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Hemoglobin (Hb) Values Correlated with Fatigue in Patients Undergoing Hemodialysis

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Abstract

Kidney damage can reduce the production of erythropoietin, a hormone that stimulates the formation of red blood cells in the bone marrow. This leads to anemia due to a lack of red blood cells. One of the signs of anemia symptoms in chronic kidney disease that has undergone hemodialysis is fatigue. The type of the study was correlation analytic which aimed to analyze the correlation of hemoglobin values with fatigue in patients undergoing hemodialysis with a cross-sectional approach. The population in this study was all patients undergoing hemodialysis in the HD room of RSI Siti Hajar as many as 108 patients. A sample of 40 respondents was taken using a consecutive sampling technique for 4 days. The research instrument used the FAS (Fatigue Assessment Scale) questionnaire and laboratory examination results—data analysis using the Spearman rho correlation test. The results showed that p values of 0.031 < α 0.05 proved a correlation between hemoglobin values and fatigue levels in hemodialysis patients in the HD room of RSI Siti Hajar Sidoarjo. The correlation coefficient (r) of 0.341 indicated a positive correlation with a fairly strong and unidirectional level of correlation strength. The lower the hemoglobin level, the more fatigue patients tend to experience. Therefore it is very important to maintain Hb levels to prevent further decline and reduce fatigue as a result.

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INTRODUCTION

Chronic kidney disease is a global health problem with an increasing incidence, prevalence, and morbidity so it is still one of the concerns in the world, especially in the Indonesian region. Chronic renal failure is a progressive and irreversible impairment of kidney function, which has an estimated LGF of 59 mL/min/1.73 m² to < 15 mL/min calibrated with serum creatinine counting, in which the body is unable to maintain metabolism, fails to maintain fluid and electrolyte balance, thus causing an increase in urea (Lisa Lolowang et al., 2021; Sumah, 2020). In the terminal stage of chronic renal failure, kidney replacement therapy is needed to support the quality of life of patients, one of which is in the form of hemodialysis therapy. Physical fatigue and lack of energy are effects of hemodialysis because patients experience a decrease in hemoglobin values caused by erythropoietin hormone deficiency (Putri et al., 2023). Fatigue is a subjective feeling of overwhelming fatigue at rest, activity, and lack of energy for daily tasks, as well as lack of stamina or lethargy (Davey et al., 2020). This fatigue complaint is felt by 70% to 80% of clients with chronic kidney failure (Gregg et al., 2019). Around 80-90% of chronic kidney failure patients experience complications of anemia. When the hemoglobin value = 10 g/dl, it is necessary to evaluate with the hemoglobin target of 11-12 g/dl. Hemoglobin is often used as a parameter for the occurrence of anemia. The risk of anemia increases as the stage increases. Patients with stages 3-5 have a high risk of developing anemia (Vestergaard et al., 2020). The decrease in the glomerular filtration rate impacts the gradual increase in the incidence of anemia. In population studies, it is said that patients experience anemia if hemoglobin levels < 11 g/dl. The prevalence of anemia in patients with chronic kidney failure stage 2 was obtained as much as 1.3%, stage 3 as much as 5.2% and stage 4 as much as 44.1% (Himmelfarb & Ikizler, 2018). Based on a preliminary study in the hemodialysis room of Bayu Asih Hospital, Purwakarta Regency, data was obtained that all patients with chronic kidney failure with hemodialysis have been diagnosed with stage 5 chronic kidney failure based on data on medical records. When interviewed with the head of the room, he said that on average, patients experienced anemia with hemoglobin levels below normal and calcium levels that were also below normal. It is proven based on laboratory data on medical records, 9 out of 10 patients have hemoglobin levels below normal with an average hemoglobin level of 7.2 g/dl (Ladesvita & Mulyani, 2021). According to the World Health Organization, in 2015 the incidence of CRF in the world reached 10% of the population, so chronic kidney failure patients undergoing hemodialysis are estimated at 1.5 million people worldwide. Estimated to increase by 8% per year, chronic kidney failure is a chronic disease with the 20th highest mortality rate in the world. Based on data from the Indonesian Renal Registry (IRR) in 2015, in Indonesia, the number of chronic kidney failure patients registering for HD units continues to increase by 10% every year. Based on Basic Health Research (2018) the prevalence of chronic kidney disease is 499,800 (2%) people in Indonesia, with the highest prevalence being in the Maluku region with 4,351 (0.47%) people suffering from chronic kidney failure. The number of diagnoses of chronic kidney failure in hemodialysis (HD) patients in East Java Province was 113,045 people (0.29%) (Kemenkes RI, 2018). Fatigue is a symptom with a high prevalence among dialysis patients with renal replacement therapy in the long term, fatigue symptoms are felt by 60-97% of patients (Putri et al., 2023). Based on the results of a preliminary study conducted on May 2, 2023, at RSI Siti Hajar by conducting direct interviews with 5 out of 12 patients complaining of dizziness, body weakness, easy to feel tired, walking a little too strong, when working standing for a long time it is easy to feel tired, after finishing work feeling very tired and difficult to concentrate. The results of laboratory tests according to data from medical records in the hemodialysis room averaged 8 patients with Hb 8.9 gr/dL, 2 patients with Hb 10.5 gr/dL, 1 patient with Hb 6.9 gr/dL, and 1 patient with Hb 12.4 gr/dL. Fatigue or fatigue in hemodialysis patients can occur due to physiological factors (anemia) and demographic factors (age, education, occupation,

type of support) (Muaesaroh et al., 2020). The decrease in hemoglobin (Hb), hematocrit, and erythrocyte index which can cause a decrease in the carrying capacity of oxygen carriers to body tissues is a sign of an anemic event (Natalia et al., 2019). Anemia is often found in most chronic kidney failure patients caused by erythropoietin (EPO) deficiency, but other factors can cause anemia in CRF patients, namely shortening the age of red blood cells, inflammation, hypothyroidism, severe hyperparathyroidism, hemoglobinopathy and mostly due to iron and folate deficiency (Yuniarti, 2021). Anemia can be characterized by the appearance of symptoms such as lethargy, fatigue, shortness of breath while working, headaches, dizziness, and muscle weakness (Sanjaya et al., 2019). Fatigue in patients with chronic kidney disease is caused by decreased oxygen levels in the blood due to anemia. Oxygen has a significant role in the body, one of which is as fuel to get energy and metabolic processes, cellular energy obtained from the reaction between oxygen and glucose will produce adenosine triphosphate (ATP) which is then used for muscle work, muscles need a lot of ATP when they contract so they need more oxygen when contraction occurs. If Hb levels decrease, ATP production will also decrease so that energy decreases and if it lasts a long time, it will have an impact on fatigue (Supriyadi et al., 2021). The impact of fatigue on hemodialysis patients is that physical function is disrupted when undergoing daily routines, experiencing changes in correlations with people around them, facing social isolation, and experiencing changes in sexual function, dimensions of spirituality, and quality of life (Muna, 2022). Progressive Muscle Relaxation (PMR) which is one part of Nursing Intervention Classsification (NIC) which is at level 1 of the basic: physiological domain with the physicalcomfort promotion class has a role in reducing fatigue in chronic kidney disease patients who undergo hemodialysis associated with psychological factors, namely depression and anxiety whose triggers are stress. Patients who undergo dialysis become stressed because they have to depend on this therapy throughout their lives, the management of a very strict regimen starting from food, fluid restriction and medication, and can even threaten their life at any time due to the disease they experience (Feby Adolf Metekohy, 2021).

METHODS

In this study, a correlation analytical design with a cross-sectional approach was used. The population in this study was all patients undergoing hemodialysis in the Hemodialysis Room of RSI Siti Hajar Sidoarjo, with as many as 108 respondents. The sampling method in this study used a non-probability sampling technique, namely the Consecutive Sampling type with the number of samples taken based on inclusion criteria and exclusion criteria as many as 40 respondents for 4 days. The sample in this study had the following inclusion criteria: patients who had undergone hemodialysis procedures for at least one month, patients who suffered from chronic kidney failure and routinely underwent hemodialysis therapy twice a week in the hemodialysis unit, patients who were able to communicate well, patients who were willing to become respondents filled out and signed informed consent. The exclusion criteria in this study were patients who had physical limitations, namely speech and hearing impairments, and patients with emergency conditions such as decreased consciousness, shortness of breath, seizures, excessive nausea, vomiting, and shock. The variables in this study were divided into 2, the independent variable, namely the value of hemoglobin (Hb), and the dependent variable, namely fatigue (fatigue). The instrument in this study to measure fatigue was the FAS (Fatigue Assessment Scale) questionnaire, and the instrument to measure hemoglobin values was based on secondary data from laboratory results contained in the medical record. Data analysis using the Spearman Rho correlation test through the SPSS for Windows version 2.6 program using a meaning level of α 0.05.

Ethical Consideration

The research approved the study and has conducted ethical tests. Besides, it passed the ethical

test and obtained a research permit from the Institute for research and community service PPNI Health Development University Mojokerto Regency with number 10/0720/HPI/KS/VII/2022.

RESULTS

1. General Data

Respondent Characteristics based on age, gender, education, occupation, length of time in HD & HD frequency.

Table 1. Distribution of respondents' frequency by age, gender, education, occupation, length of time in HD & HD frequency

No.	Characteristics	Frequency (f)	Percentage (%)
1.	**Age**		
	25-35 year	2	50%
	36-45 year	8	20%
	46-55 year	18	45%
	56-65 year	11	27.5%
	≥66 year	1	2.5%
2.	**Gender**		
	Male	24	60%
	Female	16	40%
3.	**Education**		
	Equivalent Elementary School	8	20%
	Junior High School Equivalent	6	15%
	High School/Vocational Equivalent	20	50%
	College	6	15%
4.	**Work**		
	Not Working	11	27.5%
	Self-employed	15	37.5%
	Pensioner	3	7.5%
	Miscellaneous	11	27.5%
5.	**Long Time in HD**		
	<12 Month	7	17.5%
	12– 24 Month	15	37.5%
	>24 Month	18	45%
6.	**Frequency HD**		
	2x Week	40	100%
	Total	40	100%

Source: *Primary Data*

Based on Table 1 shows that most respondents aged 46-55 years as many as 18 respondents (45%), the majority of respondents are male, namely as many as 24 respondents (60%), the majority of respondents have the equivalent high school / vocational education as many as 20 respondents (50%), the majority of respondents have self-employed jobs as many as 15 respondents (37.5%), the majority of the length of time undergoing hemodialysis >24 months is as many as 18 respondents (45%), and with a hemodialysis frequency of 2x a week as many as 40 respondents (100%).

2. Specific Data

Table 2. Cross-tabulation of the correlation between hemoglobin (Hb) levels and Fatigue

Hemoglobin Value	Kelelahan *(Fatigue)*						Total	
	Usual		Moderate		Severe			
	n	%	n	%	n	%	n	%
Usual	1	50%	1	50%	0	0%	2	100%
Mild Anemia	1	25%	2	50%	1	25%	4	100%
Moderate Anemia	8	33.3%	11	45.8%	5	20.8%	24	100%
Severe Anemia	0	0%	5	50%	5	50%	10	100%
Total	10	25%	19	47.5%	11	27.5%	40	100%
Correlation Coefficient (r) 0,341*, *p* = 0,031								

*Signifikan *p value* <0.05

***Correlation Coeffisient* (+) Significant

Based on Table 2 above shows that of the 40 respondents obtained, respondents who have normal hemoglobin levels who do not suffer from fatigue or normal amounted to 1 respondent (50%), and those who had moderate fatigue levels amounted to 1 person (50%), and severe fatigue levels amounted to 0 respondents (0%). Respondents who had hemoglobin levels with mild anemia who did not suffer from fatigue or normal amounted to 1 respondent (25%), those who had moderate fatigue levels amounted to 2 respondents (50%), and those with severe fatigue levels amounted to 1 respondent (25%). Respondents who had hemoglobin levels with moderate anemia who did not suffer from fatigue or normal amounted to 8 respondents (33.3%), and those who had moderate fatigue levels amounted to 11 respondents (45.8%), and severe fatigue levels amounted to 5 respondents (20.8%). %). Respondents who had hemoglobin levels with severe anemia who did not suffer from fatigue or normal 0 respondents (0%), and who had moderate fatigue levels 5 respondents (50%), and severe fatigue levels 5 respondents (50%). The results of the Spearman Rho correlation statistical test showed that the p-value = 0.031 (<0.05). In addition, the value of the correlation coefficient r = 0.341, meaning that the level of correlation strength or correlation has a level of strength, which is strong enough and has a positive correlation direction. In other words, if hemoglobin levels decrease, then fatigue levels tend to increase.

DISCUSSION

Based on the results of this study, after conducting statistical tests the correlation of Spearman rho with SPSS obtained p = 0.031 where the significant value of p-value < α 0.05 the correlation coefficient results showed the value of r = 0.341 meaning that the level of strength of the correlation or correlation has a strong enough level of strength and is unidirectional. This means that the lower the hemoglobin value, the level of fatigue in patients tends to increase. Thus, if the probability value (p) is less than the significance level (a), then the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. With these results, it can be concluded that there is a correlation between hemoglobin values and fatigue levels in hemodialysis patients at RSI Siti Hajar Sidoarjo.

Fatigue is an unpleasant subjective feeling in the form of fatigue, weakness, and lack of energy and is the main complaint of hemodialysis patients with a prevalence reaching 60-97% (Amelia et al., 2021). The causative factor of fatigue during hemodialysis is caused by several factors, one of which is the factor of low hemoglobin levels. The decrease in Hb levels is due to the disruption of erythropoietin hormone production (Pitoyo, 2018). Low hemoglobin levels will cause the number of red blood cells to be less, resulting in decreased oxygen transport throughout the body. As a result, the body's metabolism will also decrease because cells need oxygen to produce energy. The production of ATP, which is the main energy molecule in the body, will

decrease due to a lack of oxygen, which will eventually lead to sustained physical fatigue (Supriyadi et al., 2021). Clinical symptoms include general weakness, pain throughout the body, fatigue, decreased activity tolerance, sleep disturbances, and difficulty concentrating.

Based on cross-tabulation analysis between hemoglobin (Hb) values and fatigue in patients undergoing hemodialysis in the HD room of RSI Siti Hajar Sidoarjo, it was found that patients with anemia status on average experienced fatigue. Other factors contribute to fatigue in hemodialysis patients since the causes of fatigue in hemodialysis patients are varied. The first factor of fatigue is low hemoglobin levels allowing the appearance of main symptoms and other complaints, such as difficulty breathing, lack of physical energy, and fatigue. When red blood cell production decreases there will be a decrease in oxygen transport to body tissues, which can cause fatigue. In addition, anemia in hemodialysis patients can be caused by blood loss due to hemodialysis therapy, the patient's uremic status, and bleeding in digestion, then the patient will feel fatigued if hemoglobin levels are less than normal limits with symptoms that appear such as lack of energy, decreased concentration and easily feel tired. The second factor of fatigue was the age of 11 respondents aged 56-65 years & $\geq$ 66 years as many as 1 respondent, where increasing age in patients undergoing hemodialysis will be accompanied by an increase in the incidence of fatigue due to degenerative processes that make kidney function decrease. Conditions in the elderly also experience a decrease in physical strength and endurance as a natural aging process that affects the body's energy, daily activities, and quality of life making them tired quickly when doing activities. The third factor of fatigue is the work of 15 respondents working as self-employed. Work and daily activities influence improving fatigue levels. High activities such as work, will bring strong encouragement and motivation to overcome fatigue felt due to feelings of involvement in the activities they do. While lack of activity can cause a decrease in energy and motivation, so fatigue is easier to feel. The fourth factor of fatigue is the length of time undergoing hemodialysis. Hemodialysis is done to help kidneys that have decreased function in removing ureal levels and other body wastes. A total of 18 respondents had undergone hemodialysis > 24 months, where the longer a person undergoes hemodialysis, the lower the Hb levels in the body this is associated with high urea that will interfere with the production of the EPO hormone. In addition, someone with long-term hemodialysis therapy also gets older along with the therapy. Increasing age can worsen a person's health condition and physical abilities. Research conducted by Maesaroh et al., (2020) showed that there was no correlation between sex and the occurrence of fatigue, meaning that when the condition has decreased, regardless of gender, all have the same impact, namely fatigue during hemodialysis. From the results of the study, as many as 24 respondents had a male gender. The onset of fatigue is not gender-related, fatigue itself already has an impact on a person with chronic kidney disease who is undergoing hemodialysis. And in men tend to work harder so they don't pay attention to their health and fatigue is easily detected.

CONCLUSION

There is a correlation between hemoglobin (HB) values and fatigue in patients undergoing hemodialysis at the HD unit of RSI Siti Hajar Sidoarjo with p-value = 0.031 (<0.05), the correlation coefficient results show r = 0.341 meaning that the level of correlation strength or the correlation has a strong enough level of strength and has a positive correlation direction so that the lower the hemoglobin level, Then the level of fatigue in patients tends to increase. Chronic kidney failure can affect the production of erythropoietin, a hormone that stimulates the bone marrow to make red blood cells. Impaired erythropoietin production in patients undergoing hemodialysis can cause anemia, which is a condition in which the number of red blood cells becomes less, as a result of which oxygen transport decreases, metabolism decreases, ATP production decreases and if this lasts a long time it has an impact on fatigue. Other factors affect

fatigue in CRF patients such as age, gender, length of hemodialysis, and work.

SUGGESTION

Management of anemia and fatigue should be standard in the care of hemodialysis patients so that anemia status does not tend to decrease and fatigue does not get worse.

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CONFLICTS OF INTEREST

The author states that there is no conflict with other related topics or objects after the publication of this study.

AUTHOR CONTRIBUTION

Emyk Windartik as Lead Researcher, coordinating research, data collection, preparation of manuscripts. Ima Rahmawati collecting data, assisting data analysis, drafting manuscripts.

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