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Relationship between Blood Pressure with Glomerular Filtration Rate (GFR) in Patients with Chronic Renal Failure

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Abstract: *The prevalence of hypertension and chronic kidney disease continues to increase worldwide and has the potential to experience more significant cardiovascular disease. Older patients have also reported an association between a modest decrease in glomerular filtration rate (GFR) and an increase in systolic blood pressure. As the prevalence of chronic kidney disease (CKD) increases with age, multiple complications can occur, including hypertension, diabetes, and other cardiovascular diseases. Multimorbidity is defined as the condition of having two or more chronic morbidities. This study aims to evaluate the relationship between blood pressure and multimorbidity with the glomerular filtration rate (GFR) of chronic renal failure patients at RST Dompet Dhuafa Parung, Bogor. This research is retrospective research with the Consecutive Sampling method. Data was taken through a medical record in 112 samples of chronic renal failure patients undergoing hemodialysis from January 2021 to March 2022. The results of the Spearman correlation test showed a p-value 0.025 in the relationship between systolic blood pressure and GFR and a p-value 0.008 in the relationship between blood pressure diastolic with GFR. At the same time, the results of Kendall's Tau_B correlation test showed a p-value 0.212 in the relationship between the number of comorbidities and GFR. It can be seen that there is a relationship between systolic blood pressure and diastolic blood pressure, and GFR. Whereas, there is no relationship between the number of comorbidities and GFR in chronic renal failure patients in RST Dompet Dhuafa Parung Bogor.*

Keywords: *Chronic Renal Failure, Blood Pressure, Multimorbidity, Glomerular Filtration Rate*

INTRODUCTION

The prevalence of hypertension and chronic kidney disease continues to increase worldwide. It has the potential to experience more significant cardiovascular disease, so hypertension and chronic kidney disease (CKD) are health challenges for the global community (Garofalo et al., 2016). The kidneys are essential in regulating blood pressure by controlling renal perfusion pressure and extracellular volume (Vääräniemi et al., 2014).

In the 1999-2002 National Health and Nutrition Examination Survey (NHANES), mild decline in renal function without chronic kidney disease (CKD) was associated with hypertension in women but not men. Older patients have also reported an association between a modest decrease in glomerular filtration rate (GFR) and an increase in systolic blood pressure. (Vääräniemi et al., 2014).

In the United States, in chronic kidney disease (CKD), one or more than seven people experience kidney failure, ranging from stage 2 to stage 5. In America, more than 37 million people experience kidney failure, and chronic kidney disease increases morbidity rates and mortality, length of stay, and the burden of medical expenses (Chua et al., 2021).

The prevalence of chronic kidney disease (CKD) increases sharply with age. Therefore, it is likely that several comorbidities, including hypertension, diabetes, and other cardiovascular diseases, will occur. Multimorbidity is defined as the condition of having two or more chronic morbidities.

Comorbidity is considered vital because it impacts the treatment burden, quality of life, drug management, and survival of patients with chronic kidney failure (Fraser et al., 2015).

Some research results show a link between decreased kidney function and increased arterial stiffness as an effect of blood pressure levels (Vääräniemi et al., 2014). Previous studies have also shown an association between multimorbidity and increased clinical risk of exacerbation in patients with CKD. This study aims to evaluate the relationship between blood pressure with GFR and multimorbidity with GFR in patients with chronic renal failure at RST Dompet Dhuafa Parung in Bogor.

METHOD

This research is a descriptive correlation study conducted to explain the relationship between two independent variables, namely blood pressure and the number of comorbidities in chronic kidney failure patients, and their relationship with the glomerular filtration rate (GFR). This research is retrospective research. The retrospective is one research method where the data collected comes from the past in the form of patient medical record data used to answer the current study.

This research instrument is the patient's medical record observation sheet, and the data used is secondary data. The observation sheet contains the demographic characteristics of respondents, which include gender, age, occupation, education, comorbidity (diabetes mellitus/hypertension/etc.), the number of comorbid, and blood pressure. The research began after the researcher received an ethical test letter issued with number 202/V/2022/KEPK and received approval from data collection with number 013/SKIP/KEPRS/III/2022. The ethical principles that researchers apply include applying the principle of confidentiality and considering the benefits and losses caused. The medical record data obtained will be kept confidential by researchers by storing the data safely and not providing data for purposes other than legal or trial needs.

In univariate analysis, frequency distribution tables will be displayed for categorical data and central tendency tables will be displayed for numeric data. The results of the data normality test were found that in the diastolic blood pressure variable, the number of comorbidities, and GFR in sequence are 0,000; 0,000; and 0,000. This shows that the data is not normally distributed. Whereas in the systolic blood pressure variable, the normality test result is 0.090. Because the dependent variable does not meet the data normality test, bivariate analysis is carried out through the Spearman and Kendall's Tau_B test. The spearman test was carried out to determine the relationship between systolic blood pressure and diastolic blood pressure with GFR, while the Kendall's Tau_B test was carried out to determine the relationship between the number of comorbidities and GFR with a significance level of $p<0.05$.

The population in this study consisted of all medical record data of chronic kidney failure patients at the RST Dompet Dhuafa, with inclusion criteria (1) Registered in the medical record from January 2021 to March 2022, (2) Chronic kidney failure patients undergoing hemodialysis, (3) Possess complete supporting examination data and medical records such as gender, age, education, occupation, comorbidity (diabetes mellitus/hypertension/kidney stone/CHF/Pulmonary TB), a number of comorbid, and blood pressure. At the same time, the exclusion criteria were (1) Chronic kidney failure patients undergoing CAPD (Continuous Ambulatory Peritoneal Dialysis) therapy, (2) Chronic kidney failure patients who had undergone kidney transplants, (3) Chronic renal failure patients undergoing hemodialysis for the period January 2021 to March 2022 but has not yet been included in the database so cannot be used as a respondent.

The samples were taken using a consecutive sampling technique. The number of samples was calculated using the Lemeshow proportion estimation formula, and the number of samples obtained was 109 respondents. However, the number of respondents who meet the inclusion criteria is more than 109, and the data was entered into the sample of this study

Data analysis in this study is a univariate analysis and bivariate analysis. The description of the research variable and data analysis used is as follows:

	Operational Definition (OD)		**Measuring Scale/Type of Data**		**Type of Analysis**
	Independent Variables	**Dependent Variables**	**Independent Variables**	**Dependent Variables**	
1	Systolic blood pressure OD: Blood pressure when the heart pumps blood into the arteries	Glomerular Filtration Rate (GFR) OD: Values that describe the kidneys' ability to filter the results of metabolism and substances contained in the blood can be seen from the calculation of the creatinine level of kleenex using the Cockroft-gault formula.	Rasio (Numeric)	Rasio (Numeric)	Bivariate (Spearman Test)
2	Diastolic blood pressure OD: Blood pressure when the heart expands and sucks blood again		Rasio (Numeric)		Bivariate (Spearman Test)
3	Number of Comorbids OD: The number of comorbids suffered based on the results of the doctor's diagnosis		Ordinal (Categorical)		Bivariate (Kendall's tau_b Test)

	Operational Definition (OD)	**Measuring Scale/Type of Data**	**Type of Analysis**
Confounding Variables			
1	Age OD: The length of time of the respondent's life to the research took place which was calculated from the date of birth.	Interval (Numeric)	Univariate (Tendency Central)
2	Gender OD: Biological characteristics as a physical difference in an individual.	Nominal (Categorical)	Univariate (Frequency Distribution)
3	Occupation OD: The current job status of the patient has.	Nominal (Categorical)	Univariate (Frequency Distribution)
4	Education OD: The last education of the patient has.	Ordinal (Categorical)	Univariate (Frequency Distribution)
5	Comorbidity OD: A history of accompanying diseases in respondents.	Nominal (Categorical)	Univariate (Frequency Distribution)

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RESULTS

The study was conducted in the hemodialysis room of RST Dompet Dhuafa from March to May 2022. Data taken included the demographic characteristics of respondent's demographic characteristics, such as gender, age, education, occupation, comorbidity (diabetes mellitus/hypertension/kidney stone/CHF/Pulmonary TB), a number of comorbid, and blood pressure, which can be seen in table 1 and table 2.

Table 1. Frequency Distribution of Respondents Based on Gender, Occupation, Education, Comorbidities, and Number of Comorbidities Suffered by Patients (n=112)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	56	50
Female	56	50
Occupation		
Housewives/Not Working	92	82,1
Self-Employed	4	3,6
Private Sector Employee	14	12,5
Civil Servant	1	0,9
Retired	1	0,9
Education		
Elementary School	28	25
Junior High School	9	8
Senior High School	28	25
College	6	5,4
Unknown	41	36,6
Comorbidities		
Hypertension	93	64,6
Diabetes Mellitus	35	24,3
Kidney Stones	10	7
CHF	4	2,7
Pulmonary Tuberculosis	2	1,4
Number of Comorbidities		
1	84	75
2	24	21,4
3	4	3,6

Table 2. Average Distribution of Respondents by Age, GFR, Systolic Blood Pressure, and Diastolic Blood Pressure (n=112)

Characteristics	Mean	SD	Min	Max	95% CI	
					Lower	Upper
Age	52,95	9,81	26	74	51,11	54,78
GFR	13,19	11,30	2,1	60,3	11,08	15,31
Systolic Blood Pressure	145,80	25,70	90	208	140,99	150,62
Diastolic Blood Pressure	83,79	12,26	63	134	81,50	86,09

Table 1 presents an overview of the characteristics of respondents based on gender, occupation, education, comorbidities and number of comorbidities. The results showed that the number of female and male respondents was equal, with 56 people each. The majority of respondents were housewives/not working (82.1%) with a balanced level of education between the elementary and high school, while 41 people (36.6%) did not know their education.

The majority of respondents had at least one type of comorbid (75%), with hypertension being the most common comorbid suffered by respondents with a total of 93 people (64.6%), followed by diabetes mellitus as the second most commonly comorbid with a total of 35 people (24.3%)), kidney stones in 10 people (7%), CHF in 4 people (2.7%), and pulmonary tuberculosis in 2 people (1.4%).

Table 2 shows that the average age of the respondents was 53 years old. The oldest age being 74 years and the youngest age being 26 years, with an average GFR value in this study is 13.19 mL/minute/1.73m2. The highest GFR value was obtained at 60.3 mL/minute/1.73m2, and the lowest GFR value was obtained at 2.1 mL/minute/1.73m2. Statistical test results show an average systolic pressure of 145.80 mmHg, with a maximum systolic pressure of 208 mmHg and a minimum systolic pressure of 90 mmHg. At the same time, the mean diastolic pressure was 83.79 mmHg, the maximum diastolic pressure was 134 mmHg, and the minimum diastolic pressure was 63 mmHg.

Table 3. Analysis of the Relationship between Systolic Blood Pressure and Diastolic Blood Pressure with Glomerular Filtration Rate (GFR) (n=112)

Variables	GFR		
	n	r	*p-value*
Systolic Blood Pressure	112	-0,211[a]	0,025*
Diastolic Blood Pressure	112	-0,248[a]	0,008*

Spearman Test [a]; *Significant at α 5%

Table 3 shows a relationship between systolic blood pressure and glomerular filtration rate (GFR) as evidenced by a p-value <0.05 and a value of r = -0.211, which indicates a weak degree of relationship and a negative relationship. This means that the relationship between the two is opposite. If the systolic blood pressure increases, the GFR value will decrease. The same results also showed a relationship between diastolic blood pressure and glomerular filtration rate, as evidenced by a p-value <0.05 and a value of r = -0.248, which indicates the degree of relationship is weak and the direction of the relationship is negative. If the diastolic blood pressure increases, the GFR value will decrease.

Table 4. Analysis of the Relationship between Number of Comorbidities and Glomerular Filtration Rate (GFR) (n=112)

Variabel	Number of Comorbidities		
	n	r	*p-value*
GFR	112	0,096[b]	0,212

Kendall's tau_b Test[b]

Table 4 shows no relationship between the number of comorbidities and the glomerular filtration rate (GFR), as evidenced by the p-value = 0.212 and r = 0.096, which shows the degree of relationship is very weak.

DISCUSSION

The proportion of hemodialysis in the population aged 15 years and over in West Java was 252 people with the largest age group undergoing hemodialysis in the age group 55 to 64 years of 47 people (30.15%) (Kementerian Kesehatan RI, 2019). Based on research by Aisara et al. (2018) in patients with chronic kidney failure undergoing hemodialysis, it was shown that the largest age group was in the age range of 40 to 60 years. A study also found similar results Artiany et al. (2021) where based on age level, ages 56 to 65 years were the largest age group for chronic kidney failure patients undergoing hemodialysis therapy. This study's youngest patient with chronic kidney failure was 26 years old. Similar results were found in a study by Artiany et al. (2021) that the youngest age characteristic of chronic kidney failure patients was in the 26-35 year group, with a percentage of 7.62% in the case group.

One of the risk factors that cause chronic kidney failure is increasing age. As a person ages, kidney function will decrease, associated with a decrease in the glomerular filtration rate. It is usual for the glomerular filtration rate to decrease on a small scale as you age. This decrease in glomerular filtration rate also does not cause symptoms in the body because it can still be tolerated by the kidneys (Pranandari & Supadmi, 2015). The glomerular filtration rate will decrease by 0.75 ml/minute annually after individuals aged 40 years and over. However, a decrease in glomerular filtration rate can occur more quickly due to comorbid factors (Sulistiowati & Idaiani, 2015).

Gender is also a risk factor that can increase the incidence of chronic kidney disease. The prevalence of men suffering from chronic kidney failure is higher than women, with the proportion of men at 0.3% and women at 0.2% (Kementerian Kesehatan RI, 2019). Men have a two times higher risk of chronic kidney failure than women. Men have worse lifestyles than women, such as the consumption of cigarettes and alcohol (Artiany et al., 2021). In addition, women are more compliant in treatment than men (Morningstar et al, 2002 dalam Pranandari & Supadmi, 2015).

Chronic kidney disease occurs in individuals who have active status. The same thing was found in a study by Arifa et al. (2018) that 66.1% of respondents with working status experienced chronic kidney failure. However, statistical tests showed no association between work and the incidence of chronic kidney failure. Work is closely related to income. Income affects the level of health. It is known that mortality rates increase in individuals with low economic status (Halimah et al., 2022). In addition, various jobs can cause kidney failure, such as employees who work sitting for a long time. Sitting position that lasts a long time will cause the ureters in the kidneys to be squeezed. Heavy activities carried out in a job that emits more sweat will also result in dehydration. Dehydration will make the urine consistency more concentrated, which, if it occurs continuously for a long time, will aggravate the filtration function due to the widening of the kidney filtration podocyte gap, which over time causes failure to filter, thereby triggering chronic kidney failure (Arifa et al., 2018).

Research by Arifa et al. (2018) shows no significant relationship between an individual's education level and the incidence of chronic kidney failure. The level of personal knowledge in understanding the disease is in line with the high level of education of the individual. So this is an effort in the early detection of disease (Arifa et al., 2018). Education affects the ability to understand the information obtained when receiving information. The level of education also influences a person's efforts to access health services, choose and decide on actions related to their illness, and seek appropriate treatment for their condition (Nursita & Pratiwi, 2020). The low level of knowledge caused by low education will cause a lack of individual awareness in realizing the condition of the disease, resulting in delays in treatment (Arifa et al., 2018). In line with research Sulistiowati & Idaiani (2015) which explains that there is no relationship between education and the incidence of chronic kidney disease. However, it can be seen that the proportion of chronic kidney failure patients with higher education is less (1.0%) than those with moderate to low education.

Comorbid is a condition with comorbidities other than chronic kidney disease that affect the work of other organs in the body. Comorbidities worsen and affect the survival of chronic kidney failure patients undergoing hemodialysis. Hypertension is the most common comorbid disease found in this study. The same was shown in a study by Artiany et al. (2021) which explained that the first highest comorbid was hypertension (54.61%). Hypertension has a higher risk of 3.2 times experiencing chronic kidney failure. Increased blood pressure in patients with hypertension is associated with an increased risk of chronic kidney disease. Increased blood pressure will cause an increase in intravascular pressure on blood flow to the glomerulus. The afferent arteries will experience vasoconstriction due to hypertension (Pranandari & Supadmi, 2015).

The second highest comorbid in this study was diabetes mellitus. The analysis results Sulistiowati & Idaiani (2015) show that someone with diabetes mellitus has a 2.5 times risk of suffering from chronic kidney failure. Increased blood sugar levels can damage blood vessels and affect the structure of the kidneys or what is known as nodular and diffuse glomerulosclerosis. The same thing was also found in research Pranandari & Supadmi (2015) which showed that a history of diabetes mellitus had a statistical relationship with chronic kidney failure. One of the complications of diabetes mellitus is chronic kidney failure. The leading cause of terminal kidney failure is diabetic nephropathy (Pranandari & Supadmi, 2015). Sclerosis of the nephrons is caused by hyperfiltration of the remaining healthy nephrons. The mechanism for increasing the glomerular filtration rate (GFR) in diabetic nephropathy occurs due to the dilation of afferent arterioles, which experience a glucose-dependent effect mediated by vasoactive hormones, IGF-1, nitric acid, glucagon, and prostaglandins (Rivandi & Yonata, 2015). Diabetic conditions such as hyperglycemia, sorbitol accumulation, and insulinogenic can increase the glomerular filtration rate (GFR), although the mechanism is still unknown (Pardede, 2016). However, according to Rivandi & Yonata (2015), the direct effects of hyperglycemia are stimulation of cell hyperplasia, TGF-β production, and extracellular matrix synthesis mediated by protein kinase C (PKC) contained in serine-threonine kinase. This serine-threonine kinase has vascular functions such as capillary permeability, contractility, cell proliferation, and blood flow functions. From high glucose levels, glycosylation of basement membrane proteins occurs, which results in the thickening of the basement membrane and accumulation of basement membrane glycoprotein-like substances in the mesangium so that the glomerular capillaries are gradually squeezed, and blood flow will be disrupted. This can cause glomerulosclerosis and nephron hypertrophy, resulting in diabetic nephropathy (Rivandi & Yonata, 2015). Thus, poor control of hyperglycemia is a cause of diabetic nephropathy and is associated with the accumulation of advanced glycosylation end products (AGEs). AGEs play a role in atherosclerosis through cell activation and inflammation, the release of growth factors and cytokines, increase in endothelial and vascular matrix permeability. The increased production of AGEs will stimulate the synthesis of growth factors such as TGF-β and IGF-1 (Pardede, 2016). Glomerulosclerosis will cause changes in the permeability of the glomerular basement membrane, which eventually causes large proteins such as albumin not to be filtered. This condition causes albuminuria (Pranandari & Supadmi, 2015).

Kidney stones are stones found in the urinary tract. This stone is usually found composed of calcium crystals. Mineral deposits, most often Ca2+ oxalate (calcium oxalate) and Ca2+ phosphate (calcium phosphate), uric acid deposits, and crystals are the causes of kidney stones. For example, if the calcium level in the body is too high, the kidneys tend to excrete it in the urine. However, if the calcium level is too high is still there, kidney function will decrease. So calcium will accumulate and slowly precipitate, forming a solid mass. These kidney stones are usually located in the pelvis and the lining of the kidneys (Hasanah, 2016). Research by Arifa et al. (2018) shows that a history of kidney stones relates to the incidence of chronic kidney failure. Kidney stone disease has a risk of 132.2 times suffer from chronic kidney disease. Stones in the urinary tract can cause obstruction. Obstruction causes vasoconstriction of blood vessels and increased intratubular pressure, which eventually causes ischemia in the kidney. Ischemia that occurs over a long period will cause glomerulosclerosis, interstitial fibrosis, and renal tubular atrophy. Obstruction within 24 hours will result in a permanent loss of 15% of nephron function. According to research by Shang et al. (2017), the pathophysiological relationship between kidney stones and the development of chronic kidney disease is unknown. Nevertheless, several reasons could explain the observed association. Recurrent episodes of kidney stone-associated obstruction lead to a series of renal tubular events followed by interstitial macrophage infiltration, ultimately leading to glomerulosclerosis, reduced GFR, and renal failure. In addition, the presence of ammonium ions that are not wasted in the urine will be very toxic and can injure and even kill healthy nephron cells. Kidney stones and chronic kidney disease may share risk factors.

Congestive Heart Failure (CHF) is the second lowest comorbid disease in patients with chronic kidney failure. Heart failure is a disease that contributes to morbidity and mortality rates and a high burden of treatment. The left side of the heart in someone over 40 years of age will experience shrinkage. This shrinkage occurs in response to the light workload required by the heart (Nursita & Pratiwi, 2020). According to research by Mcintyre et al. (2019) decreased GFR and albuminuria can develop due to heart failure. Therefore, CKD and heart failure occur bidirectionally with considerable overlap. The prevalence of heart failure increases with the increasing severity of chronic kidney disease. It is estimated that about 44% of hemodialysis patients have heart failure with 13% HfrEF, 10% HfpEF, and 21% unspecified. Salt and water retention can cause excessive preload. Excessive preload occurs continuously, which can lead to heart failure.

Pulmonary tuberculosis is one of the comorbid patients with chronic kidney failure. Pulmonary tuberculosis is an infectious disease that can attack several organs, especially the lungs (Herawati & Purwanti, 2018). The research results by Nursidika et al. (2020) explain that pulmonary tuberculosis is more common in men and women in these cases. Likewise, a study by Herawati & Purwanti (2018) showed that pulmonary tuberculosis patients were dominated by 40 men and 32 women in this case. In a study by Nursidika et al. (2020) also found that pulmonary tuberculosis patients who underwent tuberculosis treatment for less than two months had higher creatinine values than those who underwent tuberculosis treatment for more than two months. Changes in increased creatinine levels are caused by several factors, including the intake of drugs that can cause kidney function to get worse. Reducing the dose of anti-tuberculosis medications can reduce the risk of nephrotoxicity. Research by Chang et al. (2014) shows that 50% or more of acute kidney failure events occur within two months after anti-tuberculosis treatment. The findings also suggest that patients with CKD may be more susceptible to more severe and permanent kidney damage.

The results of this study reveal a negative correlation between systolic blood pressure and glomerular filtration rate (GFR), meaning that if blood pressure increases, the GFR will decrease. This is consistent with the research Garofalo et al. (2016) that a decrease in GFR is associated with an increased prevalence of poorly controlled hypertension. This study's results clarify a significant positive relationship between systolic blood pressure and a decrease in glomerular filtration rate (GFR). In addition, research by Kanno et al. (2012) showed a susceptible however extensive dating among systolic blood stress and the improvement of proteinuria. Protein that enters the urine indicates that there has been damage to the kidney tubules and glomerulus (Surya et al., 2018). The research results by Garofalo et al. (2016) also explain a relationship between higher diastolic blood pressure and a reduce in glomerular filtration rate (GFR). If systemic hypertension continues for a long period of time, it may cause pathological changes such as atherosclerosis, renal blood flow disorder, renal ischemia, and decreased renal function (Kanno et al., 2012). Atherosclerosis due to increased blood pressure over a long period can lead to nephrosclerosis. Increased blood pressure causes damage to the glomerular capillaries. This damage is a direct cause of ischemia due to the narrowing of the intrarenal vessels. The narrowing of blood vessels reduces blood flow to the glomeruli and kidney tubules, resulting in damage to all nephrons, and chronic kidney failure occurs (Rajagukguk, 2019). However, chronic kidney failure can also cause an increase in blood pressure due to disruption of the function of renin-angiotensin-aldosterone and water and salt retention because they cannot be excreted from the body (Surya et al., 2018).

The research results regarding the glomerular filtration rate in this study obtained an average of 9.57 mL/minute. This means that the average respondent is in the final stage of kidney failure because the GFR is less than 15 mL/min/1.73m^2, with the majority of respondents having at least one type of comorbid disease (75%), 21.4% having two kinds of illness comorbid, and 3.6% had three types of comorbid disease.

Research conducted by Fox et al. (2004) explains that 14%, 8%, and 4% of respondents with a GFR of less than 90 mL/min/1.73m^2, 90-119 mL//min/1.73m^2, and 120 mL//min/1.73m^2 or more, individual kidney disease will develop during follow-up. An initial GFR <90 mL//min/1.73 m^2 was associated with almost a 3-fold increase in the incidence of CKD, and a GFR between 90 and 119 mL//min/1.73 m^2 was associated with the possibility of developing CKD 77 percent. These possibilities will increase as the number of risk factors increases.

Comorbid is a condition with a disease other than chronic kidney failure affecting other organs, so the presence of comorbidities can worsen the survival of patients with chronic kidney failure. Multimorbidity is the presence of two or more comorbidities or conditions of two or more chronic morbidities. More comorbidities are associated with more drugs consumed (Fraser et al., 2015).

The results of the analysis of this study indicate that there is no relationship between the amount of comorbidity and the glomerular filtration rate (GFR), which is indicated by the p-value = 0.212 with a very weak relationship. Respondents with one, two, or three comorbidities remain in a decrease in kidney function. But in this study, it was found that the number of comorbidities among respondents was uneven, which was dominated by respondents with one comorbidity. So that when the analysis test is carried out, there is no relationship between the amount of comorbidity in patients and kidney function. These results differ from the first meta-analysis and systematic review that analyzed the relationship of multimorbidity in CKD patients. The study found that patients with CKD and multimorbidity are associated with high mortality rates and are more at risk for long-term care. Management of patients with multiple comorbidities and disease clusters is increasingly recognized as a challenging problem for patients with chronic kidney disease (Sullivan et al., 2020). In a study by Tanaka et al. (2022), it was found that patients who had 1 to 2 comorbid diseases had a 2.22 times chance of experiencing a decrease in kidney function, while patients with more than five comorbid diseases had a 4.37 times higher chance of decreasing kidney function than patients without comorbidities. The higher the odds ratio (OR) of decreased kidney function is associated with the higher number of main comorbidities. Research by Sullivan et al. (2021) also explains that multimorbidity and severe kidney disease have a negative relationship related to the need for long-term renal replacement therapy, a reduce in the GFR of 30% or GFR decreased to <15 mL/min/1,73 m^2. The results of this study explain that an increase in the length of stay in patients with chronic kidney failure is associated with the need for dialysis. It was also found that concordant and discordant comorbidities were prevalent in patients with chronic renal failure and chronic pain and mental health conditions. These three forms of comorbidity have a strong, independent, and gradual relationship to the risk of death and long hospitalization (Tonelli et al., 2015).

Research Fraser & Taal (2016) says that comorbidity may be a significant concern rather than kidney function in patients with chronic renal failure, especially in the early asymptomatic stage. This study also noted that comorbidities were indeed common in the Kidney Early Evaluation Program (KEEP) study. Of the 27,000 people with CKD who are 65 years or older, 40% have two comorbid conditions, and as many as 30% have three or more comorbid conditions.

Chronic kidney disease is indeed a disease that is rarely suffered without other diseases that co-occur. Chronic kidney disease is associated significantly with heart failure, hypertension, myocardial infarction, anemia, atrial fibrillation, and hip fractures (Corsonello et al., 2020).

The advantage of investigating multimorbidity in patients with CKD is that health workers and patients with CKD will understand the risks. Therefore, health workers and patients can prioritize specific interventions to minimize the chances that will occur, such as modification of cardiovascular risk factors and the creation of vascular access (Sullivan et al., 2020).

Research by Bowling et al. (2017) shows that several studies show the prevalence of chronic kidney disease has a relationship with specific chronic conditions such as cardiovascular disease, hypertension, and diabetes. The same thing was also found in a study Stevens et al. (2010) that the majority of CKD patients in that study had more than one clinical disease condition, and patients with CKD were indeed more likely to suffer from diabetes, hypertension, hypercholesterolemia, cerebrovascular disease. , coronary artery disease, and cancer. So it was found that there is a relationship between low GFR levels and multimorbidity, characterized by decreased GFR and the increasing incidence of cardiovascular disease, congestive heart failure, and coronary artery disease.

CONCLUSION

Based on the results of the discussion, it can be seen that there is a significant but weak negative relationship between systolic blood pressure and diastolic blood pressure with the glomerular filtration rate (GFR) in chronic kidney failure patients undergoing hemodialysis in RST Dompet Dhuafa Parung Bogor in the period January 2021 to March 2022. Whereas the no relationship between the number of comorbidities and glomerular filtration rate (GFR). However, several other journals show a positive relationship between multimorbidity and the rate of glomerular filtration (GFR), characterized by a decrease in GFR along with the increase in the prevalence of coronary artery disease, congestive heart failure, and other cardiovascular diseases. The limitations of this study are data taken from medical records where laboratory supporting examination data such as creatinine is not done routinely. It affects the results of the GFR. In addition, to see further the relationship between the amount of comorbidity and GFR can be carried out further research with a greater number of research samples.

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