An-Najah National University

Faculty of Graduate Studies

MORTALITY IN HEMODIALYSIS PATIENTS AND THE LEADING CAUSE OF DEATH IN A SINGLE CENTER AT THE NORTHERN OF WEST BANK: A RETROSPECTIVE COHORT STUDY

By

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This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Critical Care Nursing, Faculty of Graduate Studies, An-Najah National University, Nablus - Palestine.

2022

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Dedication

الى من قاد قلوب البشرية وعقولهم الى مرفأ الأمان معلم البشرية الأول سيدنا وحبيبنا وشفيعنا محمد عليه أفضل الصلاة والسلام

الى الشهداء الابرار والاسرى البواسل والجرحى الميامين واهلهم الصابرين المناضلين

الى من بذلا الغالي والنفيس في سبيل وصولي لدرجة علمية ويرا ثمرة غرسهما الى والداي حفظهما الله.

الى زوجتي ورفيقة دربي الذي تحملت معي مشقة الطريق والوصول وما زالت

الى السند والعضد والساعد اخواني واخواتي.

الى قرة عيني ومهجة قلبي لجين الغالية.

الى كل من علمني حرفا من اساتذتي منذ الابتدائية حتى الدرجة العلمية ز

الى من احبه قلبي اصدقائي وزملائي.

الى كل هؤلاء اهدي هذه الرسالة راجيا من الله ان تكون نافذة علم وبطاقة معرفة..... وان ينفعنا وينفع بنا

ابنكم واخوكم

مالك عصام عبدالغني

Acknowledgement

To the light God guided us the way.

This research paper has been prepared with the help of my dear wife, family and friends. We extend our gratitude to the following important advisors and contributors.

First of all, we would like to thank Dr. Nizar Said for his support and encouragement to me. Read my article and give invaluable detailed advice on the rules, organization, and topic of the paper, and to reprimand the newspaper as well.

Secondly, I would like to thank Dr. Aida Alkaissi for taking the time to read our thesis and provide valuable advice. Thirdly, I would like to thank Dr. Zakaria Hamdan for supporting me and facilitating my research task.

Finally, I would like to thank everyone for helping me finish this thesis.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

MORTALITY IN HEMODIALYSIS PATIENTS AND THE LEADING CAUSE OF DEATH IN A SINGLE CENTER AT THE NORTHERN OF WEST BANK: A RETROSPECTIVE COHORT STUDY

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: مالك حسام عبد العزيز

Signature: ______________

Date: 21/12/2022

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MORTALITY IN HEMODIALYSIS PATIENTS AND THE LEADING CAUSE OF DEATH IN A SINGLE CENTER AT THE NORTHERN OF WEST BANK: A RETROSPECTIVE COHORT STUDY

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Abstract

Background: Currently, there were 5 to 7 million patients who have end-stage renal disease (ESRD) that need renal replacement therapy. This study was conducted to determine the mortality rates among hemodialysis patients at An-Najah National University Hospital which is one of the main referral centers in the north of the West Bank of Palestine. The study also aimed to describe the causes of death among this group of patients.

Methods: This study used a quantitative correlational retrospective cohort design. The study included all adult patients with ESRD who underwent hemodialysis irrespective of their gender, and duration of dialysis. Demographic variables, etiology of the ESRD, presence of comorbidities, and laboratory findings of the patients were collected.

Results: Medical records of 348 ESRD patients who were on hemodialysis between January 2017 and December 2021 were reviewed. Of the 348 ESRD patients, 95 patients died giving an overall mortality rate of 27.3%. Of the patients who died, 68.4% were male and 91.6% were dialyzed for 1-3 years. Cardiovascular disease was the leading cause of death (43.2%) among the patients in this study. Diabetic nephropathy was the leading cause of ESRD (77.9%) among the patients who died in this study. Of the patients who died in this study, 60% had diabetes mellitus and hypertension and 88% had hypoalbuminemia. Mortality was associated with older age and smoking.

Conclusions: The mortality rate among patients on hemodialysis was within the range of mortality rates reported in the regional studies. Cardiovascular disease was the leading cause of death among the patients in hemodialysis. More studies are still needed to investigate the effects of manipulating some modifiable risk factors on the mortality rates among hemodialysis patients in Palestine.

Keywords: Chronic kidney disease; End-stage renal disease; Hemodialysis; Mortality.

Chapter One

Introduction and Theoretical Background

1.1 Chronic kidney disease

Globally, chronic kidney disease (CKD) is one of the most important public health issues (Yang et al., 2021). According to recent estimates, the prevalence of CKD was 13.4% (11.7% to 15.1%) worldwide (Lv & Zhang, 2019). In 2017, the global prevalence of CKD was 9.1%, with an increase by 29.3% from 1990 to 2017, but age-standardized prevalence remained the same. Also, in 2017, 1.2 million people died from CKD, with an increase by 41.5% in mortality from 1990 to 2017, with the diabetic nephropathy being the most common cause of disability-adjusted life years from CKD (Collaboration, 2020). Additionally, there were 5 to 7 million patients who have end-stage renal disease (ESRD) that need renal replacement therapy (Bello et al., 2022; Molaoa et al., 2021; Thurlow et al., 2021). Previous studies have shown that CKD the main underlying factors driving the progressively increasing prevalence of CKD were the global epidemic of type 2 diabetes mellitus, ageing of global populations, cardiovascular disease, hypertension, and obesity (Yang et al., 2021). In addition to this, several drugs which are widely used in general population such as non-steroidal anti-inflammatory drugs (NSAIDs) that can affect renal function (Sriperumbuduri & Hiremath, 2019).

Hemodialysis involves the use of extracorporeal circulation of the blood of the patient as a therapeutic approach to improve azotemia, electrolytes, fluid, and abnormalities of the acid-base balance (Elliott, 2000). Hemodialysis is used as an artificial surrogate of the kidney functions, especially in end stage renal disease cases. Dialysis cannot replace 100% of lost kidney function, but to some extent, hemodialysis improved the abnormalities caused by loss of optimal renal functions. In general, hemodialysis is recommended for patients with CKD when the glomerular filtration rate falls below 15 ml/min/1.73m^2 (Negishi et al., 2019).

There are multiple indicators that can be used for the assessment of renal function. The most important indicators that are used include: glomerular filtration rate, urinary excretion, tubular secretion and absorption, renin and erythropoietin secretion, vitamin D, and autacoids metabolism. The glomerular filtration rate (GFR) is the classical kidney function test that is used for kidney disease scoring measurement (Schwartz & Furth, 2007). The GFR is defined as the total amount of filtered fluid per unit of time throughout all of the functioning filtration units (nephrons) inside the human kidneys (Schwartz & Furth, 2007).

According to the Kidney Disease Improving Global Outcomes (KDIGO) foundation, the latest update in the definition of CKD depends on kidney damage markers, which measure proteinuria and the GFR. The presence of both factors (GFR less than 60 mL/min and albumin levels greater than 30 mg/gram of creatinine) alongside the kidney structure or function abnormalities for a period of time greater than 3 months signifies CKD (Benjamin & Lappin, 2021). According to the guidelines of 2012, there are 5 stages of CKD considering the GFR level, where the first stage occurs when GFR is normal with the presence of kidney damage, while the mild reduction of GFR between 60 and 89 mL/min is found in the second stage. The final (fifth) stage of CKD, i.e., renal failure or ESRD, occurs when the GFR is less than 15 mL/min (Benjamin & Lappin, 2021).

The annual report of CKD in the United States Renal Data System (USRDS) concluded that 14.9% of the US population who were surveyed in 2015 to 2018 had CKD based on lowered GFR, and the percentage was relatively stable over the years (Saran et al., 2020). The prevalence of the different stages of CKD was estimated by the National Health and Nutrition Examination Survey (NHANES) to be 4.7% for the first stage, 3.3% for the second stage, 6.4% for the third stage, 0.4% in the fourth stage, and 0.1% in the fifth stage (Uhm et al., 2018).

1.2 Prevalence of CKD worldwide, in the Arab World, and in Palestine

Today, over 850 million people live with CKD around the world (Jager et al., 2019). By the year 2040, CKD would become the 5th most common cause of death (Foreman et al., 2018). The global prevalence rate of CKD was estimated at 13.4% (11.7% to 15.1%) (Lv & Zhang, 2019). The number of patients with ESRD who require renal replacement therapy was estimated between 5 to 7 million (Lv & Zhang, 2019; Thurlow et al., 2021). The global average prevalence for dialysis was 215 patients per million. In Europe, the median prevalence of CKD was projected at 132,900, 11,500, and 4,300 per million population for stages 3, 4, and 5, respectively (Kainz et al., 2015).

A cross-sectional study done by Park and Baek (2016) in health and nutritional status of the non-institutionalized Korean population (Park et al., 2016). The study aimed to survey using a stratified, multistage, clustered probability design to select a representative, nationwide sample. The result show that from 15319 the total prevalence estimate of CKD for adults aged ≥ 20 years in Korea was 8.2%. By disease stage, the prevalence of chronic kidney disease was as follows: stage 1, 3.0%; stage 2, 2.7%; stage 3a, 1.9%; stage 3b, 0.4%; and stages 4-5, 0.2%.

A study on the basis of data reported by Japanese Society for Dialysis Therapy Renal Data Registry concluded that the total number of chronic dialysis patients in Japan at the end of 2018 had reached 339,841 patients, representing 2688 patients per million population (Nitta et al., 2019). Furthermore, it stated that mortality is an important way to determine the outcome in dialysis patients.

A cross-sectional correlational study done by Khalil et al., (2018) at the Jordanian university aimed to uncover the prevalence of CKD in a national sample of Jordanian patients at high risk and examine the association of CKD with demographic and clinical factors (Khalil et al., 2018). The study finding that 4,000 Jordanians with ESRD were on hemodialysis.

According to the 2021 annual health report of the Palestinian Ministry of Health the last survey done in August 2021 for dialysis patients in Palestine was 1,008 cases. Another cross-sectional study was conducted by Mousa et al., (2018) on CKD patients undergoing hemodialysis at 12 different dialysis centers in Palestine (Mousa et al., 2018). The purpose of the study was to describe the relation between hemodialysis patients' self-efficacy and their quality of life, to assess factors associated with self-efficacy among hemodialysis patients, and to assess factors associated with quality of life among hemodialysis patients. The tool that used in this study was the Efficacy for Managing Chronic Disease Six-Item Scale and a measure of health-related quality of life. The study reported that the overall number of dialysis patients in the West Bank of Palestine had increased from 1014 patients in 2015 to 1119 patients in 2016.

In another study in Palestine, the point prevalence of ESRD was estimated at 240.3 per million population (Khader et al., 2013). The study reported that 57.7% of patients were males, mainly living in villages (62.3%), and mostly aged between 45 and 64 years old

(45%). Of the patients, 22.5% were diabetic, and 11.1% were hypertensive, while 10.6% were having both diseases, while 27.6% determined no specific cause for developing ESRD.

Currently, there is a shortage in studies that focus on specific areas of ESRD among the Palestinian patients. Some previous studies have focused on the prevalence and disease-specific morbidity among ESRD patients. In 2020, a Palestinian study reported the prevalence of CKD among diabetic adults in North West Bank at 23.6%, with 19.7% of the patients having third stage, followed by 2.6% having fourth stage, while final stage accounted for 1.3% (Nazzal et al., 2020). It was also concluded that patients older than 60 years old have an odd of 3.2 times to develop CKD than young adults, while hypertensive patients have 5.7 times the odd more than normotensive patients, and smokers were 2.3 times riskier to develop CKD than non-smokers.

1.3 Cardiovascular and respiratory diseases among patients with CKD

Cardiovascular disease is a type of disease that involve the heart and blood vessels. Cardiovascular disease is linked with atherosclerosis in which fatty deposits form within arteries which lead to narrowing and/or completely closing the arteries. Atherosclerosis is leading cause of heart attacks, peripheral arterial disease, and strokes (Libby, 2021). Cardiovascular disease is highly prevalent among patients with CKD and those with ESRD. Presence of cardiovascular disease deteriorates the health of patients with CKD and ESRD.

Studies have shown that patients with CKD and ESRD were at higher risk for vascular disease and myocardial infarctions as a result of ischemic heart disease, congestive heart failure, peripheral vascular disease, and cardiac arrhythmias (Vallianou et al., 2019). According to the United States Renal Data System, congestive heart failure, coronary heart disease, and myocardial infarction were prevalent in 40%, 42%, and 12% of patients with ESRD (Collins et al., 2015). Cardiovascular disease is the leading cause of death in ESRD patients. Of total deaths, cardiac arrests account for about 40%. Previous studies have shown that cardiovascular disease-related deaths were higher among patients with diabetes mellitus compared to nondiabetic patients (Klinger & Madziarska, 2019).

Respiratory diseases are diffused complications in patients with CKD, notably in the late stages. A variety of pulmonary deformation, including pulmonary embolism, acute respiratory distress syndrome, pulmonary fibrosis, calcification, pulmonary hypertension, pleural effusion, pulmonary fibrosis, and sleep apnea syndrome were identified in patients with CKD (Kitamura et al., 2019; Salerno et al., 2017). The failure in lung function may be a directly due to urinary toxicity or may be indirectly caused by fluid overloaded, anemia, immune suppression, osteoporosis, malnutrition, electrolyte disorders, and/or acid imbalances, which is the most common issues in patients with CKD in the last stages receiving dialysis treatment (Kovelis et al., 2008).

1.4 Mortality among patients with CKD

Google Scholar, PubMed and ScienceDirect were searched for mortality among patients with CKD. The following keywords were used: “hemodialysis” “chronic kidney disease”, “mortality”, “worldwide”, “Arab countries”.

Some of the identified studies attempted to identify the possible predictors of mortality among hemodialysis patients. A Moroccan study is a good example on these studies (Msaad et al., 2019). In this study, Msaad et al., (2019) identified predictors of mortality among hemodialysis patients using a retrospective descriptive design. The study included 126 patients between the period of 2012 and 2016. The study analyzed demographic, clinical, biological and anthropometric variables of the hemodialysis patients. The study showed that 22 patients (17.5%) died during the study period. Analytical statistics showed that there was a significant difference in the mean patient age of deceased (53.09 years old) and survived (43.07 years old) patients (p-value = 0.001). Also, the deceased patients had significantly lower albumin level (35.37 g/l vs 37.92 g/l, p-value = 0.010) and higher c-reactive protein (CRP) (42.93 mg/l vs 24.76 mg/l, p-value = 0.006) than the survived patients, respectively. The other laboratory readings like hemoglobin (Hgb), calcium, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and body mass index (BMI) were not significantly different between deceased and survived patients. When investigating for the predictors, patients’ age of older than 60 years old had 1.26 times the hazard to die (p-value = 0.002), having cardiovascular diseases increased the hazard by 2.91 times (p-value = 0.001), having malnutrition defined by albumin level of less than 38 g/l increases the hazard by 1.85 times (p-value = 0.01), while having inflammation defined by CRP level of more than 10 mg/l increased the hazard by 1.15 times (p-value = 0.03) compared to survived patients, respectively. The study concluded that malnutrition, cardiovascular diseases and inflammation are considered to be predictors of increased mortality among hemodialysis patients, and simple actions can be implemented to decrease malnutrition and inflammation incidences, like dialysis dose optimization, arteriovenous fistula enhancement and biocompatibility of the membranes.

A study was conducted in a single hemodialysis center in Dubai, United Arab Emirates to determine the 5-year mortality rate among hemodialysis patients (Ahmed et al., 2020). The study was conducted in the period between 2012 and 2016. In this study, patients with ESRD who were on hemodialysis were included regardless of their gender, age, or duration of hemodialysis. The study collected data relevant to gender, age, duration of hemodialysis, presence of comorbidities, causes of ESRD, and age at the time of death. A total of 411 patients were included in the study. Of those, 112 died, giving a 5-year mortality rate of 27.3%. Of the patients who died, more than half were male, the mean age at the time of initiation of hemodialysis was 59.38 ± 13.5 years, and the mean age at which the patient died was 63.8 ± 13.6 years. The results of the study showed that 13 patients died early (within the first year of initiation of hemodialysis). The leading cause of ESRD among the majority of the patients (73%) was diabetes mellitus. However, hypertension was also a highly prevalent comorbidity among the patients who died. Of the patients, 72%, 54%, and 46% had hypoparathyroidism, hypoalbuminemia, and anemia, respectively. Moreover, 63% and 61.6% of the patients who died had abnormal ferritin and phosphorus levels, respectively. In this study, the leading cause of death among the 42.9% of the patients was cardiovascular disease. Sepsis/infection was the cause of death of 18.8% of the patients and cerebrovascular events were the cause of death of 6.2% of the patients. The other patients died due to pulmonary embolism, liver disease, gastrointestinal hemorrhage, and other reasons that could not be determined. High mortality rates were associated with age, having diabetes mellitus, longer duration of hemodialysis, and present of cardiovascular disease.

In Tripoli (Libya), Buargub investigated the 5-year mortality rate among hemodialysis patients in a single center (Buargub, 2008). The study was conducted in the 2007 and included patients who started their hemodialysis between 2000 and 2002. The study included 124 hemodialysis patients. The majority of the hemodialysis patients were male (63.6%) and the mean age was 49 ± 14 years. In 27.4% of the patients, the underlying CKD was diabetic nephropathy. During the 5 years period, 18 patients received kidney transplants and 3 were transferred to other centers. Of the remining 103 patients, 51.4%

died during the 5 years period. Higher mortality rates were associated with diabetic nephropathy and older age. Of the patients with diabetes mellitus, 74.1% died. Mortality rates were higher among patients who were male, older, had hypertension, had diabetes mellitus, and higher body weight. Mortality rates were also higher among smokers and black patients.

In Qatar, Shigidi et al., (2009) conducted a study to describe the demographic variables and outcomes of hemodialysis patients during a 5-years period (Shigidi et al., 2009). The study included patients who were on hemodialysis in the period between 2002 and 2006. The study reported that ESRD was prevalent in 624 patients per million people and the incidence rate was 202 patients per million people per year. During the study period, 278 patients were on hemodialysis. Of the patients, 51% were male and 44.6% aged between 65 and 74 years. The leading cause of ESRD was diabetic nephropathy. The other common causes were hypertensive glomerulopathy and primary glomerulonephritis. During the study period, the survival rate in the first year was 84% and the 5-year survival rate was 53%.

In another study in Qatar, Ghonimi et al., (2021) determined the mortality rates among patients on hemodialysis and peritoneal dialysis (Ghonimi et al., 2021). The study included patients who were on hemodialysis and peritoneal dialysis in the period between 2014 and 2016. In this study, 164 patients died and the crude mortality rate was 6.4%. Mortality rates were significantly associated with older age and female gender. Hemodialysis was associated with higher mortality rates compared to peritoneal dialysis. The leading causes of mortality were cardiovascular disease (37.7%) and sepsis (26.8%). Diabetes mellitus, dyslipidemia, and cerebrovascular accident were more commonly prevalent among hemodialysis patients.

A Chinese prospective study was conducted by Shi et al., (2020) to investigate the correlation between glycemic variation and the all-cause mortality among 1240 selected diabetic adult (18 – 80 years old) patients who underwent hemodialysis between the period of December 2012 and December 2018 for more than 3 months with stable hemoglobin readings in the last 3 months (Shi et al., 2020). Glycemic variation was used as a convenient reading of blood glucose level that was measured each 3 minutes using a specific attached device for up to 48 hours, with the first 24 hours beginning at the day of hemodialysis and the second 24 hours are during the hemodialysis-off day. The results showed that the mean glycemic reading for all patients was 176.4 mg/dL, with the hemodialysis-off day having significantly higher glycemic readings (205.2 mg/dL) compared to hemodialysis day (151.2 mg/dL, p-value < 0.001). In the study, the median follow-up period was 2.4 years (ranging from zero to 3 years), and the all-cause mortality rate was 27.4% (340 out of 1240 patients). Using the suitable inferential analysis, the odd of all-cause mortality increases by 1.7 to 2.2 times with increased glycemic variation (p-value < 0.05). In more details, the upper 4th quartile of glycemic variation had a mortality rate of 37.7% compared to 23.6% for the lowest 4th quartile. The study concluded that higher glycemic variation was significantly associated with increased mortality rate among diabetic patients who underwent hemodialysis, regardless to the hemoglobin, CRP, albumin, prior cardiovascular disease history, hypoglycemia or medications, with the highest possibility of the link between them was the relationship of diabetes with the development of macrovascular and microvascular complications, alongside the increased risk of hypoglycemia among diabetic patients undergoing hemodialysis.

To compare the all-cause mortality rate in hemodialysis departments (as intended to be conducted in the current study) with the in-hospital incident hemodialysis, a study was conducted in Peru to investigate the all-cause mortality among patients who had hemodialysis during their hospital admission (Shi et al., 2020). Most of the 312 patients (93.6%) who were included in the study were dialyzed using a transient central venous catheter and were followed up from 2012 to 2017. The results showed a total mortality rate of 24.7% (77 patients), with an in-hospital all-cause mortality rate of 5.6 per 1000 person-years, and a mean in-hospital length of stay of 16.1 days. The study also showed that male patients had lower incidence of diabetic nephropathy (38.9%) compared to female patients (55.6%, p-value = 0.004), with higher percentages of recent ESRD diagnosis and less late percentage of ESRD diagnosis time compared to female patients (p-value = 0.019, as well as higher acidosis (42.1% vs 27.4%, p-value = 0.009), hyperkalemia (30.8% vs 12.9%, p-value = 0.001) as criteria to start hemodialysis. Regarding mortality during hospital stay, 71.4% of the dead patients had encephalopathy, compared to 52.8% of the alive patients (p-value = 0.004), while 84.1% of the alive patients had eGFR less than 7 mL/min, compared to 62.3% of the dead patients (p-value < 0.001). In conclusion, having encephalopathy and higher eGFR (> 7 mL/min) were associated with higher mortality among hemodialysis patients who start dialysis in-hospital.

Some of the corresponding variables that were found in literature were new and were not fully studied, because they were new ideas that came up during observations by the clinical teams. One of these phenomena is the link between chronic itching and the mortality rate among hemodialysis patients. In Germany, Grochulska et al., (2019) recruited hemodialysis patients in a cluster-sampling method from 25 hemodialysis units (Grochulska et al., 2019). The study included 724 patients. The results showed a 1-year mortality rate of 15.3% among the patients from the start of the follow up in 2013 to 2017. A total of 48.1% of the patients died (348 patients) in this period. At the start of the study, the mean age of the patients was 68.6 years old and 56.5% were males. Survived patients were significantly younger (mean age = 63.7 years old) compared to deceased patients (mean age = 73.6 years old, p-value = 0.008). In general, the mean age at death was 75.76 years old, with a mean duration of hemodialysis of 6.64 years. Regarding itching, the intensity was measured on a 4-point scale (none, mild, moderate and severe), with female patients having more severe and male patients having more mild and moderate itching intensity. On the other hand, no significance relationship was found between having chronic itching and increased mortality rate among hemodialysis patients, while the patients who had secondary scratch lesions on the skin had a higher mortality rate.

One of the major laboratory tests that are essential to be followed up among hemodialysis patients is the serum potassium level, because it is highly associated with cardiovascular complications, mainly arrhythmias. A Japanese study was conducted by Ohnishi et al., (2019) aimed to investigate the correlation between post-dialysis hypokalemia and all-cause mortality on a sample of 3967 hemodialysis patients in two phases (2009 – 2012 and 2012 – 2015) (Ohnishi et al., 2019). The results showed that the mean age at the beginning of the study was 65 years old, with more than half of them (64%) were males, majorly treated with a 2.0 - 2.5 mEq/L potassium level in the dialysate. The mortality rate during the study period was 14% (562 patients), resulting in a total mortality rate of 6.7 per 100 person-years. When comparing to post-dialysis level of potassium between 3 and 3.5 mEq/L, patients who had a post-dialysis potassium level of less than 3 mEq/L had 1.84 times hazard ratio to die, while having a combination of pre- and post-dialysis hypokalemia was associated with a significantly higher hazard ratio of 1.72 times to die.

In conclusion, although post-dialysis hypokalemia was associated with higher hazard of all-cause mortality in hemodialysis patients, it was not independent of pre-dialysis hypokalemia.

In Japan, Hiyamuta et al., (2021) conducted a study to determine the basic factors that led to the deaths of patients in Japan who were receiving continuous hemodialysis (Hiyamuta et al., 2021). This study was an observational study that took place over the course of ten years and involved 3528 outpatients in Japan who were receiving maintenance hemodialysis. The clinical results were analyzed, and the six broad categories of cardiovascular diseases, infectious illnesses, malignant neoplasms, cachexia, trauma/accidents, and other disorders were utilized to define the causes of death, along with more specific subcategories. Over the course of the study's 10-year follow-up period, 1748 patients died (49.5 percent of the total). The greatest contributors to death were cardiovascular disorders (36.1%), infectious diseases (25.8%), and malignant neoplasms (13.5%). Sudden death, pulmonary infection, and lung cancer were the three conditions that were responsible for the highest number of fatalities that were caused by cardiovascular problems, infectious diseases, and malignant neoplasms, respectively. Throughout the course of the study's follow-up period of ten years, specifics regarding the causes of death in Japanese hemodialysis patients were uncovered. Patients undergoing hemodialysis are at an increased risk of dying from heart disease, particularly from sudden cardiac arrest.

In patients undergoing hemodialysis, the connection between smoking and the manifestations of co-existing diseases is not well established. A study was conducted with the objective to determine whether or not there was a correlation between a patient's history of smoking tobacco and the patient's chance of requiring hospitalization or passing away as a result of their condition (Li et al., 2018). This was a retrospective review of prior patients who participated in a cohort trial. Patients who were adults, were receiving hemodialysis at one of the 2,223 dialysis centers in the United States that had been operating for less than 30 days, and had completed a tobacco smoking status survey as part of the standard care between April 2013 and June 2015 were included in this study. Patients who were receiving hemodialysis at a center that had been operating for less than 30 days were excluded from the study. The time until death was determined with the help of the Kaplan-Meier analysis and the Cox proportional hazards regression. The time until the first hospitalization was determined with the help of the cumulative incidence function and the Cox proportional hazards regression. Finally, the number of hospitalizations was determined with the help of the negative-binomial regression. 13% of the 22,230 patients who participated in the trial were active smokers at the time of the analysis. It was found that the probability of death increased with greater exposure to smoking (17%, 22%, 23%, and 27% for never, moderate, and former heavy smokers, respectively; P0.001), and the incidence rates for first hospitalization also increased with greater exposure to smoking (23%, 27%, and 30%, respectively; P0.001). The hazard ratio (HR) for heavy smokers was 1.41 (95% confidence interval [CI]: 1.18-1.69); the HR for moderate smokers was 1.39 (95% confidence interval [CI]: 1.24-1.55); and the HR for former smokers was 1.19 (95% confidence interval [CI]: 1.11-1.28). Heavy smokers had the highest mortality rate. There was no association between living with a smoker and an increased risk of passing away (hazard ratio [HR], 0.93; 95% confidence interval [CI], 0.72-1.22). The HRs of patients who were admitted for the first time revealed patterns that were very similar. Those who had diabetes and smoked on a regular basis had an incidence rate of mortality that was 173.7 per 1,000 patient-years, whereas those who had diabetes but had never smoked had an incidence rate of mortality that was 103.5 per 1,000 patient-years. Those who had diabetes but had never smoked had a mortality rate that was 103.5 per 1,000 patient-years (incidence rate ratio, 1.68; P 0.001). Patients undergoing hemodialysis who smoke have dramatically elevated risks for death and hospitalization, with the dangers being at their greatest for younger those and patients who also have diabetes. There was no evidence to support the hypothesis that passive smoking is linked to worse clinical outcomes.

Patients who have been diagnosed with ESRD often make the choice to stop taking their renal replacement medication; however, end-of-life service planning can be challenging when there is a lack of population-specific data. A study was conducted provide a description of mortality after treatment cessation in ESRD patients in Australia and New Zealand, as well as an analysis of the reasons of death that were certified (Khou et al., 2021). This was to be done in conjunction with providing an analysis of the causes of death that were certified. Using data obtained from the Australian and New Zealand Dialysis and Transplant registry, a retrospective cohort analysis was conducted on patients who were diagnosed with end-stage renal disease (ESRD) for the first time in Australia between the years 1980 and 2013, and in New Zealand between the years 1988 and 2012, respectively. The study was conducted in both countries. We generated a list of withdrawal-related deaths that took place during the first year after a change in treatment technique and analyzed mortality rates (by age, sex, calendar year, and country). The certified causes of death for each individual were determined with the help of data linkage with the Australian National Death Index and the New Zealand Mortality Collection database. There were a total of 60 823 people who died from ESRD after having been diagnosed with the condition over the course of 381 874 person-years. Of those patients, 8111 passed away as a direct result of the treatment being discontinued, while 26 207 passed away as a result of other reasons. It was discovered that mortality rates associated to withdrawal were higher in females and older age groups than younger age groups. The rate increased from 1142 (with a 95% confidence interval of 1064-1226) to 2706 (with a 95% confidence interval of 2498-2932) between the years 1995 and 2013, with the greatest increase occurring between 1995 and 2006. One of every three deaths that occurred during withdrawal was a direct result of a shift in the therapeutic technique that was being utilized. The national death registry found that renal failure was the underlying cause of death in twenty percent of cases involving discontinuation. Diabetes was another cause of death, accounting for twenty one percent of all cases, while hypertensive illness accounted for seven percent. There was no mention of kidney difficulties in 18% of the individuals who were going through withdrawal. The rate of treatment discontinuation has increased by more than 100% since 1988, accounting for 24% of all deaths caused by ESRD. It is possible for clinical data to be complemented by population data throughout the process of planning for end-of-life kidney-related services; but, population data cannot take the place of clinical data.

In patients undergoing hemodialysis, there is a dearth of information concerning the factors that place them at increased risk for sudden cardiac death. Within the context of the hemodialysis study, a study was conducted to identify the characteristics that were associated with a wide range of causes of death, as well as to develop a prediction model for sudden cardiac death utilizing a competing risk approach (Shastri et al., 2012). In this study of 1745 persons who had had hemodialysis, the methodology, the environment, the participants, and the measurements were all taken into consideration. The total mortality rate was divided into three groups: cardiac deaths that did not occur suddenly, cardiac deaths that did occur suddenly, and deaths that did not involve the heart. A competing risk strategy was applied in order to obtain absolute risk projections for sudden cardiac death. The Cox proportional hazards models, which are specific to each cause of death, were utilized in order to analyze the predictors for each cause of death. Over the course of the study's median follow-up time of 2.5 years, 808 persons were found to have passed away. The rate of sudden cardiac death was 22%, the rate of other types of cardiac death was 17%, and the percentage of fatalities that were not caused by the heart was 61%. The risk factors that are connected with the various causes of death in patients getting hemodialysis are quite unique from one another. The researchers found that factors such as advanced age, diabetes, peripheral vascular disease, ischemic heart disease, elevated blood creatinine levels, and elevated alkaline phosphatase levels were independent predictors of sudden cardiac death. The calibration was good ((2) = 1.1; P = 0.89) and the C-statistic for sudden cardiac death over a period of three years was 0.75 (95% confidence interval: 0.70-0.79). When compared with the competing risk method, the standard Cox model overestimated the risk for sudden cardiac mortality at years 3 and 5 of follow-up by 25% and 46%, respectively, on the relative scale, and by 2% and 6%, respectively, on the absolute scale. This occurred on both the relative scale and the absolute scale. In patients who are undergoing hemodialysis, the risk factors for each of the several causes of death are distinct from one another. The model that has been described for forecasting sudden cardiac death takes into account the various factors that contribute to mortality, including the competing causes of death.

It has been shown in the past that males, in comparison to females, and whites, in comparison to blacks, are members of subgroups that have a higher probability of passing away as a direct result of having dialysis treatment. In order to get a better understanding of the disparity in mortality rates between males and females as well as whites and blacks in the United States, a comparison of the causes of death between males and females as well as between whites and blacks was done, adjusting for age, the cause of end-stage renal disease (diabetic versus nondiabetic), dialysis modality, and time on dialysis (less than one year versus more than one year) (Bloembergen et al., 1994). This comparison was carried out with information obtained from both the national level and the Renal Data System. The research investigated a total of 42,372 fatalities that happened during the period of 170,700 patient years spent in a high-risk category. Males had a 22% higher risk of death than females due to a higher risk of mortality due to acute myocardial infarction (relative death rate ratio (RR) = 1.48; P = 0.001), all other cardiac causes (RR = 1.3; P = 0.001), and malignancy (RR = 1.59; P = 0.001) than females did (P 0.001).

Whites had a 29% higher risk of death compared to blacks, which can be explained by an increased risk of death due to acute myocardial infarction (RR = 1.34), all other cardiac causes (RR = 1.30), withdrawal from dialysis (RR = 2.72) (all P 0.001), and infection (RR = 1.09; P = 0.005). These results were found using the statistical test known as the probability test. This study expands our knowledge and comprehension of the excess mortality seen in male and white subgroups, which is an essential step in the process of developing methods to reduce the high mortality rate seen in dialysis patients. In addition, the risk of death due to acute myocardial infarction was higher for white patients.

A recent study demonstrated that a model that incorporated clinical and fundamental imaging data was able to accurately predict the presence of coronary artery calcification and the degree to which it had progressed in patients who underwent regular hemodialysis. The application of predictive algorithms was necessary in order to achieve this goal. A study was conducted to report on the capacity of the same algorithm to accurately forecast death due to any reason (Bellasi et al., 2013). The study analyzed the risk of death owing to any cause in 141 patients who were receiving maintenance hemodialysis and were being followed continuously at two distinct dialysis sites for a median of 79 months after they were enrolled in the study. The risk of the patients was determined with the use of a straightforward cardiovascular calcification index, which took into consideration the patient's age, the length of time they had been on dialysis, the calcification of the heart valves, and the calcification of the abdominal aorta. Calcification of the abdominal aorta was found in 57% of the patients, while calcification of the aortic and mitral valves was found in 44% and 38% of the patients, respectively. The average age of the patients was 55, and their ages ranged from 14 to Calcification of the abdominal aorta was found in 57% of the patients. There were a total of 75 deaths that occurred throughout the duration of the follow-up (93 deaths per 1000 person-years). The cardiovascular calcification index and the risk of mortality were related to one another in a way that might be described as linear. As a consequence of this, the hazard risk (HR) was shown to have increased by 12% for every point increase in the cardiovascular calcification index (P 0.001 for both hypotheses). Additional adjustments made for age, sex, study center, diabetes mellitus, history of cardiovascular disease, hypertension, congestive heart failure, left ventricular hypertrophy, and systolic and diastolic blood pressure did not significantly alter the strength of this association (HR 1.10; 95%CI: 1.00-1.21; P = 0.03). Using a straightforward clinical model known as the cardiovascular calcification index, patients who are receiving maintenance hemodialysis can be categorized according to the level of risk that they are at by doing so.

It is not known how frequently persons who are receiving hemodialysis pass away unexpectedly or what circumstances put them at risk for these kinds of deaths. A study aimed to assess the frequency of unexpected fatalities as well as the factors that enhance the risk of unexpected deaths in Japanese patients who were having hemodialysis treatment (Hiyamuta et al., 2020). There were a total of 3,505 patients that were younger than 18 years old and receiving hemodialysis during the course of ten years. We used a Cox proportional hazards model to obtain the HR after multivariate adjustment, along with a 95% confidence interval (95% CI) for each risk factor that was linked with an unexpected death. This was done so that we could compare the results accurately. There were a total of 1735 patients who passed away during the course of the ten-year follow-up period; of these fatalities, 227 (or 13%) were unanticipated. As an incidence rate, the rate of sudden death was 9.13 times for every 1000 person years. According to a multivariable-adjusted Cox analysis, factors such as male sex (hazard ratio [HR] 1.67; 95% confidence interval [CI] 1.20-2.33), age (HR 1.44; 95% CI 1.26-1.65 per 10-year higher), the presence of diabetes (HR 2.45; 95% CI 1.82-3.29), the history of cardiovascular disease (HR 1.85; 95% CI 1.38-2.46), cardiothoracic ratio [HR Within the scope of this research project, both the frequency of unanticipated deaths and the particular factors that contributed to those deaths were explored among Japanese patients who were participating in hemodialysis treatment.

1.5 The problem of the study

In spite of the advancement and general improvement in the treatment of CKD, the incidence of this public health issue has been increasing worldwide. Globally, millions of peoples are on dialysis or underwent renal transplants to stay alive. Moreover, it was estimated that one in five men and one in four women aged in between 40 and 80 years are suffering from ESRD.

Currently, there is a scarcity in studies investigating mortality rates and describing causes of mortality among patients on hemodialysis in the local region of Palestine and neighboring Arab countries. Previous studies have focused on the prevalence of CKD and ESRD among the Palestinians.

In practice, hemodialysis patients in Palestine were observed to suffer considerable mortality. Therefore, this study was conducted to determine the mortality rates among hemodialysis patients at An-Najah National University Hospital which is one of the main referral centers in the north of the West Bank of Palestine. The study also aimed to describe the causes of death among this group of patients.

1.6 Questions of the study

The study attempted to answer the following questions:

- What are the most common characteristics of the Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital?
- What is the mortality rate among the Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital?
- What are the most common risk factors associated with increased mortality among Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital?

1.7 Objectives of the study

The current study attempted to achieve the following objectives:

- Describe the most common characteristics of the Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital.
- Determine the mortality rate among the Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital.
- Determine the most common risk factors associated with increased mortality among Palestinian ESRD patients who were treated with hemodialysis at An-Najah National University Hospital.

1.8 Significance of the study

This study focused on the mortality rates among the ESRD patients who were treated with hemodialysis at An-Najah National University Hospital. The findings of this study would provide valuable information on the most common causes of the mortality rate among the ESRD patients who were treated with hemodialysis at An-Najah National University Hospital. The findings of this study might be informative to clinicians, healthcare providers, and other decision makers who might need to develop or modify guidelines on how to manipulate modifiable risk factors to reduce mortality, improve outcomes, and quality of life of the ESRD patients who are treated with hemodialysis at An-Najah National University Hospital.

Chapter Two
Methods

This chapter includes study design, site and setting, sample and sampling, inclusion and exclusion criteria, period of the study, data collection, statistical analysis and ethical considerations.

2.1 Study design

This study used a quantitative retrospective cohort design. In this study, the data were collected from the computerized database of An-Najah National University Hospital. The quantitative correlational retrospective cohort design is considered suitable for the current study because it is time- and cost-efficient.

Retrospective studies have the advantage of the ability to collect data from a large group of people, and they are representative to the population because they are already members of it (Sedgwick, 2014). On the other hand, the retrospective study has the limitation of having plenty of missing data, because the researcher is not sure if all the variables that are desired to be collected are already measured or stored in the previous dataset (Sedgwick, 2014).

2.2 Study settings

This study was conducted in at An-Najah National University Hospital which is one of the main referral centers in the northern part of West Bank of Palestine. The center was established in 2013 in cooperation with the Faculty of Medicine and Health Sciences at An-Najah National University. The center is considered a tertiary center and one of Palestine's leading institutions in the field of health care. With more than 100 inpatient beds, the center includes a well-equipped 3 intensive care units, as well as the nephrology department that provides services for hospitalized patients and both hemo- and peritoneal dialysis for more than 350 outpatients. The center also includes a radiology department and emergency unit. The center offers different services for complex medical conditions which require cardiac care and ophthalmology services, as well as surgery. Additionally, care services in sub-specialties like orthopedics, oncology and urology are also offered. It is also the center that contains the largest dialysis department in Palestine, and other many departments.

The center is the only healthcare facility that offers hemodialysis treatments in the northern part of the West Bank. Hemodialysis is defined as the therapy that filters wastes and water from the body when the kidneys are no longer healthy enough to do this work. During hemodialysis blood is removed, filtered and returned to the body using a machine that facilitates an artificial kidney. When a patient is diagnosed with ESRD and hemodialysis is ordered by a physician, multiple laboratory studies such as a hepatitis profile, along with other pertinent chemistry studies are completed on a regular basis. During the initial hemodialysis therapy, the patient receives three consecutive hemodialysis treatments before the doctors puts them on three-day per week hemodialysis schedule.

The Nephrology Unit at the center is equipped with forty-two dialysis machines produced by B. Brown and Fresenius. On a normal day, patients are offered dialysis treatment within three to four hours per section four times a day. There is an attending nephrologist on the unit, and the typical staffing ratio is one nurse to four patients. When a patient is admitted for diagnosis, the admission nurse reviews the diagnosis orders for the physician noting the amount required for fluid removal and any potential medications or blood products required during treatment. Before connecting a patient to a dialysis machine, the nurse records the patient's current weight and after dialysis, and vital signs on a dialysis flow sheet. During treatment, vital signs are recorded according to the patient's response or any signs and symptoms. Once the treatment is completed, the patient remains in the unit for observation before being discharged from the hospital. Multiple periodic examinations are performed like blood samples complete blood count, serum electrolytes, coagulations, vitamins level and others lab tests for all ESRD patients, hepatitis vaccinations and titers, COVID-19 vaccinations, seasonal flu vaccinations are followed up and given for all ESRD patients at the center.

The center was chosen as the site for the current study because it is a well-known therapeutic center for ESRD in the targeted area, and it receives transfers from governmental section, so all hemodialysis patients are 100% financially covered by the government. This hospital also collects the medical data from the patient in a professional manner, and is concerned with teaching process, thus the data retrieving and collection will be easier.

2.3 Study population

The study included all died adult patients ESRD ongoing hemodialysis irrespective of their gender, and duration of dialysis.

2.4 Sample size

Sampling is done using the total population sampling method, in which means that the sample includes all died ESRD patients at the center who met the inclusion criteria.

Total population sampling is a type of purposive sampling methods, which was chosen in this study because all patients in the population share an uncommon characteristic, that is hemodialysis. It is conducted in three steps: definition of population characteristics to ensure that all the patients share that uncommon characteristic, and then the creation of population list, which is already found in the health information system at the center, and followed by contacting the list members, which will be done retrospectively when collecting the data from the health information system after granting the permission.

2.5 Inclusion criteria

- All patient with end stage renal disease how died during the study period.
- Receives hemodialysis service regularly at the center as outpatients between January 2017 and December 2021

2.6 Exclusion criteria

- All patients below 18 years old.
- Patients not meeting the inclusion criteria
- Peritoneal dialysis patients

2.7 Development of the data collection sheet

A data collection form was specifically developed for this study. The data collection form was based on previous studies (Ahmed et al., 2020; Can et al., 2022; do Sameiro-Faria et al., 2013; Herrera-Añazco et al., 2020). The items included in the data collection form were reviewed and evaluated for suitability by hemodialysis specialists included the head nurse and the nephrology specialists at the Nephrology Department of the center. Additionally, the final data collection form was reviewed by 6 nephrologists / Intensivists / researchers / academicians from the Faculty of Medicine and Health Sciences at An-Najah National University and other hospitals.

2.8 Data collection

The data needed for this retrospective correlational study were collected through medical records of the patients. A self-developed well-structured tool that was informed by previous studies was used to collect data from medical records of ESRD patients who were on hemodialysis between January 2017 and December 2021 was used. The data collection tool consisted from three sections. The first section collected the demographic variables of the patients like gender, age at the start of hemodialysis, age at which the patient died, duration of dialysis, smoking status, COVID-19 status, transplantation status, hepatitis status, and etiology of the ESRD. The second section collected the comorbidities like diabetes mellitus, hypertension, and cardiovascular disease. The third section collected laboratory findings like albumin, blood urea nitrogen (BUN), creatinine, chloride, calcium, ferritin, phosphate, potassium, sodium, random blood glucose, transferrin saturation, iron, hemoglobin (Hbg), platelets (PLT), and white blood cells (WBCs).

2.9 Data collection period

The data were collected in the period between 26/07/2022 and 05/09/2022.

2.10 Data and statistical analyses

Medical records of 348 ESRD patients who were on hemodialysis between January 2017 and December 2021 were reviewed at a single center in the north of the West Bank of Palestine. The records of 95 dead patients were used in this study to answer the study questions. Demographic data (gender, age at the start of hemodialysis, age at death), the etiology of ESRD and duration of renal replacement therapy (RRT) (duration of dialysis, hepatitis profile, COVID-19, transplant, smoker) were recorded. Laboratory profile, comorbidities, complications during dialysis, and cause of death were also included. Comorbid conditions such as diabetes mellitus, cardiovascular disease, virology report, neoplasms, vascular diseases, and hypertension were considered. Laboratory parameters like albumin, BUN, creatinine, chloride, calcium, ferritin, phosphate, potassium, sodium, random blood sugar, transferrin saturation, iron, HGB, PLT, WBC levels were also collected.

The statistical analyses were performed using IBM SPSS for Windows version 22.0. Results were systematically tabulated and statistically analyzed. Descriptive statistics were calculated for quantitative variables (mean, standard deviations) and frequencies and percentage for qualitative variables. Chi-square test was applied to test the association of the duration of dialysis with confounding variables, such as gender, previous renal transplant status, and serology report. p-value ≤ 0.05 was taken as significant.

2.11 Ethical considerations

The study was conducted in compliance with the Declaration of Helsinki, which was established by the World Medical Association (WMA) as a set of ethical standards for human medical research. Key ethical standards like respect, beneficence, nonmaleficence, veracity, and justice and other principles of virtue were respected in this study.

The study was reviewed and approved by the Institutional Review Board (IRB) of An-Najah National University. Because the study involved human subjects, it was necessary to follow strict ethical principles. After obtaining the study approval from the IRB of An-Najah National University, the following ethical principles were respected:

- Official permission was obtained from the respected departments (Faculty of Graduate Studies, IRB of An-Najah National University, and Nephrology Department of the center).
- All data and results were handled and treated confidentially.
- Patients were identified by their medical record numbers. The names of the patients were not collected.
- One person reviewed the files of the patients.
- The collected data were treated as confidential and were kept in safe place.

Chapter Three
Results

In this study, medical records of 348 ESRD patients who were on dialysis between January 2017 and December 2021 were reviewed at a single center in the north of the West Bank of Palestine. The records of 95 dead patients were used in this study to answer the study questions. Demographic data (gender, age at the start of hemodialysis, age at death), the etiology of ESRD and duration of dialysis, hepatitis status, COVID-19 status, transplant, and smoking status) were recorded. Laboratory findings, comorbidities, complications during dialysis, and cause of death were also collected. Comorbid conditions such as diabetes mellitus, cardiovascular disease, virology report, vascular disease, and hypertension were considered. Laboratory parameters like albumin, BUN, creatinine, chloride, calcium, ferritin, phosphate, potassium, sodium, random blood sugar, transferrin saturation, iron, HGB, PLT, WBC levels were also collected.

3.1 Mortality rate

The results presented in this section may answer the study question: What is the mortality rate among the Palestinian ESRD patients who were treated with hemodialysis in the single center in the north of the West Bank of Palestine?

The results of Table 1 show that 95 (27.3%) fatalities occurred in 348 dialysis patients during the conduct of this retrospective study in the span of five years (2017-2021) with an annual death rate/year ranged from 31.1%–33.8% in the span (2017-2020) decreased to an annual death rate/year 11.8% in the year 2021. So, the general mortality rate is 27.3% for the whole span of the study.

The results in Table 1 show the number of patients who started hemodialysis each year in the study span, number of patients who died after being on hemodialysis each year in the study span, and the mortality rate in the years of the study span.

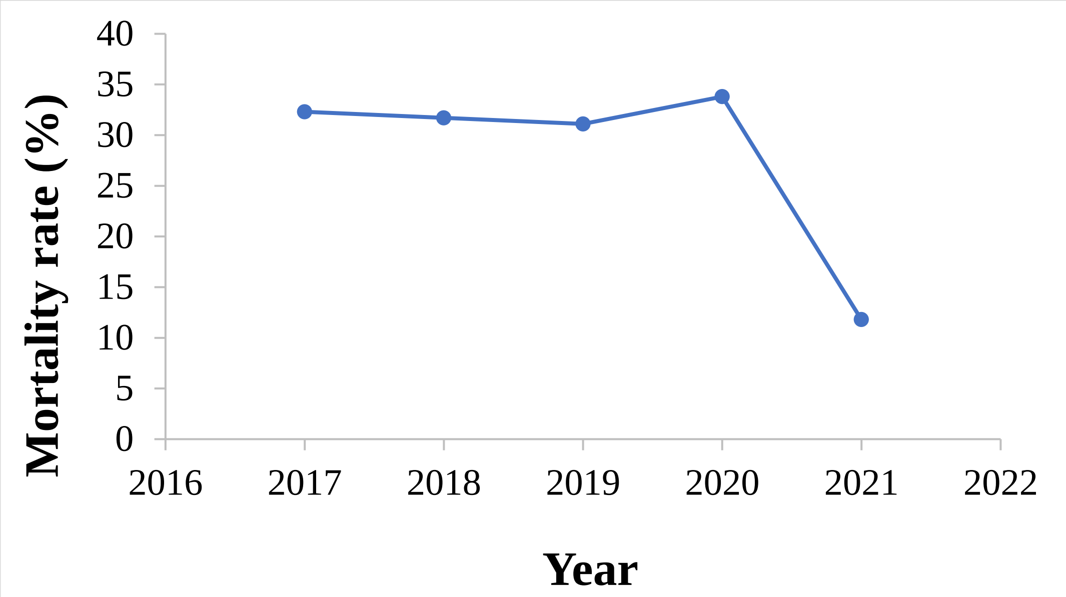
Table 1

Mortality rate in the study span (2017-2021)

Year	# of patients	# of dead patients	Mortality rate = (# of dead patients/ # of patients) X 100%
2017	65	21	32.3
2018	63	20	31.7
2019	61	19	31.1
2020	74	25	33.8
2021	85	10	11.8
Total	348	95	27.3

Figure 1

Year-wise mortality rate



3.2 Demographic and disease characteristics of the patients who died

In this study, data for a total of 95 patients were included and analyzed. Of the 95 dead patients, 65 patients were males (68.4%) and 30 were females (31.6%). The mean of age at the start of hemodialysis was (62.65 ± 11.93) years with 24 (25.3%) patients aged at the start of hemodialysis less than or equal 55 years and 71 (74.7%) aged at the start of hemodialysis more than 55 years. The mean of age at death was (64.02 ± 12.23) years with 35 (36.8%) patients died at age less than or equal 60 years and 60 (63.2%) patients died at age more than 60 years. The results showed that most (n = 87) of the 95 dead patients were dialyzed 1-3 years (91.6%) and only 8 patients were dialyzed more than 3 years (8.4%). The results showed that 50 of the dead patients were smokers (52.6%), and

19 patients had positive COVID-19 test (20%), only one patient had a kidney transplant, and only 4 patients had hepatitis B (4.2%). The demographic and disease characteristics of the patients who were included in this study are shown in Table 2.

Table 2

Demographic and disease characteristics of the patients who were included in this study (n = 95)

Variable	N	%	(Mean ± SD)
Gender			
Male	65	68.4	
Female	30	31.6	
Age at the start of hemodialysis (year)			62.65 ± 11.93
≤ 55	24	25.3	
> 55	71	74.7	
Age at death (year)			64.02 ± 12.23
≤ 60	35	36.8	
> 60	60	63.2	
Duration of dialysis (year)			2.00 ± 1.04
1-3	87	91.6	
>3	8	8.4	
Smoker			
No	45	47.4	
Yes	50	52.6	
COVID-19			
Negative	76	80.0	
Positive	19	20.0	
Transplant			
No	94	98.9	
Yes	1	1.1	
Hepatitis profile			
No	91	95.8	
Yes	4	4.2	

3.3 Causes of death

The results presented in this section may answer the study question: What are the most common characteristics of the Palestinian ESRD patients who were treated with hemodialysis in the single center in the north of the West Bank of Palestine?

The results in Table 3 show the frequencies and percentages for the causes of death of the patients in study population.

Table 3

Frequencies and percentages for the causes of death of the patients in study population (n = 95)

Cause of death	Number (%)
Sepsis	11 (11.6%)
COVID-19	16 (16.8%)
Cardiovascular	41 (43.2%)
Pulmonary edema	9 (9.5%)
Cerebrovascular Accident	5 (5.3%)
Unknown	13 (13.7%)
Total	95 (100%)

The results in the table above show that the cardiovascular is the highest cause of death for the patients (n=41, 43.2%), the second one was the COVID-19 (n=16, 16.8%) followed by sepsis (n=11, 11.6%), and the last causes of death were the pulmonary edema (n=9, 9.5%) and cerebrovascular accident (n=5, 5.3%). The number of cases with unknown cause of death were 13 cases (13.7%).

3.4 Primary renal disease

The results in Table 4 show the frequencies and percentages for the primary renal disease of the patients in study population.

Table 4

Frequencies and percentages for the primary renal disease of the patients in study population (n = 95)

Primary renal disease	Number (%)
Chronic glomerulonephritis	3 (3.2%)
Diabetic nephropathy	74 (77.9%)
Gout	4 (4.2%)
Obstructive uropathy	4 (4.2%)
Unknown	10 (10.5%)
Total	95 (100%)

The results in the table above show that the highest primary renal disease for the patients was the diabetic nephropathy (n = 74, 77.9%). The percentages of the other primary renal diseases were ranged between 3.2% and 4.2%, and the number of cases with unknown primary renal disease was 10 cases (10.5%).

3.5 Comorbidities

The results in the next table show the frequencies and percentages for the comorbidities of the patients in study population.

Table 5

Frequencies and percentages for the comorbidities of the patients in study population (n = 95)

Comorbidities	Number (%)
Cardiovascular disease	19 (20.0%)
Diabetes mellitus	78 (82.1%)
Hypertension	12 (12.6%)
Unknown	2 (2.1%)
No comorbidities	2 (2.1%)
Total	95 (100%)

The results in the table above show that regarding the comorbidities, the highest one was diabetes mellitus with (n = 78, 82.1%), followed by cardiovascular disease with (n = 19, 20%) and hypertension with (n = 12, 12.6%). The number of the unknown comorbidities was 2 cases (2.1%) and the number of cases with no comorbidities was 2 cases (2.1%) also.

3.6 Hematological and biochemical parameters

The results presented in this section may answer the study question: What are the most common risk factors associated with increased mortality among Palestinian ESRD patients who were treated with hemodialysis in the single center in the north of the West Bank of Palestine?

The results in Table 6 show the frequencies and percentages for the qualitative variables, and means and standard deviations for the quantitative variables for the hematological and biochemical parameters of patients in the study population.

Table 6

Frequencies, percentages, means, and standard deviations for the hematological and biochemical parameters of patients in the study population (n = 95)

Variable	Number (%)/(Mean ± S.D)
Albumin	3.33 ± 0.63
<4	81(88%)
4-5	11(12%)
>5	0(0%)
Total	92(100%)
BUN	53.4 ± 26.1
<5	1(1.1%)
5-22	8(8.4%)
>22	86(90.5%)
Total	95(100%)
Creatinine	6.74 ± 2.59
<0.7	0(0%)
0.7-1.2	0(0%)
>1.2	94(100%)
Total	94(100%)
Chloride	98.76 ± 4.86
<98	40(42.6%)
98-107	51(54.3%)
>107	3(3.2%)
Total	94(100%)
Calcium	8.45 ± 0.85
<8.5	44(48.4%)
8.5-9.4	36(39.6%)
>9.4	11(12.1%)
Total	91(100%)
Ferritin	1540.96 ± 6930.12
<20	0(0%)
20-300	24(26.7%)
>300	66(73.3%)
Total	90(100%)
Phosphate	5.15 ± 2.26
<2.5	5(5.4%)
2.5-4.5	37(40.2%)
>4.5	50(54.3%)
Total	92(100%)
Potassium	4.73 ± 0.89
<3.5	5(5.3%)
3.5-4.8	48(50.5%)
>4.8	42(44.2%)
Total	95(100%)

Sodium	138.56 ± 5.13
<135	19(20%)
135-155	75(78.9%)
>155	1(1.1%)
Total	95(100%)
Random blood sugar	152.54 ± 95.61
<74	4(4.8%)
74-110	29(34.9%)
>110	50(60.2%)
Total	83(100%)
Transferrin Saturation	47.41 ± 48.77
<200	76(95%)
200-360	4(5%)
>360	0(0%)
Total	80(100%)
Iron	55.17 ± 25.77
<250	88(100%)
250-410	0(0%)
>410	0(0%)
Total	88(100%)
HGB	10.05 ± 1.95
<13.7	89(94.7%)
13.7-17.2	5(5.3%)
>17.2	0(0%)
Total	94(100%)
PLT	201.43 ± 82.94
<140	20(21.1%)
140-440	74(77.9%)
>440	1(1.1%)
Total	95(100%)
WBC	9.14 ± 6.74
<4	7(7.4%)
4-9	57(60%)
>9	31(32.6%)
Total	95(100%)

The results in the table above showed under normal levels of albumin for the most of the dead patients (n=81, 88%) with mean (3.33 ± 0.63), under normal levels of Transferrin Saturation for the most of the dead patients (n=76, 95%) with mean (47.41 ± 48.77), under normal levels of iron for the most of the dead patients (n=88, 100%) with mean (55.17 ± 25.77), under normal levels of HGB for the most of the dead patients (n=89, 94.7%) with mean (10.05 ± 1.95), under normal levels of Calcium for the most of the dead patients (n=44, 48.4%) with mean (8.45 ± 0.85).

From the other hand, the results in the table above showed above normal levels of BUN for the most of the dead patients (n=86, 90.5%) with mean (53.4 ± 26.1), above normal levels of Creatinine for the most of the dead patients (n=94, 100%) with mean (6.74 ± 2.59), above normal levels of Ferritin for the most of the dead patients (n=66, 73.3%) with mean (1540.96 ± 6930.12), above normal levels of Random blood sugar for the most of the dead patients (n=50, 60.2%) with mean (152.54 ± 95.61), above normal levels of Phosphate for the most of the dead patients (n=50, 54.3%) with mean (5.15 ± 2.26).

Finally, the results in the table above showed normal levels of Chloride for the most of the dead patients (n=51, 54.3%) with mean (98.76 ± 4.86), normal levels of Potassium for the most of the dead patients (n=48, 50.5%) with mean (4.73 ± 0.89), normal levels of Sodium for the most of the dead patients (n=75, 78.9%) with mean (138.56 ± 5.13), normal levels of PLT for the most of the dead patients (n=74, 77.9%) with mean (201.43 ± 82.94), normal levels of WBC for the most of the dead patients (n=57, 60%) with mean (9.14 ± 6.74).

3.7 Relationships between duration of dialysis and the probable risk factors

The results presented in this section may answer the suggested study question: is there any effect of the duration of dialysis on the most common risk factors associated with increased mortality among Palestinian ESRD patients who were treated with hemodialysis in the single center in the north of the West Bank?

The results in Table 7 show the frequencies, percentages, and the chi-square test of relationships between the duration of dialysis and some probable risk factors.

Table 7

Frequencies, percentages, and the chi-square test of relationships between the duration of dialysis and some probable risk factors (n = 95)

Variable	Category	Duration of dialysis 1-3 years (n=87) N (%)	>3 years (n=8) N (%)	Chi-square	P-value
Gender	Male	59(67.8%)	6(75%)	0.18	0.676
	Female	28(32.2%)	2(25%)		
Age at the start of hemodialysis	<=55	23(26.4%)	1(12.5%)	0.75	0.385
	>55	64(73.6%)	7(87.5%)		
Age at death	<=60	33(37.9%)	2(25%)	0.53	0.468
	>60	54(62.1%)	6(75%)		
Smoker	No	42(48.3%)	3(37.5%)	0.34	0.559
	Yes	45(51.7%)	5(62.5%)		
COVID-19	Negative	73(83.9%)	3(37.5%)	9.86	0.002
	Positive	14(16.1%)	5(62.5%)		
Transplant	No	86(98.9%)	8(100%)	0.09	0.760
	Yes	1(1.1%)	0(0%)		
Hepatitis profile	No	84(96.6%)	7(87.5%)	1.49	0.222
	Yes	3(3.4%)	1(12.5%)		
Albumin	<4	75(88.2%)	6(85.7%)	0.04	0.843
	4-5	10(11.8%)	1(14.3%)		
	>5	0(0%)	0(0%)		
BUN	<5	1(1.1%)	0(0%)	0.91	0.633
	5-22	8(9.2%)	0(0%)		
	>22	78(89.7%)	8(100%)		
Creatinine	<0.7	0(0%)	0(0%)	-	-
	0.7-1.2	0(0%)	0(0%)		
	>1.2	86(100%)	8(100%)		
Chloride	<98	35(40.7%)	5(62.5%)	1.55	0.461
	98-107	48(55.8%)	3(37.5%)		
	>107	3(3.5%)	0(0%)		
Calcium	<8.5	39(47%)	5(62.5%)	1.43	0.489
	8.5-9.4	33(39.8%)	3(37.5%)		
	>9.4	11(13.3%)	0(0%)		
Ferritin	<20	0(0%)	0(0%)	0.53	0.468
	20-300	21(25.6%)	3(37.5%)		
	>300	61(74.4%)	5(62.5%)		
Phosphate	<2.5	5(5.9%)	0(0%)	1.14	0.567
	2.5-4.5	33(38.8%)	4(57.1%)		
	>4.5	47(55.3%)	3(42.9%)		
Potassium	<3.5	5(5.7%)	0(0%)	1.41	0.493
	3.5-4.8	45(51.7%)	3(37.5%)		

	>4.8	37(42.5%)	5(62.5%)		
Sodium	<135	16(18.4%)	3(37.5%)	1.73	0.421
	135-155	70(80.5%)	5(62.5%)		
	>155	1(1.1%)	0(0%)		
Random blood sugar	<74	4(5.2%)	0(0%)	4.27	0.041
	74-110	29(37.7%)	0(0%)		
	>110	44(57.1%)	6(100%)		
Transferrin Saturation	<200	71(95.9%)	5(83.3%)	1.86	0.173
	200-360	3(4.1%)	1(16.7%)		
	>360	0(0%)	0(0%)		
Iron	<250	81(100%)	7(100%)	-	-
	250-410	0(0%)	0(0%)		
	>410	0(0%)	0(0%)		
HGB	<13.7	82(94.3%)	7(100%)	0.43	0.515
	13.7-17.2	5(5.7%)	0(0%)		
	>17.2	0(0%)	0(0%)		
PLT	<140	17(19.5%)	3(37.5%)	1.48	0.477
	140-440	69(79.3%)	5(62.5%)		
	>440	1(1.1%)	0(0%)		
WBC	<4	4(4.6%)	3(37.5%)	11.66	0.003
	4-9	54(62.1%)	3(37.5%)		
	>9	29(33.3%)	2(25%)		

The results in the table above show that there are significant relationships at 0.05 level between the duration of dialysis and only COVID-19, random blood sugar, WBC. The p-values of the chi-square test are less than 0.05 only corresponding to these three risk factors.

Regarding COVID-19, the results show that the percentage of positive COVID-19 patients who dialyzed >3 years (n=5, 5/8=62.5%) is significantly higher than the percentage of positive COVID-19 patients who dialyzed 1-3 years (n=14, 14/87=16.1%), the p-value of the test is 0.002<0.05. Therefore, it can be concluded that longer duration of hemodialysis increased the risk of contracting COVID-19.

Regarding the random blood sugar, the results show that the percentage of the above-normal Random blood sugar patients (>110) who dialyzed >3 years (n=6, 6/6=100%) is significantly higher than the percentage of the above-normal Random blood sugar patients who dialyzed 1-3 years (n=44, 44/77=57.1%), the p-value of the test is 0.041<0.05. Therefore, it can be concluded that longer duration of hemodialysis increased the risk of having above-normal levels of random blood sugar.

Regarding the WBC, the results show that the percentage of the under-normal WBC patients (<4) who dialyzed >3 years (n=3, 3/8=37.5%) is significantly higher than the percentage of the under-normal WBC patients who dialyzed 1-3 years (n=4, 4/87=4.6%), and also it is clear that the percentage of the normal WBC patients (4-9) who dialyzed >3 years (n=3, 3/8=37.5%) is significantly lower than the percentage of the normal WBC patients who dialyzed 1-3 years (n=54, 54/87=62.1%), the p-value of the test is 0.003<0.05. Therefore, it can be concluded that longer duration of hemodialysis increased the under-normal levels of WBC and decreased the normal levels of WBC.

From the other hand, the results in the table above show that there are no significant relationships at 0.05 level between the duration of dialysis and the other probable risk factors (gender, age at the start of hemodialysis, age at death, smoker, transplant, hepatitis profile, albumin, BUN, creatinine, chloride, calcium, ferritin, phosphate, potassium, sodium, transferrin saturation, iron, HGB, PLT). The p-values of the chi-square test are higher than 0.05 corresponding to these probable risk factors.

3.8 Relationships between causes of death and the probable risk factors

The results in Table 8 show the frequencies, percentages, and the chi-square test of relationships between the causes of death and some probable risk factors.

The results in the table show that there are significant relationships at 0.05 level between the causes of death and the age at death, the percentages of the causes of death (COVID-19, cardiovascular, pulmonary edema, cerebrovascular accident) for the patients from age at death (<60) are significantly higher than the percentages for the patients from age at death (<=60), the p-value of the chi-square test is 0.041<0.05.

The results also show that there are significant relationships at 0.05 level between the causes of death and smoking, the percentages of the causes of death (sepsis, cerebrovascular accident, COVID-19) for the smokers patients are significantly higher than the percentages for the non-smokers patients, while the percentages of the causes of death (pulmonary edema or the unknown causes) for the smokers patients are significantly lower than the percentages for the non-smokers patients, the p-value of the chi-square test is 0.02<0.05.

Table 8

Frequencies, percentages, and the chi-square test of relationships between the causes of death and some probable risk factors (n = 95)

Variable	Category	Cause of death: Sepsis	COVID-19	Cardiovascular	Pulmonary edema	Cerebrovascular Accident	Unknown	Total	Chi-square(P-value)
Gender	Male	7(63.6%)	14(87.5%)	26(63.4%)	5(55.6%)	4(80%)	9(69.2%)	65(68.4%)	4.291(0.508)
	Female	4(36.4%)	2(12.5%)	15(36.6%)	4(44.4%)	1(20%)	4(30.8%)	30(31.6%)	
Age at the start of hemodialysis	<=55	4(36.4%)	3(18.8%)	9(22%)	0(0%)	1(20%)	7(53.8%)	24(25.3%)	10.056(0.074)
	>55	7(63.6%)	13(81.3%)	32(78%)	9(100%)	4(80%)	6(46.2%)	71(74.7%)	
Age at death	<=60	6(54.5%)	4(25%)	14(34.1%)	1(11.1%)	1(20%)	9(69.2%)	35(36.8%)	11.605(0.041)*
	>60	5(45.5%)	12(75%)	27(65.9%)	8(88.9%)	4(80%)	4(30.8%)	60(63.2%)	
Duration of dialysis	1-3 years	11(100%)	12(75%)	38(92.7%)	8(88.9%)	5(100%)	13(100%)	87(91.6%)	8.518(0.13)
	>3 years	0(0%)	4(25%)	3(7.3%)	1(11.1%)	0(0%)	0(0%)	8(8.4%)	
Smoker	No	4(36.4%)	3(18.8%)	21(51.2%)	6(66.7%)	1(20%)	10(76.9%)	45(47.4%)	13.436(0.02)*
	Yes	7(63.6%)	13(81.3%)	20(48.8%)	3(33.3%)	4(80%)	3(23.1%)	50(52.6%)	
COVID-19	Negative	11(100%)	0(0%)	39(95.1%)	9(100%)	4(80%)	13(100%)	76(80%)	78.11(<0.001)*
	Positive	0(0%)	16(100%)	2(4.9%)	0(0%)	1(20%)	0(0%)	19(20%)	
Transplant	No	11(100%)	16(100%)	40(97.6%)	9(100%)	5(100%)	13(100%)	94(98.9%)	1.331(0.932)
	Yes	0(0%)	0(0%)	1(2.4%)	0(0%)	0(0%)	0(0%)	1(1.1%)	
Hepatitis profile	No	10(90.9%)	15(93.8%)	39(95.1%)	9(100%)	5(100%)	13(100%)	91(95.8%)	2.047(0.843)
	Yes	1(9.1%)	1(6.3%)	2(4.9%)	0(0%)	0(0%)	0(0%)	4(4.2%)	
Primary renal disease	Chronic glomerulonephritis	0(0%)	1(6.3%)	1(2.4%)	0(0%)	0(0%)	1(7.7%)	3(3.2%)	20.189(0.446)

	Diabetic nephropathy	8(72.7%)	12(75%)	35(82.9%)	8(88.9%)	5(100%)	7(53.8%)	74(77.9%)	
	Gout	1(9.1%)	1(6.3%)	1(2.4%)	0(0%)	0(0%)	1(7.7%)	4(4.2%)	
	Obstructive uropathy	0(0%)	0(0%)	1(2.4%)	0(0%)	0(0%)	3(23.1%)	4(4.2%)	
	Unknown	2(18.2%)	2(12.5%)	4(9.8%)	1(11.1%)	0(0%)	1(7.7%)	10(10.5%)	
Comorbidities	CVD	0(0%)	0(0%)	1(2.4%)	0(0%)	0(0%)	0(0%)	1(1.1%)	1.331(0.932)
	DM	10(90.9%)	15(93.8%)	33(80.5%)	8(88.9%)	3(60%)	9(69.2%)	78(82.1%)	5.541(0.353)
	HTN	1(9.1%)	0(0%)	6(14.6%)	1(11.1%)	2(40%)	2(15.4%)	12(12.6%)	6.089(0.298)
	Unknown	0(0%)	0(0%)	1(2.4%)	0(0%)	0(0%)	1(7.7%)	2(2.1%)	2.873(0.720)
	No comorbidities	0(0%)	1(6.3%)	0(0%)	0(0%)	0(0%)	1(7.7%)	2(2.1%)	4.722(0.451)
Albumin	<4	8(80%)	14(93.3%)	35(87.5%)	9(100%)	5(100%)	10(76.9%)	81(88%)	4.453(0.486)
	5-Apr	2(20%)	1(6.7%)	5(12.5%)	0(0%)	0(0%)	3(23.1%)	11(12%)	
	>5	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
BUN	<5	0(0%)	0(0%)	1(2.4%)	0(0%)	0(0%)	0(0%)	1(1.1%)	8.388(0.591)
	22-May	2(18.2%)	3(18.8%)	1(2.4%)	0(0%)	1(20%)	1(7.7%)	8(8.4%)	
	>22	9(81.8%)	13(81.3%)	39(95.1%)	9(100%)	4(80%)	12(92.3%)	86(90.5%)	
Creatinine	<0.7	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	-
	0.7-1.2	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
	>1.2	11(100%)	16(100%)	41(100%)	9(100%)	4(100%)	13(100%)	94(100%)	
Chloride	<98	2(20%)	8(50%)	16(39%)	7(77.8%)	1(20%)	6(46.2%)	40(42.6%)	10.825(0.371)
	98-107	7(70%)	8(50%)	23(56.1%)	2(22.2%)	4(80%)	7(53.8%)	51(54.3%)	
	>107	1(10%)	0(0%)	2(4.9%)	0(0%)	0(0%)	0(0%)	3(3.2%)	
Calcium	<8.5	5(62.5%)	10(62.5%)	17(41.5%)	2(22.2%)	4(80%)	6(50%)	44(48.4%)	11.574(0.315)
	8.5-9.4	2(25%)	5(31.3%)	17(41.5%)	7(77.8%)	1(20%)	4(33.3%)	36(39.6%)	

	>9.4	1(12.5%)	1(6.3%)	7(17.1%)	0(0%)	0(0%)	2(16.7%)	11(12.1%)	
	<20	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
Ferritin	20-300	4(50%)	3(18.8%)	8(20%)	6(66.7%)	1(25%)	2(15.4%)	24(26.7%)	11.865(0.037)*
	>300	4(50%)	13(81.3%)	32(80%)	3(33.3%)	3(75%)	11(84.6%)	66(73.3%)	
	<2.5	0(0%)	1(6.7%)	1(2.4%)	2(22.2%)	1(20%)	0(0%)	5(5.4%)	
Phosphate	2.5-4.5	7(77.8%)	6(40%)	17(41.5%)	0(0%)	1(20%)	6(46.2%)	37(40.2%)	18.622(0.045)*
	>4.5	2(22.2%)	8(53.3%)	23(56.1%)	7(77.8%)	3(60%)	7(53.8%)	50(54.3%)	
	<3.5	0(0%)	1(6.3%)	1(2.4%)	0(0%)	1(20%)	2(15.4%)	5(5.3%)	
Potassium	3.5-4.8	6(54.5%)	8(50%)	19(46.3%)	5(55.6%)	3(60%)	7(53.8%)	48(50.5%)	8.292(0.6)
	>4.8	5(45.5%)	7(43.8%)	21(51.2%)	4(44.4%)	1(20%)	4(30.8%)	42(44.2%)	
	<135	0(0%)	4(25%)	7(17.1%)	4(44.4%)	0(0%)	4(30.8%)	19(20%)	
Sodium	135-155	10(90.9%)	12(75%)	34(82.9%)	5(55.6%)	5(100%)	9(69.2%)	75(78.9%)	16.028(0.099)
	>155	1(9.1%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1(1.1%)	
	<74	0(0%)	0(0%)	3(7.9%)	0(0%)	0(0%)	1(10%)	4(4.8%)	
Random blood sugar	74-110	4(50%)	6(42.9%)	12(31.6%)	2(22.2%)	1(25%)	4(40%)	29(34.9%)	5.426(0.861)
	>110	4(50%)	8(57.1%)	23(60.5%)	7(77.8%)	3(75%)	5(50%)	50(60.2%)	
	<200	7(100%)	12(100%)	37(97.4%)	7(87.5%)	3(100%)	10(83.3%)	76(95%)	
Transferrin Saturation	200-360	0(0%)	0(0%)	1(2.6%)	1(12.5%)	0(0%)	2(16.7%)	4(5%)	5.993(0.307)
	>360	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
	<250	8(100%)	15(100%)	40(100%)	9(100%)	3(100%)	13(100%)	88(100%)	
Iron	250-410	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	-
	>410	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
	<13.7	11(100%)	14(93.3%)	38(92.7%)	9(100%)	5(100%)	12(92.3%)	89(94.7%)	
HGB	13.7-17.2	0(0%)	1(6.7%)	3(7.3%)	0(0%)	0(0%)	1(7.7%)	5(5.3%)	1.929(0.859)
	>17.2	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
	<140	2(18.2%)	4(25%)	6(14.6%)	2(22.2%)	1(20%)	5(38.5%)	20(21.1%)	
PLT	140-440	9(81.8%)	11(68.8%)	35(85.4%)	7(77.8%)	4(80%)	8(61.5%)	74(77.9%)	8.718(0.559)

	>440	0(0%)	1(6.3%)	0(0%)	0(0%)	0(0%)	0(0%)	1(1.1%)	
	<4	0(0%)	4(25%)	1(2.4%)	0(0%)	1(20%)	1(7.7%)	7(7.4%)	
WBC	9-Apr	5(45.5%)	9(56.3%)	26(63.4%)	7(77.8%)	2(40%)	8(61.5%)	57(60%)	14.967(0.133)
	>9	6(54.5%)	3(18.8%)	14(34.1%)	2(22.2%)	2(40%)	4(30.8%)	31(32.6%)	

Note. *The p-value is significant at 0.05 level

The results also show that there are significant relationships at 0.05 level between the causes of death and the positive COVID-19, the percentage of the cause of death (COVID-19) for the patients who had the positive COVID-19 (n=16, 100%) is significantly higher than the percentage for the patients who had not the positive COVID-19, while the percentages of all the other causes of death for the for the patients who had the positive COVID-19 are significantly lower than the percentages for the patients who had not the positive COVID-19, the p-value of the chi-square test is 0.001.

The results also show that there are significant relationships at 0.051` level between the causes of death and the ferritin, the percentages of the causes of death (COVID-19, cardiovascular, cerebrovascular accident, unknown) for the patients with above-normal levels of ferritin are significantly higher than the percentages for the patients with normal levels of ferritin, while the percentage of (pulmonary edema) cause of death for the patients with above-normal levels of ferritin is significantly lower than the percentage for the patients with normal levels of ferritin, the p-value of the chi-square test is 0.037.

Finally, the results show that there are significant relationships at 0.05 level between the causes of death and the phosphate, the percentages of the causes of death (pulmonary edema, cerebrovascular accident) for the patients with above-normal levels of phosphate are significantly higher than the percentages for the patients with normal levels of phosphate, while the percentage of (sepsis) cause of death for the patients with above-normal levels of phosphate is significantly lower than the percentage for the patients with normal levels of phosphate, the p-value of the chi-square test is 0.045.

Chapter Four

Discussions and Conclusions

4.1 Discussions and Conclusions

Globally, CKD has increased over the past decades and became one of the public health priorities due to the marked morbidity, mortality, and healthcare associated costs (Bello et al., 2022). In 2017, more than 850 million patients were estimated to be living with CKD around the world (Jager et al., 2019). The same study reported that the global prevalence of CKD could be as twice as diabetes mellitus and more than 20 times the prevalence of human immunodeficiency virus/acquired immune deficiency syndrome. According to recent estimates, more than 4 million people have CKD that require kidney replacement therapy (Bello et al., 2022; Molaoa et al., 2021; Thurlow et al., 2021). It was projected that CKD would become the 5th most common cause of death by the year 2040 (Foreman et al., 2018). Hemodialysis is the most commonly used kidney replacement therapy (Bello et al., 2022). Previous studies have reported that patients on hemodialysis are at higher risk for morbidity and mortality compared to the general population and other diseases including many types of cancer (Bello et al., 2022; Ma & Zhao, 2017). According to some estimates, more than 75% of the patients with hemodialysis suffer cardiovascular diseases (Ahmadmehrabi & Tang, 2018). Previous studies have reported that cardiovascular disease is the leading cause of death among hemodialysis patients (Ahmadmehrabi & Tang, 2018; Cozzolino et al., 2018). Patients on hemodialysis were reported to experience significant burden of symptoms, financial difficulties, and poor quality of life (Bello et al., 2022; Tang et al., 2020). It has been argued that assessment of outcomes of patients on hemodialysis could be important for the development of strategies to reduce risks of morbidity and mortality among this fragile subgroup of patients (Tang et al., 2020). Additionally, this would help inform local policies and guidelines that could be used to reduce morbidity, mortality, and optimize care services provided to this group of patients.

4.2 Discussion and Interpretation of the Main Results

4.2.1 The mortality rate

In this study, the overall mortality rate among the patients with ESRD who were on hemodialysis in a single center in the north of the West Bank of Palestine across the years was 27.3%. Over the span of the years, the mortality rates were in the range of 11.8% to 33.8%. The highest mortality rate was reported in 2020. Like the rest of the world, Palestine was affected by the COVID-19 pandemic as the first cases were reported in March 2020 (Shawahna, 2021). As reported in previous studies, COVID-19 might have increased the mortality rate among this group of patients (Bruchfeld, 2021; Hilbrands et al., 2020; Sevinc et al., 2021; Sipahi et al., 2021). The mortality rate among the patients with ESRD who were on hemodialysis in a single center in the north of the West Bank of Palestine were within the range of mortality rates reported in previous studies in the Arab World and elsewhere. It is noteworthy mentioning that previous studies have reported variable mortality rates among patients on hemodialysis in different settings. In Dubai, the 5-year mortality rate among patients who were on hemodialysis in a single center was 27.3% (Ahmed et al., 2020). On the other hand, the 5-year mortality rate among patients on hemodialysis in a single center in Tripoli, Libya was 51.4% (Buargub, 2008). In another study that used the US Renal Data System, the study reported a 5-year mortality rate of 64.7% (Leavey et al., 1998). In a previous large study that included more than 15,000 patients from 51 renal clinics in 6 states in the US reported all-cause and cardiovascular mortality rates in the range of 11.9% per year to 14.2% per year (Usvyat et al., 2012). The study showed that the mortality rate different on seasonal pattern, being higher in winter compared to summer. These reported mortality rates were comparatively higher than those reported among patients who were on peritoneal dialysis. For example, a study that was conducted in Saudi Arabia reported a 5-year mortality rate of about 15.3% among patients who were on peritoneal dialysis (Alwakeel et al., 2011). In another more recent study, the 5-year mortality rate among patients who were on peritoneal dialysis was 7.13% (Al Wakeel et al., 2018). Taken together, these findings indicated that the mortality rates among patients on hemodialysis was high. The findings reported in this study might be informative to decision makers in healthcare authorities, clinicians, and other healthcare providers who might need to improve outcomes and survival rates among patients on hemodialysis in Palestinian centers.

4.2.2 Demographic variables and comorbidities of the patients who died during the study period

In this study, the patients who died included more male and patients who started hemodialysis when older than 55 years. The demographic variables of the patients who died in this study were consistent with those reported in previous studies in the region. For example, more than half of the patients who were on hemodialysis in centers in Dubai (56%), Tripoli (63.6%), Qatar (51.0%), and Brazil (57.8%) were male (Ahmed et al., 2020; Buargub, 2008; Matos et al., 2011; Shigidi et al., 2009). These findings were not surprising as males were reported to be twice more likely to develop diabetes mellitus compare to females. Similarly, males have higher blood pressure compared to females. In this study, the mean age at which the patients started receiving hemodialysis was 62.65 ± 11.93 years. Similar to the present study, the patients in the previous studies started hemodialysis at older age. In this study, the majority of the patients died within the first 3 years of hemodialysis. These findings might stimulate more research to understand the reasons why more patients died within the first 3 years of receiving hemodialysis sessions. Additionally, these findings could be informative to decision makers, clinicians/ healthcare providers, and patient advocacy groups who might be interested to improve survival and reduce mortality among patients who receive hemodialysis in the single center in the north of the West Bank of Palestine.

In this study more than half of the patients who died were smokers and older than 60 years. Previous studies have demonstrated that older age and smoking increased the likelihood of mortality among the patients on hemodialysis (Li et al., 2018; Mc Causland et al., 2012). In a previous study, smoking increase the mortality and first hospitalization rates among patients who were on hemodialysis (Li et al., 2018). The same study reported that heavy smokers were about 1.4-fold more likely to die while on hemodialysis compared to those who never smoked. In another study in the US, exposure to smoke increased the likelihoods of the same day and 30-day mortality among patients on hemodialysis (Xi et al., 2020). Smoking was reported to be high among Palestinians, notably, males. Probably, the findings reported in this study might be informative to decision makers who might need to develop strategies to reduce smoking among the Palestinians. Of the patients who died in this study, 20.0% tested positive for COVID-19. Previous studies have reported that contracting COVID-19 increased the risk for mortality among hemodialysis patients (Bruchfeld, 2021; Hilbrands et al., 2020; Sevinc et al., 2021; Sipahi et al., 2021). It is noteworthy mentioning that the first case of COVID-19 in Palestine was reported on March 5, 2020 (Shawahna, 2021). As this was an analysis of mortality in the last years, certainly COVID-19 affected mortality in the last 2 years. On the other hand, the vast majority of the patients who died in this study did not receive kidney transplant. It is well-established that receiving kidney transplant improve quality of life and health outcomes including survival rates of the kidney transplant recipients compared to patients who receive hemodialysis (Sarhan et al., 2021). In this study, one kidney transplant recipient died. A previous study among a Japanese cohort showed that the risk for infection-related mortality was higher among kidney transplant recipients after graft failure (Kawaguchi et al., 2021). It has been argued that understanding the demographics of patients on hemodialysis might be important to identify certain groups of the population who are at risk for hemodialysis and those are at higher risk for mortality while on hemodialysis.

4.2.3 Causes of death among the study patients

In this study, cardiovascular disease was the most commonly reported cause of death among the patients on hemodialysis in the single center in the north of the West Bank of Palestine. The incidence of cardiovascular disease was reported as high among the Palestinians. Therefore, the findings reported in this study were not surprising. Similar to previous studies, cardiovascular disease was the leading cause of death among patients on hemodialysis (Ahmed et al., 2020; Fu et al., 2021; Klinger & Madziarska, 2019; Ma & Zhao, 2017; Ng et al., 2021). A recent meta-analysis that included 28 studies showed that congestive heart failure, coronary artery disease, atrial fibrillation, peripheral arterial disease, and coronary artery complications were common among patients on hemodialysis (Ng et al., 2021). Moreover, COVID-19 was the cause of death in 16.8% of the patients in this study. Studies from different countries have reported that COVID-19 caused significant mortality among hemodialysis patients (Bruchfeld, 2021; Hilbrands et al., 2020; Sevinc et al., 2021; Sipahi et al., 2021; Tan et al., 2021). Therefore, there has been many calls to protect high risk patients including those on hemodialysis. Measures to protect patients on hemodialysis included vaccination and monitoring titers (Bruchfeld, 2021; Yen et al., 2021). In this study, sepsis was the cause of death in 11.6% of the patients. Due its invasiveness, hemodialysis has been reported to be associated with sepsis and catheter-related bloodstream infections (Abou Dagher et al., 2015; Farrington & Allon, 2019; Locham et al., 2021). A recent large study that included 870,571 patients reported that 29.8% of the patients developed sepsis (Locham et al., 2021). The study showed that the patients who developed sepsis were older, smokers, obese, had diabetes, peripheral arterial disease, and congestive heart failure. Together, these findings might indicate that hemodialysis centers in the West Bank need to take measures to protect older patients and those with comorbidities from developing sepsis or contracting bloodstream infections.

4.2.4 Etiology of the primary renal disease and prevalence of comorbidities

In this study, the primary renal disease was diabetic nephropathy in the majority of the patients (77.9%). The other etiologies included glomerulonephritis, gout, and obstructive uropathy. On the other hand, the majority of the patients (82.1%) had diabetes mellitus. Previous studies have shown that diabetes mellitus and hypertension were commonly prevalent among patients with hemodialysis (Del Vecchio et al., 2013; Skonieczny et al., 2018). It is well-established that diabetes mellitus and hypertension are risk factors for developing ESRD. In a large Italian study of 4,022 patients reported that 70.3% had hypertension (Del Vecchio et al., 2013). In Dubai, diabetes mellitus was prevalent in 73.0% of the patients on hemodialysis (Ahmed et al., 2020). Diabetes mellitus is prevalence among the Palestinians. The findings reported in this study might indicate that there is a need to increase awareness of the general population and those particularly at higher risk of the harmful consequences of diabetes and hypertension.

4.2.5 Hematological and biochemical variables of the patients who died

In this study, a considerable percentage of the patients who died had hematological and biochemical abnormalities. These hematological and biochemical abnormalities can be seen in albumin, transferrin, iron, Hgb, calcium, BUN, creatinine, glycemia, and phosphate. Previous studies conducted in the region and elsewhere showed that a considerable percentage of the patients on hemodialysis had hypoalbuminemia, anemia, and other hematological and biochemical abnormalities (Ahmed et al., 2020; Al Salmi et al., 2020; Buargub, 2008; Ma & Zhao, 2017). These abnormalities could be used as predictors of the nutritional and metabolic status of the patients. Additionally, it has been argued that these abnormalities could be used and as predictors of prognosis of the disease (Tang et al., 2021). Therefore, clinicians and other healthcare providers could use these hematological and biochemical variables to guide the management of patients on hemodialysis and in the evaluation of their progress.

4.2.6 Association between the duration of hemodialysis and other variables

The findings reported in this study showed a significant association between the duration of hemodialysis with contracting COVID-19, random glucose level, and WBC count. In this study, the patients who were on hemodialysis for longer period were at higher risk for contracting COVID-19. Previous studies have shown that contacting COVID-19 increased the mortality rates among patients on hemodialysis and deteriorated the health outcomes of the patients who survived (Bruchfeld, 2021; Hilbrands et al., 2020; Sevinc et al., 2021; Sipahi et al., 2021). Together, these findings indicate that patients on hemodialysis should be considered as a high-risk group and should be vaccinated. Titers in vaccinated hemodialysis patients should be monitored and those with suboptimal titers should receive booster doses.

The patients who were on hemodialysis for longer period had subnormal WBC counts. WBCs are essential for the integrity of the immune system. Because hemodialysis is an invasive intervention, patients are at higher risk for contracting bloodstream infections and developing sepsis (Schwanke et al., 2018). A previous study in 41 dialysis centers in China reported high infection rates among patients on hemodialysis (Wu et al., 2020).

Therefore, clinicians and other healthcare providers should consider an antimicrobial use strategy including prophylaxis use among patients on hemodialysis, especially those with below normal WBC counts.

In this study, the patients who were on hemodialysis for longer periods had more elevated blood glucose levels. Diabetes mellitus was shown to be one of the leading risk factors for developing ESRD (Del Vecchio et al., 2013; Skonieczny et al., 2018). Previous regional studies among patients on hemodialysis showed that a considerable percentage of the patients had diabetes mellitus (Ahmed et al., 2020; Al Salmi et al., 2020; Buargub, 2008; Ma & Zhao, 2017). The findings reported in this study might indicate that clinicians and other healthcare providers should use more intensive therapies to control blood glycemia among hemodialysis patients, especially those who are on hemodialysis for longer periods.

4.2.7 Association between causes of death and other variables of the patients

In this study, patients were more likely to die earlier when they had cardiovascular diseases, COVID-19, pulmonary edema, or cerebrovascular accidents. It is well-established that cardiovascular diseases were the leading cause of death among patients on hemodialysis as well as among the general population (Ahmadmehrabi & Tang, 2018; Cozzolino et al., 2018). Similarly, pulmonary edema and cerebrovascular accidents are among the common causes of early mortality among patients on hemodialysis. Since the outbreak of the pandemic, COVID-19 has caused significant mortality among patients on hemodialysis (Bruchfeld, 2021; Hilbrands et al., 2020; Sevinc et al., 2021; Sipahi et al., 2021). Awareness of the most common causes of death among patients on hemodialysis might inform planning to reduce the incidence of early death among the patients managed at the single center in north of the West Bank of Palestine.

In this study, smoking was significantly associated with cerebrovascular accidents, sepsis, and COVID-19. The findings reported in this study were consistent with those reported in previous studies in which smoking increased the risk of cerebrovascular accidents (Miglinas et al., 2020). Similarly, smoking was identified as a risk factor for bacteremia among patients in hemodialysis (Wang et al., 2012). These findings might be a call to clinicians, healthcare providers, and decision makers to manipulate modifiable risk factors and reduce mortality rates among patients on hemodialysis.

In this study, abnormal ferritin and phosphate levels were shown to be associated with some causes of death among the patients who were on hemodialysis. Previous studies have shown that some hematological and biochemical variables could be used as indicators of the health status of the patients and prognosis of the disease (Tang et al., 2021). Probably, monitoring of some important hematological, biochemical, and metabolic variables can help clinicians and other healthcare providers manipulate modifiable risk factors and reduce mortality rates among patients on hemodialysis.

4.3 Strengths and limitations of the study

The findings of this study might be interpreted after considering the following strengths:

- This study is the first analysis of the mortality among hemodialysis patients and causes of death in Palestine.
- The study was conducted in one of the main referral hemodialysis centers in the West Bank of Palestine. In this referral center, patients from different regions of the West Bank receive hemodialysis. Therefore, the patients who were included in this study could be more representative of the population of hemodialysis patients in the West Ban of Palestine.
- The study included the period before and during the COVID-19 pandemic. This should have improved the informativeness of the findings reported in this study. Additionally, the findings could have provided an insight on how the pandemic affected the mortality rate among this group of patients.
- The demographic and disease characteristics of the patients who were included in this study were diverse in terms of gender, age at which hemodialysis was started, age at which the patient died, duration of hemodialysis, smoking status, COVID-19 status, whether the patient received a kidney transplant, and hepatitis B status. This diversity should have improved representation of the entire population of patients on hemodialysis in the West Bank of Palestine.

- Causes of death were collected and described in this study. Additionally, relationship between causes of death and other variables
- were investigated. Such descriptions and associations should have added depth and width to the findings reported in this study compared to the previous regional studies (Ahmed et al., 2020; Buargub, 2008; Matos et al., 2011; Shigidi et al., 2009).
- Frequencies of primary renal diseases among the patients were described and reported in this study. Additionally, such descriptions should have added depth and width to the findings reported in this study compared to the previous regional studies (Ahmed et al., 2020; Buargub, 2008; Matos et al., 2011; Shigidi et al., 2009).
- In addition to the demographic and disease variables, this study also included an analysis of hematological, biochemical, and metabolic variables. These variables could be used as indicators of the nutritional and health status of the patients. Additionally, these variables could be used to predict the prognosis of the disease and outcomes of the patients.

This study is not without limitations. When interpreting the findings reported in the study, the following limitations should be considered:

- This was a single center study. Compared to multi-center studies, single center studies are limited by approach and scope. The findings could have higher external validity if they were collected from multi-centers in Palestine.
- This study was conducted in a retrospective design. Compared to prospective studies, retrospective designs are less robust and reliable.
- The number of the patients included in this study was relatively small. Inclusion of more patients either from more center or by extending the study period (10-year analysis) could have produced more interesting results.
- This study did not investigate the quality of healthcare services provided to the patients including hemodialysis services and how they could have affected the mortality rates.
- Some causes of death were unknown in this study. This should have underestimated some of the causes reported in this analysis.

- Some patients might have died outside the center in which the study was conducted. Therefore, those patients were not included in this analysis.

4.4 Conclusion

The mortality rate among patients on hemodialysis was within the range of mortality rates reported in the regional studies. Cardiovascular disease was the leading cause of death among the patients in hemodialysis in the center. Mortality was higher among ESRD patients who were male, older, smoker, had diabetes mellitus, contracted COVID-19, and had other comorbidities like cardiovascular disease and hypertension. More studies are still needed to investigate the effects of manipulating some modifiable risk factors on the mortality rates among hemodialysis patients in Palestine.

4.5 Implications of the findings on practice, future research, and patient teaching

The findings of this study could have the implications on the practice and future research. The findings reported in this study might have the following implications on practice:

- Clinicians, other healthcare providers, and decision makers in healthcare authorities need to design measures to manipulate modifiable risk factors to reduce mortality, improve health outcomes, and increase survival rates among hemodialysis patients in Palestine.
- Clinicians, other healthcare providers, and decision makers in healthcare authorities need to vaccinate hemodialysis patients in Palestine. Additionally, titers should be monitored continuously and the patients with suboptimal titers should receive booster doses.
- Clinicians, other healthcare providers, and decision makers in healthcare authorities need to consider protecting hemodialysis patients from contracting infections. Measures might include developing antimicrobial use guidelines.

The findings reported in this study might have the following implications on future research:

- Future multicenter studies are still needed to investigate mortality rates among patients on hemodialysis in Palestine.
- Future studies are still needed to investigate how COVID-19 affected the mortality rates among patients on hemodialysis in Palestine.
- Future studies are still needed to determine the highest periods in the year in which higher mortality occurred.
- Future studies are still needed to investigate the effects of manipulating multiple modifiable risk factors on the mortality rates among hemodialysis patients in Palestine.
- Future studies should be conducted to understand the reasons why more patients died within the first 3 years of receiving hemodialysis sessions.
- More future studies are still needed to identify hematological, biochemical, and metabolic variables that could be used as predictors of nutritional, health, and metabolic status of the patients. Additionally, predictors of prognosis of the disease need to be identified.

The findings reported in this study might have the following implications on patient teaching:

- Healthcare authorities and decision makers should launch awareness campaigns to increase awareness of the general population and those particularly at higher risk of the harmful consequences of diabetes, cardiovascular disease, hypertension, and other health conditions that lead to ESRD.
- Healthcare authorities and decision makers should launch awareness campaigns to increase awareness of the general population and those with CKD and ESRD on the importance of immunization against COVID-19.

List of Abbreviations

Abbreviation	Meaning
BMI	Body mass index
BUN	Blood urea nitrogen
CKD	Chronic kidney disease
CRP	c-reactive protein
ESRD	End-stage renal disease
GFR	Glomerular filtration rate
HDL	High-density lipoprotein
Hgb	Hemoglobin
HR	Hazard risk
IRB	Institutional Review Board
KDIGO	Kidney Disease Improving Global Outcomes
LDL	Low-density lipoprotein
NHANES	National Health and Nutrition Examination Survey
NSAIDs	Non-steroidal anti-inflammatory drugs
PLT	Platelets
SPSS	Statistical Package for Social Sciences
USRDS	United States Renal Data System
WBCs	White blood cells
WMA	World Medical Association

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Appendices

Appendix A

Study approval

#6807 P.001 /008

بسم الله الرحمن الرحيم

An-Najah National University
Faculty of Medicine & Health Sciences
Department of Nursing

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
دائرة التمريض

التاريخ: 18/07/2022

حضرة أ.لؤي الزين / محترم ،، مدير دائرة التمريض في مستشفى النجاح الوطني الجامعي ،

الموضوع: تسهيل مهمة طالب الماجستير مالك عصام عبد الغني/ ماجستير

تمريض عناية مكثفه

تحية طيبة وبعد،

تهديكم دائرة التمريض والقبالة في كلية الطب وعلوم الصحه / جامعة النجاح الوطنية أطيب التحيات ونشكر لحضرتكم حسن تعاونكم معنا ونرجو الكرم بالموافقه على تسهيل مهمة الطالبة المذكورة أعلاه في المستشفى لديكم ، وهي دراسة حول معدل الوفيات لمدة خمس سنوات في مريض غسيل الكلى وأسباب الوفاة الرئيسية من شهر 2016/1 ولغاية شهر 2021/12 وأن المعلومات سوف تستخدم لأغراض البحث العلمي ولاستكمال مشروع تحت عنوان:

Five-Year Mortality in Hemodialysis patient and the leading causes of death in a Single Centre - at the Northern of Westbank (A retrospective cohort study)

تحت اشراف: د. نزار سعيد و د. زكريا حمدان

- مرفق IRB
- ملخص الدراسة

وتفضلوا بقبول الطلب ولكم فائق الاحترام ،،

منسقة برنامج ماجستير تمريض العناية المكثفه
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جـــامعـــة النجاح الوطنية

كلية الدراسات العليا

معدل الوفيات لمرضى غسيل الكلى والأسباب الرئيسية للوفاة في مركز واحد في شمال الضفة الغربية: دراسة جماعية رجعية

إِعداد

مالك عصام عوني عبدالغني

إشراف

د نزار سعيد

د زكريا حمدان

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في تمريض العناية المكثفة من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

2022

معدل الوفيات لمرضى غسيل الكلى والأسباب الرئيسية للوفاة في مركز واحد في شمال الضفة الغربية: دراسة جماعية رجعية

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د زكريا حمدان

الملخص

خلفية الدراسة: في الوقت الحالي، هناك من 5 إلى 7 ملايين مريض يعانون من مرض كلوي في مراحله الأخيرة ويحتاجون للعلاج الكلوي التعويضي. أجريت هذه الدراسة لتحديد معدلات الوفيات بين مرضى غسيل الكلى في أحد مراكز الإحالة الرئيسية في شمال الضفة الغربية لفلسطين. كما هدفت الدراسة إلى وصف أسباب الوفاة بين هذه الفئة من المرضى.

منهجية الدراسة: إستخدمت هذه الدراسة تصميم الأتراب الارتباطي الكمي بأثر رجعي. تم شمل جميع مرضى الكلى البالغين في نهاية المرحلة من غسيل الكلى المستمر بغض النظر عن جنسهم ومدة غسيل الكلى في الدراسة. تم جمع المتغيرات الديموغرافية، ومسببات المرض الكلوي في المرحلة النهائية، ووجود الأمراض المصاحبة، والنتائج المعملية للمرضى.

نتائج الدراسة: تمت مراجعة السجلات الطبية لــ 348 مريضاً بأمراض الكلى في نهاية المرحلة والذين كانوا يخضعون لغسيل الكلى بين يناير 2017 وديسمبر 2021. من بين 348 مريضاً بأمراض الكلى في نهاية المرحلة، توفي 95 مريضاً بمعدل وفيات إجمالي بلغ 27.3 ٪. من بين المرضى المتوفين، كان 68.4٪ من الذكور و91.6٪ تم غسيل الكلى لمدة 1−3 سنوات. كانت أمراض القلب والأوعية الدموية السبب الرئيسي للوفاة (43.2٪) بين المرضى في هذه الدراسة. كان اعتلال الكلية السكري السبب الرئيسي

لمرض الكلى في نهاية المرحلة (77.9٪) بين المرضى الذين ماتوا في هذه الدراسة. من بين المرضى الذين ماتوا في هذه الدراسة، كان 60 ٪ يعانون من مرض السكري وارتفاع ضغط الدم و88 ٪ يعانون من نقص ألبومين الدم. ارتبط معدل الوفيات بالشيخوخة والتدخين.

إستنتاجات الدراسة: كان معدل الوفيات بين مرضى غسيل الكلى ضمن نطاق معدلات الوفيات المذكورة في الدراسات الإقليمية. كانت أمراض القلب والأوعية الدموية السبب الرئيسي للوفاة بين مرضى غسيل الكلى في المركز الذي أجريت فيه الدراسة. لا تزال هناك حاجة لمزيد من الدراسات للتحقيق في آثار التلاعب ببعض عوامل الخطر القابلة للتعديل على معدلات الوفيات بين مرضى غسيل الكلى في فلسطين.

الكلمات المفتاحية: أمراض الكلى المزمنة، أمراض الكلى في مراحله الأخيرة، غسيل الكلى، الوفيات.