Clinical Characteristics of Chronic Kidney Disease Patients Undergoing Hemodialysis at Universitas Sebelas Maret Hospital

Muhammad Septian Surgebrama[1*], Evi Liliek Wulandari[1,2], Lukman Aryoseto[1], dan Nurhasan Agung Prabowo[1,2]

Affiliation:
1. Faculty of Medicine, Universitas Sebelas Maret, Surakarta, 57126
2. Universitas Sebelas Maret Hospital, Kartasura, Sukoharjo, 57160

*Correspondence: Muhammad Septian Surgebrama, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, 57126; mseptiansurgebrama@gmail.com

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ABSTRACT

Introduction: Chronic Kidney Disease (CKD) is a kidney function disorder lasting ≥3 months with a Glomerular Filtration Rate (GFR) <60 mL/min/1.73m². Hemodialysis is the primary therapy for end-stage CKD, replacing kidney function, alleviating uremic symptoms, and improving patients' quality of life, although it does not restore kidney function. Data on the characteristics of CKD patients undergoing hemodialysis, particularly in the Solo Raya region, remain limited; therefore, this study was conducted.
Methods: This descriptive study employed a retrospective approach using medical record data on CKD patients undergoing hemodialysis. A total of 82 patients were included using total sampling. Data were analyzed descriptively to characterize characteristics by age, gender, hemoglobin levels, duration of hemodialysis, body mass index (BMI), and etiology.
Results: CKD patients undergoing hemodialysis were predominantly aged 55–64 years and male. Most patients had anemia, with hemoglobin levels <13 g/dL in males and <12 g/dL in females. The majority had undergone hemodialysis for more than 12 months, with the most common BMI category being normal. The most frequent etiology was hypertension.
Conclusions: CKD patients undergoing hemodialysis at Universitas Sebelas Maret Hospital were predominantly aged 55–64 years, male, experienced anemia, had undergone hemodialysis for more than 12 months, had a normal BMI, and had hypertension as the most frequent etiology.

Keywords: chronic kidney disease; hemodialysis; hypertension; anemia; body mass index

INTRODUCTION

Chronic Kidney Disease (CKD) is a clinical abnormality with a Glomerular Filtration Rate (GFR) <60 mL/min/1.73m² caused by altered kidney structure and function, with or without a decrease in GFR for ≥3 months [1]. Chronic kidney disease is characterized by gross hematuria, albuminuria, flank pain, nocturia, and decreased urine volume [2].

Based on data from the 2018 Basic Health Research (Riset Kesehatan Dasar), the prevalence of CKD in Indonesia in those aged ≥15 years is 0.38%, with a prevalence of 0.42% in males and 0.38% in females. Based on age groups, the highest prevalence of CKD sufferers is in the 65-74 age group (0.82%) [3]. The most common causes of Chronic Kidney Disease are diabetic nephropathy (52%), hypertension (24%), congenital abnormalities (6%), uric acid (1%), lupus (1%), and others [4].

Kidney damage in CKD is irreversible and caused by many factors [5]. The most common causes in stage 5 CKD patients are hypertensive kidney disease (36%), followed by diabetic nephropathy (28%), primary glomerulopathy (10%), obstructive nephropathy (3%), chronic pyelonephritis (3%), lupus nephritis/SLE (1%), uric acid nephropathy (1%), polycystic kidney (1%), unknown causes (12%), and others (5%) [6].

The management of Chronic Kidney Disease depends on the severity of the patient's condition. One type of therapy for patients with CKD is hemodialysis, which replaces kidney function to remove toxic nitrogenous compounds from the blood and excess water [7]. Hemodialysis can improve the patient's quality of life but cannot restore kidney function to normal [8]. Hemodialysis is a common form of dialysis therapy for End-Stage Renal Disease (ESRD) [9]. Hemodialysis is expected to reduce albuminuria in patients with CKD and alleviate uremic symptoms. This is because toxic substances contained in the blood can be removed through hemodialysis, thereby improving the patient's clinical symptoms [5].

Data on the characteristics of CKD patients undergoing hemodialysis in Indonesia, particularly in Solo Raya, remain limited, prompting the researchers to conduct a study on the characteristics of CKD patients undergoing hemodialysis at Universitas Sebelas Maret Hospital.

METHODS

Study Design and Setting

This study employed a descriptive observational design with a retrospective approach. The objective was to describe the characteristics of the phenomenon under study by analyzing secondary data from medical records. The study was conducted at Universitas Sebelas Maret Hospital to characterize patients with chronic kidney disease (CKD) undergoing hemodialysis.

Participants and Sampling The sampling technique used in this study was total sampling. All patients who met the inclusion and exclusion criteria during the study period were enrolled, resulting in a total of 82 patients.

Data Collection and Analysis

Data were collected retrospectively from medical records. The variables analyzed included age, gender, hemoglobin levels, duration of hemodialysis, body mass index (BMI), and etiology. Data analysis was performed descriptively using Microsoft Excel software.

Ethical Consideration

This study has been granted ethical approval by the Health Research Ethics Committee, Universitas Sebelas Maret, with the ethical approval code No: 84/UN27.06.11/KEP/EC/2025, issued on June 16, 2025.

RESULTS

Clinical Characteristics: Age and Gender

Table 1 presents the 82 research samples categorized by age and gender. The majority of the sample was in the 55–64 years age group, totaling 28 individuals (34.15%). Regarding gender, the majority of the sample was male, totaling 45 individuals (54.48%).

Table 1. Clinical characteristics of age and gender in the sample

Characteristics	Category	Frequency (n)	Percentage (%)
Age Group	18 – 24 years	2	2.44%
	25 – 34 years	8	9.76%
	35 – 44 years	12	14.63%
	45 – 54 years	17	20.73%
	55 – 64 years	28	34.15%
	65 – 74 years	13	15.85%
	> 75 years	2	2.44%
Total		82	100%
Gender	Male	45	54.88%
	Female	37	45.12%
Total		82	100%

Age Distribution by Gender

Table 1 presents the 45 male patient samples. The distribution is as follows:

a. The majority were in the 55–64 years age group, totaling 13 individuals (28.89%);
b. The 45–54 years and 65–74 years age groups each included 8 samples (17.78%);
c. The 25–34 years and 35–44 years age groups each consisted of 6 samples (13.33%);
d. The 18–24- and ≥ 75-year age groups each included 2 individuals (4.44%).

Table 1 presents the 37 female patient samples. The distribution is as follows:

a. The majority were in the 55–64 years age group, totaling 15 individuals (40.54%);
b. The 45–54 years age group included 9 samples (24.32%);
c. The 35–44 years age group consisted of 6 samples (16.22%);
d. The 65–74 years age group included 5 samples (13.51%), and the 25–34 years age group included 2 samples (5.41%);
e. There were no samples (0%) in the 18–24 years and ≥75 years age groups.

Body Mass Index (BMI) Distribution

Table 2 shows the distribution of Body Mass Index (BMI) categories in the research sample. The results are as follows:

a. The majority of the sample was in the normal category, accounting for 44.44%;
b. The overweight group accounted for 25.93% of the total sample.
c. Samples classified as underweight accounted for 13.58%;
d. Obesity level 1 accounted for 12.35%;
e. Obesity level 2 was the group with the smallest proportion, at only 3.7% of the total sample.

Table 2. Distribution of Body Mass Index (BMI)

BMI Category	Percentage (%)

Underweight	13.58%
Normal	44.44%
Overweight	25.93%
Obesity Level 1	12.35%
Obesity Level 2	3.70%
Total	100%

Hemoglobin Levels

Based on Table 3, the hemoglobin distribution for male patients has a mean of 9.17 g/dL and a standard deviation of 1.82. The positive skewness of 0.69 indicates the data distribution is skewed to the right (positive), with a tail extending to higher values. A kurtosis of -0.12 indicates that the data are flatter than in a normal distribution (platykurtic). The hemoglobin range for these patients was 6.4-13.4 g/dL.

Table 5. Summary of Hemoglobin Levels Distribution

Gender	Mean (g/dL)	SD	Range (g/dL)	Skewness	Kurtosis
Male	9.17	1.82	6.4 – 13.4	0.69 (Positive)	-0.12
Female	8.13	1.18	5.9 – 10.0	-0.67 (Negative)	-1.13

Based on Table 3, the hemoglobin distribution for female patients has a mean of 8.13 g/dL and a standard deviation of 1.18. A negative skewness of -0.67 indicates the data distribution is skewed to the left, with a tail slightly longer on the left, while most data are clustered on the right side of the diagram. A kurtosis of -1.13 indicates that the data are flatter than in a normal distribution (platykurtic). The range of hemoglobin data for female patients was between 5.9 and 10 g/dL.

Duration of Hemodialysis

Table 4 presents the distribution of hemodialysis duration among patients with CKD. The results indicate:

a. The majority of the sample, 44%, had undergone hemodialysis for more than 24 months;
b. 32% underwent hemodialysis for a duration of 12–24 months;
c. The remaining 24% underwent hemodialysis for less than 12 months.
d. These findings indicate that the majority of patients were in the long-term therapy stage.

Table 4. Distribution of Hemodialysis Duration

Duration of Hemodialysis	Percentage (%)
< 12 months	24%
12 – 24 months	32%
> 24 months	44%
Total	100%

Etiology Characteristics

Table 5 shows the etiology or main causes of Chronic Kidney Disease (CKD) in patients undergoing hemodialysis. The findings are as follows:

a. The most common cause found was hypertension, with 40 cases.
b. Diabetes mellitus followed with 27 cases, and a combination of hypertension and diabetes mellitus with 11 cases.
c. Other less frequently found causes included autoimmune disease (1 case), patients' post-cyst treatment (1 case), Polycystic Kidney Disease (1 case), and unknown causes (1 case).

Table 7. Etiology of CKD in Hemodialysis Patients

Etiology	Frequency (n)
Hypertension	40
Diabetes Mellitus	27
Hypertension + Diabetes Mellitus	11
Autoimmune Disease	1
Post-cyst Treatment	1
Polycystic Kidney Disease	1
Unknown	1
Total	82

DISCUSSION

Age is a significant factor influencing the prevalence and progression of Chronic Kidney Disease (CKD). Based on the results of this study, the majority of patients undergoing hemodialysis were in the late-adult age group (55–64 years), comprising 28 individuals (34.15%), with an average age of 52.58 years. This finding indicates that CKD is commonly observed in the productive age group, as reported by Kalra [1], who noted that the 31–50 age group is the largest among hemodialysis patients in India, accounting for nearly half of the total patient population. Kalra [1] noted that hypertension is the main risk factor for kidney failure (60.35%), followed by analgesic abuse (21.30%) and diabetes (17.02%). These three factors are frequently observed among young to middle-aged adults, in whom high activity and workload are often not accompanied by regular health monitoring. Although kidney function declines physiologically beginning in the third decade of life and becomes more apparent after age 70 [2], the presence of metabolic comorbidities in the middle-aged group accelerates the decline in Glomerular Filtration Rate (GFR). This progression is also exacerbated by delayed diagnosis, low health awareness, and limited access to nephrology services, especially in developing countries like Indonesia [3].

In addition to the adult age group, the elderly (≥60 years) constituted a significant proportion (32.93%). This is consistent with the increase in life expectancy and the high burden of kidney disease in the elderly population. As mentioned by Tang et al. [4], elderly patients starting hemodialysis often have a poor prognosis due to frailty, malnutrition, and suboptimal use of vascular access. Conversely, young patients (<40 years) were also recorded in significant numbers (23.17%), generally associated with conditions such as primary kidney disease, hereditary nephropathy, or systemic complications like systemic lupus erythematosus.

Regarding gender, males were more predominant in receiving renal replacement therapy, including hemodialysis. In this study, the majority of the sample was male (45; 54.88%), whereas females comprised 37 (45.12%). Physiologically, the progression of kidney function decline is generally faster in males, which is thought to be related to lower estrogen levels since the hormone has a protective effect against kidney damage. On the other hand, females with CKD have a higher mortality risk before reaching end-stage renal failure, primarily due to cardiovascular complications [5]. The difference in proportion is also influenced by greater barriers to healthcare access experienced by females. Several studies indicate that females tend to receive less financial support, are less likely to have health insurance, and experience limitations in accessing medical facilities such as the creation of definitive vascular access (AV fistula), thus relying more on temporary catheters [6], [7]. Research at the Cilacap District Hospital also reported similar distribution, with CKD patients undergoing hemodialysis comprising 52.7% males and 47.3% females [8].

In the general population, high BMI is often associated with an increased risk of mortality and cardiovascular disease. However, in hemodialysis patients, those with higher BMI, from overweight to mild obesity, actually show better survival compared to patients with low BMI or underweight. This phenomenon is known as "reverse epidemiology" and has been observed among CKD patients undergoing hemodialysis [9]. Based on the BMI

distribution in Table 4, the majority of patients were in the normal category (44.44%). This condition can occur if patients undergoing hemodialysis tend to experience weight loss due to metabolic disorders, malnutrition, and increased protein catabolism.

The underweight category included 13.58% of the total patients, and this group clinically has the highest risk of mortality due to weak energy reserves and the possibility of chronic inflammatory malnutrition, which is common in CKD patients [10]. Conversely, the overweight and mild obesity group (Obesity Level 1), comprising approximately 38.28%, is theoretically more resilient to metabolic stress and inflammation. Patients with severe obesity (Obesity Level 2) were very few, only 3.7% of the sample. This result is similar to research by Sitompul [11], which reported that the BMI of patients undergoing hemodialysis was predominantly classified as normal. These results align with previous studies reporting that hemodialysis does not significantly affect the nutritional status of patients with chronic kidney failure [12]. However, significant physiological changes in body composition during aging are not reflected in BMI measurements, particularly reductions in muscle mass and increases in fat mass, which become evident above 65 years [13].

Based on data from 82 samples, patient hemoglobin (Hb) levels varied between 5.9 and 13.4 g/dL, with an average of 8.65 ± 1.59 g/dL. This value indicates that the majority of patients had anemia, given that the KDIGO-defined normal limits for hemoglobin are≥13 g/dL for males and ≥12 g/dL for females [14]. The average Hb level in male patients was 9.10 ± 1.74 g/dL, whereas in female patients it was lower at 8.09 ± 1.18 g/dL. Patients with CKD generally experience a decrease in hemoglobin levels due to decreased production of erythropoietin [15]. This condition is consistent with anemia symptoms often found in end-stage CKD patients. Decreased kidney function causes erythropoietin to be insufficient to stimulate the bone marrow to produce erythrocytes optimally.

The average hemoglobin level in male patients (9.17 g/dL) indicates mild-to-moderate anemia [16]. The distribution of hemoglobin values, with a relatively wide range (6.4–13.4 g/dL), indicates that anemia in male patients in this study was heterogeneous. The majority of patients had hemoglobin levels between 8–10 g/dL, indicating that mild anemia is the most common condition [17], [18]. The distribution of hemoglobin levels in female patients had a mean of 8.13 g/dL, which falls within the moderate-to-severe anemia category [19]. This can be a crucial condition because anemia is associated with greater health risks such as extreme fatigue, organ dysfunction, and increased mortality [20]. Females show a higher prevalence of anemia compared to males [21]. Biological factors, such as lower estrogen levels after menopause, menstrual blood loss, and naturally lower iron reserves in females, provide the physiological basis for the greater susceptibility of females to anemia in CKD [22]. Physiologically, females have lower hemoglobin levels than males due to hormonal differences affecting erythropoiesis. Estrogen inhibits red blood cell formation [23], [24], whereas testosterone, which is more dominant in males, plays an important role in stimulating erythropoiesis [25], [26], [27]. This study aligns with research from Prof. Dr. H. Aloei Saboe Hospital, Gorontalo, which reports that CKD patients undergoing hemodialysis are predominantly anemic [28].

Duration of hemodialysis is an important factor that can affect patient adaptation and long-term quality of life. Based on the results of this study, the majority of patients (44.44%) had undergone hemodialysis for more than 24 months. This finding aligns with the concept that most patients with end-stage chronic kidney disease tend to survive quite a long time in hemodialysis therapy. Longer hemodialysis duration improves patients' psychological and physical adjustment [29]. However, the proportion of patients who were new to hemodialysis (<12 months) was also quite large. This implies that early education and supportive interventions are important to optimize the adaptation process [30].

The results showed that hypertension and type 2 diabetes mellitus were the dominant causes in stage 5 CKD patients undergoing hemodialysis. Based on research data, as many as 40 cases (48.78%) had a history of chronic hypertension, making it the most common etiology. Furthermore, type 2 diabetes mellitus was found in 27 cases (32.93%), and a combination of hypertension and diabetes mellitus in 11 cases (13.41%). In addition to the three main causes, this study identified several other etiologies with fewer cases. Autoimmune disease was found in 1 case (1.22%), likely related to lupus nephritis [31]. Meanwhile, Polycystic Kidney Disease in 1 case (1.22%) can be

associated with progressive kidney damage due to the disease [32]. There was 1 patient with an unknown exact cause. These findings align with global epidemiological data showing that hypertension and diabetes mellitus are the two main causes of end-stage CKD [33].

CONCLUSIONS

Based on the research results, it can be concluded that the clinical characteristics of Chronic Kidney Disease (CKD) patients undergoing hemodialysis at Universitas Sebelas Maret Hospital were predominantly aged 55–64 years and male. Regarding hemoglobin levels, the majority of patients had anemia, with hemoglobin levels predominantly in the normal range. The most frequent etiology in CKD patients undergoing hemodialysis was hypertension.

Author Contributions

Conceptualization, M.S.S. and E.L.W.; methodology, L.A.; software, M.S.S.; validation, M.S.S., E.L.W. and N.A.P.; formal analysis, L.A.; investigation, M.S.S.; resources, N.A.P.; data curation, M.S.S.; writing—original draft preparation, M.S.S.; writing—review and editing, E.L.W.; visualization, L.A.; supervision, N.A.P.; project administration, M.S.S.; funding acquisition, N.A.P. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Health Research Ethics Committee of Universitas Sebelas Maret (protocol code 84/UN27.06.11/KEP/EC/2025 and date of approval 16 June 2025).

Informed Consent Statement

Patient consent was waived due to the retrospective nature of the study, which used medical record data.

Data Availability Statement

Data supporting the reported results are available in the medical record archives of Universitas Sebelas Maret Hospital. Due to privacy restrictions, the data is not publicly available.

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Conflicts of Interest

The authors declare no conflict of interest.

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