

How to Cite:

Ardinata, D., Sari, M. I., & Daulay, M. (2022). The epidemiological profile and correlation between blood hemoglobin levels and hemodialysis duration in twice-week hemodialysis patients. *International Journal of Health Sciences*, 6(S5), 580–587. <https://doi.org/10.53730/ijhs.v6nS5.8122>

The epidemiological profile and correlation between blood hemoglobin levels and hemodialysis duration in twice-week hemodialysis patients

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Abstract---A cross-sectional study was carried out at the H. Adam Malik hospital in Medan. Purposive sampling was used to identify 55 research patients receiving hemodialysis (HD). Structured questionnaire interviews with patients were used to collect epidemiology data. Medical records and retested laboratory results were used to collect data on hemoglobin, qualitative C Reactive Protein (CRP), Blood urea nitrogen (BUN), and creatinine. The majority (72.7 %) of participants were male, with the 60–69 year age group accounting for 30.90%; Karo is the most ethnic group (41.8%), and hypertension is the most prevalent ailment (43.60%). The mean duration of HD was 36.00 months, with a hemoglobin (Hb) level of 9.37 g/dl. It can be shown that there is a negative and weak correlation between Hb and HD duration ($r = -0.27$) that is significant ($p = 0.49$) and has a coefficient of determination of 7%.

Keywords---blood, hemoglobin, hemodialysis patients.

Introduction

Chronic kidney disease (CKD) is a progressive deterioration of the kidneys caused by nephron function loss. CKD can be caused by chronic glomerulonephritis,

obstructive kidney disease, infection, hypertension, or nephropathy [1]. Age, gender, BMI, hypertension, diabetes, and stroke are all independently associated with chronic kidney disease (CKD) [2]. Improvements in dialysis technique and the quality of medical care have increased the lifespan of dialysis patients, which has resulted in a decrease in the prevalence of end-stage renal disease (ESRD) as the last stage of chronic kidney disease (CKD) [3].

Anemia (low hemoglobin levels) is a typical consequence of chronic renal disease that develops gradually and worsens with the progression of the disease [4]. Anemia was prevalent among CKD patients in Singapore [5] and the United States [6]. The Kidney Disease Improving Global Outcomes Anemia Work Group recommends that health care practitioners diagnose anemia in male adults (over the age of 15) when their hemoglobin (Hb) levels are lower below 13 g/dl and in female adults when it lowers below 12 g/dl [7]. The underlying cause of anemia in patients with CKD is insufficient endogenous erythropoietin synthesis, a hormone that regulates the differentiation and maturation of red blood cell progenitors. Other contributing factors have been identified in recent years, including an impaired bone marrow response to erythropoietin caused by uremic toxins, inflammation, decreased iron availability for erythropoiesis and increased hepcidin levels, a shortened half-life of red blood cells (RBCs), and vitamin deficiencies (vitamin B12 or folic acid) [8].

Hemodialysis (HD) is a method of kidney replacement therapy that has been used in conjunction with kidney transplantation and peritoneal dialysis in patients with ESRD [9], as well as in severe acidosis, poisoning, hyperkalemia, or other electrolyte excesses, and excess fluid > 10% including indications for renal replacement therapy [10]. Graham introduced dialysis in 1861 as a method of separating relatively small molecules from large particles using semipermeable membranes, [11] with the primary goal of restoring the intracellular and extracellular fluid milieu that characterized normal kidney function [12]. The term HD adequacy refers to the adequacy of HD dose. HD can be quantified by measuring the Urea Reduction Ratio (URR), which estimates the percentage of ureum removed in one HD treatment. The measurement of URR is the simplest and most direct technique to assess the adequacy of HD treatments [13].

Methods

This study was carried out at the H. Adam Malik Medan Hospital's installation of the Hemodialysis Unit, Kidney and Hypertension. The Health Research Ethics Commission (KEPK), Faculty of Medicine, Universitas Sumatera Utara, and H. Adam Malik Hospital Medan have given ethical approval for this study. The research period runs from March 2019 to October 2019.

Study design: This is a cross-sectional analytical observational study to investigate the relationship between hemoglobin and the duration of HD.

Subjects: Subjects: Purposive sampling was used to select subjects from the general population who met the study criteria. The minimum sample size required was determined to be 55 samples based on the prevalence of patients who received HD treatment the previous year at H. Adam Malik Hospital Medan.

Criteria for the subject: (a). Men and women over the age of 18 (b). HD was performed twice a week regularly and the patient was in a stable hemodynamic state (c). Hemodialysis utilizing a polysulfane filter and a bicarbonate solution (d). Use drugs that are associated with major diseases (CKD) but do not affect Hb. (e). At least during the drug washout period, stop taking Hb-lowering medications.

Procedure: The subjects with the potential to enter the study were all CKD patients undergoing HD. The subject was given an oral and written explanation by the research team who had previously been trained to provide explanations on various matters related to the research to be carried out, followed by giving consent forms to participate as research subjects, to be signed (PSP/informed consent). All CKD patients undergoing HD who had signed informed consent were taken consecutively and assessed to see whether they met the criteria of the study subjects. The research subjects then filled out a data collection form that included subject demographic data. The Hb, blood urea nitrogen (BUN), and creatinine data are following the medical records, while the C-Reactive Protein (CRP) data was performed through the enzyme-linked immunosorbent assay (ELISA) method. The URR measurement method is performed using the formula: $URR (\%) = 100 \times (1 - Ct/Co)$, BUN before (Co), and BUN after (Ct) hemodialysis.

Statistic analysis: The IBM Social Sciences Statistical Package (SPSS) Statistics version 23 for macOS (IBM-SPSS Inc., Chicago, IL, USA) was used to analyze all data. The mean and standard deviation (SD) of normally distributed binary data was shown, while the median (Me) and minimum-max (range), number (n), and percentage (percent) of categorical data were shown. For abnormally distributed data relations, the Spearman correlation test was used. The significance level was set at $p < 0.05$.

Results

Table 1
Characteristics subject

Characteristics (n=55)	f	%
Gender:		
Man	40	72.7
woman	15	27.3
Age (years):		
20-29	6	10.9
30-39	7	12.7
40-49	6	10.9
50-59	16	29.1
60-69	17	30.9
70-80	3	5.5
Ethnicity:		
Karo	23	41.8
Toba	14	25.5
Jawa	12	21.8
Mandailing	5	9.1
Nias	1	1.8

Main Disease:		
Hypertension	24	43.6
Diabetes nephropathy	19	34.5
Obstructive Kidney	12	21.8
Disease and Infection		
Duration of HD (month), median (range)	36.0 (18.0-84.0)	
Body Mass Index after HD, median (range)	23.66 (16.44-37.15)	

During the study period, the univariate characteristics of 55 subjects having undergone hemodialysis were examined (Table 1). The majority of subjects (72.7%) are male, with the age group 60–69 years (30.90%) being the most common; Karo is the most common ethnic group (41.8%); and hypertension is the most common disease (43.60%), with a median HD duration of 36.00 months and a median BMI after HD of 23.66.

Table 2
Blood laboratory data

	Mean	Median	Std. deviation	Range	95% CI
Hb (g/dl), mean±SD	9.37	9.3	1.4	15.44-37.18	8.98-9.75
Quantitative CRP (mg/dl)	0.58	0.35	0.51	0.35-2.8	0.44-0.75
URR (%), mean±SD	0.68	0.71	0.09	0.42-0.89	0.67-0.72
Creatinine (mg/dl), mean±SD	15.5	15.48	4.05	7.02-24.86	14.40-16.58

Laboratory blood data (Table 2) shows mean Hb of 9.37, quantitative CRP levels of 0.35 mg/dl, mean URR of 0.70%, and mean creatinine of 15.5.

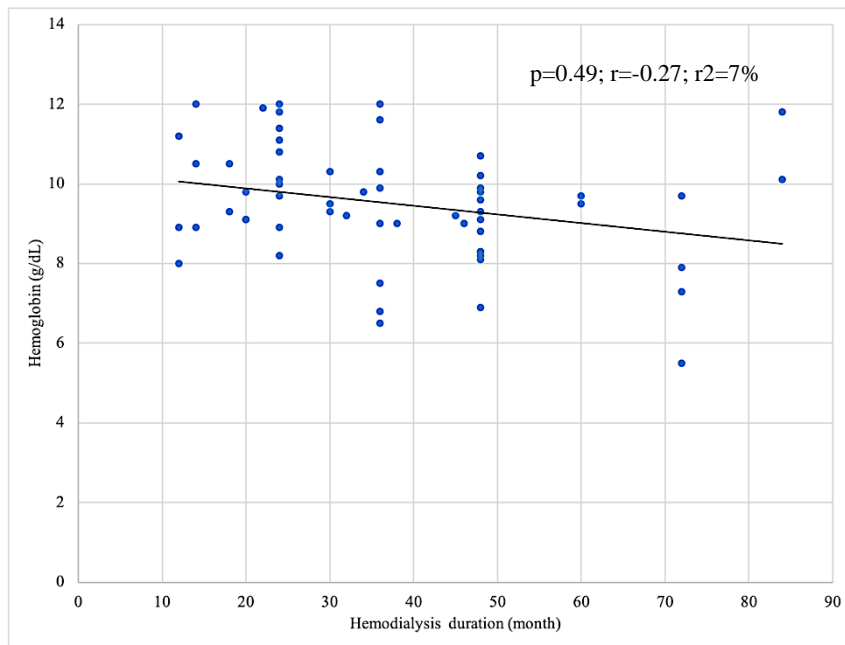


Figure 1. Correlation between hemodialysis duration and

The correlation test results in Figure 1 show a negative and weak ($r = -0.27$) and even though significant relationship between Hb and HD duration with a coefficient of determination ($r^2 \times 100\%$) = 7 %.

Discussion

Many risk factors for chronic kidney disease have been identified in previous epidemiological studies and are classified as initiating or perpetuating. Age, sex, and diabetes are initiating factors for nephron loss cycles, while proteinuria, hypertension, and hyperuricemia are indeed perpetuating factors that drive the disease process [14].

Table 1 shows that out of 55 patients undergoing HD as the study subjects, the majority were male, with 72.7%, with the most in the age group of 60-69 years, with 30.9%. Tjang and Pandelaki (2018) at Mardi Rahayu Hospital in Kudus, Central Java, Indonesia, found that 73% of males, and the age group 50-59 years, 35% [15]. The findings of this study are consistent with the findings of the Indonesian Renal Registry report, which revealed that male sex accounted for 56 percent of all HD patients in Indonesia in 2017, with the age group 55-64 years accounting for 30.45% of all patients [16].

Patients undergoing HD are more likely to be males than females, with an average age of over 50 years, according to this study and previous research. Sex differences were identified as important determinants of kidney function and the progression of kidney disease [17]. Furthermore, the normal aging process (aging) contributes to the lowering in kidney function and the comorbidity of renal diseases [18, 19].

Women's sex hormone estradiol is more protective to the kidneys than men's testosterone [20]. Endogenous estrogens have been found to exert antifibrotic and antiapoptotic effects on the kidney in animal models [21]. It has been demonstrated to increase angiotensinogen production while lowering renin and angiotensin-converting enzyme (ACE) production. Testosterone, on the other hand, promotes renin production [22].

Hypertension is a contributing factor for the onset and progression of chronic renal disease [23]. The correlation between high blood pressure and chronic renal disease is complicated. Chronic kidney disease is caused by hypertension. However, hypertension can complicate kidney disease in patients who were previously normotensive. Patients with chronic renal disease have a high prevalence of hypertension, which rises with the severity of the disease [24].

According to the findings of this study, hypertension and diabetic nephropathy are the most frequent causes among HD patients, contributing to 43.60 % and 34.50 %, respectively. In a study published at four hospitals in Jakarta, hypertension and diabetic nephropathy were identified in 48% and 33.8% of patients undergoing HD, respectively [25]. Pongsibidang (2017) found that hypertension (OR = 21.45) caused greater chronic kidney failure in HD patients than diabetes (OR = 12.37) in his study at RSUP, Dr. Wahidin Sudirohusodo, Makassar in 2015 [26].

The role of hypertension and diabetes nephropathy in the development of chronic kidney disease is not fully understood, but hemodynamic and metabolic actors appear to play a key role, but in recent years, inflammatory cytokines and reactive oxidative species have become increasingly recognized as significant contributors [27].

Anemia (low hemoglobin levels) is common in chronic kidney disease patients (CKD). Iron deficiency and erythropoietin deficiency affect the majority of chronic kidney disease patients, causing fatigue, weakness, and an increased risk of cardiovascular complications [7]. Low hemoglobin levels can be caused by (a) uremic poisoning, which inhibits erythropoiesis; (b) insufficient anemia treatment; or (c) a poor response to anemia treatment, which is commonly affected by poor general health or acute sickness [28]. A significant negative correlation between HD duration and Hb levels was reported in this investigation (Figure 1). Mohammadi et al., 2021 published their findings, which revealed a significant correlation between hemoglobin and ferritin levels ($P < 0.001$), as well as a correlation between hemodialysis duration (4.62 ± 4.0 years) and serum iron ($P = 0.001$) [29].

The Study's Limitations

The cross-sectional design of this study had a limitation in that it did not explain the causal relationships between two or more variables but instead demonstrated their association.

Conclusion

This study shows the correlation of blood hemoglobin level with the duration of hemodialysis patients, which is negative, weak, and significant in patients at H. Adam Malik Hospital Medan.

Acknowledgment

This study was funded by the Universitas Sumatera Utara through the Talenta scheme 2019 with contract No. 232 / UN5.2.3.1 / PPM / KP-TALENTA USU / 2019.

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