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Diabetes, Obesity, and Quality of Life Among End-Stage Renal Disease Patients Receiving Hemodialysis

Austyn Lee Cross
Bethel University

Hailey Grace Shaull
Bethel University

Paige Elizabeth Urquhart
Bethel University

DIABETES, OBESITY, AND QUALITY OF LIFE AMONG END-STAGE RENAL DISEASE PATIENTS RECEIVING HEMODIALYSIS

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BY
AUSTYN CROSS, PA-S
HAILEY SHAULL, PA-S
PAIGE URQUHART, PA-S

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ABSTRACT

Within the last thirty years, in the United States alone, the number of patients receiving treatment for end-stage renal disease (ESRD) doubled (Centers for Disease Control and Prevention [CDC], 2018b). Previous research has indicated lower quality of life in patients with ESRD and has also shown further reduced quality of life with the presence of diabetes and obesity (eg. Liu, Yeh, Weng, Bai, & Chang, 2017). The purpose of this study was to determine the existence and nature of any relationship between quality of life and comorbidities of diabetes mellitus and obesity in ESRD patients receiving hemodialysis treatment. Mean quality of life scores were gathered from an electronic version of the WHOQOL-BREF survey distributed through use of a social media platform, Facebook. The survey was available on multiple kidney disease support group pages and the National Kidney Foundation Facebook page. Scores were determined based on WHOQOL-BREF scoring instructions and mean quality of life scores were then analyzed using unpaired t-tests across five domains: total, environmental factors, physical health, psychological health, and social relationships. Results of the study concluded that participants with comorbid diabetes reported decreased quality of life when compared to participants with obesity alone, diabetes and obesity, and those without comorbid diabetes or obesity. Participants with obesity reported lower quality of life scores when compared to participants with no comorbidities. Finally, participants without diabetes and obesity (control group) reported the highest quality of life scores across all domains. Findings from this study could be utilized to aid in further research including exploration of glycemic control or severity of obesity with regard to quality of life. More extensive research to determine causal factors with regard to this population may help to improve understanding and promote interventions to address quality of life in the ESRD population.

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Chapter One: Introduction

Introduction

Between 1990 and 2016, the number of end-stage renal disease patients receiving treatment in the United States doubled (Centers for Disease Control and Prevention [CDC], 2018b). With ESRD gaining prevalence in the United States, recognizing which factors impact quality of life among ESRD patients is important. Notably, research suggests that people with ESRD undergoing hemodialysis have a poor quality of life (e.g., Liu, Yeh, Weng, Bai, & Chang, 2017). The focus of this study was to determine the impact of diabetes mellitus and obesity on the quality of life of patients with ESRD who were receiving hemodialysis treatment. In doing so, this study added to the current understanding of the factors that influence quality of life in hemodialysis patients, thus guiding the ability to improve patient quality of life.

The remainder of Chapter One will discuss background information related to quality of life in ESRD patients on hemodialysis, present the problem statement, distinguish the purpose and significance of this study, identify research questions, discuss limitations and delimitations of this study, and define important terms.

Background

End-stage renal disease is defined as chronic kidney disease with renal function less than 15% of the normal capacity, patients with previous kidney transplantation, or patients who are on dialysis (Inker et al., 2014). Obesity is a significant risk factor for kidney disease, however, diabetes mellitus is the leading cause of chronic kidney disease and subsequent progression to ESRD (Mottl, Tuttle, & Bakris, 2019). Treatment options for ESRD include hemodialysis, peritoneal dialysis, kidney transplantation, and conservative management (Medical Education Institute, 2014). Of the available treatment options, 91.7% of ESRD patients choose

hemodialysis for treatment (Medical Education Institute, 2014). Despite available treatment options, kidney disease is the ninth leading cause of death in the United States (CDC, 2018a). Research regarding the quality of life among ESRD patients is summarized below.

The available research suggests that patients with ESRD have a lower quality of life than individuals without ESRD (e.g., Liu, Yeh, Weng, Bai, & Chang, 2017). Furthermore, ESRD patients receiving hemodialysis have a lower quality of life than ESRD patients not receiving hemodialysis (Schell, 2019). In addition, ESRD patients on hemodialysis with comorbid conditions, such as diabetes mellitus and obesity, have a lower quality of life than ESRD hemodialysis patients without comorbid conditions (Liu, Yeh, Weng, Bai, & Chang, 2017; Mandoorah, Shaheen, Mandoorah, Bawazir, & Alshohaib, 2014). The available research does not address the relative quality of life in patients with diabetes mellitus and ESRD, patients with obesity and ESRD, or patients with diabetes mellitus, obesity, and ESRD. Research comparing these groups is important as additional variables that affect quality of life in hemodialysis patients may be identified, allowing for the creation of focused interventions to improve patient quality of life. The next section defines the problem that this study will address.

Problem Statement

End-stage renal disease is a growing issue affecting hundreds of thousands of individuals across the United States (CDC, 2018b). While there has been extensive research on the causes of kidney disease and the outcomes of the various treatment options, a gap in research describing the quality of life in ESRD patients with comorbid diabetes mellitus and obesity exists. Research has already confirmed that ESRD patients who are undergoing hemodialysis have a decreased quality of life (Liu, Yeh, Weng, Bai, & Chang, 2017; Beberashvili et al., 2019; Alhajim, 2017). Quality of life is further decreased in the presence of comorbid conditions; however, the

relationship between comorbid obesity, diabetes mellitus, or both on quality of life is unknown in ESRD patients (Liu, Yeh, Weng, Bai, & Chang, 2017; Beberashvili et al., 2019; Alhajim, 2017).

In order to assess the quality of life of ESRD patients across the country, this study was conducted through support groups found on Facebook, a social media platform. The study focused on the evaluation of the quality of life among participants receiving hemodialysis treatment. The participants' quality of life was assessed and compared based on the presence or absence of comorbid conditions (i.e., diabetes mellitus and obesity). The data collected from the study was analyzed to determine which of the aforementioned comorbid conditions was most associated with participant quality of life.

Purpose of the Study

The purpose of this study was to determine if the quality of life in ESRD patients undergoing hemodialysis was more strongly related to comorbid obesity, comorbid diabetes mellitus, or comorbid obesity and diabetes mellitus. This study compared the quality of life among participants based on their comorbid conditions in order to understand the potential influence of comorbid conditions on quality of life.

Significance of the Study

In 2016, there were 726,331 people in the United States receiving treatment for ESRD (CDC, 2018b). The overall Medicare cost for patients with ESRD reached $35 billion in 2016, which equals nearly $79,000 per person (CDC, 2018a). Due to the enormous financial and morbidity burden of ESRD, evaluation of quality of life in this patient population is significant. By determining which ESRD patients are at greater risk for poorer quality of life, supportive efforts can be made to improve quality of life. Specifically, dialysis treatment centers and healthcare providers will be able to use the information found in the study to better address

patients with comorbid conditions and provide more focused resources to support and improve quality of life. The research questions were directed at evaluating the quality of life in participants with and without comorbid conditions.

Research Questions

To better understand the relationship between quality of life in ESRD patients receiving hemodialysis and comorbid obesity and diabetes mellitus, this study was designed to answer the following questions:

1. What relationship, if any, exists between diabetes mellitus and quality of life in ESRD patients receiving hemodialysis treatment?
2. What relationship, if any, exists between obesity and quality of life in ESRD patients receiving hemodialysis treatment?
3. Which comorbidity, diabetes mellitus or obesity, is more strongly related to quality of life in ESRD patients who are receiving hemodialysis?

With the research questions in mind, the following paragraphs discuss delimitations, as well as potential limitations, of conducting and evaluating the results of this study.

Limitations and Delimitations

As stated previously, this study focused on participants with ESRD who were being treated with hemodialysis. Therefore, in order to control the focus of this study, the sample was limited to the participant population on ESRD support group pages and the National Kidney Foundation page. Participant quality of life was measured with a voluntary questionnaire developed by the World Health Organization (WHO), known as the WHOQOL-BREF. The WHOQOL-BREF measures quality of life with Likert scales and utilizes a set formulary to interpret results (WHO, 2019; Bonomi, Patrick, Bushnell, & Martin, 2000). While the

WHOQOL-BREF was not specifically created for evaluation of quality of life in ESRD patients, the questionnaire has been used in numerous studies to reliably determine ESRD patient quality of life (e.g., Alhajim, 2017). Therefore, the WHOQOL-BREF was an appropriate tool to measure quality of life in this study. The population, location, and questionnaire were intentionally set in order to narrow the scope of the study and for consistency of results. While delimitations constrained the extent of the study, limitations may have unintentionally impacted the results of this study.

Other factors may have unintentionally interfered with the evaluation of quality of life in the selected patient population. Limitations included potential participant response bias to the WHOQOL-BREF and sampling bias as the population was obtained solely through the social media platform, Facebook. In order to limit the participant response bias to the WHOQOL-BREF, the methodology reflects that the participants received no incentives for taking the questionnaire and participants were encouraged to provide accurate information without expectation of results. The available research indicates that quality of life decreases with comorbid conditions; as researchers, the expectation of such results in the present study existed. Utilizing the WHOQOL-BREF questionnaire ensured that questions were not written to benefit or give disadvantage to groups within the population. The inclusion of complete questionnaires guaranteed that results were representative of the study population. Researchers also understood that the participant population may not have been an accurate representation of all ESRD patients on hemodialysis. In order to set clear and consistent terminology throughout the remainder of this study, the following section defines terms used for study description and evaluation.

Definition of Terms

To ensure an accurate understanding and consistent interpretation of the study, contextual definitions of common terms used throughout the study are presented in this section.

Participant: Participants within this study were ESRD patients who were receiving hemodialysis treatment and were members of one of the the following Facebook groups: “Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group”, “Hemodialysis Support Group”, “Dialysis and Kidney Disease Support Group”, “Kidney Dialysis Support Group”, or the Facebook page controlled by the National Kidney Foundation (NKF) at the time of data collection.

Glomerular filtration rate: An estimation tool used to determine how quickly the kidneys filter blood based on the Cockcroft-Gault equation and measured serum creatinine levels (Inker & Perrone, 2019).

Albuminuria: Presence of protein, specifically albumin, in the urine (Albuminuria, 2019).

Chronic kidney disease (CKD): The presence of kidney damage markers or decreased glomerular filtration rate for greater than three months (Inker et al., 2014).

End-stage renal disease (ESRD): Patients with kidney function below 15% normal capacity, a previous kidney transplantation, or patients on dialysis treatment (Inker et al., 2014).

Comorbid conditions: The simultaneous presence of another medical condition in addition to ESRD. Diabetes and obesity were the two primary comorbid conditions in the study.

Diabetes mellitus: Participants with previously diagnosed diabetes mellitus, either type 1 or type 2, were included in the diabetic comorbidity group.

Body Mass Index: A ratio of weight to height that is used to classify obesity.

Obesity: Body mass index greater than 30 kg/m^2 (CDC, 2017).

Hemodialysis: A renal replacement treatment option for ESRD that involves the removal of patient blood, filtration of blood in a dialysis machine, and replacement of blood into the patient (Rosenberg, 2019).

Quality of life: Quality of life is defined by the World Health Organization (2019) as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”.

Participant Facebook group pages: “participant Facebook group pages” refers to the Facebook groups used to post the survey, including “Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group”, “Hemodialysis Support Group”, “Dialysis and Kidney Disease Support Group”, and “Kidney Dialysis Support Group” Facebook pages, as well as a Facebook page controlled by the National Kidney Foundation.

Control or control group: participants within the study without a reported diagnosis of diabetes and BMI calculated from reported height and weight under the CDC outlined criteria for obesity (BMI less than 30 kg/m^2).

Conclusion

Chapter One discussed background information related to ESRD and quality of life, the issues this study examined, the purpose, significance, research questions, limitations and delimitations, and definitions of terms related to this study. The chapter addressed the importance of understanding kidney disease and quality of life in ESRD patients, as ESRD is a large and growing issue in the United States today (CDC, 2018b). Particularly, ESRD patients on hemodialysis have a lower quality of life than the general population, especially when they have a diagnosed comorbidity (i.e., diabetes mellitus or obesity) (e.g., Liu, Yeh, Weng, Bai, & Chang, 2017; Beberashvili et al., 2019; Alhajim, 2017). To fill in the gaps in current knowledge, this

study examined whether comorbid obesity, comorbid diabetes mellitus, or comorbid obesity and diabetes mellitus was more strongly related to a change in quality of life in ESRD patients on hemodialysis. Chapter Two will review the literature regarding chronic kidney disease, ESRD, and the available treatment options for kidney disease. Most importantly, the chapter includes a summary of research related to the quality of life among those affected by kidney disease.

Chapter Two: Literature Review

Introduction

The purpose of this literature review was to determine if comorbid diabetes mellitus or obesity in patients with end-stage renal disease (ESRD) receiving hemodialysis has a negative relationship with quality of life. The topic was addressed by examining the available research regarding kidney disease in peer reviewed journals from scientific databases, textbooks, and online resources. The following sections include: kidney function, chronic kidney disease (CKD) and ESRD (e.g., risk factors and complications), treatment options for ESRD, and the quality of life of people receiving hemodialysis. Ultimately, this review assesses quality of life in ESRD patients who are receiving hemodialysis.

Kidney Function

In thirty minutes, healthy kidneys can filter all of the blood in the body (CDC, 2018a). Through the excretion of excess fluid, the kidneys are able to maintain blood pressure and regulate electrolyte balance within the body (CDC, 2018a). Nephrons are the functional units of the kidneys that are responsible for resorption of fluid and solutes, as well as excretion of waste products (Costanzo, 2018). Each kidney consists of approximately one million nephrons that work together to filter blood (Costanzo, 2018). Blood enters the kidneys through the renal arteries where the vessels continue to branch until reaching the smallest vessel size as arterioles. The afferent arterioles supply blood to the glomerular capillaries where filtration begins (Costanzo, 2018). The arterioles leave glomeruli as efferent arterioles to supply blood to nephrons where solutes and water are further reabsorbed or secreted (Costanzo, 2018). Waste products are excreted into tubules that lead to minor and major calyces, which are extensions of the ureters (Costanzo, 2018). The ureters extend to the bladder for the storing and eventual

elimination of waste. When the kidneys are not functioning well due to disease or damage, they cannot filter blood as efficiently (Costanzo, 2018).

As blood filtration becomes less efficient, excess fluid begins to accumulate in the body eventually leading to health issues including cardiovascular disease or stroke (CDC, 2018a). As the disease progresses, patients are at an increased risk of infections and can also experience a loss of appetite, anemia, lower quality of life, or depression (CDC, 2018a). The kidneys are responsible for maintaining fluid levels, removing wastes, and reabsorbing nutrients from the blood. Increased fluid retention, as well as build up of bodily wastes and toxins associated with kidney malfunction, negatively impacts the overall health of all organ systems (CDC, 2018a).

Glomerular filtration rate. Estimated glomerular filtration rate (GFR) is a tool used to monitor the filtration of blood through the kidneys. In a healthy kidney, GFR is equal to the sum of the activity of all the nephrons within both kidneys (Inker & Perrone, 2019). A healthy kidney filters approximately 180 liters of blood plasma in a day, which amounts to 125 milliliters per minute (Inker & Perrone, 2019). GFR varies by age, sex, and the size of the body, with young women usually filtering 120 milliliters per minute and young men averaging 130 millimeters per minute (Inker & Perrone, 2019). As age increases, GFR tends to decrease (Inker & Perrone, 2019). When the kidneys are diseased or damaged, the number of functional nephrons is reduced (Inker & Perrone, 2019). With mild damage or early disease states, the remaining nephrons can adapt and maintain the total GFR, however, as the disease progresses, GFR is drastically reduced (Inker & Perrone, 2019). GFR can be estimated by creatinine clearance calculated with the Cockcroft-Gault equation and serum creatinine levels (Inker & Perrone, 2019). The average serum creatinine level is 1.13 mg/dL and 0.93 mg/dL in men and women, respectively (Inker &

Perrone, 2019). By measuring the serum creatinine levels, GFR can be estimated and used to evaluate the severity of kidney disease.

Classification of Chronic Kidney Disease

In 2002, the National Kidney Foundation set guidelines regarding the classification of CKD through the Kidney Disease Outcomes Quality Initiative (KDOQI) (Levey & Inker, 2018). Chronic kidney disease is defined as the presence of kidney damage markers or decreased GFR for greater than three months (Inker et al., 2014). The KDOQI has recommended that CKD staging includes the cause of disease, GFR category, and albuminuria category (Inker et al., 2014). The cause of kidney disease is determined by identifying which portion of the kidney is damaged and evaluating for the presence of systemic disease markers (Inker et al., 2014). While the cause of disease is an important consideration in staging, estimated GFR is the most utilized staging criteria for CKD.

Glomerular filtration rate can be categorized into G1, G2, G3a, G3b, G4, and G5 subdivisions with G5 being the most severe functional deficit (Inker et al., 2014). Specific markers of kidney damage include albuminuria, urine sediment abnormalities, electrolyte abnormalities due to tubular disorder, abnormal histology, structural abnormalities on imaging, and history of a kidney transplant (Inker et al., 2014). Albuminuria occurs when the kidneys are not functioning correctly and proteins begin to escape the bloodstream and enter the urine (“Albuminuria”, 2019). The presence of protein in the urine indicates disease or damage of the kidneys requiring further evaluation and possible treatment (“Albuminuria”, 2019). Together, these criteria define CKD and allow standardized patient assessment and diagnosis.

If a patient presents with GFR within categories G3 through G5 and/or an elevated albuminuria for three or more months, diagnosis of CKD is appropriate. General prognosis can

be determined when the albuminuria category is crossed with the GFR category (Inker et al., 2014). Table 1 indicates the ranges of GFR for each stage of kidney damage, eventually leading to kidney failure at a GFR less than 15 ml/min/1.73 m^2. As discussed previously, the average GFR for a young person is approximately 125 ml/min/1.73 m^2 while the expected GFR for an older individual is reduced to 90 ml/min/1.73 m^2 (Inker & Perrone, 2019). Thus, less than 15% of normal kidney function qualifies as ESRD.

Table 1.

Glomerular Filtration Rate Categories in CKD (Inker et al., 2014).

GFR Category	GFR (ml/min/1.73 m^2)	Terms
G1	≥ 90	Normal to high
G2	60-89	Mildly decreased
G3a	45-59	Mildly to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure

As kidney damage increases, the amount of protein in the urine (i.e., albuminuria) also increases. Table 2 indicates the categories of albuminuria and cut off lab values related to the levels of severity. Albuminuria levels that are substantially increased for a prolonged period of time are associated with greater risk for worsening GFR, ESRD, and cardiovascular disease (Mottl, Tuttle, & Bakris, 2019).

Table 2.

Albuminuria Categories in CKD (Inker et al., 2014).

Category	AER (mg/24 hours)	Terms
A1	<30	Normal to mildly increased
A2	30-300	Moderately Increased
A3	>300	Severely Increased

Causes and Risk Factors of Chronic Kidney Disease

Many factors influence the development of CKD and the subsequent progression to ESRD. The following sections include the available research that describes the relationship between CKD, the progression to ESRD, and the most common risk factors including genetic predisposition, diabetes mellitus, and obesity.

Genetic predisposition. While lifestyle plays a major role in the development of kidney disease, genetic predisposition is also a factor for many people with kidney disease. For example, variation in the apolipoprotein L1 (APOL1) gene is thought to be responsible for 70% of all CKD in the nondiabetic African American population (Witasp et al., 2012). A prospective cohort study of 3,067 African American adults without CKD were evaluated for the presence of risk alleles in the APOL1 gene (Foster et al., 2012). Forty-three percent of those participants had one risk allele and 13% had two risk alleles (Foster et al., 2012). The participants with two risk alleles were at a 1.51 greater risk of CKD than those with one risk allele (Foster et al., 2012). The participants with two risk alleles also had an increased risk of ESRD with a 1.92 risk ratio

when compared to those with one risk allele of the APOL1 gene (Foster et al., 2012). In addition to the APOL1 gene, congenital anomalies increase the risk of developing CKD.

While the focus of the review is on adults and their risk factors for kidney disease, genetic or developmental disorders also increase the risk of disease in children and adolescents. Between 30% and 50% of all ESRD cases in children are caused by congenital anomalies of the kidney and urinary tract (CAKUT), while the majority of cases in adults are caused by diabetes mellitus (Rosenblum, 2017). In the following sections, diabetes mellitus and obesity are discussed in relation to adult populations exclusively.

Diabetes Mellitus. Type 1 and type 2 diabetes mellitus are leading causes of CKD and progression to ESRD worldwide (Mottl, Tuttle, & Bakris, 2019). Fifty percent of all cases of ESRD in the United States are attributed to diabetes mellitus with the number continuing to rise due to the increased prevalence of diabetes mellitus in the population (Mottl, Tuttle, & Bakris, 2019). Approximately 40% of those with type 2 diabetes mellitus develop albuminuria, increased blood pressure, and declining kidney function consistent with diabetic kidney disease (Kasper et al., 2004). Specifically, prolonged hyperglycemia and insulin resistance associated with diabetes mellitus results in inflammation and fibrosis of the renal tissues (Mottl & Tuttle, 2019). While commonly associated with uncontrolled hyperglycemia, kidney disease also occurs in diabetic patients with well-controlled blood glucose levels (Mottl, Tuttle, & Bakris, 2019). In the early stages of diabetes mellitus, activation of the renin-angiotensin-aldosterone system (RAAS) initiates increased plasma flow and filtration fraction resulting in an elevated GFR (Mottl & Tuttle, 2019). Over time, GFR decreases due to progressive inflammation and eventual fibrosis of tissues, causing kidney disease (Mottl, Tuttle, & Bakris, 2019). The rate at which the estimated glomerular filtration rate declines is prognostic for ESRD and mortality in diabetic

kidney disease (Mottl, Tuttle, & Bakris, 2019). Studies across the world have been done to compare incidence of CKD and ESRD in diabetic and nondiabetic populations.

One cohort study done in the United States, which included 932 patients with type 1 diabetes mellitus who were diagnosed between 1965 and 1980, showed a 5.5% incidence of ESRD in 20 years and a 27% incidence in 40 years (Mottl, Tuttle, & Bakris, 2019). These results were compared to a cohort of 7,871 patients with type 1 diabetes mellitus in Norway who were diagnosed between the years of 1971 and 2012 (Mottl, Tuttle, & Bakris, 2019). The 20 year incidence rate of ESRD was 0.7% while the 40 year incidence was 5.3% among the diabetic patients in Norway (Mottl, Tuttle, & Bakris, 2019). While many factors may have been influential in the difference in disease progression between the United States and Norway, two of the major factors included glycemic and blood pressure control (Mottl, Tuttle, & Bakris, 2019).

An additional prospective cohort study done in 2004 evaluated the estimated GFR of 227 Caucasian type 2 diabetic patients with kidney disease over the course of three or more years (Kasper et al., 2004). Participants within the study that had higher baseline blood pressure, hemoglobin A1c, and age were found to have more rapid decline in GFR over the course of the study (Kasper et al., 2004). Patients without diabetic retinopathy, which is an indicator of end organ damage, had a GFR decline of only 2.6 ml/min/1.73 m^2 compared to a GFR decline of 5.5 ml/min/1.73 m^2 in patients with diabetic retinopathy (Kasper et al., 2004). The study found that the correction of modifiable risk factors including albuminuria, hemoglobin A1C, systolic blood pressure, and heavy smoking improved outcomes in type 2 diabetic patients with kidney disease (Kasper et al., 2004). While diabetes mellitus is the most heavily studied and known cause of kidney disease, obesity has also been evaluated as a potential risk factor and source of kidney damage and disease.

Obesity. Another known risk factor for kidney disease is obesity. A body mass index (BMI) between 25 and 30 kg/m^2 is classified as overweight and a BMI over 30 kg/m^2 meets criteria for obesity (CDC, 2017). Obesity, specifically abdominal obesity, is highly associated with the presence and severity of comorbidities that place an increased demand on the kidneys, potentially leading to CKD and ESRD. A systematic review evaluating diabetic patients with chronic kidney disease stages three to five, discussed obesity as an independent risk factor for kidney disease (Van Huffel et al., 2014). The review reported that weight loss through bariatric surgery improved GFR in obese patients with CKD (Van Huffel et al., 2014).

An article in the Canadian Journal of Kidney Health and Disease summarized various studies that found obesity to be associated with proteinuria, low GFR, and higher incidence of ESRD (Kovesdy, Furth, & Zoccali, 2017). While obesity is known to increase risk for development of conditions that damage the kidneys, such as diabetes mellitus and hypertension, increased adiposity is also thought to directly damage the kidneys through the production of leptin, resistin, and adiponectin (Kovesdy, Furth, & Zoccali, 2017). Proposed mechanisms damage the kidneys through inflammation, oxidative stress, abnormal lipid metabolism, activation of the renin-angiotensin-aldosterone system, and increased insulin production and resistance (Kovesdy, Furth, & Zoccali, 2017).

A review of 25 cohort studies, three cross-sectional studies, and 19 case-control cases was done to determine how obesity and kidney disease relate to one another (Wang, Song, Caballero, & Cheskin, 2008). Overweight patients (BMI 25-30 kg/m^2) were found to have a 1.4 relative risk of developing kidney disease, while patients with obesity had a 1.83 relative risk when compared to those of a normal body weight (BMI 18.5-24.9kg/m^2) (Wang, Song, Caballero, & Cheskin, 2008). A cohort study of 74,989 patients who were followed for 21 years

showed that patients with both obesity and prehypertension had an increased risk for developing kidney disease (Munkhaugen, Lydersen, Wideroe, & Hallen, 2009). The studies utilized in this review evaluated patient BMI rather than waist circumference, however, waist circumference is a better measure of abdominal obesity.

Other causes and risk factors of Chronic Kidney Disease. As previously shown, any behaviors that lead to the development of diabetes mellitus, obesity, or hypertension are known to be risk factors for kidney disease. For example, smoking and alcohol use are associated with an increased risk of kidney disease (Shankar, Klein, & Klein, 2006). A longitudinal cohort study done in Wisconsin followed 3,392 participants without CKD for five years (Shankar, Klein, & Klein, 2006). The study found that three percent, or 114 participants, developed CKD with a GFR of less than 60 mL/min/1.73 m^2 (Shankar, Klein, & Klein, 2006). The study found an increased risk of CKD in the participants who either smoked or drank heavily (i.e., greater than 4 drinks per day) and a dramatically increased risk in those who both smoked and drank heavily at the time of the study (Shankar, Klein, & Klein, 2006).

While diabetes mellitus accounts for a large majority of cases, other causes of CKD and ESRD include polycystic kidney disease, pyelonephritis (i.e., recurrent kidney infection), glomerulonephritis (i.e., glomerular inflammation), interstitial nephritis (i.e., kidney tubule or surrounding inflammation), and prolonged obstruction of the urinary tract by kidney stones, cancer, or an enlarged prostate (Mayo Clinic Staff, 2019). These conditions can progress causing kidney damage within months or years (Mayo Clinic Staff, 2019). When multiple conditions and risk factors are present, patients are at an even higher risk for developing severe CKD and ESRD (Mayo Clinic Staff, 2019).

Prevalence of Chronic Kidney Disease and End-Stage Renal Disease

The CDC (2018a) reports that kidney disease is the ninth leading cause of death in the United States. The National Health and Nutrition Examination Survey done from 2011 to 2014 evaluated the prevalence of adult CKD in the United States (Obrador, 2018). The survey found that 7.2% of the population, or 8.3 million people, had CKD with a GFR of less than 60 mL/min/1.73 m^2 indicating stage three through stage five CKD (Obrador, 2018). According to the CDC (2018a), more than one in seven adults have CKD in the United States. A meta-analysis of 44 countries indicated a 13.4% prevalence of CKD globally, while another meta-analysis showed a 10.4% prevalence in men versus an 11.8% prevalence in women (Hill et al., 2016; Mills et al., 2015).

Complications of Kidney Disease

As renal disease progresses, patients often experience symptoms including nausea, vomiting, loss of appetite, fatigue, weakness, difficulty sleeping, altered focus, muscle cramping, lower extremity swelling, chest pain, and shortness of breath due to the dangerous build up of fluid and waste in the body (Mayo Clinic Staff, 2019). When kidney function meets the criteria for CKD or the kidneys are not meeting the demands of the body, treatment is required to maintain the health of the remaining organ systems (Mayo Clinic Staff, 2019). The early stages of CKD can be managed with medications, however when symptoms severely interfere with daily life, more invasive treatments are required. The next section discusses treatment options specifically for ESRD including hemodialysis, peritoneal dialysis, kidney transplant, and conservative management.

Treatment Options for End-Stage Renal Disease

Early detection and referral to a nephrologist is crucial in decreasing morbidity and mortality of patients suffering from ESRD (Rosenberg, 2019). Early intervention allows for patients to begin accepting their diagnosis, evaluating treatment options, and obtaining prompt vascular or peritoneal access for treatment (Rosenberg, 2019). Nephrologists educate patients and their families on the existing options for renal replacement therapy (RRT) and guide patients in selecting the best individual treatment option (Rosenberg, 2019). A number of treatment options are currently available for the treatment of ESRD including hemodialysis, peritoneal dialysis, kidney transplantation, and conservative management (Rosenberg, 2019). Each treatment option will be discussed in detail with a specific focus on hemodialysis.

Hemodialysis. Hemodialysis is the most popular option for renal replacement treatment accounting for 91.7% of ESRD patient treatment (Medical Education Institute, 2014). Hemodialysis includes removal of blood from the patient's vessel, filtration of the blood through a dialysis machine, and eventual return of blood to the patient's body in a continuous process (Medical Education Institute, 2014). In order to remove blood from the patient for filtration, vascular access must be obtained. An arteriovenous fistula, arteriovenous graft, or a tunneled catheter may be used for vascular access (Rosenberg, 2019). Maintaining healthy vascular access is crucial to patient survival on hemodialysis; when all options for access are exhausted, hemodialysis cannot continue and without treatment the patient will die (Medical Education Institute, 2014). A team of direct patient care staff including patient care technicians, nurses, and doctors are responsible for administering hemodialysis treatment during the patient's scheduled session, typically at an outpatient dialysis center (Medical Education Institute, 2014).

A typical hemodialysis treatment regimen includes three sessions per week lasting between three and five hours each. Patient attendance to all hemodialysis treatment sessions is crucial. One retrospective cohort study found that missing or shortening dialysis treatments is linked to severe electrolyte imbalance, fluid overload, and life threatening arrhythmias (Chamberlain, Hunt, Bashir, & Zager, 2012). The cardiovascular symptoms associated with missed treatments lead to an increase in hospitalizations and increased cardiovascular mortality among ESRD patients (Chamberlain et al., 2012).

Unfortunately, despite consistent attendance to treatment, complications during hemodialysis arise for most patients. Common complications of hemodialysis include hypotension, nausea, muscle cramps, and pruritus (Medical Education Institute, 2014). While serious complications are uncommon, air embolism, anaphylaxis, and cardiac arrest are all possible complications of hemodialysis (Medical Education Institute, 2014). Despite the associated risks, patients with ESRD rely heavily on hemodialysis as survival is dependent upon the removal of excess fluid and toxins from the bloodstream.

Hemodialysis is the most common treatment option for ESRD patients, however, there are limitations associated with the treatment (Medical Education Institute, 2014). Functioning kidneys can remove all excess fluid from the body, whereas hemodialysis can only remove a limited amount of fluid with each treatment (Medical Education Institute, 2014). Hemodialysis can remove some bodily waste and phosphorus while controlling blood pressure through fluid removal and sodium balance, however, not as efficiently as functional kidneys (Medical Education Institute, 2014). Due to treatment limitations, patients must limit fluid gains between each treatment while also maintaining a high protein, low sodium, and low potassium diet. In addition, failing kidneys cannot produce erythropoietin, a hormone that initiates red blood cell

production (Medical Education Institute, 2014). Therefore, in order to avoid anemia, supplemental erythropoietin shots are given to ESRD patients during hemodialysis treatment (Medical Education Institute, 2014). Although a popular and beneficial treatment option for patients with ESRD, hemodialysis is not as efficient as normal functioning kidneys.

Peritoneal dialysis. Peritoneal dialysis (PD) is a treatment option utilized by patients who wish to "fit their treatment into their lives – not fit their lives into a center's treatment" (Medical Education Institute, 2014, p. 35). Peritoneal dialysis is a feasible treatment option for patients who can administer their own care, continue to work, and want fewer dietary restrictions (Medical Education Institute, 2014). With two PD treatment options available, patients can choose between continuous ambulatory peritoneal dialysis (CAPD) or continuous cycling peritoneal dialysis (CCPD) depending upon which treatment option fits better into their lifestyle (Medical Education Institute, 2014). Patients who are eligible for peritoneal dialysis often suffer from fewer comorbidities when compared to patients on hemodialysis (Burkart, 2019). In 2009, when considering the total number of patients receiving dialysis, approximately six percent were receiving peritoneal dialysis while 94% were receiving hemodialysis (Burkart, 2019). Peritoneal dialysis shows some short-term benefits in first year survival when compared to hemodialysis (Burkart, 2019). In patients with comorbidities (i.e., diabetes mellitus or hypertension), PD shows no benefit to first year survival, with comparable or even decreased survival after the first year, when compared to hemodialysis (Burkart, 2019). Peritoneal dialysis is an option for patients who seek independence in their treatment and lifestyle. Despite the added independence, PD does not show substantial benefit when compared to hemodialysis.

Transplantation. According to Rosenberg (2019), "kidney transplantation is considered the treatment of choice for ESRD". A number of factors are evaluated when determining if a

patient is a candidate for transplantation (Rossi & Klein, 2019). Although kidney transplantation is the gold standard treatment, of the 100,000 people who are diagnosed with ESRD each year, only about 15,000 receive transplants (Medical Education Institute, 2014). According to Rossi and Klein (2019), kidney transplantation is a selective process with absolute contraindications including active infection, malignancy, substance abuse, noncompliance to current treatment, and significantly decreased life expectancy. Initial screening for transplantation candidates includes evaluating labs (e.g., blood type, serological testing, human leukocyte antigen) and imaging (e.g., chest x-ray, electrocardiogram, and ultrasound) (Rossi & Klein, 2019). In addition to labs and imaging, patients seeking transplantation are extensively evaluated for comorbidities including diabetes mellitus, hypertension, peripheral vascular disease, angina, cardiomyopathy, hematological disorders, and obesity (Rossi & Klein, 2019). Patients that meet kidney transplant criteria wait for a kidney to become available.

Three options are available for kidney transplantation: a kidney from a living blood relative, a kidney from a living, non-blood relative, and a kidney from a deceased donor (Medical Education Institute, 2014). Kidney transplantation is likely a more permanent treatment option when compared to dialysis, but is not a cure for ESRD as kidney rejection is always a possibility (Medical Education Institute, 2014). According to the Medical Education Institute (2014), 92% of deceased donor transplant kidneys are functioning one year after transplant, 71% are functioning after five years, and only 45% are functioning after 10 years. If the kidney transplant fails, patients are reassigned a number on the transplant list and begin treatment with PD or hemodialysis as they wait for another kidney (Medical Education Institute, 2014).

Conservative management. Conservative care is a treatment option chosen by patients who do not wish to undergo dialysis or transplantation (Schell & Arnold, 2019). Often patients

who elect this method of care suffer from advanced comorbidities and want to shift their focus from intensive medical care to managing and maintaining a more optimal quality of life (Schell & Arnold, 2019). Although an option for every patient with ESRD, according to the Renal Physician Association, conservative care is most often considered for patients over 75 years of age who have two or more the following qualities indicative of a poor prognosis: "impaired functional status", "severe malnutrition", "multiple comorbidities", or "positive response to the question: 'No, I would not be surprised if this patient died within the next year.'" (Schell & Arnold, 2019, para. 11). With a median survival of six months, conservative care focuses on the management of symptoms, blood pressure, and optimizing quality of life (Schell & Arnold, 2019).

Quality of Life

Quality of life is an ambiguous term that describes the effects of multiple objective and subjective constructs on a person's wellbeing, including but not limited to: self-esteem, self-efficacy, social values and beliefs, relationships, aspirations, life expectations, physical functionality, independence, and psychological health (Carr, Higginson, & Robinson, 2003). The World Health Organization (WHO) (2019, p. 1) defined quality of life as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns". A definitive tool for measuring quality of life is not currently used, but many resources exist for evaluation. For example, the WHO developed the WHOQOL-100 and an abbreviated version, the WHOQOL-BREF, which are questionnaires that measure quality of life reliably and accurately across cultures (WHO, 2019).

Using tools like the WHOQOL-100, quality of life is often assessed in healthcare settings to help determine patients' well-being and assess their functional status (Carr, Higginson, & Robinson 2003). A gold standard measurement tool has not been established for measuring quality of life in ESRD patients (Holley, 2019). Current recommendations for assessing patients with kidney disease involve quality of life assessment at the time of CKD diagnosis and routine reassessment at the time of symptom evaluation, throughout the progression of the disease, and until the death of the patient (Holley, 2019). The information gathered from these studies reveals important insights into the lives of CKD and ESRD patients, showing primarily that patients with CKD or ESRD have a decreased quality of life (Holley, 2019).

Research supports the idea that people with kidney disease have a lower quality of life than those without kidney disease (e.g., Liu, Yeh, Weng, Bai, & Chang, 2017). Notably, patients with ESRD often experience complications such as depression, sexual dysfunction, decreased functional status, and low employment rates, all of which may impact quality of life (Holley, 2019). End-stage renal disease patients receiving hemodialysis may also experience symptom burdens, such as being undertreated and feeling under-recognized, which may also negatively impact quality of life (Koncicki, 2018; Schell, 2019). In one study, life satisfaction in ESRD patients decreased significantly during initiation of hemodialysis and remained low throughout the remainder of the patients' lives (Schell, 2019).

Many factors have been measured that correlate to quality of life in ESRD patients. Age, for example, has been linked to quality of life in these patients (e.g., Alhajim, 2017), but current research has not determined age alone as a scientific predictor of life quality (Madhan, 2008). However, research has suggested that frailty (commonly associated with geriatric patients) in ESRD is positively correlated with mortality and negatively correlated with quality of life and

functional status in patients receiving hemodialysis (Holley, 2019; Hornik & Duwala, 2019). Relatedly, one study showed that after initiation of hemodialysis, geriatric patients spent half of their remaining life in treatment or in the hospital, which may significantly impact their quality of life (Koncicki, 2018).

The health of end-stage renal disease patients is also related to quality of life. Improved mental and physical health have been shown to positively predict quality of life in hemodialysis patients (Madhan, 2008). In terms of physical health, studies have shown that low-intensity exercise can improve functional status and quality of life in ESRD patients on hemodialysis (Manfredini et al., 2017; Hornik & Duwala, 2019). Furthermore, decreased physical activity in hemodialysis patients was found to increase anxiety in these patients (Hornik & Duwala, 2019).

In terms of mental health, one study revealed that patients with depression prior to starting hemodialysis had a mortality rate three times higher than those without depression (Chiang, Guo, Livneh, Lu, Yen, & Tsai, 2015). Another study showed that patients with kidney disease, especially those with ESRD recieving hemodialysis, are at a significantly higher risk of committing suicide than people without kidney disease (Liu, Yeh, Weng, Bai, & Chang, 2017). Kidney disease patients are four times more likely to commit suicide during the initiation of hemodialysis than at any other point during their disease progression (Liu, Yeh, Weng, Bai, & Chang, 2017). Thus, promoting and managing mental and physical health in hemodialysis patients is important in quality of life outcomes.

Comorbid health issues also impact the lives of ESRD patients. For example, diabetes mellitus, hypertension, cardiomyopathy, and arthropathies, have been shown to reduce quality of life in patients with kidney disease (Liu, Yeh, Weng, Bai, & Chang, 2017; Mandoorah, Shaheen,

Mandoorah, Bawazir, & Alshohaib, 2014). Relatedly, patients with comorbidities spend more time hospitalized, which decreases life quality (Koncicki, 2018).

In the literature, diabetes mellitus is correlated with a decrease in quality of life among ESRD patients (e.g., Alhajim, 2017). Using the WHOQOL-BREF to measure quality of life in patients with kidney disease receiving hemodialysis, one study found that comorbid diabetes mellitus, specifically, was related to decreased quality of life (Alhajim, 2017). Alhajim (2017) examined 104 ESRD patients who had been on hemodialysis for at least three months, of which 34% had diabetes mellitus. The patients with diabetes mellitus had a reduced quality of life compared to the patients without diabetes mellitus (Alhajim, 2017). Additionally, research by Zimbudzi et al. (2016), which used the Kidney Disease Quality of Life questionnaire to measure quality of life in 308 ESRD patients, suggested that patients with diabetes mellitus who developed kidney disease, but were not yet receiving hemodialysis, had a lower quality of life than patients receiving hemodialysis with kidney disease alone.

Obesity is another factor related to quality of life in kidney disease patients. For example, one systematic review concluded that obesity puts individuals at risk for not only developing CKD, but also faster disease progression (Van Huffel et al., 2014). According to another systematic review, morbidly obese ESRD patients receiving hemodialysis have lower quality of life than non-obese patients due to multiple factors such as difficulty with atrial venous fistula placement, longer duration of treatment, more frequent dialysis visits, difficulty with transportation, and inability to maneuver clinic spaces (Turgut & Abdel-Rahman, 2017). Primarily, “[t]his increase in time as well as frequency of dialysis impacts negatively on the quality of lives of these patients" (Turgut & Abdel-Rahman, 2017).

Additionally, a Danish study looked at two groups of ESRD patients receiving hemodialysis, one group in 2002 and one group in 2015 (Knudsen, Eidemak, & Molsted, 2016). The study showed that during the 13-year period between groups, there was a significant increase in mean BMI and percentage of overweight or obese patients in the 2015 group and the quality of life decreased accordingly (Knudsen, Eidemak, & Molsted, 2016). Relatedly, another cross-sectional study, which measured quality of life in hemodialysis patients and compared patients based on their level of obesity, showed that obesity in ESRD patients on hemodialysis was associated with decreased quality of life (Beberashvili et al., 2019). Waist circumference was a better indicator of decreased quality of life than body mass index, where obesity was defined as a waist circumference greater than 88 cm in women and greater than 102 cm in men (Beberashvili et al., 2019). Ultimately, the available research suggests that both diabetes mellitus and obesity are correlated with poorer quality of life.

Conclusion

An overview of the available literature indicates that the presence of comorbid conditions, specifically diabetes mellitus and obesity, negatively predicts outcomes of CKD and ESRD. While studies have identified that diabetes mellitus and obesity both influence quality of life individually, research has not shown if those with obesity have a poorer quality of life than those with diabetes mellitus or vice versa. In addition, the available studies have not indicated if those with both obesity and diabetes mellitus have a poorer quality of life than those with only one of the comorbid conditions. Using an online version of the WHOQOL-BREF within a Facebook support group, this study measured and compared quality of life in ESRD patients on hemodialysis who: (1) did not have diabetes mellitus and were not obese, (2) had diabetes

mellitus but were not obese, (3) were obese but did not have diabetes mellitus, and (4) were both diabetic and obese. The methodology of this study is discussed in Chapter Three.

Chapter Three: Methodology

Introduction

The purpose of this study was to examine the relationship between quality of life of patients with end-stage renal disease (ESRD) on hemodialysis and respective comorbidities of diabetes mellitus and obesity. The research questions this study evaluated were:

1. What relationship, if any, exists between diabetes mellitus and quality of life in ESRD patients receiving hemodialysis treatment?
2. What relationship, if any, exists between obesity and quality of life in ESRD patients receiving hemodialysis treatment?
3. Which comorbidity, diabetes mellitus or obesity, is more strongly related to a decreased quality of life among ESRD patients who are receiving hemodialysis?

This chapter describes the study design, population, procedures, data collection, limitations, and delimitations of this study.

Study Design

This study was a quantitative, descriptive study that utilized a survey, the WHOQOL-BREF translated into an online Qualtrics format (see Appendix A), to analyze the relationship between quality of life of participants with ESRD receiving hemodialysis and the comorbidities of obesity and diabetes. The WHOQOL-BREF was chosen to evaluate participant quality of life because the tool is a reliable indicator of quality of life across cultures. In addition, the tool was designed with a scoring algorithm that was used in this study to analyze the data.

The goal of this study was to determine if a relationship exists between the independent variables of quality of life and participant comorbidities of diabetes and obesity. Five categories of participant quality of life (i.e., total, physical health, psychological health, environmental

factors, social relationships) were numerically scored using the survey tool, which were evaluated across comorbidity groups to determine if any relationship existed. In addition, analysis of demographic categories including age, gender, country of residence, marital status, and education level were included to both identify significant relationships and to account for potential confounding variables.

Population

The prevalence of ESRD is rapidly growing in the United States; however, there is little research describing the quality of life of ESRD patients. The data for this study was collected from end stage renal disease (ESRD) patients who were receiving hemodialysis treatment at the time of data collection. Participants were recruited through the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group", "Hemodialysis Support Group", "Dialysis and Kidney Disease Support Group", and "Kidney Dialysis Support Group" Facebook pages, as well as a Facebook page controlled by the National Kidney Foundation (NKF). These Facebook pages will be further referred to as the "participant Facebook group pages". Male and female ESRD patients who were over the age of 18, receiving hemodialysis treatment, and were fluent in English were included in this study. The study focused on the quality of life among ESRD hemodialysis patients, therefore any patients undergoing peritoneal dialysis, transplantation, or conservative management were excluded. Surveys from participants that did not meet the criteria stated above or those that were incomplete were deleted and excluded from data analysis. We anticipated responses from 100 participants.

Procedures

Description of research plan. The research collection took place from October 1, 2020 to January 2, 2021, during which time the research materials were available on the participant

Facebook group pages. These materials, including the informed consent form, demographic information, and the WHOQOL-BREF survey, were in the format of a single online survey through the Qualtrics platform. The initial post to the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook page was made on October 1, 2020 and can be found in Appendix B. Three additional Facebook groups were added to the study due to a limited number of responses from participants (8 responses) in the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook group. Thus, the initial posts on the "Hemodialysis Support Group", "Dialysis and Kidney Disease Support Group", and "Kidney Dialysis Support Group" Facebook pages were made on October 23, 2020 (see Appendix C). Following limited data collection from the four previously mentioned Facebook groups (21 responses), the researchers contacted the National Kidney Foundation (NKF) to request posting the survey on the NKF Facebook page. After access was granted, the initial post to the NKF Facebook page was made on December 10, 2020 (see Appendix D). Researchers were granted permission to post on each of the participant Facebook group pages or were invited into the private group pages by their respective administrators.

The Facebook posts contained a description of the research project, a statement of consent, researcher contact information, and a link to the online survey (Appendix A). Individuals who were members of the participant Facebook group pages at the time of data collection could click on the link to the survey within the Facebook post and begin the survey. A reminder post was posted to each participant Facebook group page to recruit more potential participants halfway through the week. The follow-up posts for each Facebook group can be found in Appendix E for "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook page, Appendix F for the "Hemodialysis Support Group", "Dialysis

and Kidney Disease Support Group", and "Kidney Dialysis Support Group" Facebook pages, and Appendix G for the NKF Facebook page.

After clicking on the survey link, participants were electronically redirected to the online survey on the Qualtrics platform. The survey began with a description of the study and the informed consent form. Once participants acknowledged and agreed to the informed consent, the demographic information questions appeared for participants to complete. If the participant declined the informed consent, was not over 18 years of age, or was not a hemodialysis patient, the survey automatically ended.

After the demographic questions were completed, participants automatically began the WHOQOL-BREF portion of the survey. Participants were asked to answer every question, however, were not required to submit an answer. The estimated time to complete the survey was ten minutes. Upon completion of the survey, the online form was submitted to Qualtrics, which brought about the "thank you" page and concluded participation (Appendix H). Completed surveys were available solely to researchers as responses could only be accessed through the password protected Qualtrics platform on secure computers owned by researchers. Any survey responses that were incomplete, or those in which the participant did not meet inclusion criteria, were removed from the number of total responses and data analysis.

Data analysis/statistics. Once the data was collected, the WHOQOL-BREF scoring instructions were utilized to create formulas in Qualtrics that automatically assigned scores for quality of life domains including total, environmental factors, physical health, psychological health, and social relationships. Researchers elected to evaluate four of the six available domains with the addition of a total overall score for the total of five quality of life scores (i.e., physical, psychological, environment, and social). Researchers elected not to evaluate the independence

and personal beliefs quality of life domains due to the limited number of questions. The data was then downloaded onto Google Sheets to complete statistical analysis. Once on Google Sheets, any responses that did not meet inclusion criteria were deleted from the data set. Survey responses were then sorted based on comorbidity groups, age ranges, gender, time on treatment, education level, and marital status.

The collected data was then organized into groups based on the presence or absence of comorbid conditions (diabetes mellitus, obesity, diabetes mellitus and obesity, and neither [referred to as the control group]) and was analyzed and compared using unpaired t-tests (i.e., control vs. diabetic; control vs. obese; control vs. diabetes and obesity; and diabetes vs. obesity). Unpaired t-test values were used to determine if there was a statistical significance between means in each domain (i.e., total, environmental, physical, psychological, and social) amongst the comorbidity groups. Demographic information including age, gender, marital status, and education level were also collected and analyzed with quality of life data to determine the presence of any statistically significant relationships (see Appendix I). Unpaired t-tests were used to evaluate age, gender, and marital status while ANOVA was used for evaluation of time on treatment, education level, and for further analysis of marital status.

Disposition of data. After data collection ended, electronic survey data was compiled on Qualtrics and subsequently downloaded into Google Sheets onto password-protected computers owned by the researchers. Upon completion of analysis and presentation of results, the collected data was transferred to an external storage device and data was erased from all computers. The external drive will be locked in the PA program office for a minimum of five years, per requirements of Bethel University's Physician Assistant Program.

Institutional Review Board (IRB) approval. This study was approved by Bethel University's Institutional Review Board (see Appendices J, K, L). The study sought level three IRB approval. All appropriate materials were submitted to the Bethel University IRB committee in September, 2020. The study was given level three IRB approval in September, 2020 (see Appendix J). Following limited responses to the survey, researchers decided to increase the participant pool by posting the survey to additional Facebook pages including the "Hemodialysis Support Group", "Dialysis and Kidney Disease Support Group", and "Kidney Dialysis Support Group" Facebook pages. An addendum was made to the original IRB application that was both submitted to the IRB and approved in October 2020 (see Appendix K). Again, following limited responses to the survey, researchers reached out to the National Kidney Foundation, from which an administrator agreed to post the survey on the NKF Facebook page. One final addendum was made to the IRB application in November 2020 to include the NKF Facebook page and was subsequently approved in November 2020 (see Appendix L).

Data Collection

Informed consent. An informed consent form was the first page of the electronic Qualtrics survey. The informed consent varied slightly between the participant Facebook group pages. The "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook group informed consent can be found in Appendix M and the "Hemodialysis Support Group", "Dialysis and Kidney Disease Support Group", and "Kidney Dialysis Support Group" Facebook pages informed consent can be found in Appendix N, and the NKF Facebook page informed consent can be found in Appendix O.

The informed consent forms described the study, selection criteria, length of survey, and information regarding data storage and how the data would be used. The consent forms stated

that identifiable information, including name and date of birth, would not be collected or linked to survey responses. The informed consents noted that participation in the study was voluntary, participants could drop out of the study at any time, and participation in the study would not impact their relationship with Bethel University or their respective participant Facebook group. Contact information was provided to allow participants to contact the researchers regarding questions about the study. If a participant chose to not accept the consent form, the Qualtrics platform automatically ended the survey by bringing the participant to the "thank you" page (see Appendix H).

Survey tool. An online WHOQOL-BREF survey was used as the data measurement tool in this study (see Appendix A). A PDF version of the survey was available online with approval from the University of Washington School of Public Health, Department of Health Services Seattle Quality of Life Group. The approval for use of the WHOQOL-BREF survey is listed under Appendix P. All instructions, questions, and scoring in the online survey were taken directly from the PDF version of the survey. Demographic information was collected at the beginning of the survey, including age, gender, marital status, country of residence, and education level in an online format preceding the WHOQOL-BREF survey questions (see Appendix I). Participants were also asked to report height, weight, and previous diagnosis of diabetes mellitus.

In the WHOQOL-BREF survey, quantitative values from each quality of life domain were rated on Likert scales ranging from 1 (not at all) to 5 (completely) (see Appendix A). Participants were asked to reflect on experiences over the past two weeks of life to evaluate 26 items that pertained to six quality of life domains: physical health, psychological health, independence, environmental factors, social relationships, and personal beliefs. Examples of

questions included: “How would you rate your quality of life?”, “How satisfied are you with your health?”, and “How often do you have negative feelings, such as blue mood, despair, anxiety, depression?” (see Appendix A).

The survey tool contained a scoring system to calculate participant quality of life into the six domains (i.e., physical, psychological, independence, environment, social relationships, personal beliefs) (see Appendix Q) and researchers elected to evaluate four of the categories (physical, psychological, environment, and social) in addition to total score as independence and personal beliefs categories were evaluated by very few questions. First, for each domain, the raw score was calculated by summing the items related to each domain, which included reverse scoring three items. Second, the lowest possible raw score from each relative domain was subtracted from each participant’s raw score for each domain, divided by the possible raw score range, and multiplied by 100 to determine raw quality of life scores for each domain (i.e., the transformed scale score) (see Appendix Q). The total quality of life score for each participant was calculated by summing each domain raw score, subtracting the lowest possible raw score, dividing by the possible total raw score range, and multiplying by 100 (see Appendix Q).

Validity and reliability of the survey. Participant quality of life was measured with a voluntary questionnaire developed by the World Health Organization (WHO), known as the WHOQOL-BREF. The WHOQOL-BREF measures quality of life with Likert scales and utilizes a set formulary to interpret results (WHO, 2019; Bonomi, Patrick, Bushnell, & Martin, 2000). While the WHOQOL-BREF was not specifically created for evaluation of quality of life in ESRD patients, the questionnaire has been used in numerous studies to reliably determine ESRD patient quality of life (e.g., Alhajim, 2017). Therefore, the WHOQOL-BREF was an appropriate tool to measure quality of life in this study.

Limitations and Delimitations

This study focused on participants with ESRD who were receiving hemodialysis treatment at the time of data collection. In order to gather data from a wide variety of participants, the study was conducted through ESRD support group pages on Facebook, a social media platform. Additionally, participants were asked to reflect on their quality of life within the last two weeks as they answered survey questions. The population, platform, and survey tool were intentionally set in order to narrow the scope of the study and for consistency of results. The collection of demographic information also served to identify potential confounding variables that may impact quality of life of participants; specifically age, gender, country of residence, marital status, and education level. While delimitations constrained the extent of the study, limitations may have unintentionally impacted the results of this study.

Additional factors may have unintentionally interfered with the evaluation of quality of life in the selected patient population. Limitations included potential participant response bias to the WHOQOL-BREF and sampling bias as our population was obtained solely through an online social media platform. Because the survey was administered online, participants may have experienced unforeseen technical difficulties that potentially impacted their response to the survey. Additionally, participants could have potentially submitted multiple responses to the survey. The researchers further acknowledge that the COVID-19 pandemic may have impacted the quality of life in participants which could be reflected in survey scores. In order to limit the participant response bias to the WHOQOL-BREF, the methodology reflects that the participants received no incentives for completing the questionnaire and participants were encouraged to provide accurate information.

Utilizing the WHOQOL-BREF survey tool ensured that questions were not written to benefit or disbenefit groups within our population. The inclusion of only complete questionnaires guaranteed that results are representative of the study population. Researchers also understand that the participant population with access to the participant Facebook group pages may not be an accurate representation of all ESRD patients receiving hemodialysis. Additionally, researchers note that quality of life scores from participants within the support groups could be skewed compared to quality of life scores from ESRD patients who were not in a support group at the time of data collection.

Participant-reported height and weight were used to calculate BMI and measure obesity among participants, however waist circumference is known to be a better indicator of abdominal obesity and is more strongly associated with quality of life in ESRD patients (Beberashvili et al., 2019). Although waist circumference is the best indicator, BMI was chosen as participants readily know their height and weight. While limitations and delimitations of the study exist, reasonable efforts were made to minimize their impact on the study.

Conclusion

In conclusion, this study examined whether a relationship exists between quality of life of participants with ESRD receiving hemodialysis treatment and comorbidities of diabetes mellitus and obesity by comparing mean quality of life scores. The study was conducted on Facebook, an online social media platform, and was available to individuals with access to the participant Facebook pages as defined previously. Participants completed an online informed consent, demographic information, and WHOQOL-BREF survey that measured participant quality of life. The scoring tool designed for the WHOQOL-BREF was used to ensure standardization of data. Analysis of data included unpaired t-test and factorial analysis of variance (ANOVA).

Organization of data and the results of the study are presented in Chapter Four. Chapter Five includes a discussion of the results and impact of the study as well as ideas for the direction of future research regarding ESRD and quality of life.

Chapter Four: Data Analysis

Introduction

The intent of this study was to identify the presence and nature of the relationship between quality of life and comorbidity groups (neither diabetes nor obesity [control group], diabetes mellitus, obesity, or diabetes mellitus and obesity) among ESRD patients receiving hemodialysis. There were a total of 363 online surveys collected through Facebook support group pages. Data was collected and analyzed using Qualtrics and Google Sheets. There were 363 survey responses in total and 250 responses met exclusion criteria for participation and further analysis. Participant quality of life was analyzed based on comorbidity groups as well as demographic information to answer research questions and identify potential confounding variables. Tables and figures were used to display the data collected in this study.

Demographics

At the completion of data collection, 363 responses were collected and downloaded from Qualtrics to Google Sheets onto password protected, researcher owned computers. Of those responses, 18 declined the informed consent, 86 did not meet participant inclusion criteria as they were not receiving hemodialysis treatment, eight survey takers did not report a BMI, and one was discarded as an outlier because the BMI was outside of the possible range of BMI values. Thus, the final population of this study that met the inclusion criteria was 250 participants. The demographic information from the 250 surveys was analyzed using Google Sheets. Table 3 presents a breakdown of the total survey responses and number of surveys in each exclusion category as well as the final number of surveys included in the study's data analysis. The "n" represents the number of participants in all following tables.

Table 3.

Survey response breakdown describing number of surveys excluded for which criteria.

Survey Responses	n
Total Surveys	363
Declined Informed Consent	18
Participant not on Hemodialysis	86
Participant Did Not Answer BMI	8
Participant BMI Out of Range	1
Surveys Meeting Inclusion Criteria	250

Of the 250 participants, 126 were male and 124 were female, zero identified as “other” (see Table 4).

Table 4.

Part 1: Demographic information of participants; gender.

Demographic Variable	Total Participants	Percentage of Total
Gender	**n**	**%**
Male	126	50.4
Female	124	49.6
Other	0	0.0

For age, participants were grouped by ranges of approximately 10 years (see Table 5). After initial grouping revealed ranges with small sampling sizes, participants were regrouped into two larger, more equal populations for analysis. Of the 105 participants in the 20 to 59 year age group, 44 were male and 61 were female. The 145 participants in the 60 years and older group consisted of 82 males and 63 females.

Table 5.

Part 2: Demographic information of participants; age.

Demographic Variable	Total Participants	Percentage of Total
Age Range (years)	**n**	**%**
20-29	8	3.2
30-39	16	6.4
40-49	27	10.8
50-59	54	21.6
60-69	81	32.4
70-79	50	20.0
Over 80	14	5.6
Final Age Range (years)	**n**	**%**
20-59	105	42.0
Over 60	145	58.0

Of the 250 eligible responses, 69 participants had been receiving hemodialysis for six months to two years, 83 participants for two to five years, and 98 participants for five or more years. Initial treatment categories were broken down into equal time frames, however with variable population sizes in each category, the decision was made to reduce categories to those

shown below in Table 6. There were no participants included in the study with a treatment time less than six months. Because of this, researchers are confident there are no participants within the study receiving hemodialysis for an acute kidney injury and are all receiving treatment for chronic kidney disease in this study.

Table 6.

Part 3: Demographic information of participants; time on treatment.

Demographic Variable	Total Participants	Percentage of Total
Time on Treatment (years)	**n**	**%**
0-2	69	27.6
2-5	83	33.2
Over 5	98	39.2

Initial marital status groupings revealed over half of participants were married. In order to stabilize sample sizes, groups were reduced to married and unmarried. Unmarried category including single, divorced, separated, or widowed. Married including those married and those living as married. Data analysis for marital status is done with the acknowledgement that the unmarried category includes subcategories for which there may exist differences that influence quality of life scores. Total participants and percentage of total population for marital status categories are presented below in Table 7.

Table 7.

Part 4: Demographic information of participants; marital status.

Demographic Variable	Total Participants	Percentage of Total
Marital Status	**n**	**%**
Divorced or Separated	31	12.4
Married or Living as Married	133	53.2
Single	64	25.6
Widowed	22	8.8
Final Marital Status	**n**	**%**
Unmarried	117	46.8
Married	133	53.2

Grouping for education level was similar to that of marital status and age group (see Table 8). In order to create comparable groups with similar sample sizes, the “elementary” and “some high school” subgroups were combined with the “high school/GED” group. Final groups revealed 81 participants with high school or less education, 63 with an associates degree, and 106 with bachelors/masters/PhD.

Table 8.

Part 5: Demographic information of participants; education level.

Demographic Variable	Total Participants	Percentage of Total
Education Level	**n**	**%**
Elementary	1	0.4
Some High School	1	0.4
High School / GED	79	31.6
Associates	63	25.2
Bachelors/Masters/PhD	106	42.4
Final Education Level	**n**	**%**
High School or Less	81	32.4
Associates	63	25.2
Bachelors, Masters, PhD	106	42.4

Within the population of 250 participants, there were 99 participants who had neither diabetes or obesity (control group), 36 participants with diabetes only, 59 participants with obesity only, and 56 participants with both diabetes and obesity. Table 9 below shows this numerically with percentages of the comorbidity groups corresponding to the total population.

Table 9.

Part 6: Demographic information of participants; comorbidity group.

Demographic Variable	Total Participants	Percentage of Total
Comorbidity Group	**n**	**%**
None	99	39.6
Diabetes	36	14.4
Obesity	59	23.6
Diabetes and Obesity	56	22.4

Table 3 through Table 9 above describe the population of the study in detail with the total number of participants in each category and the percentage of total population each category represents. The primary focus of this study, however, is to analyze the quality of life of each of the comorbidity groups listed in Table 6. The following section discusses the process of data analysis and leads into display of results.

Data Analysis

Quality of life scores were analyzed using the scoring algorithm provided by the WHOQOL-BREF. Appendix Q outlines the guidelines used to score all eligible survey responses. Within the survey platform, Qualtrics, scores were automatically calculated for each participant in the domains of total quality of life, physical health, psychological health, environmental factors, and social relationships. Demographic information, excluding any specific participant identifiers, as well as raw data, and calculated domain scores were

downloaded onto Google Sheets. Google Sheets was then used to calculate the results between quality of life among comorbidity groups with unpaired t-tests. In addition to analyzing quality of life scores in each comorbidity group, unpaired t-tests and ANOVA statistical testing were performed to analyze quality of life scores for each demographic category. The remainder of this section is dedicated to a display of results for both the research questions and demographic analysis.

Research questions. As stated previously, the goal of the study was to evaluate the relationship between quality of life and comorbid conditions, diabetes and obesity, in the setting of end-stage renal disease. In order to answer research questions, analysis was done examining the mean quality of life scores in each of the groups across all five domains (i.e., total, physical health, psychological health, environmental factors, and social relationships). The mean total quality of life score of the control group was 64.3 (SD = 16.4), the diabetes group was 53.8 (SD = 18.9), the obesity group was 59.1 (SD = 13.9), and the diabetes and obesity group was 57.8 (SD = 15.7). The quality of life domains (i.e., environmental, physical, psychological, social) were also analyzed for each comorbidity group as shown in Table 10 through Table 14 below. Scores have all been transformed into percentages by the WHOQOL-BREF survey scoring instructions. Scores closer to 100 are consistent with higher quality of life while lower scores or those closer to zero, reflect poorer quality of life.

Table 10 provides an overview of mean quality of life scores for each comorbidity group across all domains of quality of life. In sum, this table depicts that the control group reported higher quality of life scores across all domains when compared to the other comorbidity groups. In contrast, the diabetes group reported the lowest quality of life scores across all quality of life domains when compared to the other comorbidity groups including participants with both

diabetes and obesity. Another notable trend from the data analysis is that the environmental factors domain has higher quality of life scores than all other domains within each comorbidity group. The lowest quality of life scores are found in the physical health domain.

Table 10.

Presentation of mean quality of life scores between comorbid groups.

Comorbidity	n	Total	Environmental	Physical	Psychological	Social
Control	99	64.3 ± 16.4	74.9 ± 16.3	57.5 ± 19.9	62.7 ± 19.7	58.2 ± 22.4
Diabetes	36	53.8 ± 18.9	62.5 ± 19.2	46.2 ± 20.1	53.0 ± 22.8	52.1 ± 21.5
Obesity	59	59.1 ± 13.9	67.6 ± 14.0	51.3 ± 19.1	59.7 ± 16.5	55.8 ± 21.3
Diabetes & Obesity	56	57.8 ± 15.7	67.4 ± 17.3	49.0 ± 17.8	60.3 ± 19.1	51.2 ± 22.7

Tables 11 through 14 illustrate the statistical difference between each of the comorbidity groups presented individually as compared to the control group. P values less than or equal to 0.05 are considered statistically significant while any p values greater than 0.05 are not statistically significant. Additionally, p values less than 0.01 are considered highly significant. For simplicity, any statistically significant p values are denoted as <0.05* or <0.01** to highlight significance. Any p values that are not significant are shown as their calculated value.

Table 11 starts with comparing the mean quality of life scores of the control group to the diabetes group. This analysis aims to answer research question one; “what relationship, if any, exists between diabetes mellitus and quality of life in ESRD patients receiving hemodialysis treatment?”. Unpaired t-tests were used to analyze the statistical difference between the mean

scores of each of the domains. Analysis revealed statistically significant differences (p values ≤0.05) in mean scores between the diabetes and control groups in total, environmental, physical, psychological domains. The diabetes group was shown to have lower quality of life scores in these domains when compared to the control group. Social relationships is the only non-significant domain with a p value of 0.16. Despite lack of statistical significance, the diabetes group continued to have lower quality of life scores in the social relationships domain as well, when compared to the control group. Domains for the diabetes group listed from highest score to lowest score are as follows; environmental factors, total score, psychological health, social relationships, and physical health.

Table 11.

Analysis of mean quality of life scores; Diabetes Group versus Control Group.

Comorbidity	n	Total	Environmental	Physical	Psychological	Social
Control	99	64.3 ± 16.4	74.9 ± 16.3	57.5 ± 19.9	62.7 ± 19.7	58.2 ± 22.4
Diabetes	36	53.8 ± 18.9	62.5 ± 19.2	46.2 ± 20.1	53.0 ± 22.8	52.1 ± 21.5
p value		<0.05*	<0.05*	<0.05*	<0.05*	0.16

In order to answer the second research question; "what relationship, if any, exists between obesity and quality of life in ESRD patients receiving hemodialysis treatment", an analysis of means between the control group and obesity group was done using unpaired t-tests. Analysis revealed statistically significant differences in the total quality of life and the environmental factors domain with the obesity group having poorer quality of life scores than the control group. Physical health, psychological health, and social relationships domains had p

values greater than 0.05 and therefore were not statistically significant, however the trend of lower quality of life scores in the obesity group continued. In both the control group and the obesity group, physical health had the lowest quality of life score out of all the domains with 57.5 ± 19.9 and 51.3 ± 19.1 respectively. On the other hand, both groups had the highest quality of life scores in the total category, followed by, in order from highest to lowest, environmental factors, psychological health, and social relationships.

Table 12.

Analysis of mean quality of life scores; Obesity Group versus Control Group.

Comorbidity	n	Total	Environmental	Physical	Psychological	Social
Control	99	64.3 ± 16.4	74.9 ± 16.3	57.5 ± 19.9	62.7 ± 19.7	58.2 ± 22.4
Obesity	59	59.1 ± 13.9	67.6 ± 14.0	51.3 ± 19.1	59.7 ± 16.5	55.8 ± 21.3
p value		<0.05*	<0.05*	0.06	0.31	0.51

The previous two tables, Table 11 and Table 12, portray mean quality of life scores for a single comorbidity, either diabetes or obesity, compared to that of the control group intending to answer the first two research questions. The following table, Table 13, presents the analysis of mean scores between the participants with both diabetes and obesity and participants with neither comorbid condition. This analysis is an addition to the original research questions and aims to gain understanding of how participant quality of life scores are affected by the presence of both comorbid conditions.

Again, the two groups were analyzed using unpaired t-tests to determine corresponding p values and thus presence of statistical significance. In doing so, three domains of quality of life

were found to be significantly different. Total quality of life was significantly reduced in the diabetes and obesity group (57.8 ± 15.7) when compared to the control group (64.3 ± 16.4). The environmental factors and physical health domains were found to be highly significant with the diabetes and obesity group having poorer quality of life scores than the control group. Psychological health was not statistically significant between the two groups. Social relationships, though potentially more significant than psychological health, was also found to be not significant with a p value of 0.07. The analysis of the diabetes and obesity group versus the control group followed a similar trend to those before with the highest quality of life score being environmental factors, followed by psychological health, social relationships, and, finally physical health.

Table 13.

Analysis of mean quality of life scores; Diabetes and Obesity Group versus Control Group.

Comorbidity	n	Total	Environmental	Physical	Psychological	Social
Control	99	64.3 ± 16.4	74.9 ± 16.3	57.5 ± 19.9	62.7 ± 19.7	58.2 ± 22.4
Diabetes & Obesity	56	57.8 ± 15.7	67.4 ± 17.3	49.0 ± 17.8	60.3 ± 19.1	51.2 ± 22.7
p value		<0.05*	<0.01*	<0.01*	0.46	0.07

Research question three; “Which comorbidity, diabetes mellitus or obesity, is more strongly related to a decreased quality of life among ESRD patients who are receiving hemodialysis?”, was addressed in the same way as the previous two questions. Unpaired t-tests were used to compare mean quality of life scores between the diabetes group and the obesity group. Despite the diabetes group having lower quality of life scores in every domain, this

analysis revealed no statistical difference between the two comorbidity groups. There were no p values less than 0.05 or even below 0.10. The greatest difference between the two groups was found in the psychological domain with the diabetes group scoring 53.0 ± 22.8 and the obesity group 59.7 ± 16.5. The same general trend held true for this analysis with environmental quality of life the highest scoring domain with physical health the lowest.

Table 14.

Analysis of mean quality of life scores; Diabetes Group versus Obesity Group.

Comorbidity	n	Total	Environmental	Physical	Psychological	Social
Diabetes	36	53.8 ± 18.9	62.5 ± 19.2	46.2 ± 20.1	53.0 ± 22.8	52.1 ± 21.5
Obesity	59	59.1 ± 13.9	67.6 ± 14.0	51.3 ± 19.1	59.7 ± 16.5	55.8 ± 21.3
p value		0.15	0.17	0.23	0.13	0.42

Analysis of quality of life scores between the control group, diabetes group, obesity group, and diabetes and obesity group revealed multiple statistically significant differences and trends. Environmental factors quality of life scores were the highest scores for each group while physical health consistently had the lowest quality of life scores. Of all of the comorbidity groups, the diabetes mellitus group had the lowest scores in all domains of quality of life, statistically significant in total, physical health, psychological health, and environmental factor domains. The obesity group was found to have lower quality of life scores than the control group, however, higher than the diabetes group and only statistically significant in the total and environmental factors domains. The diabetes and obesity group also had lower quality of life scores in all domains compared to the control group, with statistically significant differences in

the total, environmental factors, and physical health domains. Finally, when comparing diabetes and obesity to one another, no statistically significant differences were found. General trend, however, revealed lower quality of life scores in the diabetes group across all domains when compared to the obesity group.

While the statistical analysis across comorbidity groups shows significant differences in quality of life scores, there may be additional confounding factors to consider. The following section is dedicated to analyzing specific demographics of the study population in order to identify any potentially significant relationships between age, gender, time on treatment, education level, marital status, and quality of life scores. Data in this section is presented in a similar format to that of this section and similar analyses with unpaired t-tests and ANOVA are displayed for interpretation in Chapter Five.

Demographic analysis. As stated in previous sections, analysis was also performed on demographic information gathered as part of the quality of life questionnaire. Particular areas of interest include age, gender, time on treatment, education level, and marital status. Researchers chose not to analyze participant country of residence as there was insufficient information provided through survey responses. Tables 15 through 19 display the mean quality of life scores across all domains for each demographic category. Analysis included unpaired t-tests for analyses with two groups and ANOVA for analyses with three or more groups.

For examination of the quality of life scores between the two, larger age groups, 20 to 59 years old and 60 years and older, unpaired t-tests were used to calculate statistical significance. Table 15 displays mean scores for each domain across the two age groups. Mean quality of life scores were significantly higher in the 60 and older age group when compared to the 20 to 59 year age group. The highest quality of life score was found in the environmental factors domain

for both age groups and the lowest scores were again found in the physical health domain. Highly statistical differences between the two groups were present in the total, environmental factors, and psychological health domains with p values less than or equal to 0.01. The physical health and social relationships domains did not have statistically significant differences in mean quality of life scores.

Table 15.

Analysis of mean quality of life scores; age in years.

Age	n	Total	Environmental	Physical	Psychological	Social
20-59	105	56.6 ± 17.0	64.4 ± 18.0	50.7 ± 18.8	55.6 ± 20.2	52.6 ± 24.6
60+	145	62.6 ± 21.3	73.5 ± 15.2	53.8 ± 20.2	63.2 ± 18.4	57.0 ± 20.0
p value		<0.01*	<0.001**	0.22	<0.01*	0.13

Similar to the analysis of age above, Table 16 illustrates the mean quality of life scores across gender. Participants had the option to select “male”, “female”, or “other” for gender and approximately fifty percent were male and fifty percent were female. No participants identified as “other”. The only statistically significant difference in means between males and females was found in the social relationships domain with the p value less than 0.05. Despite there being no other statistically significant domains, females tended to have lower quality of life scores than males within the study in every domain except social relationships.

Table 16.

Analysis of mean quality of life scores; gender.

Gender	n	Total	Environmental	Physical	Psychological	Social
Female	124	59.5 ± 15.9	68.5 ± 16.7	51.6 ± 19.0	58.5 ± 18.9	58.5 ± 20.9
Male	126	60.6 ± 16.9	70.9 ± 17.2	53.5 ± 20.2	61.5 ± 20.0	51.9 ± 23.0
p value		0.60	0.25	0.45	0.22	<0.05*

The first demographic category to be analyzed using ANOVA is shown in Table 17. Participants were grouped based on years receiving hemodialysis treatment. Of note, no participants were on hemodialysis for less than six months ensuring only chronic kidney disease patients are included in the study. Statistical analysis revealed no significant differences in quality of life scores between participants receiving hemodialysis for zero to two years, two to five years, and five or more years. General trends revealed that those on hemodialysis for shorter periods of time had higher quality of life scores while those on hemodialysis for more than five years had the lowest overall quality of life scores.

Table 17.

Analysis of mean quality of life scores; time on treatment in years.

Treatment Time	n	Total	Environmental	Physical	Psychological	Social
0-2	69	62.4 ± 13.8	72.1 ± 16.1	53.8 ± 17.4	62.7 ± 15.5	58.9 ± 19.9
2-5	83	59.0 ± 16.4	69.2 ± 15.8	53.3 ± 20.6	57.4 ± 20.1	52.1 ± 22.2
5+	98	59.3 ± 18.0	68.5 ± 18.5	51.0 ± 20.4	60.4 ± 21.3	55.1 ± 23.4
p value		0.37	0.38	0.60	0.24	0.17

Perhaps the most significant demographic category for this study was education level. Participants were grouped based on education level, high school/GED/less education, associates degree, or bachelors/masters/PhD. There were only two participants with less than a high school diploma, one with elementary education and one with only some high school education. Participants with a bachelors/masters/PhD had higher quality of life scores than those with less education. Those with an associates degree tended to have lower quality of life scores than those with high school or less. Every domain of quality of life, including total score, had statistically significant differences in quality of life scores. Most notably, total quality of life and environmental factors had very highly significant differences with p values less than 0.001.

Table 18.

Analysis of mean quality of life scores; education level. High school or less, associates degree, bachelors/masters/PhD.

Education	n	Total	Environmental	Physical	Psychological	Social
≤ High School	81	57.1 ± 15.4	66.6 ± 17.0	49.5 ± 17.2	56.3 ± 18.0	52.9 ± 21.6
Associates	63	55.8 ± 17.5	64.1 ± 16.9	50.2 ± 19.5	56.3 ± 20.9	49.2 ± 25.2
≥ Bachelors	106	64.9 ± 15.3	75.4 ± 15.4	56.2 ± 21.0	65.1 ± 18.8	60.5 ± 19.5
p value		<0.001**	<0.001**	<0.05*	<0.05*	<0.05*

The last demographic category analyzed was marital status. Participants were grouped into two larger groups of married (including living as married) or unmarried (including single, divorced, separated, and widowed) to create comparable sample sizes. General trend indicates married participants had higher quality of life scores in all domains when compared to unmarried participants. Unpaired t-tests were used and statistically significant differences were found in all domains except social relationships. The greatest difference was found in the environmental factors domain, married (72.7 ± 15.9) and unmarried (57.5 ± 17.3) groups with a p value of less than 0.01. Table 19 below portrays the mean quality of life scores for each domain as related to marital status.

Table 19.

Analysis of mean quality of life scores; marital status.

Marital Status	n	Total	Environmental	Physical	Psychological	Social
Married	133	62.4 ± 15.3	72.7 ± 15.9	54.9 ± 18.6	62.4 ± 18.6	56.0 ± 20.7
Unmarried	117	57.5 ± 17.3	66.4 ± 17.6	49.8 ± 20.5	57.4 ± 20.3	54.3 ± 23.8
p value		<0.05*	<0.01*	<0.05*	<0.05*	0.55

Analysis of the demographic categories of age, gender, time on treatment, education level, and marital status revealed multiple statistically significant findings. The mean quality of life scores were significantly different between younger participants and older participants with higher scores found in those over 60 years of age in total, environmental factors, and psychological health domains. Neither gender nor time on treatment had any significant differences in mean quality of life scores while education level and marital status had statistically significant differences in all or almost all domains. In general, the quality of life scores within the demographic categories followed similar trends as previous analysis of comorbidity groups with environmental factors having had the highest scores and physical health having had the lowest.

Conclusion

The analysis of participant quality of life within demographic categories and comorbidity groups was presented throughout Chapter Four. Exclusively through the use of tables, comparisons between comorbidity groups and demographic categories were made by presenting mean quality of life scores and corresponding p values. P values less than or equal to 0.05 were

considered significant while p values greater than 0.05 were not significant. This conclusion will serve as a summary of the data analysis highlighting general trends and significant findings.

At the end of data collection, there were 250 eligible participants that met all of the inclusion criteria for the study. Of those 250 participants, 99 participants had neither diabetes nor obesity (control group), 36 participants had only diabetes, 59 participants had only obesity, and 56 participants had both diabetes and obesity. Through use of unpaired t-tests, statistically significant differences in mean quality of life scores were found between diabetes and control group participants, obesity and control group participants, and both diabetes and obesity and the control group. No statistically significant difference was found between the diabetes and obesity groups. In each of these comparisons, the comorbidity groups scored lower on quality of life measures than the control group. The diabetes group had the lowest overall quality of life scores across each domain in comparison to all other comorbidity groups, even the diabetes and obesity group. Analysis of these groups also revealed that the environmental factors domain had the highest quality of life scores across all comorbidity groups while physical health had the lowest scores in each group. While analysis of the comorbidity groups was the primary focus of this study, additional analysis of demographic categories was done to identify any significant confounding variables that may have influenced scoring trends.

For demographic analysis, unpaired t-tests were used to make comparisons within the age, gender, and marital status categories. ANOVA was used in the analysis of time on treatment and education level categories. The same p value cutoffs were used for determination of significance within these analyses (i.e., p value less than or equal to 0.05 is significant, p value greater than 0.05 is not significant). Analysis revealed statistical significance within the age, education level, and marital status categories. Participants older than 60 years of age generally

had higher quality of life scores than those younger than 60. Participants with a bachelors, masters, or PhD had higher quality of life scores than those with an associates, high school or less education. And finally, married participants had higher quality of life scores than unmarried participants. General trends also revealed that environmental factors had the highest scores while physical health had the lowest. This trend is consistent with the trends found in the comorbidity groups analysis.

Data analysis yielded multiple statistically significant differences in mean quality of life scores, both within the comorbidity groups and within the demographic categories of age, education level, and marital status. The fifth and final chapter of this study further discusses the results of data analysis, tying results to previous research, and presents potential reasons for the differences found in participant quality of life. Additionally, the chapter evaluates possible areas for further research and, again, explores limitations of this study.

Chapter Five: Discussion

Introduction

The purpose of this study was to evaluate whether a relationship exists between quality of life in ESRD patients receiving hemodialysis treatment and diabetes and obesity. The researchers in this study also examined which comorbidity, diabetes or obesity, was more significantly related to quality of life in the patient population. Specifically, the study focused on comparison of quality of life scores between the control group (neither diabetes or obesity) and diabetes, obesity, and both diabetes and obesity groups. Additional analysis of demographic information including age, gender, time on treatment, education level, and marital status was done to identify significant relationships and potential confounding variables within the study design. This chapter discusses the results of the study and includes a description of the limitations, direction for future research, and a conclusion of this research study. Discussion of results are divided based on research questions addressed and quality of life domain.

Results Related to Research Questions

When analyzing the relationship between diabetes and quality of life, this study showed that the presence of diabetes in ESRD patients receiving hemodialysis was associated with lower quality of life when compared to participants without diabetes. Participants with diabetes reported a statistically significant lower quality of life score in four of the five quality of life domains with the exception being the social relationships category as discussed in the "Social Relationship" section below.

When considering the relationship between obesity and quality of life, this study showed that participants with obesity also had lower quality of life scores when compared to the control group. Of note, the decreased quality of life scores that resulted from the obesity group were only

statistically significant in the total and environmental domains when compared to the control group.

When analyzing whether the comorbidity of diabetes or obesity is more strongly related to a decreased quality of life, there was no statistically significant evidence to conclude which comorbidity is more strongly related to a decreased quality of life. Despite there being no statistical difference, when directly comparing diabetes to obesity, participants with diabetes reported lower quality of life scores across all five of the domains when compared to participants with obesity. Furthermore, the presence of both comorbidities did not equate to lower quality of life scores when compared to diabetes or obesity alone. In fact, participants with diabetes alone had lower quality of life scores than participants with both diabetes and obesity. A detailed discussion of each quality of life domain will be discussed in the next section, "Results Related to Quality of Life Domain".

Results Related to Quality of Life Domain

Total quality of life. In this study, the control group reported the highest quality of life scores across all domains when compared to other comorbidity groups. The difference in total quality of life was statistically significant between the control group and the diabetes group, with quality of life scores being significantly higher in the control group (64.3 ± 16.4, 53.8 ± 18.9; $p<0.05$). These findings are consistent with studies that were previously discussed in Chapter Two. Most notably, one study showed that patients with diabetes mellitus and kidney disease who were not yet receiving hemodialysis had a lower quality of life than patients already receiving hemodialysis who did not have diabetes (Zimbudzi et al., 2016). Participants with diabetes may have rated their overall quality of life and satisfaction with their overall health

lower than the control group because diabetes may negatively impact things like functional status, work capacity, and financial resources due to the burden of the disease.

When considering obesity, total quality of life was significantly higher in the control group compared to the obesity group (64.3 ± 16.4, 59.1 ± 13.9; $p<0.05$). This is also consistent with the previous literature discussed in Chapter Two. For example, Turgut and Abdel-Rahman (2017) and Beberashvili et al. (2019) found that obese ESRD patients receiving hemodialysis had lower quality of life than non-obese ESRD patients. Additionally, Knudsen, Eidemak, and Molsted (2016), who examined two groups of ESRD patients 13 years apart, found that the later group had a higher BMI and lower quality of life than the earlier group.

In this study, participants with obesity may have rated their overall quality of life and satisfaction with their health lower than non-obese participants for many reasons. For example, higher incidence of hemodialysis treatment complications, limited functional status, and higher incidence of depression in obese individuals are a few of many factors that may play a role. A longitudinal meta-analysis done in 2010 (Luppino, et al.) revealed that those with obesity had a 55% higher risk of developing depression in their lifetime when compared to those without obesity, likely contributing to poorer quality of life overall.

Additionally, total quality of life was statistically significant between the control group and the diabetes and obesity group, with total quality of life scores significantly higher in the control group (64.3 ± 16.4, 57.8 ± 15.7; $p<0.05$). Relatedly, previous literature has shown that multiple comorbidities, including both diabetes and obesity, negatively impact quality of life in kidney disease patients (Liu, Yeh, Weng, Bai, & Chang, 2017; Mandoorah, Shaheen, Mandoorah, Bawazir, & Alshohaib, 2014). This finding may be because the factors that negatively impact

individuals with either diabetes or obesity confound to decrease overall quality of life in the diabetes plus obesity group.

Environmental factors. Environmental quality of life takes into account concepts such as a healthy physical environment, financial resources to meet basic needs, resources and availability for leisure activities, living space conditions, and access to health services and transportation. Environmental quality of life was found to be significantly lower in the diabetes group when compared to the control group (62.5 ± 19.2, 74.9 ± 16.3; $p<0.05$). Extensive management and complications associated with the presence of diabetes including retinopathy, neuropathy, medications, and blood sugar management could play a role in difficulties with finances, health services, and transportation which could contribute to lower quality of life scores.

The obesity group also had a significantly lower quality of life regarding environmental factors than the control group (67.6 ± 14.0, 74.9 ± 16.3; $p<0.05$). A systematic review found that morbidly obese ESRD patients receiving hemodialysis have a lower quality of life than non-obese patients due to factors including more frequent dialysis visits, difficulty with transportation, and inability to maneuver clinic spaces (Turgut & Abdel-Rahman, 2017). The aforementioned factors could contribute to the lower environmental quality of life scores.

Similar to the trends regarding the presence of diabetes or obesity, the presence of both diabetes and obesity was associated with poorer quality of life scores when compared to the control group (74.9 ± 16.3, 67.4 ± 17.3, $p<0.01$). The factors that may have contributed to decreased quality of life with each comorbidity alone could remain true and, in combination, may be further amplified given the increased disease burden of both comorbidities.

Physical health. Physical quality of life takes into account the impact of disease on activities, energy level, dependency on medical treatment as a means to function, functional status, sleep, ability to perform activities of daily living, and the capacity to work. Similar to previous trends, when analyzing the presence of diabetes, physical quality of life was significantly lower in the diabetes group when compared to the control group (46.2 ± 20.1, 57.5 ± 19.9; $p<0.05$).

As previously mentioned, diabetes can lead to various complications, each may lead to impairment of physical health. Examples of this include retinopathy, which may cause visual impairment; peripheral vascular disease, which may lead to claudication or amputation; or neuropathy, which may cause chronic pain (Inzucchi & Lupsa, 2020). Such physical impairments may limit or inhibit individuals from performing daily living activities, work requirements, or activities that promote higher quality of life (e.g., participating in family activities) (Inzucchi & Lupsa, 2020). Another notable component of physical quality of life in those with diabetes is that these individuals are likely dependent on anti-diabetic medications. These medications come with several side effects, such as hypoglycemia and weight gain that may also negatively impact quality of life (Inzucchi & Lupsa, 2020). Additionally, the potential need for injectable medications such as insulin, and fingerstick glucose checking adds physical discomfort and inconvenience to the list of factors that may decrease quality of life of diabetic participants.

There was no significant difference in physical quality of life between the control group and the obesity group (57.5 ± 19.9, 51.3 ± 19.1; $p=0.06$). Previous research has shown an increased incidence of chronic pain in individuals with obesity, as discussed in a systematic review by (Okifuji & Hare, 2015). Additionally, there is a higher incidence of functional impairment in obese individuals compared to non-obese individuals, potentially leading to

decreased quality of life (Jenkins, 2004). Less severe obesity may not cause as significant functional impairment, limitations of daily activities, or decreased work capacity. Further division of BMI categories may be beneficial in drawing additional conclusions regarding the relationship between quality of life and obesity.

When comparing the diabetes and obesity group with the control group, the diabetes and obesity group reported a statistically significant lower quality of life score when compared to the control group (57.5 ± 19.9, 49.0 ± 17.8, $p<0.01$). This finding may be due to a combination of the factors that contribute to decreased physical quality of life in the diabetes group and the obesity group described above.

Psychological health. Psychological quality of life takes into account enjoyment of life, ability to view life as meaningful, ability to concentrate, accepting bodily appearance, satisfaction with self, and the presence of negative feelings. There was a significant difference in psychological quality of life between the control group and the diabetes group, with higher psychological health in the control group (62.7 ± 19.7, 53.0 ± 22.8; $p<0.05$). Previous literature suggests that diabetes is associated with depression, negatively impacting psychological health (Bădescu et al., 2016). This associated depression could lead to the presence of negative feelings, dissatisfaction with self, and decreased enjoyment of life.

Psychological quality of life was not significantly different between the control and obesity groups (62.7 ± 19.7, 59.7 ± 16.5; $p=0.31$). Additionally, there was also no significant difference in psychological quality of life between the control group and the diabetes and obesity group (62.7 ± 19.7, 60.3 ± 19.1; $p=0.46$). Despite previous studies showing an increased risk of depression in those with obesity, participants of this study did not portray significant differences

in questions regarding satisfaction with self, enjoyment of life, ability to concentrate, or ability to view life as meaningful.

Social relationships. Social quality of life takes into account satisfaction with personal relationships, sex life, and support from friends. Social quality of life between the diabetes group and the control group (52.1 ± 21.5, 58.2 ± 22.4; p=0.16), control group and obesity group (58.2 ± 22.4, 55.8 ± 21.3; p=0.51), control group and diabetes and obesity group (58.2 ± 22.4, 51.2 ± 22.7; p=0.07), and the diabetes group and the obesity group (52.1 ± 21.5, 55.8 ± 21.3; p=0.42) revealed no statistical differences. The social quality of life may not have been significantly different in these groups given that the participants were all members of at least one support group, which may have positively influenced their social relationships by providing social support and access to personal relationships.

Demographic Findings

In addition to evaluation of the research questions using the WHOQOL-BREF, researchers evaluated demographic information including age, gender, time on treatment, marital status, and education level. The purpose of these analyses was to highlight areas of significant relationships between participant demographics and quality of life. The following discussion is divided by demographic category and is presented as supplemental to the above findings related to the research questions. While these findings are significant, they are not the primary focus of the study and are thus discussed briefly. Further investigation into these topics may yield more definitive conclusions.

Age and quality of life. There was a significant difference in the quality of life with individuals over the age of 60 reporting increased scores in total quality of life (56.6 ± 17.0, 62.6 ± 21.3, $p<0.01$), environmental factors (64.4 ± 18.0, 73.5 ± 15.2, $p<0.001$), and psychological

health (55.6 ± 20.2, 63.2 ± 18.4, $p<0.01$) when compared to individuals 59 years of age or younger. Researchers predict that participants over the age of 60 may have higher quality of life scores due to improved satisfaction with self, ability to view life as meaningful, increased access to transportation, and increased stability of financial resources. Given the significance found in this category, further research may be beneficial in identifying potentially contributing factors.

Gender and quality of life. There was no significant difference in overall quality of life between male and female participants. Of note, there was a significant difference in social quality of life scores with females reporting an overall higher social quality of life score when compared to males (58.5 ± 20.9, 51.9 ± 23.0, $p<0.05$). This may indicate that female participants have a stronger social network for support than their male counterparts. Women may feel more inclined to accept help and comfort from their friends and family than men which may relate to higher social scores for women.

Time on treatment and quality of life. There was no significant difference in quality of life when comparing the number of years receiving hemodialysis treatment. The insignificance in this section may be, like all other sections, multifactorial. Those on treatment for longer periods of time may feel more established in their treatment routine and may have reached a point of acceptance allowing them to find a new "normal" way of living. The reverse may be true of those on treatment for less time: they may have more uncertainty about their disease and the treatment course or may feel overwhelmed by the burden of disease. In this population, quality of life scores were not significantly different across length of treatment times.

Marital status and quality of life. There was statistical significance in overall (62.4 ± 15.3, 57.5 ± 17.3, $p<0.05$), environmental (72.7 ± 15.9, 66.4 ± 17.6, $p<0.01$), physical (54.9 ± 18.6, 49.8 ± 20.5, $p<0.5$), and psychological (62.4 ± 18.6, 57.4 ± 20.3, $p<0.05$) quality of life

with individuals who are married reporting an increase in quality of life scores when compared to individuals who are unmarried. The unmarried group in this study consists of those that are single, separated, divorced, and widowed. With the presence of a spouse, it is possible that qualities such as finding meaning in one's life, having readily available assistance with activities of daily living and transportation, and a decrease in personal financial strain decrease disease burden which can contribute to an increase in quality of life scores.

Education level and quality of life. There was statistical significance in all five quality of life categories; total, environmental, physical health, psychological health, social relationships. Individuals who received a bachelor degree (or higher) reported increased quality of life scores when compared to individuals with an associates degree and individuals with a high school diploma (or lower). Given the significance found in this demographic category, further studies may be warranted to evaluate the potential reasons for significant differences found in quality of life across various education levels. Consideration for evaluation of socioeconomic status in conjunction with education level may be beneficial in drawing further conclusions.

Limitations

Some unforeseen limitations during the data collection period of the study include world events such as the COVID-19 pandemic. The presence of these worldly events could have unintentionally impacted overall quality of life scores. For example, COVID-19 may have caused decreased quality of life in this patient population as a whole as ESRD patients are at a higher risk for complications from the virus.

Additionally, and as previously described, BMI was calculated via participant reported height and weight. This is a limitation because previous literature has shown that waist

circumference is a better predictor of obesity in this population and is more strongly associated with quality of life in ESRD patients (Beberashvili et al., 2019). Also, in an effort to maintain validity of the study, the researchers thoroughly examined each individual's BMI and eliminated one participant from the study due to an outlier value that was very likely an inaccurate BMI.

The population, platform, and survey tool were intentionally set in order to narrow the scope of the study and for consistency of results. The collection of demographic information also served to identify potential confounding variables that may impact quality of life of participants; specifically age, gender, country of residence, marital status, and education level. While delimitations constrained the extent of the study, limitations may have unintentionally impacted the results of this study. Previously discussed limitations including response bias, possibility of multiple responses from individuals, need for internet access, and belonging to a support group continue to be acknowledged and should be considered a limitation.

Further Research

The results obtained in this study are consistent with the findings from the literature review in Chapter Two. The comorbidity of diabetes in conjunction with ESRD was found to be significant in that individuals with diabetes and ESRD reported an overall lower quality of life score when compared to individuals with ESRD without diabetes. This finding could open up possible avenues of research to explore if type one versus type two diabetes, glycemic control, and/or the presence of other comorbidities associated with diabetes (e.g., retinopathy, neuropathy) influence the quality of life of ESRD patients receiving hemodialysis.

The results of this study also concluded that the presence of obesity with ESRD resulted in lower quality of life scores when compared to individuals with ESRD who were not obese. Further avenues of research could include comparing more specific classes of weight (i.e.,

underweight, normal, overweight, obese, and morbidly obese) to further assess significance of BMI on quality of life among ESRD patients. There may be significant differences in quality of life scores if obesity was further broken up into BMI sections, comparing BMI values rather than doing not obese versus obese.

Additionally, further research could be conducted to evaluate the statistical findings from the demographics section of the survey. For example, participants with bachelor's degrees reported a statistically significant increase in quality of life across all five domains when compared to participants with an associate's degree or less. Similarly, participants who are married reported a statistically significant increase in quality of life in four of the five domains when compared to unmarried participants. Additional research opportunities may lie in assessing the relationship between participant demographics and their influence on the quality of life in ESRD patients receiving hemodialysis.

Lastly, the most statistically significant domain in each of the different analyses was found to be environmental factors. Further research into the environmental factors questions of this survey may yield a greater understanding of why this area is so important to quality of life among ESRD patients receiving hemodialysis.

Conclusion

This study aimed to explore the differences between comorbid diabetes and comorbid obesity and their impact on quality of life in the ESRD patient population who receive hemodialysis treatment. The results of this study were obtained through various support groups on Facebook. Results of the study were collected and analyzed in an effort to determine what relationship, if any, exists between the aforementioned comorbidities and quality of life. A number of relationships were found within the data. Most notably, participants with comorbid

diabetes reported a decreased quality of life among all five domains when compared to participants with obesity and those with no comorbidities (i.e., the control group). In terms of statistical significance, diabetes was found to have a decreased quality of life score when compared to the control group in four of the five domains. Though diabetes and obesity yielded statistically significant results when compared to the control group, when compared to each other, neither comorbidity showed to be statistically significant in its impact on quality of life.

A review of study limitations and further research opportunities was also included within the chapter. Worldly events such as the COVID-19 pandemic may have impacted the study in unforeseeable ways. Discussion regarding study design and use of waist circumference instead of BMI and further evaluation of severity of diabetes and obesity may be considered in the future. The results of this study may be utilized to improve understanding of the ESRD patient population and to shed light on the growing burden of disease. These findings can be used in an effort to further support individuals with comorbid diabetes and/or obesity and may lead to development of interventions aimed to improve quality of life in ESRD patients receiving hemodialysis.

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APPENDIX A

Survey Tool

Q4.1.
This questionnaire asks how you feel about your quality of life, health, or other areas of your life. Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last two weeks.

Q4.2. How would you rate your quality of life?

Very poor	Poor	Neither poor nor good	Good	Very good

Q4.3. How satisfied are you with your health?

Very dissatisfied	Dissatisfied	Neither satisfied or dissatisfied	Satisfied	Very satisfied

Q5.1.
The following questions ask about **how much** you have experienced certain things in the last two weeks.

Q5.2. To what extent do you feel that physical pain prevents you from doing what you need to do?

Not at all	A little	A moderate amount	Very much	An extreme amount

Q5.3. How much do you need any medical treatment to function in your daily life?

Not at all	A little	A moderate amount	Very much	An extreme amount

Q5.4. How much do you enjoy life?

Not at all	A little	A moderate amount	Very much	An extreme amount

Q5.5. To what extent do you feel your life to be meaningful?

Not at all	A little	A moderate amount	Very much	An extreme amount

Q6.1. How well are you able to concentrate?

Not at all	Slightly	A moderate amount	Very much	Extremely

Q6.2. How safe do you feel in your daily life?

Not at all	Slightly	A moderate amount	Very much	Extremely

Q6.3. How healthy is your physical environment?

Not at all	Slightly	A moderate amount	Very much	Extremely

Q7.1. The following questions ask about **how completely** you experienced or were able to do certain things in the last two weeks.

Q7.2. Do you have enough energy for everyday life?

Not at all	A little	Moderately	Mostly	Completely

Q7.3. Are you able to accept your bodily appearance?

Not at all	A little	Moderately	Mostly	Completely

Q7.4. Do you have enough money to meet your needs?

Not at all	A little	Moderately	Mostly	Completely

Q7.5. How available to you is the information you need in your day to day life?

Not at all	A little	Moderately	Mostly	Completely

Q7.6. To what extent do you have the opportunity to experience leisure activities?

Not at all	A little	Moderately	Mostly	Completely

Q7.7. How well are you able to get around?

Very poor	Poor	Neither poor nor well	Well	Very well

Q8.1. The following questions ask you to say how **good or satisfied** you have felt about various aspects of your life over the last two weeks.

Q8.2. How satisfied are you with your sleep?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.3. How satisfied are you with your ability to perform your daily living activities?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.4. How satisfied are you with your capacity for work?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.5. How satisfied are you with yourself?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.6. How satisfied are you with your personal relationships?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.7. How satisfied are you with your sex life?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.8. How satisfied are you with the support you get from your friends?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.9. How satisfied are you with the conditions of your living place?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.10. How satisfied are you with your access to health services?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q8.11. How satisfied are you with your mode of transportation?

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied

Q9.1. The following question refers to **how often** you have felt or experienced certain things in the last two weeks.

Q9.2. How often do you have negative feelings, such as blue mood, despair, anxiety, depression?

Never	Seldom	Quite often	Very often	Always

Thank you for taking the time to participate in this survey. Your answers have been recorded!

APPENDIX B

Researcher Data Collection Script - Initial Facebook Post for the “Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group” Facebook Group

Hello, we are students from Bethel University's Physician Assistant Program. We are conducting research regarding quality of life in people receiving hemodialysis treatment. The study consists of an online survey that asks questions about your demographic information and quality of life. If you choose to proceed, the survey will take approximately 10 minutes to complete. No confidential information will be collected. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University or the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook group. Following completion of the study, all information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX C

Researcher Data Collection Script - Initial Facebook Post for the “Hemodialysis Support Group”, “Dialysis and Kidney Disease Support Group”, and “Kidney Dialysis Support Group” Facebook Pages

Hello, we are students from Bethel University's Physician Assistant Program. We are conducting research regarding quality of life in people receiving hemodialysis treatment. The study consists of an online survey that asks questions about your demographic information and quality of life. If you choose to proceed, the survey will take approximately 10 minutes to complete. No confidential information will be collected. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University or the Facebook group. Following completion of the study, all information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX D

Researcher Data Collection Script - Initial Facebook Post for the National Kidney Foundation

Hello, we are students from Bethel University's Physician Assistant Program. We are conducting research regarding quality of life in patients receiving hemodialysis treatment. The study consists of an online survey that asks questions about your demographic information and quality of life. If you choose to proceed, the survey will take approximately 10 minutes to complete. No confidential information will be collected and no medical records are being accessed. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University. Following completion of the study, any information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX E

Follow-Up Facebook Post for “Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group” Facebook Group

Hello, again! If you are currently undergoing hemodialysis treatment and have not participated in our study about quality of life, please consider taking the survey below. The survey will take approximately 10 minutes to complete. No confidential information will be collected. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University or the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook group. Following completion of the study, all information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX F

Follow-Up Facebook Post for “Hemodialysis Support Group”, “Dialysis and Kidney Disease Support Group”, and “Kidney Dialysis Support Group” Facebook Pages

Hello, again! If you are currently undergoing hemodialysis treatment and have not participated in our study about quality of life, please consider taking the survey below. The survey will take approximately 10 minutes to complete. No confidential information will be collected. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University or the Facebook group. Following completion of the study, all information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX G

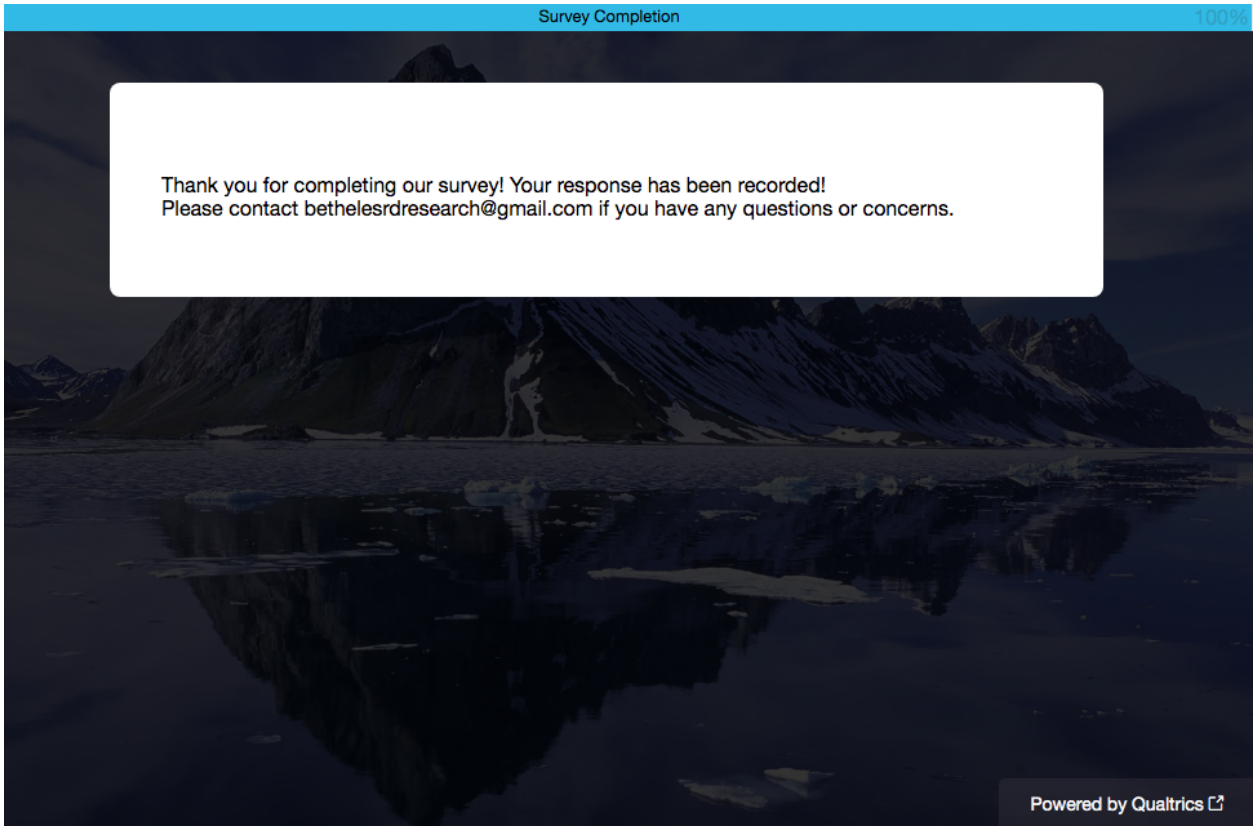
Follow-Up Facebook Post for NKF Facebook Page

Hello, again! If you are currently undergoing hemodialysis treatment and have not participated in our study about quality of life, please consider taking the survey below. The survey will take approximately 10 minutes to complete. No confidential information will be collected. Your participation is entirely voluntary and you can choose not to answer questions or discontinue participation at any time. Your decision to participate or not to participate will not impact your relationship with Bethel University. Following completion of the study, all information collected will be destroyed.

If you have any questions or difficulty with the survey link, please contact bethelESRDresearch@gmail.com.

APPENDIX H

Survey Completion “Thank You” Page


Survey Completion
100%
Thank you for completing our survey! Your response has been recorded!
Please contact bethelesrdresearch@gmail.com if you have any questions or concerns.
Powered by Qualtrics

APPENDIX I

Demographic Information Questions

Q2.1. Are you currently receiving hemodialysis treatment?

- Yes
- No

Q2.2. How long have you been on hemodialysis?

Less than 6 months	6 months to 1 year	1 to 2 years	2 to 3 years	3 to 4 years	4 to 5 years	More than 5 years

Q3.1. To start, please answer the following demographic information to the best of your knowledge. Responses are confidential and will be used during data analysis.

Q3.2. What is your gender?

- Male
- Female
- Other:

Q3.3. What is your age in years?

Under 18	18-20	20-29	30-39	40-49	50-59	60-69	70-79	Over 80

Q3.4. What is your highest level of education?

None	Elementary	Middle School (6-8th grade)	Some High School	High School Diploma/GED	Associates Degree	Bachelor's, Master's or PhD

Q3.5. What is your marital status?

Single	Separated	Divorced	Married	Widowed	Living as married

Q3.6. What is your height?

Q3.7. What is your weight in pounds?

Q3.8. Do you have Diabetes?

- Yes
- No

APPENDIX J

IRB Approval

September 29, 2020

Austyn, Hailey, & Paige;

As granted by the Bethel University Human Subjects committee as the program director, I write this letter to you in approval of Level 3 Bethel IRB of your project entitled: " Diabetes, Obesity, and Quality of Life among End-Stage Renal Disease Patients Receiving Hemodialysis." This approval is good for one year from today's date. You may proceed with data collection and analysis. Please let me know if you have any questions.

Sincerely;

Wallace Boeve, EdD, PA-C
Program Director
Physician Assistant Program
Bethel University

APPENDIX K

IRB Addendum 1

Hi Wally,

I am writing this email as an addendum to the previous IRB approval for Paige, Hailey, and I's research project. After two weeks of data collection through the facebook page we selected, Living with Kidney Failure - ESRD Support Group, we only received 9 responses. Because of this, we are hoping to expand our data collection to an additional three Facebook groups:

1) Hemodialysis Support Group (https://www.facebook.com/groups/419872078075922)

2) Kidney Dialysis Support Group (KDSG) (https://www.facebook.com/groups/220377678299244/?multi_permalinks=1267228686947466)

3) Dialysis and Kidney Disease Support Group (https://www.facebook.com/DialysisandKidney/)

I have been granted access to these groups for posting, however there are no specific approval communications as I have not been able to contact a site administrator. Lisa reviewed this detail with Dr. Peter Jankowski and confirmed that acceptance into the group is enough permission to continue with survey distribution.

The protocol will remain the same with 1 week of data collection initially (an initial post and mid-week follow-up post) and an additional week if there are fewer than 30 responses.

I have attached our initial IRB application to this email. Please let us know if there is anything further that we can provide for approval moving forwards,

Thank you for your time and consideration.

Yes, I approve this addendum and will ask Prof. Lisa Naser as your faculty chair and PA program's research coordinator to retain a copy of this email and attach it to the IRB application to keep in your file for future reference.

Sincerely;
Wally

Wallace Boeve, EdD, PA-C
Program Director, Physician Assistant Program
Bethel Universitv

APPENDIX L

IRB Addendum 2

Project Name: Diabetes, Obesity, and Quality of Life among End-Stage Renal Disease Patients Receiving Hemodialysis

Hi Cindy,

I am writing to you to ask approval for an IRB addendum. We submitted our original IRB application for our research project on 9/29/2020 to Wally and a first addendum to that on 10/23/2020. Despite adding three more groups to our data collection with the first application addendum, we are just short of our 30 responses we discussed in our original IRB application.

We recently were granted approval to add our survey to the National Kidney Foundation Facebook page and are writing this IRB addendum to ask approval to add this group to our data collection.

The protocol has not changed, we will still have our initial post and follow-up midweek post, however the language in the informed consent and facebook posts have changed slightly. The changes are illustrated in the attached documents.

Attached to this email is the ***original*** IRB application with the edited informed consent and facebook posts added separately. I have also included the previous two IRB approvals from Wally.

If there are any questions or concerns, I am happy to answer them.
Thank you for your time and consideration,
Austyn, Paige, and Hailey

--
Austyn Cross, PA-S
Bethel University Graduate School

Hi Austyn,

Yes, I will approve this addendum to your original IRB request. I will have your faculty chair, Prof. Naser, to retain a copy of this email and attach it to the IRB application to keep in your file for future reference.

Sincerely,

Cindy
Cynthia Goetz, MPAS, PA-C
Associate Professor | Interim Program Director
Bethel University | Physician Assistant Program

APPENDIX M

Informed Consent for "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook Group

BETHEL UNIVERSITY PHYSICIAN ASSISTANT PROGRAM
INFORMED CONSENT

You have been identified as a potential participant and are invited to partake in the following survey regarding quality of life. The study is designed to determine the relationship between diabetes, obesity, and quality of life in patients with end-stage renal disease receiving hemodialysis treatment. Researchers are students in Bethel University's Physician Assistant Program and are conducting this research in partial fulfillment of their master's thesis.

Participation in the study is entirely voluntary and participants may withdraw from the study at any time. If you choose to participate, the online demographic and quality of life survey will take approximately 10 minutes to complete.

Data collected from surveys will not contain any identifiable information including: name, date of birth, or medical record number. The sealed data will be stored at Bethel University and on password protected computers belonging to researchers.

Your decision to participate and information gathered from the survey will not impact your relationship with Bethel University or the "Living With Kidney Failure - End Stage Renal Disease (ESRD) Support Group" Facebook group in any way.

If your participation in the study provokes feelings of anxiety or depression and you wish to seek help, please contact the National Disaster Distress hotline at 1-800-985-5990.

This research project has been approved by Bethel University's PA Program Director with Bethel's Levels of Review for Research with Humans. If you have any questions about the research and/or research participants' rights or wish to report a research-related injury, please contact:
Austyn Cross (Researcher)
Hailey Shaull (Researcher)
Paige Urquhart (Researcher)
Lisa Naser (Bethel University Faculty Sponsor)
Wallace Boeve (Bethel University Faculty Sponsor)
By checking this box and completing the survey, you are granting consent to participate in this research.

Yes, I have read the informed consent and agree to participate in the study.

No, I do not wish to participate in the study.

APPENDIX N

Informed Consent for “Hemodialysis Support Group”, “Dialysis and Kidney Disease Support Group”, and “Kidney Dialysis Support Group” Facebook Pages

BETHEL UNIVERSITY PHYSICIAN ASSISTANT PROGRAM
INFORMED CONSENT

You have been identified as a potential participant and are invited to partake in the following survey regarding quality of life. The study is designed to determine the relationship between diabetes, obesity, and quality of life in patients with end-stage renal disease receiving hemodialysis treatment. Researchers are students in Bethel University's Physician Assistant Program and are conducting this research in partial fulfillment of their master's thesis.

Participation in the study is entirely voluntary and participants may withdraw from the study at any time. If you choose to participate, the online demographic and quality of life survey will take approximately 10 minutes to complete.

Data collected from surveys will not contain any identifiable information including: name, date of birth, or medical record number. The sealed data will be stored at Bethel University and on password protected computers belonging to researchers.

Your decision to participate and information gathered from the survey will not impact your relationship with Bethel University or the Facebook group in any way.

If your participation in the study provokes feelings of anxiety or depression and you wish to seek help, please contact the National Disaster Distress hotline at 1-800-985-5990.

This research project has been approved by Bethel University's PA Program Director with Bethel's Levels of Review for Research with Humans. If you have any questions about the research and/or research participants' rights or wish to report a research-related injury, please contact:
Austyn Cross (Researcher)
Hailey Shaull (Researcher)
Paige Urquhart (Researcher)
Lisa Naser (Bethel University Faculty Sponsor)
Wallace Boeve (Bethel University Faculty Sponsor)
By checking this box and completing the survey, you are granting consent to participate in this research.

Yes, I have read the informed consent and agree to participate in the study.

No, I do not wish to participate in the study.

APPENDIX O

Informed Consent for the National Kidney Foundation Facebook Group

BETHEL UNIVERSITY PHYSICIAN ASSISTANT PROGRAM
INFORMED CONSENT

You have been identified as a potential participant and are invited to participate in the following survey about quality of life. The objective of the study is to explore the relationship between diabetes, obesity, and quality of life in people with end-stage renal disease who are receiving hemodialysis treatment. Researchers are students in Bethel University's Physician Assistant Program.

Participation in the study is entirely voluntary and you may withdraw without repercussions at any time by closing the Qualtrics browser or choosing to not answer all questions. If you choose to participate, the online demographic and quality of life survey will take approximately 10 minutes to complete.

Data collected from surveys will not contain any identifiable information including: name or date of birth. Participants and their responses will remain anonymous. The sealed data will be stored at Bethel University and on password protected computers belonging to researchers.

Your decision to participate and information gathered from the survey will not impact your relationship with Bethel University in any way.

If your participation in the study provokes feelings of anxiety or depression and you wish to seek help, please contact the National Helpline at 1-800-662-HELP (4357).

This research project has been approved by Bethel University's PA Program Director with Bethel's Levels of Review for Research with Humans. If you have any questions about the research and/or research participants' rights or wish to report a research-related injury, please contact:
Austyn Cross (Researcher)
Hailey Shaull (Researcher)
Paige Urquhart (Researcher)
Lisa Naser (Bethel University Faculty Sponsor)

By checking this box and completing the survey, you are granting consent to participate in this research.

Yes, I have read the informed consent and agree to participate in the study.

No, I do not wish to participate in the study.

APPENDIX P

Approval for WHOQOL-BREF Use

World Health Organization Quality of Life (WHOQOL) Instrument Order Form

US English Version Only

Your responses have been submitted.

Thank you for the interest in the WHOQOL-BREF. Download the PDF version of the questionnaire and scoring instructions here:

http://depts.washington.edu/seaqol/docs/WHOQOL-BREF%20and%20Scoring%20Instructions.pdf

Thank you.

Thank you for your interest in the World Health Organization Quality of Life — BREF US English Version Instruments.

We distribute the WHOQOL-BREF U.S. English Version free of charge as electronic files.

We are unable to answer questions about the WHOQO-BREF not addressed in the user manual.

Although this information isn't required, we would also appreciate a short description of how you plan to use the instrument. The information would be used to enhance the effectiveness of future instruments or revisions.

Sincerely,

Instrument Dissemination Coordinator, US WHOQOL Center

APPENDIX Q

WHOQOL-BREF Scoring

WHOQOL-BREF Scoring

The WHOQOL-Bref, still in field trials, is a subset of 26 items taken from the WHOQOL-100. The same steps for the scoring WHOQOL-100 should be followed to achieve scores for the Bref. Although scoring the Bref is identical to scoring the WHOQOL-100, there are some differences that need to be addressed:

- The WHOQOL-Bref does not have facet scores
- Mean substitutions are recommended for Domain 1 *Physical Health* and Domain 4 *Environment* if no more than one item is coded missing
- Only three items need to be reversed before scoring

The WHOQOL-Bref (Field Trial Version) produces a profile with four domain scores and two individually scored items about an individual's overall perception of quality of life and health. The four domain scores are scaled in a positive direction with higher scores indicating a higher quality of life. Three items of the Bref must be reversed before scoring. They can be seen in Table 9, indicated by the "- (reverse)" denotation in the *Direction of scaling* column.

TABLE 9. Scoring Domains of the WHOQOL-BREF

Domains and questions 236/BREF		Direction of scaling	Raw domain score	Raw item score
Overall Quality of Life and General Health			....(2-10)	
G1.1/B1	How would you rate your quality of life?	+		....(1-5)
G2.3/B2	How satisfied are you with your health?	+		....(1-5)
Domain 1	**Physical Health**		....(7-35)	
F1.2.5/B3	To what extent do you feel that physical pain prevents you from doing what you need to do?	-(reverse)		....(1-5)
F13.1.4/B4	How much do you need any medical treatment to function in your daily life?	-(reverse)		....(1-5)
F2.1.1/B10	Do you have enough energy for everyday life?	+		....(1-5)
F11.1.1/B15	How well are you able to get around?	+		....(1-5)
F4.1.1/B16	How satisfied are you with your sleep	+		....(1-5)
F12.2.3/B17	How satisfied are you with your ability to perform your daily living activities?	+		....(1-5)
F16.2.1/B18	How satisfied are you with your capacity for work?	+		....(1-5)
Domain 2	**Psychological**		....(6-30)	
F6.1.2/B5	How much do you enjoy life?	+		....(1-5)
F29.1.3/B6	To what extent do you feel your life to be meaningful?	+		....(1-5)
F7.1.6/B7	How well are you able to concentrate?	+		....(1-5)
F9.1.2/B11	Are you able to accept your bodily appearance?	+		....(1-5)
F8.2.1/B19	How satisfied are you with yourself?	+		....(1-5)
F10.1.2/B26	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	- (reverse)		....(1-5)
Domain 3	**Social relationships**		....(3-15)	
F17.1.3/B20	How satisfied are you with your personal relationships?	+		....(1-5)
F3.2.1/B21	How satisfied are you with your sex life?	+		....(1-5)
F18.2.5/B22	How satisfied are with the support you get from your friends?	+		....(1-5)

Domains and questions 236/BREF		Direction of scaling	Raw domain score	Raw item score
Domain 4	**Environment**		....(8-40)	
F20.1.2/B8	How safe do you feel in your daily life?	+		....(1-5)
F27.1.2/B9	How healthy is your physical environment?	+		....(1-5)
F23.1.1/B12	Have you enough money to meet your needs?	+		....(1-5)
F25.1.1/B13	How available to you is the information that you need in your daily-to-day life?	+		....(1-5)
F26.1.2/B14	To what extent do you have the opportunity for leisure activities?	+		....(1-5)
F21.2.2/B23	How satisfied are you with the condition of your living place?	+		....(1-5)
F24.2.1/B24	How satisfied are you with your access to health services?	+		....(1-5)
F28.2.2/B25	How satisfied are you with your transport?	+		....(1-5)

If no more than one item from the *Physical Health* or *Environment* domains has been coded as missing, we recommend that a domain score be calculated by substituting a person-specific average across the completed items in the same scale. For example, if a respondent does not have a value for item B16 *How satisfied are you with your sleep?* in the Physical Health domain, but has answered all of the other items in that domain, then the value for item B16 would be the average of the remaining 6 items. If two or more items are coded missing in these two domains, the domain score should not be calculated, likewise if any items are coded missing in the *Psychological* and *Social Relationships* domains, a domain score for that respondent would not be calculated.

After item recoding and handling of missing data, a raw score is computed by a simple algebraic sum of each item in each of the four domains. Once complete, check the frequencies of each domain to be sure that the scores are within the correct range indicated in Table 9 *Raw domain score* column. The next step is to transform each raw scale score using the formula on page 32. The possible raw score ranges for each domain are as follows: *Physical Health*=28, *Psychological*=24, *Social Relationships*=12, and *Environment*=32.

Scoring Exercise and Test Dataset for the WHOQOL-BREF Instrument

The purpose of this scoring exercise is to help WHOQOL-Bref users to evaluate results from each step in the process of calculating the Domain summary scores of the instrument. This exercise was created for SPSS users, but with minor modifications, can be adapted for other computer programs or can be useful for those scoring the survey manually.

A test dataset and SPSS code for scoring the WHOQOL-Bref a computer disk in this packet. The test dataset, which is called "**WQ_BREF.TXT**" on the disk, contains data from 64 administrations of the WHOQOL-BREF. The data can be seen in *Appendix F*. The enclosed diskette also provides the user with the SPSS syntax used to:

- import raw data into SPSS format [**WQ_B_DL.SPS**]
- derive the WHOQOL-BREF domain summaries [**WQ_BREF.SPS**]

The SPSS code (called "**WQ_BREF.SPS**") on the disk begins by labeling all items and checking for out-or-range values. It then recodes the 3 negatively stated items so that a higher score indicates better health. The 4 domains are then scored, labeled, and transformed to a 0 to 100 scale used to interpret and compare to other validated instrument tools such as the WHOQOL-100. A copy of the SPSS syntax is reproduced in Appendix F.

Table 10 presents statistics for the transformed domains for the WHOQOL-Bref. After scoring the test dataset, the means, standard deviations, and minimum and maximum observed values should agree with those presented in Table 10

TABLE 10. Test Dataset Descriptive Statistics: WHOQOL-BREF

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Physical (TRANSFORMED)	64	32.14	92.86	66.7969	14.5480
Psychological (TRANSFORMED)	64	37.50	95.83	73.5026	13.7165
Social Relations (TRANSFORMED)	64	25.00	100.00	73.1771	17.0891
Environment (TRANSFORMED)	64	28.13	100.00	72.8027	14.1592
Valid N (listwise)	64				

DOMAIN SCORES

Domains	WHOQOL-100 Facets	Raw domain score	Raw score range
Domain 1: Physical	Facet 1 + Facet 2 + Facet 3	12 - 60	48
Domain 2: Psychological	Facet 4 + Facet 5 + Facet 6 + Facet 7 + Facet 8	20 – 100	80
Domain 3: Level of Independence	Facet 9 + Facet 10 + Facet 11 + Facet 12	16 – 80	64
Domain 4: Social relationships	Facet 13 + Facet 14 + Facet 15	12 – 60	48
Domain 5: Environment	Facet 16 + Facet 17 + Facet 18 + Facet 19 + Facet 20 + Facet 21+ Facet 22 + Facet 23	32 – 160	128
Domain 6: Spirituality / Religion / Personal beliefs	Facet 24	4 – 20	16

TRANSFORMATION OF SCALE SCORES

The next step involves transforming each raw scale score to a 0-100 scale using the formula shown below:

$$\text{Transformed Scale} = \left[\frac{(\text{Actual raw score} - \text{lowest possible raw score})}{\text{Possible raw score range}}\right] \times 100$$

where "Actual raw score" is the values achieved through summation, "lowest possible raw score" is the lowest possible value that could occur through summation (this value would be 4 for all facets), and "Possible raw score range" is the difference between the maximum possible raw score and the lowest possible raw score (this value would be 16 for all facets: 20 minus 4).

This transformation converts the lowest and highest possible scores to zero and 100, respectively. Scores between these values represent the percentage of the total possible score achieved. The WHOQOL-100 scores from other Centers may not be transformed to the 0-100 scale. The U.S.WHOQOL instruments and scoring programs have used this transformation to provide comparative data for interpretation.

Example: A Facet 1 "Pain and discomfort" raw score of 15 would be transformed as follows:

$$\text{Transformed Scale} = \left[\frac{(15 - 4)}{16}\right] \times 100 = 68.75$$