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Correlation between Urea, Creatinine and Potassium Results in Kidney Failure Patients

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Abstract

The kidney is a vital organ that performs a number of essential metabolic functions. In renal failure, the kidneys are no longer able to function normally. The purpose of this study is to determine the impact of urea, creatinine, and potassium test results on chronic kidney disease ents with kidney failure whose medical records serve as the sample. Test employing the Pearson correlation test. This study's correlation analysis revealed a correlation between urea and potassium with a significance level of 0.000. The correlation between creatinine and potassium has a sig value of 0.004 as well. The coefficient of correlation between urea and potassium is 0.592, while the coefficient of correlation between creatinine and potassium is 0.366. Accordingly, there is a strong correlation between urea and potassium levels and creatinine and potassium levels in patients with chronic kidney failure and the direction of the test. With these results, it is possible to conclude that there is a correlation between urea, creatinine, and potassium levels.

Keywords: *Urea, Creatinine, Potassium, Kidney Failure.*

INTRODUCTION

Minerals perform a physiological role in the human body consisting of both macroelements and microelements. Calcium (Ca), phosphorus (P), potassium (K), sulfur (S), sodium (Na), chlorine (Cl), and magnesium macroelement compounds (Godswill et al., 2020; Nieder et al., 2018). In the meantime, microelement compounds like iron (Fe) exist. Iodimn (1), copper (Cu), zinc (Zn), manganese (Mn), and cobalt (Co). The principal ion of extracellular fluid is sodium, while the principal ion of intracellular fluid is potassium. According to Lee et al. (2013) and Iwahori et al. (2017), the recommended ratio of sodium to potassium intake is 1:1.

Guyton et al. (1972) and Blain et al. (2015), The kidney is the primary regulator of chemical compound homeostasis within the human body. Potassium and sodium regulate the osmotic pressure of body fluids, making them essential for nerve function, specifically the transmission of nerve impulses (Zoroddu et al., 2019; Mears & Treacy, 2020). The kidneys play a role in body balance, including the process of balancing the essential elements required by the body, controlling the volume of fluids in the body, maintaining the balance between acidic and alkaline compounds, and maintaining the balance between

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compound concentrations in body fluids and blood pressure (van de Poll et al., 2004; Vitetta & Gobe, 2013).

The kidneys are essential organs that function to maintain blood composition by preventing waste accumulation and controlling fluid balance in the body, maintaining stable electrolyte levels (Na, K, Cl, Mg, Ca), and producing hormones and enzymes that help control blood pressure (Wallace, 1998; Baldwin & Fealy, 2009; Segar et al., 2021).

Loss of kidney function over time is the hallmark of chronic kidney disease (CKD), an illness. A glomerular filtration rate (GFR) of less than 60 ml/minute/1.73 m2 is indicative of chronic kidney disease, a condition in which the kidneys are unable to control the body's metabolic processes or fluid levels and which is caused by a variety of disorders with gradual progression. an imbalance of electrolytes and uremia (Cowgill et al., 2016; Faria & de Pinho, 2021). The kidneys are crucial in controlling the amount of extracellular fluid, its electrolyte composition, and its osmolarity. If the remainder of the body's metabolism allows these chemicals to build up, they can be hazardous, especially to the kidneys (Huang et al., 2002; Gounden et al., 2018). Allowing metabolic waste to build up in the body can have this effect. Two separate studies (Kanda et al., 2017; Romagnani et al., 2017) Long-term kidney replacement therapy, such as dialysis or a kidney transplant, is required for people with chronic renal disease so that the kidneys may continue to perform their normal functions of regulating the body's metabolism and maintaining fluid and electrolyte balance.

The prevalence of chronic kidney disease (CKD) rises with age, diabetes, and hypertension, as reported by Iseki (2008) and Fischer and O'Hare (2010). In 1990, chronic kidney disease ranked as the 27th biggest cause of death worldwide, but by 2010, it has risen to the 18th spot, as reported by the Global Burden of Disease research. More than two million people around the world benefited from dialysis or a kidney transplant in 2010. About 113,136 Americans were diagnosed with ESRD in 2011 (MOH, 2013). Diabetes and hypertension were the primary causes, and the average age of ESRD patients was above 70. Kidney failure affected over 499,800 Indonesians (or about 2% of the population) in 2013. The BPJS estimates that 1,499,400 people in Indonesia, or 6 per 1,000, suffer from kidney stones. After heart disease, this is the most expensive condition to treat. Diagnosing kidney disease and measuring its effects on health is greatly aided by laboratory tests (MOH, 2017).

Urea and creatinine are chemical compounds that can be used as indicators of kidney function (Kluwe, 1981; Bagalad et al., 2017). Urea is a nitrogen product excreted by the kidneys from protein diets. In patients with kidney failure, serum urea levels show the best picture for detecting signs of urea toxicity compared to creatinine (Depner, 2001; Pepin et al., 2007). Normal values of serum creatinine < 1.5 mg/dL and urea 10-50 mg/dL. In patients with chronic kidney failure, high urea levels can cause toxic urea and is a common symptom besides

creatinine (Finco, 1997; Saatkamp et al., 2016). Extracellular fluid can increase potassium whenever there is cell damage (tissue catabolism) or movement of potassium out of tissue cells. An increase in potassium levels in the body occurs when there is a decrease in kidney function. Normally, potassium levels in adults and children are 3.6–5.5 mmol/L, whereas those in infants are 134-150mEq/L (Banfi et al., 2007; Tammen et al., 2005).

Laboratory examinations of urea, creatinine, and electrolytes such as Na, K, Cl, Ca, and Mg can be used to evaluate kidney function in patients with a diagnosis of kidney failure; however, potassium is typically the only electrolyte examined. The chemical compounds urea and creatinine are indicators of healthy kidney function. Therefore, the urea creatinine test is always used to determine kidney function in individuals with a history of kidney disease (Astor et al., 2002; Coresh et al., 2003).

In chronic kidney disease, Heyns & Rimington (1987), Chen et al. (2013), and Gasparini et al. (2019) discovered a correlation between creatinine levels and potassium levels. However, existing research indicates that there is no urea parameter for assessing kidney function. At Budhi Asih Hospital in East Jakarta, kidney failure is a significant health concern. The number of kidney failure patients at the Budhi Asih Hospital in 2020 was 7023, with 382 cases of chronic kidney failure. Because the hospital has hemodialysis facilities in the Jakarta area, RSUD Budhi Asih is one of the referral hospitals for chronic renal failure patients.

The authors wished to determine the relationship between the results of urea, creatinine, and potassium tests in patients with chronic kidney disease at Budhi Assih Hospital in East Jakarta.

LITERATURE REVIEW

There are several potential causes for the pathophysiological process known as chronic kidney disease, which ultimately results in kidney failure. Renal failure, another medical term, is defined as an irreversible loss of kidney function necessitating long-term renal replacement therapy like dialysis or a kidney transplant. When the kidney's nephron count drops to 70–75% of normal, serious clinical signs usually start to show (Coombs et al., 1940). Based on Pernefri 2001, the factors of chronic kidney failure are caused by the following things:

1. Dehydration
   Dehydration and loss of electrolytes can lead to irreversible prerenal renal failure. In the history it is necessary to ask about fluid balance (sweat, vomiting, diarrhea, inadequate fluid intake (Langston, 2008). Use of drugs, especially diuretics, mannitol, phenacetin (nephropatic analgesic), digitalis (which can also cause vomiting) must be asked.
2. Urinary tract infection
   Urinary tract infections accompanied by urologic abnormalities

will exacerbate kidney function, such as what occurs when there are stones, strictures or impaired bladder function (Clark et al., 2010).

3. Obstructive Uropathy
   Urinary tract obstruction, among other things, can be caused by necronic kidney papillae (for example in diabetes mellitus, analgesic nephropathy), prostatic hypertrophy, stones and persistent catheters (Becker & Baum, 2006).
4. Uncontrolled hypertension
   The frequency of hypertension is increasing in patients whose kidney function is getting worse. This increase in blood pressure, if it is malignant, will decrease kidney function, but efforts to lower blood pressure can also cause decreased kidney perfusion (Hall, et al., 1996). The principle of therapy is to seek the best benefit by considering the two things above.
5. Drug Consequences
   Diuretics will cause a reduction in body fluid volume. Digitalis intoxication will result in vomiting. Indometacin and aspirin will inhibit cyclooxygenase. The aminoglycoside group has nephrotoxic effects (Palmer, 2011). All of these things will result in decreased kidney function.
6. Food supply
   Patients with terminal renal failure undergoing chronic hemodialysis often experience protein calorie malnutrition. Malnutrition will cause a deficiency in the immune response, so that sufferers are prone to infection and septicemia (Mattern et al., 1982). The worse the nutritional status, the worse the quality of life for patients with terminal renal failure. Malnutrition in terminal renal failure is caused by uremic toxins and by hemodialysis procedures

METHODS

From April to June 2022, the research was carried out at Budhi Asih Hospital in East Jakarta. This study's population comprised chronic kidney failure patients at Budhi Asih Hospital in East Jakarta. The research sample consists of data from up to 60 chronic renal failure patients in 2021. The independent factors in the study were urea and creatinine levels, while the dependent variable was potassium levels. Secondary data gathered from the patient's medical record is utilised. With a 95% confidence level, this study used descriptive analysis and a statistical Pearson correlation test.

RESULTS AND DISCUSSION

The following is a summary of the findings of a study on the correlation between creatinine and potassium levels in patients with chronic renal disease, which was conducted in the laboratory at Budhi Asih Hospital in East Jakarta.

Table 1. Frequency Distribution of Respondent Characteristics Based on Gender and Age

Characteristics	Frequency (n)	Percentage (%)
Gender		
Man	36	60.0
Woman	24	40.0
Age (Years)		
< 41	6	10.0
41-64	46	76.7
65-74	6	10.0
> 74	2	3.3
Amount	60	100

Based on Table 1, it can be seen that of the 60 chronic kidney disease data examined for urea, creatinine, and potassium levels, there were 36 males (60%) and 24 females (40%) and most of them suffered from 41-64 years of age with a percentage of 76.7%.

Table 2. Analysis of Urea, Creatinine and Potassium Levels

Variable	Method	SD	SE	The Highest Score	Lowest Value
Urea Levels	120.95	63.37	8.18	359	16
Creatinine Level	6.66	3.76	0.49	15.92	1.45
Potassium Level	4.7	1.29	0.16	8.1	2.6

Based on Table 2, the average urea level was 120.95 mg/dL (with an SD of 63.37), the lowest urea level was 16 mg/dL and the highest was 359 mg/dL. The average creatinine level was 6.66 mg/dL (with an SD of 3.75), the lowest creatinine level was 1.45 mg/dL and the highest was 15.92 mg/dL. Then it was also found that the average potassium level was 4.7 mmol/L (with an SD of 1.29), the lowest potassium level was 2.6 mmol/L and the highest potassium level was 8.1 mmol/L.

Table 3 Data Normality Test

Check Parameters	*Kolmogorov* -Smirnov
	Sig.
Urea – Potassium levels	0.200
Creatinine - Potassium Level	0.020

Table 3 shows the Sig value of urea and potassium in the Kolmogorov-Smirnov column of 0.200 greater than the alpha value (α) = 0.05 and the Sig value of creatinine and potassium levels in the Kolmogorov-Smirnov column of 0.020, which is greater than the alpha value. (α) = 0.05, so from the results of the data normality test it can be concluded that the data is normally distributed. Because the results of normal data distribution were obtained, the correlation test was continued with the Pearson test.

Table 4 Correlation Test Results for Urea, Creatinine, and Potassium Levels

Pearson correlation	N	*p-value*	R
Correlation of urea and potassium	60	0.000	0.517
Correlation of creatinine and potassium	60	0.004	0.366

The results of the correlation test for urea and potassium levels in

Table 4 with a sample (N) of 60 people show a significance value (p-value) of 0.000, which is less than alpha (α) = 0.05, indicating that H0 is rejected and there is a correlation between levels Urea and Potassium in kidney disease. The correlation number (r) found was 0.592, indicating a strong association between urea and potassium levels in chronic kidney disease with a positive (+) test direction, whereas the creatinine and potassium correlation test revealed a significant value. (p-value) = 0.004 is smaller than alpha () = 0.05, indicating that H0 is rejected and that there is a link between urea and potassium levels in chronic kidney disease. The obtained correlation number (r) is 0,

There were 36 men (60%) and 24 women (40%) among the 60 patient records, and the majority (76.7%) were patients aged 41 to 64 years. The results of this study are consistent with 2018 Riskesdas data indicating that the prevalence of chronic kidney disease is higher in male patients than in female patients. aging, decreased kidney function, and decreased glomerular excretion rates and worsening tubular function are associated with a variety of moderate to severe complaints (Sherman et al., 2003).

The average level of urea is 120.95 mg/dL, and the average level of creatinine is 6.66 mg/dL. Urea is rich in other nitrogens, which are ordinarily excreted by the kidneys from the blood vessels, so elevated levels of urea can indicate kidney failure (Gounden et al., 2018). The relationship between creatinine levels and muscle mass reflects variations in kidney function (Levey et al., 1988). Additionally, it was discovered that the average potassium concentration was 4.7 mmol/L. This study's findings are inconsistent with Windi's 2021 research, which found an average result of 6,4 mmol/L, which is above the normal value. Patients with chronic kidney failure can achieve normal potassium levels by restricting their potassium intake (Guyton & Hall, 1996).

According to the results of the Kolmogorov-Smirnov test for data normality, the distribution of data in this study was normal. With a sig value of 0.200 for levels of urea and potassium and 0.20 for levels of creatinine and potassium. Since the data distribution is normal, the Pearson correlation test will be used to determine correlation.

This study's correlation analysis revealed a correlation between urea and potassium with a significance level of 0.000. The correlation between creatinine and potassium has a sig value of 0.004 as well. The coefficient of correlation between urea and potassium is 0.592, while the coefficient of correlation between creatinine and potassium is 0.366. In patients with chronic renal failure and a positive test direction, there is a strong correlation between urea and potassium levels and creatinine and potassium levels.

CONCLUSION

From this study it can be concluded that kidney disease is more common in men and mostly affects men aged 41-64 years. The average urea level in chronic kidney disease is 120.95 mg/dL, the creatinine level is 6.66 mg/dL, the average potassium level is 4.7 mmol/L. There is a relationship between urea, creatinine, and potassium levels in chronic kidney disease.

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