ADHERENCE, PATIENT SATISFACTION, AND MENTAL HEALTH AMONG ORGAN TRANSPLANT PATIENTS DURING THE COVID-19 PANDEMIC

by

Kennedy S. Anderson, B. S.

A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Arts
with a Major in Psychological Research
May 2021

Committee Members:

Joseph Etherton, Chair

Kelly Haskard-Zolnierek

Ollie Seay

FAIR USE AND AUTHOR'S PERMISSION STATEMENT

DEDICATION

This thesis is dedicated to my husband, who has helped me pursue my personal, academic, and professional dreams, and my mother, who inspires my research.

ACKNOWLEDGEMENTS

I would like to acknowledge my graduate advisor, Dr. Joe Etherton, for helping me with this process and preparing me for my future career. I would also like to thank Dr. Kelly Haskard-Zolnierek and Dr. Krista Howard for helping to create this project. Finally, I would like to thank Kristen Hardin-Sigler and Dylan Sigler for their excellent collaboration and support.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

ABSTRACT

The COVID-19 pandemic upended the physical and mental health of millions around the globe. Organ transplant patients are physically and psychologically vulnerable during the COVID-19 pandemic due to their frequent morbidities, required immunosuppressant medication, and high prevalence rate of psychopathology. Previous research has shown that poor mental health affects treatment adherence and patient satisfaction in transplant patients, which can result in negative health outcomes as severe as organ rejection and death. In the current study, 99 organ transplant patients were recruited through social media sites to complete a survey on their mental health status (depression, anxiety, post-traumatic stress symptomology, etc.), treatment adherence, and patient satisfaction. Mental health was found to be poor in this sample, as 30% were classified as having a mental health disorder. However, adherence and patient satisfaction was generally high during the pandemic. Notably, patients with a mental health disorder had significantly lower treatment adherence, but the same was not observed for patient satisfaction. Nonadherent transplant patients had greater pandemic-related concern and were less resilient than adherent patients. Although mental health was suboptimal, adherence and patient satisfaction levels did not indicate an insidious trend during the pandemic. This may, in part, be due to the use of telemedicine. Future research should further explore predictive factors of poor adherence, patient satisfaction, and mental health during the pandemic to identify potentially vulnerable patients.

I. INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), now referred to as COVID-19, has wreaked havoc on the physical, emotional, and financial lives of millions of people across the globe. By January of 2021, the United States alone saw over 25 million cases and over 420,000 deaths (CDC COVID Data Tracker, 2021). The physical toll of the virus has been devastating, and we are only beginning to understand the effects of the pandemic on mental health. Additionally, with hospitals and healthcare centers under the strain of the coronavirus, access to routine medical care may be more difficult or avoided altogether.

The Centers for Disease Control and Prevention (CDC, 2020) reported that up to 41% of adults in the United States had avoided or delayed medical care due to pandemic-related concerns in 2020. A majority of people who avoided urgent and routine medical care had underlying health conditions that put them at high risk for COVID-19 (CDC, 2020). Those with underlying conditions, such as cancer, diabetes, heart conditions, obesity, and other conditions resulting in an immunocompromised state, are at a higher risk of severe illness if they contract COVID-19 (CDC COVID-19, 2021). Lack of routine healthcare, or avoidance of care due to fear of contracting the virus, during the pandemic may have a particularly harmful effect on people who need to manage underlying or chronic conditions (CDC, 2020; Zakaria et al., 2020).

Solid organ transplant patients have been considered a vulnerable population during the pandemic due to the required immunosuppressant medications and frequent morbidities posttransplant (CDC COVID-19, 2021). Strict adherence to medications and routine appointments with their medical team are crucial to ensure the survival of the organ and overall health of the patient (United Network for Organ Sharing, 2021; UNOS). Potential disruptions in medical care as well as an increased vulnerability to the effects of COVID-19 have put transplant patients at particularly high risk during the pandemic. The purpose of this study was to examine treatment adherence, patient satisfaction, and mental health status among organ transplant patients during the unprecedented COVID-19 pandemic.

Organ Transplant Patient Physical Vulnerability to COVID-19

According to UNOS (2021), a record-breaking 39,000 organ transplants took place in the United States in 2020. As of February 2021, approximately 108,000 people were waiting for a major organ transplant (UNOS, 2021). After an organ transplant, routine medical care and strict adherence to medications are crucial in preventing rejection of the newly transplanted organ. Transplant patients require many appointments and tests in the months to years following the transplant to ensure that the transplanted organ is functioning well. Typically, patients have two appointments a week in the months following the transplant, which will then taper off to once every 3 to 4 months around a year posttransplant (UNOS, 2021). However, the number of appointments and lab tests will vary depending on the health of the patient and the transplanted organ. The number of required medications, tests, and appointments after surgery are daunting, but overall physical function and quality of life do significantly improve posttransplant (Dew et al., 1997). Attending the required appointments and adhering to physician recommendations is vital to the health of the patient and improving overall physical function following a transplant.

One crucial requirement posttransplant is the lifetime use of immunosuppressant medications, which are used to stave off rejection of the new organ. Side effects of immunosuppressant medication include mood swings, weight gain, loss of appetite, hair growth, trembling, and more relevantly, vulnerability to disease, infections, and viruses (Orlicka et al., 2013; UNOS, 2021). A suppressed immune system is necessary to avoid organ rejection posttransplant, but a suppressed immune system is responsible for the heightened vulnerability to COVID-19 for transplant patients. The World Health Organization (WHO) and the CDC quickly classified organ transplant patients as a vulnerable and high-risk group for severe COVID-19 complications (CDC, 2020; WHO, 2020). Transplant patients often have several comorbidities following a transplant such as hypertension, diabetes, obesity, and more (Latif et al., 2020). The presence of these comorbidities also put organ transplant patients at high risk for severe COVID-19 reactions.

Several recent studies have supported the heightened vulnerability of organ transplant patients to severe COVID-19 cases. Over the course of 3 weeks in March and April of 2020, researchers at Columbia University Irving Medical Center and Weill Cornell Medicine monitored 90 organ transplant patients who received a positive COVID-19 test (Pereira et al., 2020). Of the 90 patients, 46% had a moderate case and 30% had a severe case or reaction to the COVID-19 virus. The patients who were classified as having a severe case were more likely to also have hypertension and cancer comorbidities, two underlying conditions that increase the risk for COVID-related complications. Over 75% of the sample was hospitalized, and 18% (16 patients) died, a rate much higher than the estimated 1.7% case-fatality ratio in the United States (Johns Hopkins Mortality Analyses, 2021).

A similar study by Latif et al. (2020) specifically examined a cohort of 803 heart transplant patients, 28 of whom had a confirmed COVID-19 diagnosis. Common morbidities in the infected sample included hypertension, diabetes, kidney disease, obesity, and cardiac allograft vasculopathy. Of the 28 COVID-19-positive patients, almost 80% were hospitalized, and 25% of the sample (7 patients) died due to COVID-19-related complications. Although the fatality rate is alarming, the sample size was quite small and not all 803 patients were tested, so any potential asymptomatic individuals were not included in the study.

Although research on organ transplant patients during the coronavirus pandemic is fairly limited, several literature reviews and meta-analyses have been conducted to rapidly inform clinical practice and identify gaps in current understanding. A review of immunosuppression and COVID-19 research available through May of 2020 examined the mortality rate of immunocompromised transplant patients (Lai et al., 2020). Compared to the general population, immunocompromised transplant patients appeared to have a lower prevalence rate of COVID-19, but a higher fatality rate of approximately 23%. The review posited that the higher average age of organ transplant patients and frequent morbidities were responsible for the increased fatality rate.

Another systematic review and meta-analysis examined available information through October of 2020 on COVID-19 and transplant patients (Raja et al., 2020). The analysis identified an all-cause fatality rate of 18.6% for transplant patients with COVID-19, slightly lower than the Lai et al. review, but a very high hospitalization rate of 81% for COVID positive patients. However, the review acknowledged that the high hospitalization rate may be due to over caution and awareness of the vulnerability of organ transplant patients. Research on the physical vulnerability of organ transplant patients to COVID-19 is ongoing, but evidence thus far has supported that transplant patients are at greater risk of severe infection and death than the general population.

Organ Transplant Patient Mental Health Vulnerability

Organ transplant patients face obvious physical challenges posttransplant. However, there are also inherent mental health difficulties that accompany such a physically demanding recovery. For instance, it was estimated that up to 20% of kidney, 30% of liver, and 60% of heart transplant patients develop a mood or anxiety disorder within the first year following their transplant (Corbett et al., 2013). One of the earlier studies on the prevalence of mental health disorders among organ transplant patients, conducted by Dew et al. (2001), examined a total of 191 heart transplant patients within the first 3 years posttransplant. The patients participated in several examinations of psychiatric status using the Structured Clinical Interview for DSMIII-R (SCID) over the course of the 3 years. Major depressive disorder (MDD), generalized anxiety disorder (GAD), posttraumatic stress disorder related to transplant (PTSD-T), and adjustment disorders were specifically examined. Other relevant information such as medical history, social support, and sociodemographic information were also collected. Within the first 3 years posttransplant, the cumulative prevalence of any of the examined disorders was 38.3%. Approximately 25% of the sample experienced episodes of MDD, usually within the first year posttransplant, while 20% of the sample met criteria for an adjustment disorder. PTSD-T had a prevalence rate of 17%, with the initial onset almost exclusively occurring within the first 12 months posttransplant.

Dew et al. (2001) also identified several risk factors for developing a disorder posttransplant, including being female, low social support, impaired physical function, longer hospitalization time, and a history of psychiatric disorders pre-transplant. These risk factors are cumulative so a patient with two or more risk factors (i.e., being female and having low social support) would be at greater risk of developing a disorder than a patient with just one risk factor. The prevalence of MDD, PTSD, and adjustment disorders among transplant patients are far above the general population (DSM-5, 2013). It is important to consider the high prevalence rate and the above risk factors in future research as the additional stress experienced during the pandemic may increase the risk of developing a mental health disorder or exacerbate existing psychological vulnerabilities in organ transplant patients (Tsamakis et al., 2020).

The high prevalence of mental health disorders among organ transplant patients has real-life physical and functional consequences. A review by Corbett et al. (2013) examined the relationship between mental health disorders and physical outcomes such as morbidity and mortality. Most studies included in the review identified depression as a significant risk factor for both increased comorbidity and death. Depression had a similar negative association regardless of organ transplant type; depression in liver transplant patients was associated with abnormal liver function posttransplant, and depression was significantly associated with mortality in both heart and renal transplant patients.

At the time of Corbett et al.'s (2013) review, relatively few studies examined the connection between anxiety disorders and physical outcomes following organ transplant. However, the review did present some evidence that anxiety is a significant predictor of poor health-related quality of life in transplant patients. The onset of PTSD related to the transplant (PTSD-T) usually occurred within the first year posttransplant and was often related to poor medication adherence and increased mortality. Other mental health disorders, such as schizophrenia and psychosis, are not often studied, as the nature of the disorder is not conducive to the strict adherence required posttransplant. Resembling the Dew et al. (2001) review, independent and cumulative risk factors for developing a psychiatric disorder posttransplant were a history of psychopathology pre-transplant, longer hospitalization, poor functionality, low social support, and being female.

Poor mental health is also associated with lower treatment adherence, which in turn increases the likelihood of rejection and mortality (Prihodova et al., 2014). A systematic review of 21 studies examined the prevalence of PTSD following transplant (Davydow et al., 2015). All patients were assessed with a validated measure of PTSD, either a clinician-administered structured diagnostic interview or a self-report questionnaire of PTSD symptoms. The prevalence of PTSD diagnosis established by clinical interview was 17%, and the incidence according to self-report was 15% at 2 years posttransplant. The development of PTSD symptoms posttransplant was associated with poor health-related quality of life and worse overall physical health. Additionally, PTSD symptoms were linked with treatment nonadherence, but this relationship was only examined in one of the included studies in the review and required further exploration. This review also identified several risk factors for developing PTSD following a transplant including female gender, younger age, less education, and lower income (Davydow et al., 2015).

The high prevalence of mental health disorders among the transplant population is certainly concerning, but poor mental health following a transplant is not inevitable. Tian et al. (2016) found that resilience is an important trait for keeping psychological distress at bay after a transplant. This cross-sectional study examined psychological distress, resilience, and perceived social support in 152 kidney transplant patients over the course of a year. Of the 152 patients, 59 (42.4%) were experiencing psychological distress. Those who were experiencing psychological distress scored significantly lower on resilience and perceived social support than the non-distressed patients. Furthermore, resilience was significantly related to psychological distress, so, in a regression model, a 1-point increase in resilience was associated with decreased probability of experiencing psychological distress. This relationship held even when controlling for perceived social support. Resilience may be an important protective factor for mental health in organ transplant patients during the COVID-19 pandemic. However, it is unknown if the relationship between resilience and psychological distress is causal or mediated by other factors, such as income.

Poor mental health is associated with undesirable physical outcomes, including rejection and mortality, following a transplant. The relationship between poor mental health and suboptimal physical outcomes is especially concerning when considering the high prevalence of psychiatric disorders in the transplant population. The COVID-19 pandemic has further complicated matters by presenting a significant mental health challenge. Anxiety, depression, and stress have increased in the general population during the pandemic, but the increase is even more prevalent in individuals with pre-existing conditions (Shevlin et al., 2020; Tsamakis et al., 2020).

To date, research on organ transplant patient mental health is limited, but there is some evidence that mental health has declined in the transplant population since the start of the pandemic. A cross-sectional study by Zgoura et al. (2020) examined change in life satisfaction and perceived action competence (an individual's ability to select and execute an action; Odabasi et al., 2011) before and after the COVID-19 pandemic began in 62 kidney transplant patients. Cardiovascular patients and healthy controls served as comparison groups in addition to the pre- and post-pandemic examination of the transplant patients. The researchers found that life satisfaction and action competence had declined during the pandemic in transplant patients, but the same pattern was observed in the healthy controls and cardiovascular patients. However, transplant patients had significantly worse action competency than the control group during the pandemic, but there was not a significant difference between the three groups on life satisfaction. This implies that transplant patients are not alone in their decline of mental health and life satisfaction, but certain aspects of mental health may be more severely affected than the general population. It is important to examine mental health in organ transplant patients during the pandemic to better understand and address the current and future needs of this population.

Treatment Adherence Among Organ Transplant Patients

As previously stated, strictly adhering to treatment recommendations and the necessary medication regimen are crucial for preventing rejection of the newly transplanted organ. According to the WHO (2003), adherence is defined as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with the agreed recommendations from a health care provider" (p. 3). Nonadherence to physician recommendations, most often to immunosuppressant medications, has been linked to increased mortality (Dew et al., 2007). For instance, nonadherence or imperfect adherence to regimented immunosuppressant medication was associated with an increased risk of rejection and was responsible for up to 25% of deaths following transplant (Bunzel & Laederach-Hofmann, 2000; Hansen et al., 2007). Nonadherence can have serious consequences for transplant patients, so it is essential to identify any factors that may positively or negatively impact patient adherence. These factors were even more crucial to address during the COVID-19 pandemic so patients could be properly supported and encouraged to adhere to their treatment.

Although nonadherence carries serious consequences, it is fairly common among transplant patients. An analysis of 218 organ transplant patients examined a range of nonadherent behaviors related to organ transplantation, such as taking immunosuppressant medications, following a healthy lifestyle, and general medication adherence (Germani et al., 2011). Most of the sample was male with an average age of 52 years. In this sample, approximately 38% reported nonadherence to immunosuppressant medications, 39% reported nonadherence to a healthy lifestyle, and 13% admitted nonadherence to general medications. Interestingly, kidney transplant patients had significantly better adherence than the other organ transplant types (i.e., liver, heart, and lung). Men were also more likely to be nonadherent to a healthy lifestyle. Additionally, compared to the adherent group, nonadherent patients had more time elapse since transplant indicating that patients were less likely to adhere as more time passed since their transplant (Germani et al., 2011).

This association of increased nonadherence with increased time since transplant has also been established in other studies. One of the first studies to characterize adherence in organ transplant patients over time was conducted by Dew et al. (1996).

Eight domains of adherence (i.e., exercise, monitoring blood pressure, diet, medications, having blood work completed, clinic attendance, smoking, and heavy drinking) were examined in 101 heart transplant patients over the course of the year immediately following their transplant. Rate of adherence for each domain was collected at 2-, 7-, and 12-months posttransplantation. The domain with the highest rate of nonadherence was exercise (37%) while medication nonadherence occurred in about 20% of the sample. Adherence to physician recommendations in most domains significantly decreased over time (Dew et al., 1996).

Time since transplant is one significant predictor of treatment nonadherence, but several other factors influence a patient's ability to adhere to treatment regimens. Years of research on organ transplant patients have provided evidence that poor mental health posttransplant significantly contributes to nonadherence (Akman et al., 2007; Cukor et al., 2009; Dew et al., 1999; Favaro et al., 2011; Gorevski et al., 2013). Dew et al. (1999) assessed mental health, adherence, and physical outcomes among 145 heart transplant patients at several time points: 2 months, 7 months, 1-year, and 3-years posttransplant. The Structured Clinical Interview for DSM-III (SCID) was used to assess mental health status (MDD, GAD, Adjustment Disorder, and PTSD-T), and adherence information was also gathered via interview at each time point. Physical health outcomes, such as morbidity and mortality, were also measured.

The sample had a prevalence of 15.8% for MDD, 15.8% for PTSD-T, 8.8% for adjustment disorders, and not a single case of GAD at 1 year after transplant. Over a third of the sample reported that they did not adhere to immunosuppressant medications, and almost half (46%) reported nonadherence to both immunosuppressant medications and other prescriptions. Patients who experienced symptoms of depression were also 4 to 8 times more likely to develop a serious complication posttransplant, such as cardiac allograft disease (CAD) by year three. Those with a diagnosis of PTSD-T were an alarming 13 times more likely to die. Notably, there was a significant decline in adherence in the first year posttransplant. The researchers indicated a temporal association between psychological disorders and adherence with physical morbidities (such as graft rejection and cardiac allograft disease), which were, in turn, related to higher mortality. This study demonstrated that psychiatric symptomology is related to nonadherence, poor physical outcomes, and an increased risk of death posttransplant.

A study by Favaro et al. (2011) assessed adherence and the prevalence of MDD and PTSD-T over several years in 107 heart transplant patients. Participants were transplant patients who received a transplant within 1 to 5 years prior to the study. On the initial assessment, they completed a retrospective interview to establish mental health status prior to transplant and then were assessed for their current psychological state (an average of 3.4 years posttransplant). Then physical outcomes, such as rejection and death, were assessed several years after the initial interview (an average of 7.8 years after the interview). The Structured Clinical Interview for DSM-III (SCID) was used to assess mental health and adherence and physical outcomes were established by their physician.

Of the 107 patients, only 8% had an MDD diagnosis pre-transplant, whereas 41% met the criteria for MDD posttransplant. PTSD-T was present in 13% of the sample at the time of the interview. A significant relationship between PTSD-T symptoms and poor adherence was observed. However, this relationship was not observed in patients with MDD in this sample. Unfortunately, 30% of the sample passed away, with poor adherence, cancer, and age as significant predictors of mortality posttransplant.

Although depression was not observed to be significantly related to adherence in the Favaro et al. (2011) sample, this relationship has been reported in other studies. An examination by Cukor et al. (2009) analyzed the relationship between medication adherence, locus of control, and depression (measured via the Beck Depression Inventory 2nd edition, BDI-II) at a single time point in 94 kidney transplant patients. Cukor et al. (2009) found a significant, negative correlation between depression scores and medication adherence, indicating that patients with more severe depression scores had lower medication adherence.

An analysis of variance (ANOVA) was also conducted to examine differences between patients classified by adherence (Perfect Adherence, Nearly Perfect Adherence, and Less Than Perfect Adherence). Patients classified as having Less Than Perfect Adherence had significantly higher scores on the BDI-II than both the Perfectly Adherent and Nearly Perfect Adherence groups. Additionally, when using a cutoff score of >15 on the BDI-II to assess clinical depression, those with MDD had significantly lower adherence than non-depressed transplant patients. Finally, in regression analysis, depression was a significant, independent predictor of nonadherence in this sample of kidney transplant patients. A similar significant relationship between depression and poor adherence has also been supported in several other kidney transplant patient samples (Akman et al., 2007; Gorevski et al., 2013).

General psychological distress is also a risk factor for poor adherence. Treatment adherence, transplant-related stress, perceived stress, psychosocial stress, and feelings of guilt toward their donor were examined in a cohort of 50 kidney transplant patients

(Achille et al., 2006). A total of 46% of the sample had imperfect adherence, primarily reporting that they were not taking medication exactly as prescribed. The sample was divided into two groups: those who were adherent and those who were nonadherent. The nonadherent group had significantly higher psychological distress and perceived stress than the perfectly adherent group. The relationship between poor adherence and psychological distress is even more concerning during a global pandemic, when anxiety, stress, and depressive symptom prevalence are amplified (Shevlin et al., 2020).

The relationship between poor mental health and nonadherence is not unique to the transplant population. Mental health issues such as anxiety, depression, and stress can affect treatment adherence of any kind. An example of this relationship can be observed in hypertensive patients, who require blood pressure medication. A study by Kretchy et al. (2014) examined medication adherence and mental health (i.e., depression, anxiety, and stress) in 400 hypertensive patients. Over half the sample (56%) experienced symptoms of anxiety, 20% experienced stress, and 4% experienced depressive symptoms. The researchers found that stress was significantly associated with poor medication adherence. Specifically, patients who had high stress levels were significantly more likely to be nonadherent than patients with low stress levels.

In addition to time since transplant and poor mental health, other psychosocial and demographic factors are associated with nonadherence in transplant patients. One major roadblock to adherence is the complexity of the medication regimen (Hansen et al., 2007; Morales et al., 2011). Specifically, as more medications and doses are added to a patient's daily regimen, they are less likely to adhere to their medications (Hansen et al., 2007). Psychosocial factors that have proven to be significant predictors of nonadherence have included younger age (i.e., children and adolescents), being single, employing avoidant coping strategies, and substance use (Bunzel & Laederach-Hormann, 2000). Low neighborhood socioeconomic status has also been significantly related to poor adherence, rejection, and increased mortality in transplant patients (Wayda et al., 2018). Satisfaction with treatment and beliefs about medication have also been important contributors to adherence. Previous research has shown that adherent patients were more satisfied with their treatment and had more positive beliefs regarding their medications than nonadherent transplant patients (Hugon et al., 2014). Other risk factors for poor adherence were living alone and heart transplantation (Hugon et al., 2014).

Adherence During the COVID-19 Pandemic

Information regarding adherence among organ transplant patients during the COVID-19 pandemic is not yet available, but several studies have been conducted thus far on adherence in other populations with chronic conditions. So far, results on adherence have been mixed and seem to be dependent on the type of condition and that condition's vulnerability to COVID-19. A study conducted in Italy in May of 2020 examined medication adherence using the Fail-To-Refill project, which tracked medication refills in chronic therapy patients (Degli Esposti et al., 2020). This project had been collecting data since "pre-COVID" times, and the authors stated it will continue to be collected until after the COVID-19 pandemic subsided. Preliminary analysis revealed a decrease in refills among chronic disease patients during the months of lockdown in Italy. It is unclear if the decrease in medication refills, and therefore medication adherence, were caused by the lockdown itself, lack of medical center or pharmaceutical resources, fear of contracting the virus, or another cause (Degli Esposti et al., 2020).

Similarly, in Saudi Arabia, 1066 chronic disease patients were monitored for medication adherence during the pandemic (Zakaria et al., 2020). The type of chronic disease varied widely, with 78 different chronic diseases included in the study. About 30% of the sample was nonadherent to their medications, and a large majority (about 68%) were not comfortable attending their local healthcare center out of concern of contracting COVID-19. It is suggested that poorer adherence to medications and hesitancy to visit healthcare centers may result in increased complications and mortality rates among chronic disease patients during the pandemic (Zakaria et al., 2020).

However, the trend of decreased adherence and fewer healthcare visits has not been observed in all chronic disease patients. A study on adherence in patients with asthma and chronic obstructive pulmonary disease (COPD), two vulnerable populations during the pandemic, saw an increase in adherence at the start of the pandemic in the United States (January through March of 2020; Kaye et al., 2020). The specific medication monitored in this study was a prescribed inhaler medication therapy. A large sample ($N = 7578$) was assessed over the span of 3 months. Researchers observed a 15% increase in daily medication adherence in the sample, with higher adherence in older participants. Over half of the sample had an adherence rate of 75% or higher during the span of the study. Although a cause cannot be discerned, the researchers posited that the significant increase in medication adherence may be due to the sample's vulnerability to the COVID-19 virus. Patients who are at increased risk to the virus because of their medical condition may be more motivated to adhere to control their illness (Kaye et al., 2020).

Other studies have found good adherence or no change in adherence during the pandemic. A study by Murray et al. (2020) examined rheumatic musculoskeletal disease (RMD) patients in Ireland who relied on immunosuppressant medications to manage their illness. A total of 1,381 RMD patients were included in the analysis, with a high adherence rate of nearly 85% of the sample. However, adherence was lower in patients who reported COVID-19 symptoms (Murray et al., 2020). An analysis of COPD patients in China found no significant change in adherence during the pandemic when compared to adherence rates during normal times (Zhang et al., 2020). Adherence rates did not seem to be negatively affected by the pandemic in this sample. In fact, patients who had frequent supervision by their doctor had significantly higher adherence, indicating that a close relationship or frequent interaction with the patient's doctor may positively influence patient adherence during a pandemic (Zhang et al., 2020).

Organ Transplant Patient Satisfaction

Patient satisfaction is an important indicator of care quality and patient experience (Prakash, 2010). Measures of patient satisfaction are often used to assess physician performance, but there are real, tangible outcomes tied to patient satisfaction for the patient as well as the provider. In a healthcare setting, for example, patient satisfaction is related to patient retention, reduced malpractice claims, and higher employee satisfaction for healthcare workers (Browne et al., 2010). In terms of the patient, patient satisfaction is defined as "positive evaluations of distinct dimensions of the health care" (Linder-Pelz, 1982, p. 578). Dimensions of patient satisfaction include, but are not limited to, communication, time spent with doctor, accessibility and convenience, technical quality, interpersonal manner, and financial aspects (Marshall & Hays, 1994).

Generally, satisfied patients have better short- and long-term health outcomes and superior treatment adherence (Browne et al., 2010; Fenton et al., 2012; Fremont et al., 2001). A large multi-site study of 188 kidney transplant sites found a significant relationship between the patient's perception of care quality and physical outcomes such as organ loss and death (Srinivas et al., 2014). Furthermore, satisfied patients also tend to have fewer visits to the emergency room (Fenton et al., 2012). Patient satisfaction may have been negatively affected during the pandemic for a myriad of reasons including fewer doctor or hospital resources, longer appointment wait times, and fewer in-person visits with their doctor (The Commonwealth Fund, 2020).

There are several factors that influence satisfaction among organ transplant patients. One factor that may influence patient satisfaction pre- and posttransplant is the patient's education regarding their transplantation. A small study of 41 patients on the kidney transplant waitlist specifically examined health literacy, beliefs about medications, and patient satisfaction (Jones et al., 2016). Patients with higher health literacy, which is often tied to patient education (Wittink & Oosterhaven, 2018), had a better understanding and confidence regarding their medications. However, patient satisfaction was deemed to be suboptimal with approximately 30% of the sample unsatisfied with their education on the medication regimen, clinical appointments, and lifestyle changes that would be needed after their transplant took place (Jones et al., 2016).

Information on what to expect with organ transplantation is also related to patient satisfaction posttransplant. Cao et al. (2020) assessed patient satisfaction and employment outcomes in liver transplant patients. Prior to transplant, over half of the sample (56%) was employed full-time, but that rate dropped significantly to approximately 21%

posttransplant. Additionally, number of hours worked each week and annual salaries dropped for the entire sample posttransplant. Although this trend in employment is not unusual following a transplant, patient expectations were quite different than the reality. Most of the fully employed patients pre-transplant anticipated returning to work following their surgery. The difference in employment expectation and the reality posttransplant was related to decreased patient satisfaction (Cao et al., 2020). Preparing a transplant patient with adequate knowledge and expectations for their transplant may be an important part of improving satisfaction.

As previously mentioned, patient satisfaction has a significant relationship with adherence. Albekairy et al. (2016) demonstrated this relationship in their study of 154 liver transplant patients. Participants completed treatment satisfaction and medication adherence questionnaires, and additional medical and sociodemographic information was collected. Only 60% of the sample had high adherence scores while 32% had moderate adherence and 8% had low medication adherence. Participants were split into two groups based on adherence scores so that the low and moderately adhering patients formed one group, labeled "nonadherent," and the high adherence group was labeled "adherent." The only demographic factor related to adherence in this sample was age, with older participants adhering better to their medications. When the adherence groups were compared on patient satisfaction, the adherent group was significantly more satisfied with their treatment than the nonadherent group. The researchers suggested that improving patient satisfaction would be a crucial aspect of future care planning when aiming to improve patient adherence. However, a causal relationship between patient satisfaction and adherence was not established in this study, and future research should aim to examine a potential causal relationship in transplant patients, while considering possible confounding factors such as physical function, complications posttransplant, and more.

Research by Ortega et al. (2012) supported the same relationship between satisfaction and adherence, but in kidney transplant patients. In this multisite study, patient satisfaction, immunosuppressant medication adherence, medication dosage, graft function, number of medications, and health-related quality of life were examined in 206 kidney transplant patients. The overall rate of nonadherence to immunosuppressant medication was approximately 30%, while health-related quality of life and patient satisfaction scores were quite high in this sample. Notably, a significant relationship between adherence and patient satisfaction was identified. A significant association between satisfaction and health-related quality of life was also observed. Furthermore, patient satisfaction was significantly related to factors such as age, graft function, and medication dosage (Ortega et al., 2012). It is important to examine the relationship between patient satisfaction and adherence as one or both may be negatively impacted by the COVID-19 pandemic.

Other demographic and psychosocial variables are related to satisfaction in transplant patients. One cross-sectional study of over 300 kidney transplant patients examined patient satisfaction, health-related quality of life, and other sociodemographic variables (Yildirim, 2006). This study utilized the 15-dimensional scale (15D) to assess health-related quality of life and the Patient Satisfaction Questionnaire short form (PSQ-18) to measure patient satisfaction. The specific sociodemographic variables examined were gender, education, age, marital status, employment, time spent waiting for an appointment, and time spent with their doctor. The sample was mostly male (56%), a majority were married (75%), and most received a middle or high school level education (59%). Male transplant patients had higher mean scores than female transplant patients on both quality of life and patient satisfaction. A significant positive correlation was identified between level of education and patient satisfaction, indicating that the more educated patients were also the most satisfied with their treatment. Likewise, patients who were employed were significantly more satisfied with their treatment than unemployed patients. Finally, patients who were married were significantly more satisfied than single or widowed patients and a significant, positive relationship between patient satisfaction and quality of life was observed (Yildirim, 2006). Variables such as gender, education, marital status, quality of life, and employment status have been associated with patient satisfaction in organ transplant patients under normal circumstances and should therefore be examined under unusual situations, like the COVID-19 pandemic.

Decades of research on organ transplant patients have linked mental health, treatment adherence, and patient satisfaction with physical outcomes following a transplant. Specifically, poor mental health, low satisfaction, and suboptimal adherence are all linked to poor physical outcomes for transplant patients, which can be as severe as organ rejection and death. Recent research supports the likelihood that these factors could be negatively influenced by the COVID-19 pandemic, potentially leading to a rise in complications and deaths in the organ transplant population. The transplant population's physical vulnerabilities already put them at high risk for severe COVID-19-related complications, so a decline in mental health, adherence, or satisfaction during the pandemic may result in even greater susceptibility. It is imperative to examine these factors, so physicians and healthcare teams can better understand and address the needs of this population during the coronavirus outbreak and any future pandemic.

Hypotheses

Mental Health Hypotheses

1. It was predicted that there would be a high prevalence of mental health disorders in this sample. Specifically, the prevalence rate of participants who met the diagnostic criteria for mental health disorders (i.e., MDD, GAD, PTSD, and high perceived stress) would be higher than the DSM-5 prevalence and the prevalence in organ transplant patients during non-pandemic times.
2. Furthermore, participants who met the criteria for a mental health disorder would have lower adherence and patient satisfaction scores than participants who do not meet diagnostic criteria for a mental health disorder.

Adherence Hypotheses

1. It was predicted that the sample would have low general adherence scores but high pandemic protocol adherence.
2. It was also predicted that participants who were nonadherent would have higher mental health symptom severity than adherent patients.
3. Finally, it was expected that factors such as time elapsed since transplant, marital status, gender, and age would be predictive of adherence.

Patient Satisfaction Hypotheses

1. It was predicted that patient satisfaction and healthcare quality would be low during the COVID-19 pandemic.
2. It was also predicted that patient satisfaction would have a positive

relationship with adherence, so that patients with high satisfaction would also have high adherence.

3. Additionally, it was expected that there would be significant differences in patient satisfaction based on education level, employment, and marital status.

II. METHOD

The current study analyzed previously collected, deidentified data. The data collection for this project was conducted by the graduate student, Kennedy Anderson, for an exploratory study on organ transplant patients in the summer of 2020. The data was collected from a one-time online survey of transplant patients. The variables of interest in the current study were not examined prior to the current study and have not been utilized in other projects. The Institutional Review Board (IRB) approved the original project, and the Research Integrity and Compliance (RIC) committee approved the use of the collected data for the current study.

Procedures

This study used deidentified data previously collected by the researcher in the summer of 2020 during the COVID-19 pandemic. For the original data collection, participants were recruited through various social media websites such as Facebook and Reddit, as well as through local and national support groups for transplant patients. The study was conducted exclusively through an online survey on the Qualtrics platform. Survey participation was completely voluntary. Monetary compensation was not offered to all participants, but participants were offered the opportunity to enter into a raffle for one of two $25 Amazon gift cards. Participating in the raffle was optional. To be entered into the raffle, participants clicked on a link that brought them to a separate survey where they entered their email address. The separate survey was necessary so that participant email addresses were not connected to their survey responses. After the survey closed, two email address were randomly selected to receive the Amazon gift cards. The gift cards were sent electronically to the email accounts selected in the raffle. No identifying information such as IP address was collected, and all responses were anonymous.

When a participant opened the survey, they were immediately brought to the informed consent page. After reviewing the consent form, they were instructed to continue the survey if they wanted to participate. After agreeing to participate, they completed basic demographic questions (e.g., age, gender, race/ethnicity, marital status, education level, insurance type). Transplant patients were also asked questions regarding their physical health and transplant experience. Participants completed several measures of mental health, adherence, patent satisfaction, and pandemic-related concern. At the end of the survey, participants were directed to a closing page with the contact information for the researchers and instructions on how to enter the raffle. The total time to complete this study was approximately 30 minutes.

Participants

Participants were 99 organ transplant patients from around the world, but a majority were currently living in the United States at the time of the study. Table 1 shows all relevant demographic information for the sample. Participants were excluded from the final analysis if they did not complete a majority of the survey or if their completion time was too short to allow for accurate responses. A majority of the sample was female (65.7%) and identified as White/Caucasian (81.8%). The average age was 47.6 (*SD* = 13.7) years old with a range of 18 to 85 years. Most of the sample was married (58.6%) and highly educated. Employment status varied widely, with full-time employment being the most common response (28.3%), followed by unemployed (18.2%), retired (13.1%), part-time employment (13.1%), then by other employment status (21.2%).

Transplant characteristics are displayed in Table 2. The most common single organ transplant was a heart transplant (48.5%), followed by liver (23.2%), kidney (13.1%), lung (2.0%), pancreas (1.0%), and other (1.0%). Seven of the participants (11.2%) had multiple organ transplants. The average time since transplantation was 6.8 years (*SD* = 7.4) with a range of 0 to 29 years posttransplant at the time of the study. The sample had an average of 3.2 (*SD* = 2.2) morbidities reported with some participants reporting up to 12 total health morbidities (morbidity information can be viewed in Table 3). Nearly all of the participants (96.8%) experienced one or more complications following their transplant. Finally, approximately 30% of the sample reported a mental health diagnosis at the time of the survey.

Measures

Demographic Information

Participants were asked basic demographic questions regarding their age, gender, race/ethnicity, state of residence, employment status, marital status, and education level. Several demographic questions specifically addressed the participant's physical health and transplant experience. Participants answered questions on the type of organ transplant (i.e., heart, liver, kidney, etc.), date of transplant, length of hospital recovery, number of morbidities (e.g., hypertension, diabetes, cancer, etc.), complications following transplant, height, weight, and type of medical insurance.

Mental Health Measures

Perceived Stress Scale. The Perceived Stress Scale (PSS) is a 10-item scale that assessed perception of stress. The scale asked the participant how often a particular thought or feeling occurred in the past month (e.g., "In the last month, how often have you been upset because of something that happened unexpectedly?"). Responses ranged from 0 (*never*) to 4 (*very often*). Total scores range from 0 to 40; a score from 14 to 26 indicates moderate stress and a score from 27 to 40 would be considered high perceived stress (Cohen et al., 1983). The internal consistency for the PSS in the current sample was excellent (α = .91).

The Patient Health Questionnaire-9 (PHQ-9). The Patient Health Questionnaire-9 (PHQ-9) was used to measure symptoms of depressions. The PHQ-9 is a 9-item self-report diagnostic tool used to assess symptoms of depression in the previous two weeks. An example of an item is: "Little interest or pleasure in doing things," with response options ranging from 0 (*not at all*) to 3 (*nearly every day*). The PHQ-9 has strong internal reliability with a Cronbach's alpha of .89 and good test-retest reliability (r = .84 for 48-hour interval) (Kroenke et al., 2001). The internal reliability for the current sample was good (α = .86).

General Anxiety Disorder-7 (GAD-7). The GAD-7 is a 7-item scale used to measure symptoms of Generalized Anxiety Disorder (GAD) over the previous 2 weeks, such as "feeling nervous, anxious, or on edge." Response options range from 0 (*not at all*) to 3 (*nearly every day*), with total scores ranging from 0 to 21. A score of 5 to 9 indicates mild anxiety, 10 to 14 indicates moderate anxiety, and 15-21 indicates severe anxiety. The GAD-7 has good convergent validity, correlating well with the Beck Anxiety Inventory (r = .72) and the anxiety subscale of the Symptom Checklist-90 (r = .74) (Spitzer et al., 2006). The internal reliability for this study was acceptable (α = .78).

PTSD Checklist for DSM-5 (PCL-5). The PCL-5 is a 20-item self-report measure of PTSD symptoms over the past month using DSM-5 criteria (Blevins et al., 2015). The original PCL was developed in 1993 (Weathers et al., 1993), but it was recently updated to include the changes to the PTSD criteria in the DSM-5. Items address PTSD criteria (i.e., “In the past month, how much were you bothered by repeated, disturbing dreams of the stressful experience?”) with response options ranging from 0 (*not at all*) to 4 (*extremely*). Total scores for the 20 items can range from 0 to 80. The scale can be scored using a total scale score for symptom severity and by DSM-5 cluster severity scores (Weathers et al., 2013). For the purpose of this study, a recommended cutoff score of 31 was used for a provisional diagnosis of PTSD. The PCL-5 has demonstrated good internal consistency, test-rest reliability, and strong discriminant and convergent validity (Blevins et al., 2015). The internal consistency was also strong in the current sample ($\alpha = .94$).

UCLA Loneliness Scale. The UCLA Loneliness Scale is 20-item measure designed to assess subjective feelings of loneliness and social isolation with items such as “How often do you feel left out?” and “How often do you feel part of a group of friends?” Response options range from 1 (*never*) to 4 (*always*), with total scores ranging from 20 to 80 (Russell et al., 1978). Some items are reverse scored so that higher scores indicate greater loneliness. The internal reliability for the UCLA measure was excellent ($\alpha = .93$).

Satisfaction with Life Scale. The 5-item Satisfaction with Life Scale (SWLS) was used to assess overall life satisfaction among participants (Diener et al., 1985). A sample item is “In most ways my life is close to ideal.” Response options ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Total scores range from 5 (Extreme dissatisfaction) to 35 (Extremely satisfied). The scale has strong internal consistency (Cronbach’s alpha = .89) and test-retest reliability ($r = .84$). The internal consistency for the current sample was good ($\alpha = .85$). Low scores on the SWLS have also been predictive of future suicidal behaviors (Satisfaction with Life Scale, n.d.).

Brief Resilience Scale (BRS). Resilience was measured using the Brief Resilience Scale (BRS) developed by Smith et al. (2008). The BRS is a short 6-item scale with items such as “I tend to bounce back quickly after hard times.” Responses are on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” The internal consistency for the BRS was excellent in the current study ($\alpha = .90$).

Pandemic-Related Concern. The assessment used to evaluate pandemic-related concerns was developed by Texas State University faculty for a study on the psychological effects of the pandemic. This assessment included a list of concerns with a corresponding Visual Analog Scale (VAS), with response options ranging from 0 to 10 to indicate level of concern (10 being very concerned). Concerns include access to food, water, and medicine; job security; and fear of contracting the virus, among others. This scale is considered a mental health measure because it measures concern, or anxiety, regarding different aspects of the pandemic.

Qualitative Analysis. Several open-ended questions were included in the survey to capture qualitative information from the participants. The open-ended question that addressed mental health during the pandemic was: “Please explain the ways in which you think the COVID-19 pandemic has affected your mental health, if at all.” Participant written responses were analyzed using a Valence Aware Dictionary and Sentiment Reasoner (VADER) sentiment analysis tool.

Measures of Adherence

Medical Outcomes Study (MOS) General Adherence Scale. The MOS General Adherence scale is a brief, 5-item measure of general adherence with good internal consistency and validity (DiMatteo et al., 1993). The MOS measure addresses adherence in the past 4 weeks. An item example from the MOS scale is "I followed my doctor's suggestions exactly" with responses ranging from 1 (*none of the time*) to 6 (*all of the time*). The MOS General Adherence total scores were linearly transformed to a distribution that ranged from 0 to 100, as done by DiMatteo et al. (1993). This conversion made the scale easier to interpret and use in analyses.

Pandemic Protocol Adherence Scale. The Pandemic Protocol Adherence Scale was developed by Texas State University faculty in the Department of Psychology. This measure uses a Visual Analog Scale (VAS) to assess the participant's adherence to pandemic safety protocol. Pandemic protocol included keeping a distance of 6 feet from individuals not in your household, hand washing, adhering to stay-at-home protocols, covering mouth/nose, and avoiding touching face, eyes, and hands. Rate of adherence ranges from 0 to 100 so that 0 means they did not adhere to the protocol at all, 50 means they followed the protocol half of the time, and 100 means they followed the protocol all of the time.

Measures of Patient Satisfaction and Care Quality

Patient Satisfaction Questionnaire (PSQ-18). The PSQ-18 is a short-form of the Patient Satisfaction Questionnaire which is used to assess general patient satisfaction with medical treatment (Marshall & Hays, 1994). Items include "doctors are good about explaining the reason for medical tests" and "I have easy access to the medical specialists

I need." Each item is ranked on a 5-point Likert scale ranging from strongly agree to strongly disagree. Seven subscales make up the PSQ-18: General Satisfaction, Technical Quality, Interpersonal Manner, Communication, Financial Aspects, Time Spent with Doctor, and Accessibility and Convenience. The short-form has strong correlations with the 50-item PSQ and has demonstrated good internal consistency in previous research (Marshall & Hays, 1994). The internal consistency for the entire scale was excellent in the current sample ($\alpha = .91$).

Qualitative Analysis. Patient satisfaction was also addressed using open-ended responses and yes/no questions. Participants were asked if the quality of care decreased during the pandemic with "yes," "no", and "unsure" response options. Additionally, participants were asked if they could maintain their regular appointments with their doctor during the pandemic, with responses including "yes," "no," and "not applicable." There were two open-ended questions that were analyzed using the VADER analysis tool, which were "do you have any comments or concerns regarding your health care during the pandemic?" and "please explain the effects that the COVID-19 pandemic has had on your health care and medical care, if any."

Data Analysis

Univariate and multivariate analyses were conducted to address the hypotheses using IBM SPSS version 27 (IBM, Chicago, IL). A qualitative analysis tool was also used to assess the open-ended questions included in the survey. The VADER sentiment analysis tool was used to read and then assign a sentiment score to each participant's response. The sentiment score denoted if the overall message of the participant response was positive, neutral, or negative by examining the meaning and strength of the words used by the participant. The tool created two scores for each response, a coded score (similar to a Likert scale) and a composite score. Composite scores were calculated by adding valence scores and then standardizing that sum onto the designated scale; composite scores have been the most used indicators of sentiment in research (Hutto & Gilbert, 2014). The coded scores ranged from 0 (extremely negative) to 8 (extremely positive), and the composite scores ranged from -1.0 (extremely negative) to +1.0 (extremely positive). The coded and composite scores were averaged for the sample. A detailed legend for the qualitative scores can be found in Table 4.

Table 1. Organ Transplant Sample Demographic Information

Variable (*N* = 99)	% (*n*)/ *M*(*SD*)
Gender	
Male	34.3 (34)
Female	65.7 (65)
Age (Years)	47.57 (13.70)
Marital Status	
Married	58.6 (58)
Single	30.6 (30)
Divorced	7.1 (7)
Widowed	1.0 (1)
Ethnicity	
White/Caucasian	81.8 (81)
Hispanic	7.1 (7)
Black/African American	4 (4)
Multiracial/Other	7.1 (7)
Employment	
Full-Time	28.3 (28)
Part-Time	13.1 (13)
Unemployed	18.2 (18)
Retired	13.1 (13)
Student	5.1 (5)
Other	22.2 (2)
Education Level	
High school or below	17.2 (17)
Bachelor's or higher	58.6 (58)
Vocational/Technical	13.1 (13)
Associate's degree	11.1 (11)

Note: %: The percentage of the sample; *N*: Total sample number; *n*: number of participants in each group; *M*: Mean; *SD*: Standard deviation

Table 2. Transplant Characteristics

Variable (N = 99)	%(n) / M (SD); Range
Organ Transplant	
Heart	48.5 (48)
Liver	23.2 (23)
Kidney	13.1 (13)
Lung	2.0 (2)
Multiple Transplant	11.2 (7)
Other	2.0 (2)
Time Since Transplant (years)	6.77 (7.36); 0-29
Number of comorbidities	3.23 (2.20); 1-12
Number of Complications	5 (3.36); 0-17
Hospital Recovery (days)	25.75 (31.92); 3-180
Height (inches)	66.54 (3.94); 59-77
Weight (pounds)	167.18 (47.94); 85-340

Note: %: The percentage of the sample; *N*: Total sample number; *n*: number of participants in each group; *M*: Mean; *SD*: Standard deviation; Range: minimum to maximum value range

Table 3. Comorbidities in the Current Sample

Condition	*n*
Hypertension	37
Diabetes	13
Cancer	6
Cardiovascular Disease	9
Metabolic Syndrome	2
High Cholesterol	18
Arthritis	15
Migraine/Headaches	19
Irritable Bowel Syndrome	10
Asthma	7
Anemia	11
Autoimmune Disorder/Disease	18
Insomnia/Sleep disturbance	28
Seizures	6
Allergies	22
Substance Use	3
Female Reproductive Condition	2
Male Reproductive Condition	4
Other	17

Note: *n*: The number of participants who indicated they had the illness

Table 4. VADER Sentiment Analysis Legend

Code	Composite	Sentiment
0	-1.0 to -0.7	Extremely Negative
1	-0.7 to -0.5	Very Strongly Negative
2	-0.5 to -0.3	Strongly Negative
3	-0.3 to -0.1	Moderately Negative
4	-0.1 to 0.1	Neutral
5	0.1 to 0.3	Moderately Positive
6	0.3 to 0.5	Strongly Positive
7	0.5 to 0.7	Very Strongly Positive
8	0.7 to 1.0	Extremely Positive

III. RESULTS

Mental Health Results

Mental Health Hypothesis 1

The prevalence of depression, anxiety, and PTSD were examined using the recommended cutoff scores established by each measure. Other mental health variables such as stress, life satisfaction, and resilience were assessed based on recommended severity criteria for total scale scores. Using the recommended PCL-5 cutoff score of 31, the incidence of PTSD in the current sample was 20.2% ($n = 17$). Using the PHQ-9 symptom endorsement scoring guidelines, MDD was present in 17% ($n = 15$) of the sample. This scoring method required the endorsement of at least two symptoms: little interest or pleasure in doing things and feeling down, depressed, or hopeless. When examining total scores for the depression scale (i.e., symptom severity), 34.1% ($n = 30$) of the sample met severity criteria for moderate or severe depression. The discrepancy in the percentage of participants with moderate to severe depression severity versus the symptom endorsement scoring method (34.1% versus 17%, respectively) is likely due to overlapping symptomology of depression and chronic medical conditions, such as having trouble sleeping and feeling tired or having little energy. Participants likely endorsed high severity scores for the physical symptoms on the PHQ-9, giving them a higher total score, but they did not endorse the key symptoms needed for the endorsement method. GAD-7 scoring indicated that 30.7% ($n = 27$) reported no anxiety, 47.7% ($n = 42$) had mild anxiety, and 21.6% ($n = 19$) had moderate anxiety. Not a single participant was classified as having severe anxiety.

The overall prevalence for any disorder was 30.7% ($n = 27$). These participants scored within a clinically meaningful range for at least one mental health disorder (i.e., PTSD, MDD, or GAD); this percentage was nearly identical to the number of participants who disclosed a mental health condition in the demographic section (31.3%, *n* = 26). Around 10% (*n* = 9) met criteria for only one diagnosis, 13.6% (*n* = 12) met criteria for two diagnoses, and 6.8% (*n* = 6) met criteria for three diagnoses. The 12-month prevalence rate in the general population for MDD, PTSD, and GAD are 7%, 3.5%, and 2.9%, respectively (DSM-5, 2013). The prevalence rates for the current sample are higher than the DSM-5 prevalence for the general population but are approximately the prevalence rate of mental health disorders in the transplant population during non-pandemic times.

Total scores were calculated for the other mental health variables including perceived stress, life satisfaction, resilience, loneliness, and pandemic-related concern. Most of the sample experienced moderate perceived stress (58.8%, *n* = 50) while 32.9% (*n* = 28) had low perceived stress and 8.2% (*n* = 7) had high perceived stress. Most participants had low or neutral life satisfaction (54.2%, *n* = 45). The sample mostly had normal (62.7%, *n* = 52) to high (15.7%, *n* = 13) resilience. The current sample had an average ULCA Loneliness Scale score of 43.5 (*SD* = 10.8). The range for possible total scores for the UCLA scale is 20 to 80, indicating that this sample was not particularly lonely, as responses most often fell between 2 (*rarely*) and 3 (*sometimes*). The average total score for pandemic-related concern was 99.7 (*SD* = 47.1). When total scores were averaged to resemble the original scale, the sample average was 4.2 (*SD* = 1.9), indicating that pandemic-related concern was fairly low as the average was below the halfway point (5) on a scale of 0 to 10.

The qualitative analysis tool assessed the participants' thoughts and feelings regarding their own mental health during the COVID-19 pandemic ("*Please explain the ways in which you think the COVID-19 Pandemic has affected your mental health, if at all").* The average coded score was 2.7 (*SD* = 2.1) and the average composite score was -.27 (*SD* = .44), indicating that the patients' sentiment towards their mental health during the pandemic was moderately to strongly negative. An example of a participant response that was coded in the moderately to strongly negative range is: "Increased isolation and worry because of suppressed immune system."

Mental Health Hypothesis 2

The second mental health hypothesis predicted that participants who scored above the cutoffs for a mental health disorder (MDD, GAD, or PTSD) would have lower general adherence and patient satisfaction scores than transplant patients who did not have a mental health disorder. Participants were therefore separated into two groups based on whether they met the criteria for any of the three measured disorders. It is important to note that the diagnoses have not been verified via clinical interview, but established through diagnostic screeners, therefore creating a proxy mental health diagnosis group. As previously mentioned, 30.7% (*n* = 27) of the sample met criteria for one or more of the disorders. This group, labeled Mental Health DX, was compared to those without a mental health disorder. The group without mental health disorders consisted of 61 organ transplant patients, or 69.3% of the sample, and was labeled No DX. An independent samples *t*-test analysis was used to compare adherence and patient satisfaction scores between the Mental Health DX and No DX groups.

The *t*-test analysis was conducted with the transformed MOS General Adherence scores, the PSQ-18 total scores, and PSQ-18 subscale scores as dependent variables. The mean scores for all PSQ-18 subscales were higher in the No DX group, indicating that organ transplant patients without a mental health disorder were more satisfied than those with a mental health disorder. However, the only moderately significant difference between groups was found for the Financial Aspects subscale, $t(85) = 1.93$, $p = .058$. There was not a significant difference between the mental health groups for the PSQ-18 total score variable, $t(36.4) = 1.71$, $p = .097$). As expected, there was a significant difference in adherence between the Mental Health DX and No DX groups, specifically that those without a disorder had higher adherence than those with a mental health diagnosis, $t(85) = 2.16$, $p = .034$. Table 5 lists *t*-test results for each of the dependent variables.

Adherence Results

Adherence Hypothesis 1

The first adherence hypothesis predicted that there would be low general adherence and high pandemic protocol adherence among organ transplant patients. The MOS General Adherence Scale and the newly created pandemic protocol adherence scale were used to address this prediction. When examining average adherence on the original 6-point Likert scale, the average score on the MOS scale for the sample was 5.2 (SD = 0.7), or an average of 83.3 (SD = 14.4) when linearly transformed to a scale of 0 to 100. The unconverted MOS average falls between the response options of 5 "*most of the time*" and 6 "*all of the time*," indicating that patients adhered at least most of the time to their treatment. The linearly transformed average of 83.3 indicates a high general adherence score on a scale with a max value of 100.

The pandemic protocol adherence scores proved to be high for the sample. The average scale score was 86.9 (*SD* = 11.2) on a distribution of 0 to 100, implying that participants adhered to pandemic protocol around 87% of the time. These average scale scores demonstrate that this sample of organ transplant patients had high adherence to pandemic protocol and general treatment adherence.

Adherence Hypothesis 2

The second hypothesis predicted that nonadherent participants would have higher mental health symptom severity than adherent patients. A score of 80 on the distribution of 0 to 100 was used as a cutoff score to separate participants into two groups: one that was less adherent (those below a score of 80) and one more adherent (those with a score of 80 or above). This cutoff score was established in previous research on chronic disease and transplant patients for identifying poor adherence in patients (Hashmi et al., 2007; Hassan et al., 2006; Sackett et al., 1975, Schweizer et al., 1990). The low adherence group had 26 participants and the high adherence group had 66 patients. The average MOS score for the low adherence group was 65.2 (*SD* = 11.2) and the high adherence group average was 90.4 (*SD* = 7.8); these averages were significantly different, $t(90) = -10.48$, $p < .001$. An independent *t*-test analysis was used to compare the adherence groups on mental health symptom severity. The total scores for loneliness, pandemic-related concern, perceived stress, life satisfaction, resilience, depression, anxiety, and PTSD variables were used as dependent variables.

There were several significant differences on the mental health variables between the low and high adherence groups. First, the low adherence group had significantly higher pandemic-related concern (*M* = 115.2, *SD* = 45.7) than the high adherence group

(*M* = 92.7, SD = 46.8), *t*(78) = 2.03, *p* = .046. Additionally, low adherence patients were significantly less resilient (*M* = 3.2, *SD* = 0.9) than the high adherence patients (*M* = 3.6, *SD* = 0.75), *t*(80) = -2.05, *p* = .044. The low adherence group had higher symptom severity for loneliness, stress, depression, anxiety, and PTSD than the high adherence group, but these differences were not statistically significant. These results suggest that less adherent patients had worse mental health in terms of greater pandemic-related concern and lower resilience than the more adherent transplant patients during the COVID-19 pandemic.

Adherence Hypothesis 3

Finally, it was predicted that time elapsed since transplant, marital status, gender, and age would be significant predictors of adherence in organ transplant patients as all of these factors were found to be significant predictors of adherence in previous research. To test this hypothesis, a multiple regression was performed. The linearity, homoscedasticity, and multicollinearity assumptions were met for the predictors, however, none of the predictors were significantly related to adherence (all *p*s over .062). The lack of relationship indicates that time since transplant, age, marital status, and gender were not predictive of treatment adherence in this sample of organ transplant patients, *F*(4, 80) = 1.15, *p* = .340. There was a small to medium effect size for the multiple regression analysis (Cohen's f^2= .073).

Patient Satisfaction Results

Patient Satisfaction Hypothesis 1

The first patient satisfaction hypothesis predicted that there would be low patient satisfaction and healthcare quality during the COVID-19 pandemic. The PSQ-18 total score and subscale scores were used to measure overall patient satisfaction. The average total score on the PSQ-18 for this sample was 68.3 (*SD* = 12.5) on a possible total score range of 18 to 90. A higher total score indicates greater patient satisfaction. The patient satisfaction level was good in this sample with responses ranging most often between 3 (*uncertain*) and 4 (*agree*) regarding their satisfaction with their care. The averages for the seven subscales of the PSQ-18 were also examined and can be seen in Table 6. All subscale averages were above a score of 3 (the neutral midpoint of the scale), with the highest average belonging to the Interpersonal Manner subscale, and the lowest average was the Financial Aspect subscale. Like the PSQ-18 total score, each subscale indicated good patient satisfaction.

To measure healthcare quality, participants were specifically asked if they believed the quality of their care had decreased during the pandemic ("*Do you feel that the quality of your medical care has decreased since the start of the COVID-19 pandemic?")*. Over half of the sample indicated that the quality of their care had not worsened during the pandemic (57.5%, *n* = 50), while 27.6% (*n* = 24) said their care had decreased and 14.9% (*n* = 13) were unsure. Participants were also asked if they were able to maintain their healthcare appointments during the pandemic ("*Have you been able to maintain your regular appointments with your doctor(s) during the COVID-19 pandemic?*"). A large portion of the sample (65.6%, *n* = 59) was able to maintain their regular appointments during the pandemic.

Finally, qualitative analysis was used to examine an open-ended question regarding participant experience with healthcare during the COVID-19 pandemic ("*Do you have any comments or concerns regarding your health care during the pandemic?*"

and "*Please explain the effects that the COVID-19 Pandemic has had on your health care and medical care, if any*"). The VADER Sentiment Analysis tool was used to analyze and score these open-ended responses. The analysis revealed that the sample had neutral sentiment regarding their healthcare during the pandemic. The first question had an average coded score of 4.05 (SD = 1.9) and an average composite score of 0 (SD = 0.4). The second question had a coded average of 4.2 (SD = 1.6) and a composite score average of 0.03 (SD = 0.3). The neutral sentiment indicates that participants did not feel particularly negatively or positively about their healthcare during the pandemic.

Patient Satisfaction Hypothesis 2

The second patient satisfaction hypothesis predicted a positive relationship between patient satisfaction and treatment adherence. This relationship was examined using a bivariate Pearson correlation between the PSQ-18 total score and the transformed MOS General Adherence variables. As predicted, there was a moderate, significant positive correlation between the two variables ($r(85) = .43, p < .001$) indicating that higher patient satisfaction was related to higher adherence (see Figure 1). Approximately 18% of the variance in patient satisfaction was attributed to treatment adherence. All seven subscales of the patient satisfaction questionnaire were positively correlated with treatment adherence. Six of the seven subscale correlations were statistically significant: General Satisfaction ($r(89) = .38, p < .001$), Technical Quality ($r(89) = .46, p < .001$), Communication ($r(88) = .41, p < .001$), Financial Aspect ($r(88) = .31, p = .003$), Time with Doctor ($r(88) = .38, p < .001$), and Access and Convenience ($r(88) = .30, p = .004$). Interpersonal Manner was positively correlated with adherence, but the relationship was not statistically significant ($p = .077$).

Patient Satisfaction Hypothesis 3

The final patient satisfaction hypothesis predicted that there would be significant differences in patient satisfaction based on education level, employment, and marital status. Significant differences in patient satisfaction for these demographic variables have been observed in previous research. Univariate analysis of variance (ANOVA) was used to separately examine the difference in patient satisfaction by employment status (full-time, part-time, unemployed, retired, other) and education level (high school education or less, technical or vocational training, and a college degree). A t-test analysis was conducted to examine the difference in patient satisfaction based on marital status (married or single).

The univariate ANOVA revealed no significant differences in patient satisfaction based on employment status ($F(4,106) = 2.08$, $p = .088$). There was also no significant difference in patient satisfaction between married and single patients, $t(75) = .14$, $p = .891$. However, a significant difference in patient satisfaction was identified between education levels ($F(2, 85) = 3.36$, $p = .039$). A Tukey's post hoc test revealed that patients with a college degree (an associate's degree or higher) had significantly higher patient satisfaction ($M = 70.3$, $SD = 10.7$) compared to transplant patients with technical or vocational training ($M = 60.8$, $SD = 12.8$) (see Figure 2).

Table 5. Mental Health DX *t*-test Analysis on Patient Adherence and Satisfaction

Variable	Mental health DX *M* (*SD*)	No DX *M* (*SD*)	*t* value	*p* value
MOS Adherence	77.78 (15.90)	84.87 (13.32)	2.16	.034
PSQ-18 Total Score	64.04 (15.34)	69.69 (10.80)	1.70	.097
PSQ-18 Subscales				
General Satisfaction	3.67 (1.10)	3.89 (0.79)	0.93	.357
Technical Quality	3.80 (0.94)	4.01 (0.70)	1.19	.236
Interpersonal Manner	4.00 (0.92)	4.16 (0.80)	0.81	.423
Communication	3.50 (1.04)	3.90 (0.77)	1.80	.079
Financial Aspects	3.10 (1.33)	3.63 (1.16)	1.93	.058
Time with Doctor	3.46 (1.16)	3.83 (0.94)	1.57	.118
Access & Convenience	3.54 (0.92)	3.74 (0.64)	1.02	.313

Note: *M*: Mean; *SD*: Standard Deviation; *p* value: Significance value for the *t* test analysis.

Table 6. PSQ-18 Subscale Averages

PSQ-18 Subscale	*M (SD)*
General Satisfaction	3.82 (0.89)
Technical Quality	3.95 (0.79)
Interpersonal Manner	4.07 (0.90)
Communication	3.78 (0.87)
Financial Aspects	3.43 (1.22)
Time with Doctor	3.73 (1.02)
Access and Convenience	3.71 (0.74)

Note: PSQ-18: Patient Satisfaction Questionnaire Short Form; *M*: Sample average; *SD*: Standard Deviation

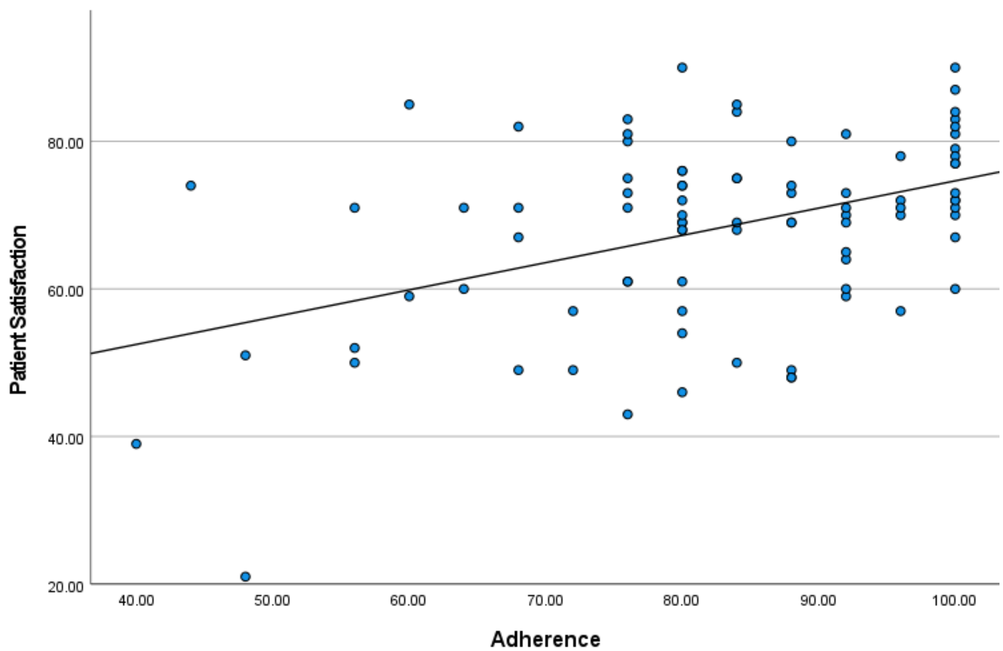

Figure 1. Patient Satisfaction is Related to High Adherence.
Note: The correlation was significant ($p < .001$) and positive ($r = .43$).

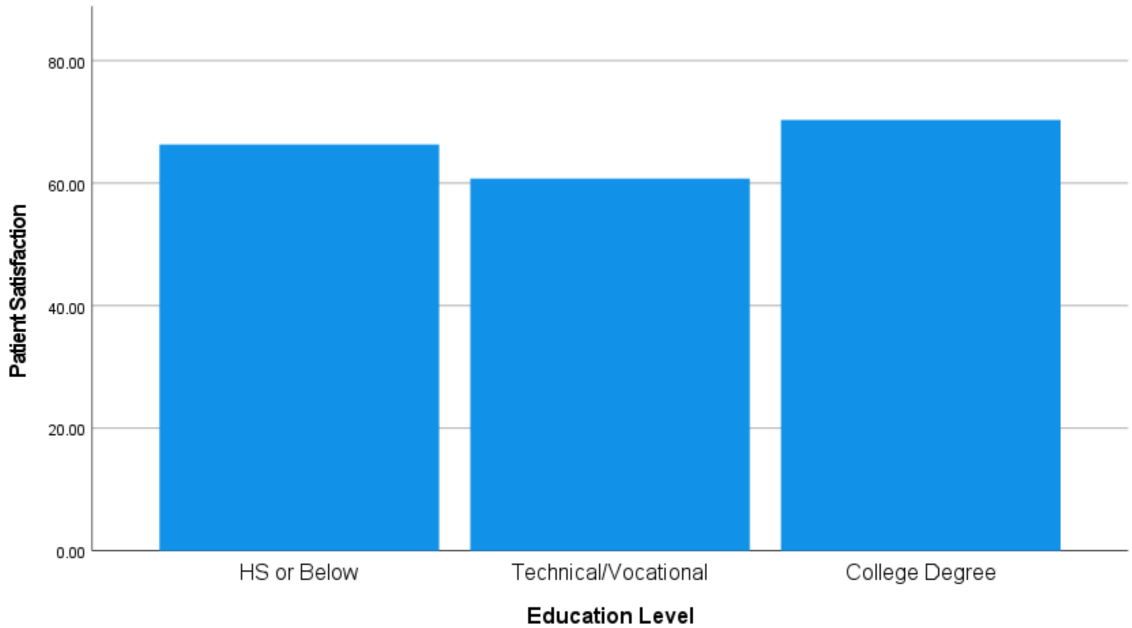

Figure 2. Patient Satisfaction Means by Education Level.
Note: The advanced degree and technical/vocational training means were significantly different (p = .039); CI: Confidence Interval; HS: High School

IV. DISCUSSION

The goal of the current study was to examine mental health, treatment adherence, patient satisfaction, and the relationships between each, among organ transplant patients during the COVID-19 pandemic. To date, this study is the first to examine all three aspects in the transplant population during the COVID-19 pandemic. Organ transplant patients are a high-risk population during the pandemic due to their physical and psychological susceptibilities, making them an important group to study during this unprecedented outbreak. It is vital that we identify any declines in healthcare, adherence, or mental health in this population since each factor can have serious consequences for patient outcomes posttransplant.

Mental Health

It was predicted that, like the general population (Shevlin et al., 2020; Tsamakis et al., 2020), transplant patients would experience poorer mental health during the pandemic. There is some evidence of a decline in mental health during the COVID-19 pandemic, specifically in the transplant population (Zgoura et al., 2020), but research is limited at this time. Since transplant patients experience a high prevalence rate of psychopathology under normal circumstances (a prevalence rate for any disorder posttransplant is often 30% or higher; Corbett et al., 2013; Dew et al., 2001), the incidence of mental health disorders would need to surpass the baseline prevalence rate in order to be considered elevated during the pandemic. Therefore, the hypothesis was not supported in the current study. Although the prevalence of any disorder in the current sample was approximately 30%, this is not unusual for this population during non-pandemic times. Qualitative analysis also supported the finding of poor mental health in this sample, with a moderately negative sentiment regarding participant mental health. However, this does not imply that addressing mental health issues in transplant patients is unimportant during the pandemic. The rate of mental health disorders is still far above the general population and should be treated accordingly.

Mental health was also predicted to influence treatment adherence and patient satisfaction in transplant patients during the pandemic, consistent with previous research (Cukor et al., 2009; Davydow et al., 2015; Dew et al., 1999; Favaro et al., 2011; Kaldenberg, 2001). In the current study, two groups were created based on mental health criteria: those who met diagnostic criteria for one or more disorders and those who did not meet diagnostic criteria for a mental health disorder. The hypothesis was partially supported, specifically regarding patient adherence. Those with a mental health disorder had significantly lower adherence scores; however, a difference was not observed in patient satisfaction total scores or subscales, excluding the Financial Aspect subscale. Overall, patient satisfaction does not seem to be negatively influenced by mental health or more specifically, the COVID-19 pandemic. Adherence, however, is significantly worse in transplant patients who met the criteria for a mental health disorder. Poor adherence can have serious consequences during posttransplant recovery, so it is important for physicians to carefully monitor transplant patients with poor mental health, particularly during a pandemic, when psychological disturbance may be elevated. The relationship between mental health, patient satisfaction, and adherence should continue to be examined throughout and after the COVID-19 pandemic.

Adherence

It was predicted that general treatment adherence would be low in transplant patients during the COVID-19 pandemic largely due to constraints the virus has put on the healthcare system (CDC, 2020; The Commonwealth Fund, 2020) and hesitation to visit medical centers for routine care out of pandemic-related concern (Zakaria et al., 2020). Thankfully, this hypothesis was not supported in this sample due to the high general treatment adherence observed during the pandemic. It is possible that, like the COPD and asthmatic patients studied earlier in the pandemic (Kaye et al., 2020), transplant patients were aware of their vulnerability to the coronavirus and improved treatment adherence as a precaution. Nonadherence to their treatment regimen carries serious consequences for transplant patients, including organ rejection and death (Bunzel & Laederach-Hofmann, 2000; Corbett et al., 2013; Hansen et al., 2007), so good adherence, even during a pandemic, is likely a priority for the patient and their medical care team. Pandemic protocol adherence was predicted to be high because of the population's high-risk group designation by the CDC and WHO. This hypothesis was supported as pandemic protocol adherence was very high, with safety guidelines followed nearly 87% of the time on average.

The second adherence-related hypothesis was that nonadherent organ transplant patients would have worse mental health than adherent patients. This prediction proved to be true in the current sample as less adherent patients had greater pandemic-related concern and were less resilient than the adherent patients. Although the direction of this relationship is unclear, mental health symptoms, specifically pandemic-related concern and low resilience, are related to nonadherence in transplant patients. The low adherence group had higher severity scores for all other mental health measures (i.e., loneliness, stress, anxiety, and PTSD symptoms) than the adherent group, but the differences were not significant. The relationship between poor mental health and nonadherence has been established during non-pandemic times, but it is still unknown if this connection has been heightened during the COVID-19 pandemic. It is important that providers address mental health concerns, particularly pandemic-related concern and low resilience, which may, in turn, improve adherence in transplant patients. It is especially crucial to address nonadherence and declining mental health during unprecedented and stressful circumstances like the COVID-19 pandemic, which may result in a decline in both mental health and adherence among transplant patients.

Finally, it was hypothesized that adherence would be predicted by several patient factors including age, gender, marital status, and time since transplant. Each of these factors have proven to be independent predictors of adherence in transplant patients in previous research (Bunzel & Laederach-Hormann, 2000; Cukor et al., 2009; Favaro et al., 2011; Germani et al., 2011). However, none of the variables were significant predictors of adherence in this sample; in fact, none of the variables were even significantly related to adherence. This lack of relationship could be due to sample size, insufficient power, or the possible uniqueness of the sample in composition or circumstance. Other patient-related variables should be further investigated to identify predictive factors of adherence during unusual circumstances like the COVID-19 pandemic. Pinpointing specific predictors of adherence during a period of heightened vulnerability is important to improve or maintain high adherence.

Patient Satisfaction

Thankfully, the hypothesis of poor patient satisfaction and healthcare quality during the pandemic was not supported in this study. Both patient satisfaction and healthcare quality was quite high in this sample during the Summer of 2020 of the COVID-19 pandemic. According to qualitative analysis, care quality did not substantially change during the pandemic, and most of the sample maintained their regularly scheduled medical care. However, over a quarter of the transplant patients believed their care had decreased since the start of COVID-19.

The maintenance of routine care and high patient satisfaction in transplant patients during this time is likely due to the widespread implementation of telehealth appointments and transplant patient prioritization during the pandemic. Transplant patients may have been prioritized over other less vulnerable patient groups during the COVID-19 pandemic because of their heightened susceptibility to the virus, high hospitalization and fatality rate, and necessary medical care posttransplant. Unlike our transplant sample, Deriba et al. (2020) did not find adequate patient satisfaction in their general patient sample during the pandemic. Telehealth has also proved to be a useful tool in maintaining patient satisfaction while implementing social distancing and patient safety protocols. One retrospective analysis of lung transplant patients found that patient satisfaction with video appointments was very high during the pandemic, and physicians were effective in making clinical decisions using this medium (Kayser et al., 2020). Another study by Delman et al. (2021) found no significant difference in transplant outcomes between “pre-COVID-19” and “COVID-19” liver transplant cohorts when utilizing telehealth and alternative healthcare practices during the pandemic. Telehealth appears to be an effective alternative to in-person care for transplant patients during the COVID-19 pandemic and should continue to be utilized as needed during the coronavirus outbreak and any future pandemic.

The second hypothesis predicted that patient satisfaction would have a positive relationship with adherence so that a patient with high patient satisfaction would also have high treatment adherence, and vice versa. This relationship has been established among transplant patients in previous research (Albekairy et al., 2016; Hugon et al., 2014; Ortega et al., 2012). It was important to examine the relationship between patient satisfaction and adherence, as one or both may have been negatively impacted by the pandemic. It was critical to identify if this relationship held during a novel situation, like the COVID-19 pandemic, to help physicians and healthcare centers address any concerns regarding patient satisfaction and adherence during this time. The hypothesis was supported as patient satisfaction and adherence had a significant, positive relationship during the pandemic. The connection between patient satisfaction and adherence was maintained during the unprecedented circumstances. As suggested in previous research (Albekairy et al., 2016), improving patient satisfaction may in turn improve adherence in transplant patients. Continued use of telehealth and remote consultation may be an effective way to improve or maintain patient satisfaction in transplant patients during a global pandemic, or even non-pandemic times.

Finally, it was predicted that patient satisfaction would differ by education level, employment status, and marital status. This hypothesis was partially supported since patient satisfaction varied by education level, but no significant differences were found for employment or marital status. In previous research, a higher level of education was associated with greater patient satisfaction (Yildirim, 2006). This finding was also observed in the current study; transplant patients with an associate's degree or higher were significantly more satisfied than patients who received technical or vocational training. This difference in patient satisfaction identified across education level could be tied to employment status, as patients with a high school degree or vocational training were significantly more likely to be unemployed than those with a college degree ($\chi^2(8) = 23.76$, $p = .003$, with 45% of the variance in employment status attributed to education level). Previous research has indicated that transplant patients who are employed are more satisfied than unemployed patients, but there were no significant differences in patient satisfaction when employment status was examined in isolation. The relationship between patient satisfaction, education, employment, and marital status should be further investigated because of conflicting evidence from this study as compared to findings of previous research (Anderson & Zimmerman, 1993; Yildirim, 2006).

Limitations

There are a few limitations to the current study. First, the study exclusively utilized self-report measures due to the nature of the online study. Self-reported medical history, mental health, adherence, and patient satisfaction may differ from more objective measures. Many studies of transplant patients take place within a healthcare setting where researchers have access to such objective measures, such as participant medical histories and health outcomes. The addition of a more objective measure of adherence, such as a pill counter or electronic monitoring, would be beneficial since self-reported adherence may be subject to social desirability bias (Adams et al., 1999). Furthermore, all mental health diagnoses were provisional and not established by clinical interview.

The current sample size was geographically diverse; patients responded from 29 different states within the United States, and 9% of the sample lived internationally. However, the sample was majority White, female, and highly educated. This demographic does not represent the entirety of the transplant population, particularly in gender and ethnicity. Therefore, we should exercise caution when applying the results to different racial and ethnic groups, which have been disproportionately affected by the pandemic (CDC, 2020).

Future Research

The results of the current study provide a glimpse into the mental health, treatment adherence, and patient satisfaction among transplant patients during the COVID-19 pandemic. However, these factors should continue to be studied throughout and after the pandemic has subsided because of the strong implications these variables have on the health outcomes of transplant patients. Ideally, a longitudinal study should be carried out by research teams or medical centers that had previously collected mental health, adherence, or patient satisfaction information on transplant patients prior to the start of the pandemic. Pre-pandemic information could be directly compared to transplant patient status during and after the COVID-19 pandemic. This would allow researchers to ascertain if any of the measured variables saw a decline due to the pandemic. This information would be vital in preparing interventions targeted at the transplant population to ensure optimal physical and mental health and recovery.

Additionally, the current study found null or contradicting results regarding adherence and patient satisfaction. Specifically, factors that predict treatment adherence and patient satisfaction should be further examined during the COVID-19 pandemic and beyond since many of the included variables in this study were not related to adherence or patient satisfaction as predicted by previous research. Variables such as time since transplant, age, gender, employment status, and marital status should be targeted. It is possible that the unexpected findings were a result of the pandemic, but the effect at this time is unclear. Monitoring transplant patient health outcomes over time will be helpful in improving physical and mental health care, adherence, and patient satisfaction during the COVID-19 or any future pandemic situation. Finally, future research should aim to include a diverse sample of transplant patients, particularly in race and ethnicity.

V. CONCLUSION

The current study is one of the first to examine mental health status, adherence, and patient satisfaction among organ transplant patients during the COVID-19 pandemic. This study provided insight into the mental and physical health status of this vulnerable group during an unprecedented time. Although mental health was poor in this sample, treatment adherence and patient satisfaction remained fairly high. As demonstrated in previous research, mental health symptom severity was related to worse adherence in transplant patients. This is especially concerning during the COVID-19 pandemic when psychological stress is elevated, which may therefore lead to a decline in adherence. Patient satisfaction seemed to be unaffected by the pandemic and most patients were able to maintain their regular care, likely because of the implementation of telemedicine. Although levels of adherence and patient satisfaction in the current sample did not indicate an insidious trend, efforts should be made to identify and address low satisfaction, adherence, and poor mental health in transplant patients during and after the pandemic. These three factors should continue to be studied as they are intertwined with patient outcomes posttransplant. Future research should specifically target predictors of poor adherence, patient satisfaction, and mental health during the COVID-19 pandemic so vulnerable transplant patients can be adequately supported.

REFERENCES

Achille, M. A., Ouellette, A., Fournier, S., Vachon, M., & Hebert, M. J. (2006). Impact of stress, distress and feelings of indebtedness on adherence to immunosuppressants following kidney transplantation. *Clinical Transplantation, 20(3), 301–306.* doi:10.1111/j.1399-0012.2005.00478.x

Adams, A. S., Soumerai, S. B., Lomas, J., & Ross-Degnan, D. (1999). Evidence of self-report bias in assessing adherence to guidelines. *International Journal for Quality in Health Care, 11*(3), 187–192. https://doi.org/10.1093/intqhc/11.3.187

Akman, B., Uyar, M., Afsar, B., Sezer, S., Ozdemir, F. N., & Haberal, M. (2007). Adherence, depression and quality of life in patients on a renal transplantation waiting list. *Transplant International, 20*(8), 682–687. https://doi.org/10.1111/j.1432-2277.2007.00495.x

Albekairy, A. M., Alkatheri, A. M., Jarab, A., Khalidi, N., Althiab, K., Alshaya, A., Saleh, K. B., Ismail, W. W., & Qandil, A. M. (2016). Adherence and treatment satisfaction in liver transplant recipients. *Saudi Journal of Gastroenterology: Official Journal of the Saudi Gastroenterology Association*, *22*(2), 127–132. https://doi.org/10.4103/1319-3767.164209

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, L. A., & Zimmerman, M. A. (1993). Patient and physician perceptions of their relationship and patient satisfaction: a study of chronic disease management. *Patient Education and Counseling*, *20*(1), 27–36. https://doi.org/10.1016/0738-3991(93)90114-c

Beck, A.T., Steer, R.A., & Brown, G.K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *Journal of Traumatic Stress*, *28*(6), 489–498. https://doi.org/10.1002/jts.22059

Browne, K., Roseman, D., Shaller, D., & Edgman-Levitan, S. (2010). Analysis & commentary. Measuring patient experience as a strategy for improving primary care. *Health Affairs, 29*(5), 921–925. https://doi.org/10.1377/hlthaff.2010.0238

Bunzel, B., & Laederach-Hofmann, K. (2000). Solid organ transplantation: Are there predictors for posttransplant noncompliance? A literature overview. *Transplantation, 70*(5), 711 –716.

Cao, C., Halegoua-DeMarzio, D., Guirguis, S., Chen, C., Fenkel, J. M., & Herrine, S. (2020). Employment and patient satisfaction after liver transplantation. *Journal of Clinical and Translational Hepatology*, *8*(3), 299–303. https://doi.org/10.14218/JCTH.2020.00010

Center for Disease Control and Prevention. (2021, February). COVID-19. Retrieved January 28, 2021, from https://www.cdc.gov/coronavirus/2019-nCoV/index.html

Center for Disease Control and Prevention. (2021, February). *COVID data tracker*. Retrieved January 28, 2021, from https://covid.cdc.gov/covid-data-tracker/#cases_totalcases

Center for Disease Control and Prevention. (2021, February). *COVID-19, People with certain medical conditions.* Retrieved January 28, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html#:~:text=Having%20COPD%20(including%20emphysema%20and,severe%20illness%20from%20COVID%2D19

Center for Disease Control and Prevention. (2020, December). *COVID-19 racial and ethnic disparities*. Retrieved March 15th, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/index.html

Corbett, C., Armstrong, M. J., Parker, R., Webb, K., & Neuberger, J. M. (2013). Mental health disorders and solid-organ transplant recipients. *Transplantation*, *96*(7), 593–600. https://doi.org/10.1097/TP.0b013e31829584e0

Cukor, D., Rosenthal, D. S., Jindal, R. M., Brown, C. D., & Kimmel, P. L. (2009). Depression is an important contributor to low medication adherence in hemodialyzed patients and transplant recipients. *Kidney International*, *75*(11), 1223–1229. https://doi.org/10.1038/ki.2009.51

Davydow, D. S., Lease, E. D., & Reyes, J. D. (2015). Posttraumatic stress disorder in organ transplant recipients: a systematic review. *General Hospital Psychiatry, 37*(5), 387–398. https://doi.org/10.1016/j.genhosppsych.2015.05.005

Degli Esposti, L., Buda, S., Nappi, C., Paoli, D., Perrone, V., & Network Health (2020). Implications of COVID-19 infection on medication adherence with chronic therapies in Italy: A proposed observational investigation by the Fail-to-Refill Project. *Risk Management and Healthcare Policy*, *13,* 3179–3185. https://doi.org/10.2147/RMHP.S265264

Delman, A. M., Turner, K. M., Jones, C. R., Vaysburg, D. M., Silski, L. S., King, C., Luckett, K., Safdar, K., Quillin, R. C., 3rd, & Shah, S. A. (2021). Keeping the lights on: Telehealth, testing, and 6-month outcomes for orthotopic liver transplantation during the COVID-19 pandemic. *Surgery*, S0039-6060(21)00009-X. Advance online publication. https://doi.org/10.1016/j.surg.2020.12.044

Deriba, B. S., Geleta, T. A., Beyane, R. S., Mohammed, A., Tesema, M., & Jemal, K. (2020). Patient satisfaction and associated factors during COVID-19 pandemic in North Shoa Health Care Facilities. *Patient Preference and Adherence*, *14*, 1923–1934. https://doi.org/10.2147/PPA.S276254

Dew M. A., Roth, L. H., Thompson, M. E., Kormos, R. L., & Griffith, B. P. (1996). Medical compliance and its predictors in the first year after heart transplantation. *Journal of Heart and Lung Transplantation, 15*(6), 631–45.

Dew, M. A., DiMartini, A. F., De Vito Dabbs, A., Myaskovsky, L. Steel, J., Unruh, M. Switzer, G. E., Zomak, R., Kormos, R. L., & Greenhouse, J. B. (2007). Rates and risk factors for nonadherence to the medical regimen after adult solid organ transplantation. *Transplantation*, *83*(7), 858–873. https://doi.org/10.1097/01.tp.0000258599.65257.a6

Dew, M. A., Kormos, R. L., DiMartini, A. F., Switzer, G. E., Schulberg, H. C., Roth, L. H., & Griffith, B. P. (2001). Prevalence and risk of depression and anxiety-related disorders during the first three years after heart transplantation. *Psychosomatics*, *42*(4), 300–313. https://doi.org/10.1176/appi.psy.42.4.300

Dew, M. A., Kormos, R. L., Roth, L. H., Murali, S., DiMartini, A., & Griffith, B. P. (1999). Early posttransplant medical compliance and mental health predict physical morbidity and mortality one to three years after heart transplantation. *The Journal of Heart and Lung Transplantation, 18*(6), *549–562.* https://doi.org/10.1016/s1053-2498(98)00044-8

Dew, M. A., Switzer, G.E., Goycoolea, J. M., Allen, A.S., DiMartini, A., Kormos, R. L., & Griffith, B. P. (1997). Does transplantation produce quality of life benefits?: A quantitative analysis of the literature. *Transplantation, 64*(9), 1261–1273.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13

DiMatteo, M. R., Sherbourne, C. D., Hays, R. D., Ordway, L., Kravitz, R. L., McGlynn, E. A., Kaplan, S., & Rogers, W. H. (1993). Physicians' characteristics influence patients' adherence to medical treatment: results from the Medical Outcomes Study. *Health Psychology,12*(2), 93–102. https://doi.org/10.1037/0278-6133.12.2.93

Favaro, A., Gerosa, G., Caforio, A. L., Volpe, B., Rupolo, G., Zarneri, D., Boscolo, S., Pavan, C., Tenconi, E., d'Agostino, C., Moz, M., Torregrossa, G., Feltrin, G., Gambino, A., & Santonastaso, P. (2011). Posttraumatic stress disorder and depression in heart transplantation recipients: the relationship with outcome and adherence to medical treatment. *General Hospital Psychiatry*, *33*(1), 1–7. https://doi.org/10.1016/j.genhosppsych.2010.10.001

Fenton, J. J., Jerant, A. F., Bertakis, K. D., & Franks, P. (2012). The cost of satisfaction: A national study of patient satisfaction, health care utilization, expenditures, and mortality. *Archives of Internal Medicine*, *172(*5), 405–411. https://doi.org/10.1001/archinternmed.2011.1662

Fremont, A. M., Cleary, P. D., Hargraves, J. L., Rowe, R. M., Jacobson, N. B., & Ayanian, J. Z. (2001). Patient-centered processes of care and long-term outcomes of myocardial infarction. *Journal of General Internal Medicine, 16*(12), 800–808. https://doi.org/10.1046/j.1525-1497.2001.10102.x

Germani, G., Lazzaro, S., Gnoato, F., Senzolo, M., Borella, V., Rupolo, G., Cillo, U., Rigotti, P., Feltrin, G., Loy, M., Martin, A., Sturniolo, G. C., & Burra, P. (2011). Nonadherent behaviors after solid organ transplantation. *Transplantation Proceedings, 43*(1), 318–323. https://doi.org/10.1016/j.transproceed.2010.09.103

Gorevski, E., Succop, P., Sachdeva, J., Cavanaugh, T. M., Volek, P., Heaton, P., Chisholm-Burns, M., & Martin-Boone, J. E. (2013). Is there an association between immunosuppressant therapy medication adherence and depression, quality of life, and personality traits in the kidney and liver transplant population? *Patient Preference and Adherence*, *7*, 301–307. https://doi.org/10.2147/PPA.S34945

Hansen, R., Seifeldin, R., & Noe, L. (2007). Medication adherence in chronic disease: Issues in posttransplant immunosuppression. *Transplantation Proceedings, 39*(5), 1287–1300. https://doi.org/10.1016/j.transproceed.2007.02.074

Hashmi, S. K., Afridi, M. B., Abbas, K., Sajwani, R. A., Saleheen, D., Frossard, P. M., Ishaq, M., Ambreen, A., & Ahmad, U. (2007). Factors associated with adherence to anti-hypertensive treatment in Pakistan. *PloS One*, *2*(3), e280. https://doi.org/10.1371/journal.pone.0000280

Hassan, N. B., Hasanah, C. I., Foong, K., Naing, L., Awang, R., Ismail, S. B., Ishak, A., Yaacob, L. H., Harmy, M. Y., Daud, A. H., Shaharom, M. H., Conroy, R., & Rahman, A. R. (2006). Identification of psychosocial factors of noncompliance in hypertensive patients. *Journal of Human Hypertension*, *20*(1), 23–29. https://doi.org/10.1038/sj.jhh.1001930

Hugon, A., Roustit, M., Lehmann, A., Saint-Raymond, C., Borrel, E., Hilleret, M. N., Malvezzi, P., Bedouch, P., Pansu, P., & Allenet, B. (2014). Influence of intention to adhere, beliefs and satisfaction about medicines on adherence in solid organ transplant recipients. *Transplantation, 98*(2), 222–228.

Hutto, C.J. & Gilbert, E.E. (2014, June). VADER: A Parsimonious rule-based model for sentiment analysis of social media text [Conference presentation]. *Eighth International Conference on Weblogs and Social Media (ICWSM-14).* Ann Arbor, MI, United States.

Johns Hopkins University of Medicine. (2021, February). Mortality analysis. Retrieved February 4, 2021, from https://coronavirus.jhu.edu/data/mortality

Jones, J., Rosaasen, N., Taylor, J., Mainra, R., Shoker, A., Blackburn, D., Wilson, J., & Mansell, H. (2016). Health literacy, knowledge, and patient satisfaction before kidney transplantation. *Transplantation Proceedings*, *48*(8), 2608–2614. https://doi.org/10.1016/j.transproceed.2016.07.018

Kaldenberg, D. O. (2001). Patient Satisfaction and Health Status. *Health Marketing Quarterly, 18(3-4), 81–101.* https://doi.org/10.1300/j026v18n03_07

Kaye, L., Theye, B., Smeenk, I., Gondalia, R., Barrett, M. A., & Stempel, D. A. (2020). Changes in medication adherence among patients with asthma and COPD during the COVID-19 pandemic. *The Journal of Allergy and Clinical Immunology: In Practice.* https://doi.org/10.1016/j.jaip.2020.04.053

Kayser, M. Z., Valtin, C., Greer, M., Karow, B., Fuge, J., & Gottlieb, J. (2020). Video consultation during the COVID-19 pandemic: A single center's experience with lung transplant recipients. *Telemedicine Journal and e-Health.* doi:10.1089/tmj.2020.0170. Advance online publication. https://doi.org/10.1089/tmj.2020.0170

Kretchy, I. A., Owusu-Daaku, F.T. & Danquah, S. A. (2014). Mental health in hypertension: Assessing symptoms of anxiety, depression and stress on anti-hypertensive medication adherence. *International Journal of Mental Health Systems, 8*(25). https://doi.org/10.1186/1752-4458-8-25

Kroenke, K., Spitzer, R.L. & Williams, J.B.W. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*, 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Lai Q., Spoletini G., Bianco G., Graceffa D., Agnes S., Rossi M. (2020). SARS-CoV2 and immunosuppression: A double-edged sword. *Transplant Infectious Disease*. https://doi.org/10.1111/tid.13404

Latif, F., Farr, M. A., Clerkin, K. J., Habal, M. V., Takeda, K., Naka, Y., Restaino, S., Sayer, G., & Uriel, N. (2020). Characteristics and outcomes of recipients of heart transplant with coronavirus disease 2019. *JAMA Cardiology*, e202159. Advance online publication. https://doi.org/10.1001/jamacardio.2020.2159

Linder-Pelz, S. U. (1982). Toward a theory of patient satisfaction. *Social Science & Medicine, 16*(5), 577–582. https://doi.org/10.1016/0277-9536(82)90311-2

Marshall, G. N., & Hays, R. D. (1994). *The Patient Satisfaction Questionnaire Short Form (PSQ-18).* RAND Corporation. https://www.rand.org/pubs/papers/P7865.html.

Morales, J. M., Varo, E., & Lázaro, P. (2012). Immunosuppressant treatment adherence, barriers to adherence and quality of life in renal and liver transplant recipients in Spain. *Clinical Transplantation*, *26*(2), 369–376. https://doi.org/10.1111/j.1399-0012.2011.01544.x

Murray, K., Quinn, S., Turk, M., O'Rourke, A., Molloy, E., O'Neill, L., Mongey, A. B., Fearon, U., & Veale, D. J. (2020). COVID-19 and rheumatic musculoskeletal disease patients: infection rates, attitudes and medication adherence in an Irish population. *Rheumatology*. Advance online publication. https://doi.org/10.1093/rheumatology/keaa694

Odabasi, H.F., Kurt, A.A., Akbulut, Y., Kuzu, E.B., Donmez, O., Ceylan, B., Sahin Izmirli, O. (2011, July 4). *ICT action competence in teacher education* [Conference session]. 3rd International Conference on Education and New Learning Technologies, Barcelona, Spain.

Orlicka, K., Barnes, E., & Culver, E. L. (2013). Prevention of infection caused by immunosuppressive drugs in gastroenterology. *Therapeutic Advances in Chronic Disease*, *4*(4), 167–185. https://doi.org/10.1177/2040622313485275

Ortega, F., Otero, A., Crespo, J. F., Delgado, J. F., Borro, J. M., Cuervo, J., & Study Group Satisfy (2013). Satisfaction and adherence with immunosuppressant treatment in renal transplant patients living with a working graft. *Journal of Nephrology, 26*(2), 297–305. https://doi.org/10.5301/jn.5000132

Pereira, M. R., Mohan, S., Cohen, D. J., Husain, S. A., Dube, G. K., Ratner, L. E., Arcasoy, S., Aversa, M. M., Benvenuto, L. J., Dadhania, D. M., Kapur, S., Dove, L. M., Brown, R. S., Rosenblatt, R. E., Samstein, B., Uriel, N., Farr., M. A., Satlin, M., Small, C. B.,… Verna, E. C. (2020). COVID-19 in solid organ transplant recipients: Initial report from the US epicenter. *American Journal of Transplantation, 20*(7), 1800–1808. doi:10.1111/ajt.15941

Prakash, B. (2010). Patient satisfaction. *Journal of Cutaneous and Aesthetic Surgery*, *3*(3), 151–155. https://doi.org/10.4103/0974-2077.74491

Prihodova, L., Nagyova, I., Rosenberger, J., Majernikova, M., Roland, R., Groothoff, J. W., & van Dijk, J. P. (2014). Adherence in patients in the first year after kidney transplantation and its impact on graft loss and mortality: a cross-sectional and prospective study. *Journal of Advanced Nursing*, *70*(12), 2871–2883. https://doi.org/10.1111/jan.12447

Raja, M. A., Mendoza, M. A., Villavicencio, A., Anjan, S., Reynolds, J. M., Kittipibul, V., Fernandez, A., Guerra, G., Camargo, J. F., Simkins, J., Morris, M. I., Abbo, L. A., & Natori, Y. (2020). COVID-19 in solid organ transplant recipients: A systematic review and meta-analysis of current literature. *Transplantation Reviews, 35*(1), 100588. Advance online publication. https://doi.org/10.1016/j.trre.2020.100588

Russell, D., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment, 42*(3), 290–294. https://doi.org/10.1207/ s15327752jpa4203_11

Sackett, D., Gibson, E., Wayne Taylor, D., Brian Haynes, R., Hackett, B., Roberts, R., & Johnson, A. (1975). Randomized clinical trial of strategies for improving medication compliance in primary hypertension*. The Lancet, 305*(7918), 1205–1207. https:doi.org/10.1016/s0140-6736(75)92192-3

Satisfaction with Life Scale (SWLS). (n.d.) *Measurement Instrument Database for the Social Sciences.* Retrieved from http://www.midss.org/content/satisfaction-life-scale-swl

Schweizer, R. T., Rovelli, M., Palmeri, D., Vossler, E., Hull, D., & Bartus, S. (1990). Noncompliance in organ transplant recipients. *Transplantation*, *49*(2), 374–377. https://doi.org/10.1097/00007890-199002000-00029

Shevlin, M., McBride, O., Murphy, J., Miller, J., Hartman, T., Levita, L., Mason, L., Martinez, A. P., McKay, R., Stocks, T. V. A., Bennett, K. M., Hyland, P., Karatzias, T., & Bentall, R. P. (2020). Anxiety, depression, traumatic stress and COVID-19-related anxiety in the UK general population during the COVID-19 pandemic. *BJPsych Open, 6*(6). https://doi.org/10.1192/bjo.2020.109

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine, 15*(3), 194–200. doi:10.1080/10705500802222972

Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine***,** *166*(10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092

Srinivas, R., Chavin, K. D., Baliga, P. K., Srinivas, T., & Taber, D. J. (2014). Association between patient satisfaction and outcomes in kidney transplant. *American Journal of Medical Quality, 30*(2), 180–185. doi:10.1177/1062860613519163

The Commonwealth Fund. (2020, May). *The impact of the COVID-19 pandemic on outpatient visits: A rebound emerges.* Retrieved January 30, 2021, from https://www.commonwealthfund.org/publications/2020/apr/impact-covid-19-outpatient-visits

Tian, X., Gao, Q., Li, G., Zou, G., Liu, C., Kong, L., & Li, P. (2016). Resilience is associated with low psychological distress in renal transplant recipients. *General Hospital Psychiatry, 39,* 86 – 90. https://doi.org/10.1016/j.genhosppsych.2015.12.004

Tsamakis, K., Triantafyllis, A.S., Tsiptsios, D., Spartalis, E., Mueller, C., Tsamakis, C., Chaidou, S., Spandidos, D. A., Fotis, L., Economou, M., & Rizos, E. (2020). COVID-19 related stress exacerbates common physical and mental pathologies and affects treatment. *Experimental and Therapeutic Medicine*, 20, 159–162. https://doi.org/10.3892/etm.2020.8671

United Network for Organ Sharing. (n.d.). *After the Transplant*. Retrieved January 30, 2021, from https://transplantliving.org/after-the-transplant/

Wayda, B., Clemons, A., Givens, R. C., Takeda, K., Takayama, H., Latif, F., Restaino, S., Naka, Y., Farr, M. A., Colombo, P. C., & Topkara, V. K. (2018). Socioeconomic disparities in adherence and outcomes after heart transplant: A UNOS (United Network for Organ Sharing) registry analysis. *Circulation: Heart Failure*, *11*(3), e004173. https://doi.org/10.1161/CIRCHEARTFAILURE.117.004173

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993). *The PTSD Checklist: Reliability, validity, and diagnostic utility* [Conference presentation]. Annual Meeting of the International Society for Traumatic Stress Studies, San Antonio, TX, United States.

Weathers, F. W., Litz, B.T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). *The PTSD Checklist for DSM-5 (PCL-5)*. Retrieved from http://www.ptsd.va.gov

Wittink, H., & Oosterhaven, J. (2018). Patient education and health literacy. *Musculoskeletal Science & Practice*, *38*, 120–127. https://doi.org/10.1016/j.msksp.2018.06.004

World Health Organization. (2003). *Adherence to long term therapies: Evidence for action.* Retrieved March 15th, 2021, from https://www.who.int/chp/knowledge/publications/adherence_full_report.pdf

World Health Organization. (2021, February). *Coronavirus Disease (COVID-19) Pandemic*. Retrieved February 2, 2021, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Yildirim A. (2006). The importance of patient satisfaction and health-related quality of life after renal transplantation. *Transplantation Proceedings*, *38*(9), 2831–2834. https://doi.org/10.1016/j.transproceed.2006.08.162

Zakaria, O., Albshr, F., Aljarrash, K., Alkhalaf, I., Alsheef, N., Yasser, M., & Daoud, M. Y. (2020). Does COVID-19 pandemic affect medication compliance among chronic patients? *The Sapporo Medical Journal*, *54*(7).

Zgoura, P., Seibert, F. S., Waldecker, C., Doevelaar, A., Bauer, F., Rohn, B., Schenker, P., Wunsch, A., Viebahn, R., Babel, N., & Westhoff, T. H. (2020). Psychological responses to the coronavirus disease 2019 pandemic in renal transplant recipients. *Transplantation Proceedings*, *52*(9), 2671–2675. https://doi.org/10.1016/j.transproceed.2020.08.043

Zhang, H. Q., Lin, J. Y., Guo, Y., Pang, S., Jiang, R., & Cheng, Q. J. (2020). Medication adherence among patients with chronic obstructive pulmonary disease treated in a primary general hospital during the COVID-19 pandemic. *Annals of Translational Medicine*, *8*(18), 1179. https://doi.org/10.21037/atm-20-6016