, 2017; Pandya et al., 2016; Sekula et al., 2015).

Research on the long-term association of hypertension with creatinine, urea, albumin, and eGFR levels is important because it can provide a more comprehensive picture of the status of kidney function and provide scientific information about the long-term impact of hypertension on kidney function. The results of this study are expected to help health workers identify hypertensive patients who are at high risk of developing kidney disorders early, so that preventive and treatment interventions can be carried out faster. In addition, this study can complement the still limited scientific evidence regarding the long-standing association of hypertension with several biomarkers of kidney function (creatinine, urea, albumin and eGFR), thereby contributing to the development of more effective health care policies and practices in reducing the number of hypertension complications.

Various obstacles in the prevention, diagnosis and management of hypertension are often found in developing countries, including Indonesia. These obstacles include the definition of hypertension that is not uniform, causing confusion in the enforcement of diagnosis and management (Kemenkes RI, 2021). In addition, the characteristics of the Indonesian population which has a high prevalence of hypertension and a low level of blood pressure control make this study important to be carried out as a basis for the development of early detection strategies for kidney complications in hypertensive patients. In an effort to overcome these various obstacles, it is important to enforce proper diagnosis through laboratory examinations and biomarkers of kidney function on a regular basis in order to reduce the risk of complications in the long term.

Based on the facts described above, this research aims to analyze the relationship between long suffering and kidney function biomarkers, namely Creatinine, Ureum and *Estimated Glomerular Filtration Rate (eGFR)* in Hypertensive Patients. The benefits of this research contributes to the body of knowledge on the pathophysiology of hypertension-related kidney damage by providing empirical evidence on which biomarker (creatinine, urea, or eGFR) is most sensitive to the duration of hypertension. This finding can enrich the literature on the progression of chronic kidney disease in hypertensive patients, particularly in the Indonesian population. The results of this study offer valuable guidance for clinicians in selecting the most appropriate laboratory biomarker for early detection of kidney impairment in long-term hypertensive patients. Regular eGFR monitoring is recommended as a cost-effective and non-invasive strategy to identify high-risk patients, enabling timely preventive interventions and reducing the burden of hypertension-related complications such as kidney failure. Furthermore, these findings can inform health policy makers in designing screening programs and clinical guidelines for hypertension management in primary care settings.

METHODS

This research uses the Observational Analytical method to identify the relationship between variables or find a relationship between the length of suffering and the biomarker of kidney function, namely creatinine, ureum and *Estimated Glomerular Filtration Rate (eGFR)* in patients with hypertension. This research was carried out at the Makassar City Hospital. The research implementation time is from August to October 2023. The population in this study is all hypertension patients who come for health checks at the Makassar City Hospital.

The sampling technique in this study is *purposive sampling* because the samples taken are in accordance with the inclusion criteria, namely a sampling technique based on

considerations made by the researcher, with a total of 30 samples of patients with type 1 hypertension and type 2 hypertension. The research instruments used by the researcher were questionnaires, for the separation of blood cells and serum centrifuges were used, and to measure creatinine, urea, albumin *sysmex automated Clinical Chemistry Analyser BX-3010*. The data used are primary data, obtained directly from hypertensive patients who come for health checks at the Makassar City Hospital, namely questionnaires; blood pressure data, length of hypertension, history of disease, smoking history, type of antihypertensive drugs, weight and height, data on creatinine, urea and *Estimated Glomerular Filtration Rate (eGFR)* levels were obtained through direct measurement using *the automated Clinical Chemistry Analyser BX-3010 system* at the Makassar City Hospital laboratory.

The data analysis used by the authors in this study is univariate analysis used to see, present, and describe the frequency distribution of each research variable studied and bivariate analysis is used to determine the relationship between the duration of suffering and the biomarkers of kidney function, namely creatinine, urea and *Estimated Glomerular Filtration Rate (eGFR)* in patients with hypertension.

RESULTS AND DISCUSSION

In this study, as many as 30 research subjects were obtained that met the research inclusion criteria. The specimens used in this study are using serum from hypertensive patients who have been diagnosed by the doctor in charge and are willing to participate in the study by providing written consent to *take* specimens and examine biomarkers of kidney function, namely creatinine, urea, albumin and egfr. The results of the study were obtained in accordance with tables 1, 2 and 3.

Table 1. Characteristics of research subjects

Categories	Quantity (n=30)	Percentage (%)
Gender		
Male	10	33,3
Women	20	66,7
Age (Years)		
33 – 45	15	50
>45	15	50
Degree of Hypertension		
Degree 1	15	50
Degree 2	15	50
Long suffering		
<5 Years	17	56,7
5 – 10 Years	10	33,3
>10 Years	3	10
Body Mass Index		
18,5 - 25,0	18	60
25,1 - 27,0	7	23,3
>27	5	16,7

Source: primary data

The characteristics of the research subjects in table 1 were obtained The number of female sufferers is more than that of men, namely 66.7% and 33.3%, for the age classification, it is found that the age of >45 and 33-4 5 years is 50% respectively, for degree 1 and 2 hypertension

are obtained 50%, for the duration of suffering from hypertension the most with the duration of suffering <5 years as much as 56.7%, 5-10 years as much as 33.3% and >10 years consists of 10%, for BMI, more have a normal BMI, which is as much as 60%.

Table 2. Frequency Distribution of Renal Function Biomarker Examination Results

Function Biomarkers Kidney	Quantity (n = 30)	Percentage (%)	Average rate of examination results
Creatinine			
Normal	27	90	0.85 mg/dL
Increase	3	10	
Urea			
Normal	26	86,7	27.08 mg/dL
Increase	1	3,3	
Downward	3	10	
eGFR			
Normal	19	63,4	97.3 ml/min/1,732
Mild Drop	9	30	
Moderate Decline	1	3,3	
Weight Loss	1	3,3	
Kidney Failure	0	0	

Source: primary data

The frequency distribution of the results of the biomarker examination of kidney function in hypertensive patients based on table 2 was obtained for more creatinine having normal levels of 90% and increasing by 10% with an average level of 0.85 mg/dl, for normal urea as much as 86.7%, increasing 3.3% and decreasing 10% with an average level of 27.08 mg/dl, for normal albumin as much as 86.7% and decreasing (hypoalbuminemia) by 13.3% with an average level of 4.0 mg.dl, For EGFR, it was found to be normal as much as 63.4%, a mild decrease of 30%, a moderate decrease of 3.3% and a weight loss of 3.3%, no kidney failure was found.

Table 3. Correlation of the results of the biomarker examination of kidney function to the length of suffering in hypertensive patients

Function Biomarkers Kidney	Hypertension Long Term (Years)			<i>p value</i>
	<5 Years	5-10 Years	>10 Years	
Creatinine				
Normal	16	9	2	0,061
Increase	1	1	1	
Urea				
Normal	15	9	2	0,198
Increase	0	0	1	
Downward	2	1	0	
eGFR				
Normal	12	5	2	0,006
Mild Drop	4	5	0	
Moderate Decline	1	0	0	
Weight Loss	0	0	1	
Kidney Failure	0	0	0	

Source: primary data

The correlation of the results of the examination of kidney function biomarkers (creatinine, urea, albumin and eGFR) to the length of suffering from hypertension in table 3, based on the results of *the SPSS* statistical test using *the Kendall's Correlation Test* obtained for creatinine value $p=0.061$ ($p > 0.05$), ureum value $p=0.198$ ($p > 0.05$), albumin value $p=0.231$ ($p > 0.05$) which means that there is no significant relationship between the results of creatinine examination, urea and albumin against long suffering from hypertension, then H_a rejected H_0 accepted. For eGFR the value of $p=0.006$ ($p < 0.005$) which means that there is a significant relationship between eGFR and the length of suffering from hypertension, then H_a accepted H_0 is rejected.

This study has been carried out at Makassar City Hospital using the Analytical Observational method with *purposive sampling techniques* to identify the relationship between variables or find the relationship between the duration of suffering and kidney function biomarkers, namely creatinine, urea, albumin and *Estimated Glomerular Filtration Rate (eGFR)* in patients with hypertension. The population in this study is all hypertensive patients who come for a medical examination and have been diagnosed with hypertension by a doctor at the Makassar City Hospital.

Characteristics of research subjects showing from 30 hypertensive patients, The number of female sufferers is more than that of men, which is 66.7% and 33.3% respectively. This is not in line with the research conducted Silviana and Kodim, (2019) who get hypertension in men more than women. Men have a 1.18 times more risk of developing hypertension than women. Similar results were obtained by Rivaldi et al., (2025) That is, the distribution of hypertension incidence based on gender is more likely to suffer from hypertension than women. This condition can be associated with lifestyle differences, such as smoking habits, alcohol consumption, and a diet high in salt that are more commonly found in men. In addition, hormonal factors in women, especially the hormone estrogen, are known to have a protective effect on the cardiovascular system, so they can reduce the risk of hypertension before menopause. However, the results of this study are in line with the research Barends et al., (2026) The number of hypertension patients was found to be higher in the female gender, namely 37 patients (57%) compared to 28 male patients (43%). After menopause, estrogen levels in women naturally decrease so that they are more susceptible to various diseases, the decrease in estrogen is related to increased activation of RAAS which causes vasoconstriction and fluid retention thus increasing the risk of hypertension.

Based on the age category, the adult category with the pre-elderly who range in age from 33-59 years has the same percentage, which is 50%. This research is in line with research Manongga et al., (2024) which states that the number of respondents who suffer from hypertension is the most in the age range of 19-59 years, the age factor greatly affects hypertension because as we age, the risk of hypertension increases. Increased blood pressure occurs because the walls of the arteries thicken due to the buildup of collagen in the muscle layer, causing narrowing and stiffening of blood vessels.

The characteristics of the research subjects based on the body mass index in this study were obtained more than having a normal BMI of 60%, overweight and obesity as much as 40%. According to Aronow, (2017), overweight and obesity are risk factors for hypertension, dyslipidemia, and diabetes mellitus. The Framingham Study shows that the prevalence of obesity is about twice as high in obese men and women compared to men and women of

relatively normal weight, The Framingham Study also shows that both men and women experience an increase in blood pressure along with an increase in overweight. People in high BMI had 16 mmHg higher systolic blood pressure and 9 mmHg higher diastolic blood pressure than people in low or normal body mass index. In this study, systolic blood pressure increased by 4 mmHg for every 4.5 kg gain in weight.

The frequency distribution of the results of the examination of kidney function biomarkers in hypertensive patients based on table 2 was obtained for more creatinine having normal levels of 90% and increasing by 10% with an average level of 0.85 mg/dl. Hypertensive patients who experienced increased creatinine levels occurred in subjects with hypertension for > years and had 54 and 55 years of age. As we age, a physiological decline in kidney function also occurs. However, a decline in kidney function can occur quickly if it is accompanied by comorbid diseases. Indicators of decreased kidney function can be seen from a decrease in glomerular filtration rate. Physiologically, the kidneys are unable to regenerate nephrons that have been damaged, so with age, there is a decrease in the number of nephrons in the kidneys. There is a decrease in kidney function of about 10% every 10 years of age in people with age 40 years (Ladesvita et al., 2020).

Based on the results of the urea examination, it was found that normal urea levels were 86.7%, increased by 3.3% and decreased by 10% with an average level of 27.08 mg/dl, increased urea levels occurred in patients who were 55 years old, suffering from hypertension for more than 10 years. The longer a person suffers from hypertension, the more severe the complications that arise. In hypertension that lasts for a long time, there will be damage to blood vessels, heart organs, brain and kidneys. In some people with hypertension, kidney function becomes worse. When a patient is declared hypertensive, usually in most patients it takes at least 10 years to see any abnormalities in kidney function or damage to kidney function until it can be detected, but there are some patients who have only had hypertension for 2 years have been diagnosed with kidney damage (Aris et al., 2024). The results of the calculation of the eGFR value using the calculation method *cockcroft-Gault* Based on the results of serum creatinine examination, the eGFR value was found to be normal as much as 63.4%, a mild decrease of 30%, a moderate decrease of 3.3% and a weight loss of 3.3%, no kidney failure was found. Mild, moderate and severe reductions in the study subjects were found in subjects with degrees of hypertension 2. High systolic blood pressure towards the renal afferent arterioles that continue to the glomerulus, can cause the stimulation of barotrauma in the glomerular blood vessels which results in an increase in local osmotic pressure, this condition if it lasts for a long time will cause glomerulosclerosis. The occurrence of glomerulosclerosis causes hypoxia in the kidneys which stimulates the release of vasoactive substances that have an impact on the vasoconstriction of the renal blood vessels (Ladesvita et al., 2020).

Correlation of the results of the examination of kidney function biomarkers (creatinine, ureum and eGFR) to the length of suffering from hypertension in table 3, based on the results of statistical tests *SPSS Using Kendall's Correlation Test* obtained for creatinine value $p=0.061$ ($p >0.05$), urea value $p=0.198$ ($p >0.05$), which means that there is no significant relationship between the results of creatinine examination and urea and the length of suffering from hypertension, then H_a rejected H_0 accepted. This is in line with research Barends et al., (2026) It was found that there was no significant relationship between blood creatinine levels and blood pressure in patients with chronic kidney disease with hypertension. The relationship between

creatinine levels and blood pressure can be influenced by a number of factors, such as gender, age, lifestyle, and medication history.

The eGFR analysis showed a value of $p=0.006$ ($p<0.005$) which means that there is a significant relationship between eGFR and hypertension for a long time, so H_0 is rejected. The results of this study are in line with Maisuri (2024) study Long-standing hypertension significantly associated with a decrease in eGFR in adult patients with hypertension ($P=0.038$), which showed that patients suffering from hypertension for more than 10 years experienced a greater percentage of eGFR decrease (37%) compared to those with hypertension for less than 10 years (28%). These findings are in line with the findings of a study conducted in Ethiopia. This can be caused because over time, high blood pressure can damage the blood vessels throughout the kidneys and reduce the blood supply to the kidneys, leading to renal vascular nephropathy, which slowly leads to a decrease in glomerular filtration rate.

Increased oxidative metabolism resulting in renal hypoxia. Renal hypoxia and decreased blood flow to the kidneys cause LFG to decrease, resulting in an increase in renin regulation of the renin angiotensin aldosterone system which promotes salt and water retention. Salt and water retention will lead to the development of hypertension (Franzen et al., 2021).

CONCLUSION

Based on the research that has been carried out on 30 subjects with hypertension, it can be concluded that the number of female sufferers is more than men, for the age classification it is found that the age of >45 and 33-45 years is 50% respectively, for hypertension of 1st and 2 degrees 50% respectively, for BMI many have a normal BMI of 60%, for a long time suffering from hypertension the most with a duration of suffering <5 years. Then a correlation test was carried out on the results of the examination of kidney function biomarkers (creatinine, urea and eGFR) on the length of suffering from hypertension, the results were obtained that there was no significant relationship between the results of the creatinine test value $p=0.061$ ($p>0.05$), urea value $p=0.198$ ($p>0.05$), albumin value $p=0.231$ ($p>0.05$) and the length of suffering from hypertension, and a significant relationship was found between eGFR and the length of suffering from hypertension value $p=0.006$ ($p<0.005$), thus, it can be concluded that the eGFR value is a potential biomarker in laboratory examinations to see the risk of complications of kidney damage in hypertensive patients. It is recommended for people with hypertension to have regular kidney function checks in order to reduce the risk of complications in the long term.

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