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The Impact of Periodontal Disease on the Health-Related Quality of Life of the Chronic Kidney Disease Patient

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This is to certify that the doctoral study by

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Walden University
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Abstract

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by

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MS. University of Maryland University College, 2012

BS, University of Bridgeport, 1976

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Chronic kidney disease (CKD) and Periodontal disease (PD) have been identified as public health issues by both the Centers for Disease Control and Prevention and the World Health Organization. The impact of PD on the health-related quality of life (HRQoL) of the CKD patient is an area where there has been little research. Previous research has not established a connection between PD and CKD although both diseases share common inflammatory markers. The focus of this cross-sectional, quantitative study was the possible impact of PD on the HRQoL of the CKD patient and the extent to which a less than optimal mental health status (< 30 days of depressed mental state once being diagnosed with CKD) plays a role. The health belief model and social construct theory provided the theoretical framework for examining patient behavior and resultant health outcomes. A random sampling (N = 96,787) was taken from the 2016 Behavioral Risk Factor Surveillance Survey. Male and female participants in this study were 45-64 years, diagnosed with CKD and PD, had either no days of depressed mental state or less than 30 days of depressed mental state. To analyze the data correlational, linear regression, and ANOVA statistical analyses were performed using SPSS v25. The results showed a statistically significant change of 6.8% in predicting the HRQoL of the CKD patient when PD was present. This study has positive social change implications that include increased collaboration between medicine and dentistry that may lead to increased early diagnosis and treatment of PD, decreased incidence of inflammatory systemic disease, increased positive rates of HRQoL, and improved overall health outcomes.

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Dedication

This is dedicated to my parents James, and Bertha Roberts, who first believed I could accomplish whatever I set out to do and taught me the true meaning of dedicated work, perseverance, and pursuing excellence. And to every patient dealing with chronic systemic illnesses who desire to live a better life and have healthier outcomes. May the information presented here act as another impetus towards a true collaborative approach between the medical and dental health providers to achieve increased positive health outcomes.

Acknowledgments

I would like to take this opportunity to recognize and acknowledge my Creator, the One who is omnipotent and has sustained me to this point in my life. The Creator has endowed me with gifts and talents of which I am at times unworthy of but am truly grateful for, To my family, Marian, Kim, my church family, and the EB book club, all of whom have continuously provided love, support, and encouragement on all levels throughout this process. Without their unconditional love and support I could not have reached this final stage. I could not have reached this milestone without the guidance, support, and encouragement from my committee chair, Dr. Pelagia Melea, and committee member, Dr. Jeanne Connors, who consistently demanded excellence and attention to detail, and provided understanding when outside circumstances interrupted this process. I thank you.

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Section 1: Foundation of the Study and Literature Review

Chronic kidney disease (CKD) has become increasingly prevalent both in the United States and globally (Maragkos et al., 2017). According to the Centers for Disease Control and Prevention (CDC), approximately 15% of all U.S. adults (37 million) are affected by CKD which has been identified as the ninth leading cause of death (www.cdc.gov/CKD). The rise of CKD in the U. S. adult population was confirmed to be 20% higher in 2016 compared to the rates between 1988-1994 (www.cdc.gov/CKD). The prevalence rate of CKD among adults in the U. S. has been calculated at 38% and is more common among those aged >60 years followed at a rate of 13% for those aged 45-64 years (https://nccd.cdc.gov/CKD). Chronic low-grade inflammatory status is a hallmark of CKD (Ismail et al., 2013). Sharma et al. (2017) identified cardiovascular disease as a major cause of death among CKD patients. The presence of this chronic low-grade inflammatory status increases the risk of CVD for the CKD patient. Statistics from the 2019 CDC website show periodontal disease (PD) affects 14% of the U. S. adult population aged 45-64 years and 23% of those aged 65-74 years (www.cdc.gov/faststats). PD is a chronic inflammatory process which can affect a patient's quality of life, leading to pain, disability, and the CKD patient's self-efficacy (Baker et al., 2016). Six of every ten U..S adults suffer from two or more chronic systemic diseases increasing the burden of comorbidities, cost of treatment, and decreased positive health outcomes (www.cdc.gov/chronicdisease/about/index.htm).

The American Academy of Periodontology (AAP) defines PD as an infection of the oral cavity that can result in tooth loss when left untreated. It is a chronic inflammatory condition which can inflame and destroy gingival tissue, the periodontal ligaments, and the alveolar bone of the periodontium. PD is characterized by bleeding gum tissues, soreness, and pain when chewing, and malodor and is a distinct sign of poor oral health (http://www.perio.org). PD is a common chronic inflammatory condition affecting 11.2% of the global population and contributes to the inflammatory burden of systemic diseases such as CKD (Sharma et al., 2017). Untreated PD can progress to the more severe form of periodontitis which is nonreversible. It is most often present in CKD patients (Kim et al., 2017) contributing to the increased presence of the inflammatory process resulting in worsened CKD status (Soroye & Ayanbadejo, 2016).

According to the 2019 CDC website, CKD is a chronic systemic inflammatory disease affecting 15% of the adult U.S. population and is often undiagnosed in the early stages. CKD patients are at an increased risk of heart disease, stroke, and early death (www.cdc.gov/faststats). Chronic low-grade inflammation is a hallmark of CKD and is one of many contributory factors in inflammation (Mihai et al., 2018). The persistent low-grade inflammation seen in CKD patient is similar to the same type of low-grade inflammation identified in PD (Grubbs et al., 2016). Anxiety and depression are quite common in CKD patients more so than in the general population and is a major factor in non-compliance with treatment, non-adherence to dietary guidelines, increased hospitalizations, decreased quality of life and increased mortality rates (Yucens et al.,

2019). HRQoL for the CKD patient is greatly affected by their mental health status because it influences how much of the patient's attention is focused on managing their illness and improving their overall health outcomes (Wang et al., 2019) and should be considered when assessing the HRQoL.

The association between these two chronic inflammatory diseases has been examined in previous research studies as early as 2011 (Fearing Tornwall et al., 2012; Grubbs et al., 2011; and Ismail et al., 2013). These studies examined the association between the presence of PD in a majority of CKD patients in an effort to establish PD as a risk factor for CKD. The study by Ismail et al. (2013) concluded that the hypotheses linking PD as a factor in CKD via the inflammatory response is credible. The authors further stipulated inflammation as a strong predictor of overall health outcomes, especially in end-stage renal disease (ESRD) patients. Araujo et al. (2015) identified chronic PD as highly prevalent in CKD patients aligned with malnutrition and inflammation. Early diagnosis and treatment of PD may result in reduced systemic inflammation as demonstrated in a study by Grubbs et al. (2016). A healthier diet with improved nutritional status may well afford the CKD patient a better HRQoL status. This aspect was shown by Siou-Hung Tsai et al. (2015) where poor nutrition, increased anxiety, and depressed mental status, affected the patients' health outcomes. The ability of the CKD patient to eat a healthy diet consisting of anti-inflammatory nutrients and vitamins is a key factor in combatting illness and supporting better health. Treatment of PD in its early stages can result in improved oral health and increased HRQoL for the CKD patient (Haag et al., 2017).

Background of the Study

There have been several studies and reviews of the research on PD and systemic diseases (i.e., diabetes and cardiovascular disease, specifically atherosclerotic heart disease) (Bansal et al., 2013; French et al., 2018; Han et al., 2013; Ismail et al., 2013; Kim et al., 2017) but none have demonstrated the effect of PD on the HRQoL as related to kidney disease. The established link between PD and CVD was a result of all the aforementioned studies and has led to the practical application of collaborations between the medical and dental professions in the care and treatment of the patient experiencing atherosclerotic heart disease. Although studies as early as 2009 by Kshirsogar et al., and Grubbs et al.(2011) gave credibility to the hypothesis of a correlation between PD and CKD, current studies on this association are not focused on the HRQoL for the CKD patient. The HRQoL of a patient is an important measure to help determine the health outcomes of the patient with ESRD (Queeley & Campbell, 2018).

This quantitative cross-sectional study was undertaken to show the significance of PD in assessing its impact on the HRQoL for the CKD patient. Measurement of the HRQoL is a critical tool used by clinical providers to evaluate the efficacy of treatments for the chronically ill (Queeley & Campbell, 2018). Increased collaborative efforts between the medical and dental health disciplines could improve the care and treatment of the patient suffering from chronic systemic diseases which could lead to decreased cost of care and improved health outcomes. Effective treatment of PD may improve the

status of CKD just as it mitigated the morbidity and mortality of atherosclerotic cardiovascular disease (Bale et al.,2017).

Problem Statement

Increased collaboration between the medical and dental professions I needed; it should include a precursory oral exam, performed by the doctor, as a part of the routine physical examination (Myers-Wright & Lamster, 2016). The earlier a diagnosis is made the earlier treatment can begin to establish a quicker path to better health and improved HRQoL for the patient (Nazir, 2020). The moderate to severe form of PD has a higher prevalence in the CKD patient population (Kim et al., 2017). The dental visit provides an opportunity for the oral health care provider to identify early on in the process if there are systemic or chronic inflammatory conditions present by performing a simple chairside screening (Dolce et al., 2019). According to the CDC six of every ten Americans are dealing with two or more chronic illnesses (www.cdc.gov/hronicdisease/about/index.htm) which increases the impact of comorbidities on health outcomes. An approach that examines the common risk factor of the inflammatory process which is present in both PD and CKD, could result in decreased inflammation and slowed progression through the stages of CKD (Grubbs et al., 2016).

Hang et al. (2017) concluded that there are risk factors shared by oral and systemic chronic diseases which affect the health-related quality of life (HRQoL) of the patient. Their work also showed edentulism and dental decay as having a negative effect on HRQoL. Armed with this information one can make the argument that PD does have an

effect on the HRQoL because tooth loss has been reported as a characteristic of PD in studies by Maragos et al.(2017) and others (French et al., 2018; Grubbs et al., 2017). Studies conducted earlier by Han et al.(2013) and Araujo et al.(2015) called for additional research to provide evidence that would encourage increased medical and dental collaborations. These collaborative efforts would provide earlier diagnoses and treatment of PD to improve the HRQoL and health outcomes of the CKD patient. The impact of chronic diseases such as PD on the HRQoL of the CKD patient has not been a focus of research studies which leaves a gap in the literature. The results of this study sought to provide additional information on the effect of PD on the CKD patient's HRQoL.

Purpose of the Study

The purpose of this quantitative, cross-sectional study was to determine if there is a statistical significance in the presence of PD on the predicted outcome of the HRQoL of the CKD patient. The results of this study may affect an increase in the collaborative efforts between medical and dental providers for early diagnosis and treatment of PD. Correlation and regression analyses with ANOVA test results of this study provide evidence to support or nullify the hypothesis related to the impact of the independent variable, PD, on the dependent variable, HRQol, adjusting for mental health status. Dialysis treatment for the CKD patient can have negative effects on the HRQoL and lead to less-than-optimal health outcomes (Wang et al., 2019). The importance of the HRQoL cannot be overstated as it is considered an essential component of the CKD patient's

overall well-being (Queeley & Campbell, 2018). Previous research has shown how a patient's ability to manage their health care successfully has improved their overall health outcomes (Havas, Douglas & Bonner, 2018). Examination of the hypothesized link between periodontal treatment and decreasing the inflammatory process was studied earlier by Han et al.(2013) and was supported in a later study Bale et al.,2017). The evidence collected in both studies did not appear to have a marked increase in collaborations between the medical and dental professions. Additional studies on a relationship between PD therapy/treatment and improved health outcomes have not been done.

Research Questions and Hypotheses

The purpose of this study was to determine if there was any statistical significance to the presence of PD on the predictions of the HRQoL of the CKD patient. This study was guided by the following research questions:

RQ1: Is there a statistical significance in the presence of PD on the predicted HRQoL of the CKD patient?

H_0: There is no statistical significance in the presence of PD on assessing the HRQoL of the CKD patient.

H_1: There is a statistical significance in the presence of PD on the predicted HRQoL of the CKD patient when compared to those patients with no PD present.

RQ2: Is there a statistical significance in the predicted HRQoL of the CKD patient with a diagnosis of PD and less than 30 reported days of depression (mental health) once being diagnosed with CKD (regardless of time of diagnosis)?

$H_0$2: There is no statistical significance in the predicted HRQoL of the CKD patient diagnosed with PD and less than 30 reported days of depression (mental health) once being diagnosed with CKD (regardless of time of diagnosis).

$H_1$2: There is a statistically significant difference in the predicted HRQoL of the CKD patient when PD and less than 30 reported days of depression (mental health) once being diagnosed with CKD (regardless of the time of diagnosis).

Theoretical Foundations for the Study

The social cognitive theory (SCT) and the health belief model (HBM) constitute the theoretical foundation of this study. Both theories include constructs which are directed toward motivating/affecting a change in a person's behavior and/or lifestyle (Glanz, Rimer & Viswanath, 2015). A major construct of the SCT is self-efficacy which represents a person's belief that they can accomplish and achieve a set of goals and tasks which they agree to. Personal, environmental, and behavioral influences all intersect in a dynamic manner to produce a behavior. Other constructs of the SCT include self-regulation and social support which can be designed to meet the specific needs and mores of cultural and ethnic subpopulations (Joseph et al., 2017). The SCT has been used for many years by clinicians and researchers to identify factors in health behavior, which in turn are essential in designing interventions to bring about behavior change (Glanz et al.,

2015). Ramsay et al.(2018) reported improved oral health status in patients who were given oral hygiene advice tailored to meet their needs. This represents an example of designing a framework for a specific subpopulation. There are three factors working in the SCT model that determine the likelihood of a person changing their health behavior – self-efficacy, the goals they set for themselves, and expected outcomes. The interaction of these three factors results in learned and effective behavior change (Beeson, Whitney & Peterson, 2017).

The HBM uses similar constructs and is widely accepted as a model in health education programs (Glanz et al., 2015). The HBM examines a person's relationship between their health beliefs and their health behaviors. It looks at their perceived risk of the disease, the severity of the disease (should they acquire it), the perceived benefits and barriers to making a change in their behavior, and the decision to act. The major suppositions of the HBM theory are as follows: a person will most likely make a change in health behavior when they believe they are at risk for getting a condition (i.e., advanced progression of kidney disease), make changes in behavior when they perceive the condition can have serious consequences (i.e., bad mouth odor, loss of teeth), take action that could lead to decreased susceptibility or severity of the condition (i.e., decreased oral inflammation leading to lowered inflammatory process of kidney disease), and recognize that the benefits of taking action outweigh the existing or perceived barriers (i.e., cost of care, inconvenience) [Glanz et al., 2015]. HRQoL represents a person's own definition of how well they are living their life and their level of

satisfaction with their life, their personal sense of well-being, their perception of their independence, and the ability to have control over their life path (Kafkia, Vahvilainen-Julkunen & Sapountzi- Krepia, 2017). This definition of HRQoL is aligned with the core concepts of the HBM theory and demonstrates how the theory is a foundation for this study.

The oral health literacy of both the CKD patient and their medical provider is an essential component of the response to periodontal treatment and improved health outcomes. Knowledge of the risks and oral health complications of PD as it relates to general health is most important when translating information to the CKD patient and their medical providers. The CKD patient's perceptions and beliefs about the relationship between the inflammatory processes of both PD and CKD can definitively help increase the CKD patient's response to oral health care. The HBM is an example of a cognitive approach. This approach explains the relationship between the person's beliefs (perceived threats, benefits) and the effects of what motivates a change in behavior at the decision-making level (Bakan, 2018).

Increased health literacy of the patient is important to understanding the correlation between systemic inflammatory diseases. For the CKD patient, identification, and confirmation of the association between the inflammation in CKD and the inflammatory process of PD may result in a change in their oral health behavior. The CKD patient may seek regular dental care. Increased self-management in the treatment of PD may also serve to raise the CKD patient's social capital by improved oral health and improved oral

hygiene (Coll-Planas et al., 2018). Lee and Jung (2018) concluded that social capital does affect health via the psychosocial mechanisms. These mechanisms include social support from family and community, social influence, actively engaging with others, and having personal contact. Social capital is considered a protective health factor impacting health outcomes (Coll-Planas, 2018). Raising the oral health literacy of the medical provider would also be helpful in increasing the needed collaboration between medicine and dentistry professionals.

Nature of the Study

This epistemological study used a quantitative, cross-sectional approach to examine the impact of PD and its possible effects on the HRQoL of the CKD patient. The purpose of this study was to determine the statistical significance of the presence of PD in the predicted outcome of the HRQoL of the CKD patient. This cumulative cross-sectional approach focused on male and female adults aged 45-64 years old who were diagnosed with kidney disease with no consideration of race/ethnicity.

The population for this study represented a large section of adults in the labor force that is the second largest age group affected by CKD (https://nccd.cdc.gov/CKD/AreYuAwarer.aspx?emailDate=September2020). Determinants of race, education, and income levels were identified but were not translated into independent or independent variables for consideration of their impact on the outcome of the HRQoL.

The study participants represented a 20% random sampling (N = 96,787) of the 2016 Behavioral Risk Factor Surveillance Survey (BRFSS) as conducted via telephone across the U.S. by approved interviewers. The BRFSS comprised 275 variables and had a total of 486, 987 respondents. The measurement tool to assess and identify PD as presented by the American Academy of Periodontology (AAP) is multifactorial and is considered complex by some dental professionals (G. Caton et al., 2018). The AAP's guidelines to assess PD does include but is not limited to the following: a clinical examination of probing depths (consisting of measuring six points along each tooth's circumference), measuring tooth mobility, loss of attached gingival tissue, and loss of alveolar bone around each tooth (http://www.perio.org). These values were not available in the 2016 BRFSS database therefore, the presence of PD relied on the participants response to the survey question of "number of missing teeth due to gum disease".

The 2016 BRFSS study was chosen because the questions in the survey were related to the key variables of the research study and provided the data needed to answer the research questions and hypotheses. Results of the 2016 BRFSS study were compiled and made available for public release in 2018, making it the most recent data for this quantitative study. Correlation analysis was used to determine whether the presence of PD is statistically significant in the predicted HRQoL as self-reported when compared to the predicted HRQoL of the CKD patient with no diagnosis of PD. Regression analysis was performed to examine the significance of the relationship between the CKD patients' HRQoL status as self-reported and the presence of PD and mental health status (i.e., days

of depression). Descriptive and inferential statistical analyses were used in this study for identification and predictive purposes in answering the research questions and hypotheses.

Literature Review

Search Strategy

To identify prospective, peer-reviewed articles (as well as books and grey literature), the following electronic databases, ABI/Inform, CINAHL, and Medline were searched for the years 2016-2020 using the following keywords: chronic kidney disease, periodontal disease, health-related quality of life, and mental health status. Search terms and phrases used to collect information and research articles were periodontal disease, chronic kidney disease, chronic kidney disease, depression, health-related quality of life, periodontal disease classification, inflammatory process + periodontal disease + chronic kidney disease, periodontal disease + health-related quality of life, and quality of life + chronic kidney disease patients. Additional information for this study was taken from textbooks available through the Walden University classroom.

Literature Review Related to Key Variables

Introduction

The purpose of this study was to determine if there was statistical significance in the presence of PD on the predicted outcome of the HRQoL of the CKD patient. Research on the subject matter of a hypothesized link between PD and CKD has led to several research studies (Bansal et al., 2013; Grubbs et al., 2017; Kiany et al., 2013) which have

cited an association between the inflammation present in PD and the inflammatory process which is seen in CKD and other systemic diseases. Studies by Okubo et al. (2014) and Pagels et al. (2012) examine the relationship between HRQoL and the progression of CKD leading to end-stage renal disease (ESRD) but do not address any influence which PD has on the stages of disease progression in CKD. Okubo et al. (2014) stated that HRQoL has an inverse relationship with the progression of stages in CKD where the HRQoL decreases as the progression of the disease increases. The current literature does not specifically address the effects of PD on the HRQoL for the CKD patient but the shared risk factors of elevated pro-inflammatory cytokines and triggered innate immune response systems which are present in both PD and CKD are enough of an impetus to further investigate this hypothesized link. A study by Grubbs et al.(2017) is currently underway to examine how nonsurgical treatment of PD may affect the health outcome and progression of CKD. I believe this study to be an important step towards understanding the impact of how the presence of PD and its manifestations in the oral cavity can adversely affect the health outcomes of the patient diagnosed with systemic illness such as CKD. Grubbs et al. (2017) states in their study that their purpose in exploring this connection can possibly demonstrate how the CKD patient's health outcomes are affected by PD and how it relates to their self-esteem, social engagement, and daily living. Results of this randomized controlled study are not currently published. Another study by Haag et al. (2017) also demonstrates that there is a need to examine the relationship between the integratory factors of oral and general health policies that are

directly associated with the common risk factors that appear in both PD and CKD. Haag et. (2017) states the weight of chronic conditions (such as PD), combined with underlying and preexisting risk factors shared with other systemic diseases has increased and it would be prudent to further investigate this relationship and its impact on the HRQoL for the patient. The presence of PD can and generally does lead to tooth loss which has a negative effect on overall health, issues of self-efficacy, decreased social capital and well-being, and lessened quality of life (Hewlett et al., 2015).

Previous Research Addressing HRQoL of the CKD Patient

Limited existing research was available that studied or explored the link between the presence of PD and its impact on the HRQoL for the CKD patient. The literature review did reveal studies which were conducted to examine the effect of treating PD and the resulting oral health outcomes for the CKD patient but did not directly address how the HRQol was affected. The lack of existing research addressing the effect of PD on the HRQoL for the CKD patient limited my exploration of this topic. However, this study does afford some insight into and provides relevant evidence for supporting the need for increased collaborative efforts between the medical and dental communities in early diagnosis and treatment of PD in an effort to curtail systemic inflammation. Studies by Soroye & Ayanbadejo (2016) postulated that PD is a risk factor for non-communicable diseases (diabetes mellitus, CVD, pulmonary, and CKD) where the results of the study demonstrated there were oral complications of renal disease, most notably bad mouth odor, loose teeth, and inflamed salivary glands. These oral complications can be related

to the construct of developing the social capital of the patient. Social capital is an important aspect of the community and its members where social determinants and environmental policies are major factors in determining the health and well-being of a population (Glanz et al., 2015). Further examination of the relationship between social capital can be identified by the definition of the term, "social epidemiology". This term has been defined as a branch of epidemiology that considers how a population's collective interactions and activities has an effect on their health (Ford et al., 2019). This study was conducted to purposely explore the relationship between the presence of PD and how the patient's perception of their control or lack thereof, may alter their health outcomes. Controlling the disease process of PD and its characteristics of bleeding gums, bad mouth odor, loss of teeth, and decreased masticatory functions is a primary concern in this study. Early diagnosis followed by intervention and dental therapy are key components in increased patient compliance to prevention and regular dental care.

Lee and Jung (2018) presented a model of the impact of social capital on health outcomes. This model explained that social conditions experienced by the patient results in the patient's social capital. The social-structural conditions (socioeconomic factors, politics of health policies, social change) provides the opportunities for social networks to exist. In turn, these networks influence the social support systems through personal contact that is a pathway to health behaviors. The patient's perception of their self-efficacy is tied to whether or not they decide to act and effect a change in their health behaviors based on their perceived susceptibility if no action is taken (Glanz et al., 2015).

Manavalan et al.(2017) socioeconomic factors were the dominant influencers of the HRQoL rates of the CKD patient. Their study also found that the HRQoL of the CKD patient was lacking and needed more exploration. Effective self-management for the CKD patient as with other patients who have systemic inflammatory conditions, should include proper diet and nutrition, adherence to medication regimen and cessation of smoking to improve their health outcomes (Havas et al., 2018).

Linking PD to CKD

Most CKD patients have been diagnosed with PD (Kim et al., 2017) which indicates the presence of an inflammatory process since PD is characterized by low-grade inflammation and persistent infection caused by gram-negative bacteria. This gram-negative bacterium is present in dental plaque biofilm and is a substance which is formed and deposited on teeth and gingival surfaces in the oral cavity (Soroye & Ayanbadejo, 2016). A mechanism for modulating systemic diseases via gingival inflammation was proposed by Bansal et al. (2013) to help understand how gingival inflammation may affect systemic diseases. The mechanism the authors presented proposed gram-negative bacteria found in gingival inflammation would trigger a release of cytokines (also known as inflammatory mediators) as an innate immune response via periodontal pathogens. This response then is shown to result in an attack on target organs such as the liver and kidneys. A diagram of their proposed mechanism of inflammation displays the release of the cytokines interleukin-6 (IL-6), interleukin-1 (IL-1), and tumor necrotizing factor-α (TNF-α) as a result of gingival inflammation (defining characteristic of PD). Another

cytokine which is released is C-reactive protein (CRP) and the elevated levels of this cytokine is related to PD as demonstrated in a later study led by Bansal (Bansal, Pandey and Asthana, 2014). The work of Bansal et al.(2013) in their mechanism of inflammation was supported by a subsequent study conducted by Araujo et al. (2015) concluding ESRD patients diagnosed with PD have increased levels of periodontal pathogens compared to those persons without ESRD.

The presence of elevated levels of CRP was concluded as a contributing factor in CKD progression via the inflammatory response by Ismail et al. (2013) and was also supported by Han et al. (2013) which was the first to establish a link between PD and CKD inflammatory biomarkers in Korean adults. In this study of Korean adults diagnosed with CKD, periodontitis was identified as an independent predictor of a decreased estimated glomerular filtration rate (eGFR), which indicates how well the kidneys are functioning. The study also found a correlation between PD and hematuria which is also a critical marker of kidney damage. This is additional evidence which suggests an association between PD and the presence of CKD. These studies were followed by a study done by Nowak & Choncol (2018) which examined the inflammatory markers present in CKD patients and their association with adverse clinical outcomes. Nowak & Choncol (2018) identified CRP as an acute phase reactant leading to a more impactful role in the inflammatory/disease process of CKD and cardiovascular events.

Following the same pathway in exploring a correlation between PD and CKD, Sharma et al. (2017) presented information and concluded in their study that the inflammatory biomarkers of CRP and IL-6 are reliable predictors of cardiovascular events and all-cause mortality in patients diagnosed with CKD. This information proved to be significant because CVD is a primary cause of mortality in CKD patients (Bale et al., 2017) further justifying linking the two inflammatory diseases of PD and CKD. All the preceding information definitively demonstrates common risk factors do exist between PD and CKD. Grubbs et al. (2016) stated in their study that PD is both a "common and modifiable" risk factor when examining CKD and the implications for progression for the disease. The study went further to suggest that PD can be a potential means of reducing risks for CKD progression because PD is treatable and preventable. Once the PD is treated and an optimum state of oral health is maintained it is assumed that the progression of CKD can be mitigated with the reduction of inflammatory mediators being present. The same inflammatory mediators that were identified as being present in both PD and CKD such as C-RP (Haag et al., 2017). This present study exhibited similar results when a correlational analysis was performed to show that a statistical significance exists between the presence of PD and the presence of CKD with the additional variable of the patient's response of their health not being good (related to the HRQoL).

Identifying Risk Factors of PD and CKD

Much of the research focused on PD and CKD as sharing common risk factors acknowledge the presence of the cytokines CRP, IL-1, IL-6, and TNF-α. Use of identifying common risk factors as a means of treatment and intervention when dealing with chronic systemic diseases such as PD and CKD does necessitate the integration of health policies and procedures surrounding both oral and general health (Haag et al., 2017). It would be wise to consider which risk factors are present in both conditions since the treatment of one disease may positively affect the progression of the other and vice versa. Myers, Wright and Lamster (2016) concluded in their study coordinated care is deemed a required component of treating persons who are dealing with multiple chronic diseases. Their study revealed two of every three older Americans are experiencing more than one chronic disease and this number represents 66% of the health costs in the US. The expected decrease in the financial burden of providing care for persons experiencing comorbid conditions which share common risk factors should be enough to have a closer look at the relationship between the presence of PD and CKD and how it may impact the HRQoL of the CKD patient. Emphasis needs to be placed on providing patients who have systemic illnesses with routine dental exams and early treatment to avoid complications of inflammation, to decrease pro-inflammatory mediators and C-Reactive proteins to combat the effects of PD on the patient's compromised systemic health.

PD and CKD are both chronic low-grade inflammatory processes and share diabetes mellitus and CVD as common risk factors (Nazir, 2017). The results of the descriptive

analysis presented here in this study also shows that 1.98% of the survey respondents were diagnosed with coronary disease and diabetes mellitus (see Table 4). It was discussed in an earlier section how atherosclerotic cardiovascular disease has been linked to the presence of PD which further demonstrates the common risk factor of CVD. A research study by Taraz et al. (2014) produced results showing chronic inflammation as a contributor to morbidity and mortality in the CKD patient. Nowak and Chonchol (2018) asserts there are strong observational data that places high inflammatory levels in CKD patients, associating those levels with less than desirable clinical outcomes in a number of health conditions.

These inflammatory levels are evident through the high-risk gram-negative pathogens in the PD process where PD can gain access to systemic circulation and result in kidney damage (Grubbs et al., 2016). The access to systemic circulation inducing kidney damage is triggered by an innate immune response as discussed earlier. This immune response occurs through toll-like receptors carried out by a group of transmembrane proteins (e.g., CRP, IL-1, IL-6, TNF-α) descending on the target organs, the kidneys, leading to renal failure (Grubbs et al., 2016). The results of the study by Grubbs et al.(2016) undeniably demonstrate the common risk factors of the cytokines being present in both PD and CKD.

Another common risk factor which can exacerbate the progress of PD and CKD is anxiety and depression and are considered measurements of a person's physical and mental health status by identifying the number of days considered healthy or unhealthy contributing to the calculation of the patient's HRQoL (Allen et al., 2015). The HRQoL

is an important measure when assessing the health outcomes of the CKD patient. It is a multidimensional concept which is a combination of the patient's perception of their physical, mental, and social well-being (Gemmell et al., 2016). Self-reported health was identified in a previous study by Medina-Solis et al. (2014) as measure worthy tool in epidemiology because it has an association with the morbidity rates of the present and future. Different causes of death can be determined by the use of health care services available. Depression is common among CKD patients due to limited physical function, dietary changes, decreased social support from family and friends and required dialysis treatments (Siou-Hung Tsai et al., 2015). A relationship between depression and marked elevation of the pro-inflammatory cytokines in CKD patients was reported by Siou-Hung Tsai et al. (2015) and the authors displayed evidence of a correlation between depression and malnutrition in this same CKD patient population, further supporting the importance of including depression as a risk factor. Results of this study revealed a link between mental health status (depression) and CKD progression. The study included the reported number of days of mental health not being good as a predictor in assessing the probability of its' impact on the reported number of days of physical health not being good (HRQoL).

Schick-Makaroff, Molzahn & Kalfoss (2018) reported a depression prevalence rate of 21.4%- 39.3% among the CKD patient population in their study. The increased depression rates definitively provide a negative effect on hospitalization, clinical outcomes, and mortality. This present study found a variation of 6.2% in the HRQoL of

the CKD patient being attributed to the presence of PD and mental health status less than optimal. One may look at the percentage of 6.2% and find that the number is not significant in terms of an amount but that percentage can be translated to the financial impact in dollars and how the cost savings would be beneficial to the government's health care funding agencies. ESRD treatment in the U.S. accounts for 6.3% of Medicare's annual expenditures with the HRQoL of the CKD patient declining with the progression of the disease (Nguyen et al., 2018). The financial impact of providing care for 37 million U.S. adults experiencing CKD continues to rise exponentially with stages 1-4 of CKD accounting for a 20% increase in 2016 than in the previous year (www.cdc.gov/chronicdisease/about/index.htm).

Social Determinants of Health in Assessing the HRQoL of the CKD Patient

The construct of the HRQoL of the CKD patient consists of different aspects of the patient's life which include the psychological, physical, and social components and what tools the patient uses to cope with their disease (Kafkia et al., 2017). The psychological and physical components have already been discussed earlier but it is important to consider and include the social aspect of the HRQoL which is inclusive of the social determinants of health (income, education, socioeconomic status, and social capital). These factors were identified by Manavalan et al. (2017) in their study as key influencers which impacted the HRQoL of CKD patients. The social cognitive theory (SCT) is one of two theoretical foundations on which this study is grounded. The SCT is important when explaining the relationship between the individual and their interaction with the physical

and social components which influence health behaviors (Wong et al., 2018). In the SCT the individual regulates their health behaviors via a sense of control or self-efficacy. The cognitive and environmental influences which can affect the CKD patient's behavior and perception of their status (HRQoL) are their outcome expectations of their actions regarding their health and the social support received in their environment (Glanz et al., 2015).

The presence of PD can adversely affect the social capital of the CKD patient due to bad mouth odor and loss of teeth leading to reduced social interactions. Quality of life can be affected by poor oral health conditions with resultant pain, dysfunction, and discomfort from the presence of PD (Baker et al., 2016). The lack of access to basic dental services and progression of PD due to no treatment produces oral complications such as dry mouth, bad mouth odor, loose teeth, and bleeding gum tissues (Soroye & Ayanbadejo, 2016). Failure to address and treat the PD may lead to increased discomfort and loss of teeth which can impact the ability to chew and digest foods which are essential in maintaining health but further jeopardizes the nutritional status of the CKD patient. Mansouri et al., (2017) reported in their study an association between deficient vitamin D levels and pro-inflammatory cytokines. The results of the study demonstrated vitamin D was an active component of the inflammation status of the CKD patient.

The presence of PD in the CKD patient who lacks access to dental services is resigned to dealing with the disease as best as possible which may lead to less social interaction. Linn and O'Neal (2018) reported poor oral hygiene was associated with CKD

and ESRD and made the connection between depression and lack of social support. It is not difficult to fathom a person's social interaction with others would decline when faced with poor oral health and loss of teeth. A person's physical appearance is usually the first impression others see followed by their smile and facial appearance. Loss of teeth and bad mouth odor contribute greatly to a person's smile and facial appearance. This can cause the patient to be reluctant in engaging in social interactions with individuals who they are not familiar with further isolating them from their social networks (family and friends) continuing to increase their depression and anxiety. This resultant behavior is evidence of the need for increased collaboration between medical and dental health care providers and better access to dental services.

Definitions

Terms that were used and discussed throughout this study are identified and defined as follows:

Chronic Kidney Disease (CKD)-when the kidneys fail to function properly and do not filter the blood in your system as they should. This is a progressive disease which can result in complete kidney failure.

Health-Related Quality of Life (HRQoL)- this a multi-dimensional concept which is inclusive of the following determinants: physical, mental, emotional, and social aspects of a person's life. It focuses on how a person's health status impacts their quality of life which helps to define the person's overall well-being.

End-Stage Renal Disease (ESRD)- the complete loss of kidney function which requires dialysis care or a kidney transplant to survive.

Inflammatory Process – the fundamental response of the body to an injury or a disease which is most often characterized by signs and symptoms of pain, localized heat (warm to the touch), redness, and swelling.

Social Capital- this is considered a social determinant of health and a factor regarding a person's health outcomes. Social support and social participation are components of social capital and combined with self-management and health literacy they become intermediate factors among social determinants and expected health outcomes. Social capital, self-management, and health literacy have the ability to lessen the severity of health inequities.

Assumptions

This study was based on two assumptions. These assumptions were (a) the answers provided by the participants in the 2016 BRFSS were collected and recorded by trained telephone interviewers hired to perform the survey data collection conducted monthly by state health departments with a standardized health questionnaire, and methodologic assistance from the CDC, and (b) that the answers given by the participants were truthful and honest in the reporting and that the 2016 BRFSS participants' answers to the survey questions are given to the best of their knowledge and recollection. These assumptions were made because the participants' medical and dental diagnoses could not be confirmed by clinical records or examination findings.

Scope and Delimitations

This study addressed participants' overall health and well-being as recorded by the variable HRQoL. Participants were 45-64 years old. They were chosen based on their medical conditions (presence of kidney disease, presence of periodontal disease as determined by number of teeth extracted because of gum disease) and the presence of mental health status (number of days of depression since being diagnosed with CKD). The number of days of depression did not exceed more than 30 days to be included in the study. The secondary data used in this study was taken from the 2016 BRFSS. This study did not consider any treatments the participants may have received in analyzing the results of the study.

Limitations of the Study

This study was limited by the use of secondary data taken from the 2016 Behavioral Risk Factor Surveillance Survey (BRFSS) but did not include additional survey questions asked in 2017 which were related to diet and nutrition. Populations used in the study were limited in size and scope by type of questions presented to the survey participants and the responses received from the participants. Medical treatments for any existing illnesses or conditions were not considered and thereby may have an altering effect on the data obtained by the original researchers. It may also affect the researchers' conclusions and final reporting. The study was also limited in the response of the participants not being validated by medical and dental professionals since their

answers to the survey questions regarding medical/dental diagnoses were not confirmed by clinical record and or examinations.

Significance of the Study

There was significance in having conducted this study because it broadens the knowledge in the discipline of collaborative care between medical and dental professionals. Inclusion of dental care as a primary health care item is important to access of care and improving health outcomes. This study can have an impact on how health policies are legislated and applied in public health settings to give people the access they need to obtain a level of optimal health that manifests overall health. Improved health outcomes and increased overall health (medical, dental, and mental health status) are a few of the components of public health. A healthier workforce has an effect on the socioeconomic status of the population, increased collaborations between medicine and dentistry increases health literacy, and earlier diagnosis and treatment may lead to decreased incidence of morbidity and mortality. Treatment options to address comorbidities such as cardiovascular issues and nutritional deficiencies become fewer when oral health is neglected. Persons with CKD have been shown to have higher incidence of hospitalization rates and increased mortality rates with poorer HRQoL (Gemmell et al., 2016).

The results of this study provide additional information to justify the inclusion and/or increased coverage of dental care services to adults other than pregnant women. Regular and preventative dental care services should be available for adult populations receiving

health care coverage through the Centers for Medicaid/Medicare Services (CMS) to help decrease the current epidemic of PD taking place in the U.S. and globally as noted in the Healthy People 2020 report (Varenne, 2015). Currently, individual states decide what dental care services they will provide under Medicaid/Medicare. Presently, adult pregnant women are generally covered by Medicaid for dental care (Calvo, Chavez & Jones, 2016). Adding dental care services for all adults could result in a healthier workforce, increased labor production, and lowered societal economic burden due to improved health outcomes.

Summary

There has not been enough research exploring the relationship between the inflammatory processes of systemic diseases such as CKD and PD. There has been research identifying the inflammatory mediators that are shared by CVD (specifically atherosclerotic cardiovascular disease) and PD, diabetes mellitus and PD, CKD and PD but little evidence of how the presence of PD may affect the health outcomes of those patients experiencing CKD. Predicting health outcomes (HRQoL) is an important measure that is used to help determine the cost of care for treating and managing chronic diseases. Increased collaborative efforts between medicine and dentistry can help with providing earlier diagnosis and treatment interventions leading to a healthier labor force, decreased cost of care, and improved overall health. Early diagnosis and treatment of PD of the patient with other chronic inflammatory conditions such as CKD may have a significant impact on the predicted health outcomes and economic status of the

population. The following sections will present the design, methodologies, and data collection used in this study. A random sampling of the secondary data taken from the 2016 BRFSS was used. Analyses and interpretation of the findings were found to be statistically significant.

Section 2: Research Design and Data Collections

Introduction

The purpose of this study was to determine the existence of a correlation between the presence of PD in the CKD patient and the predicted outcome (HRQoL) of the CKD patient. This quantitative, cross-sectional study used secondary data from the 2016 BRFSS that is one of several research surveys used by the CDC to obtain information on the health status of the adult U.S. population. This chapter will look closely at the targeted population, the social determinants of health (SDoH) (socioeconomic status, race, gender, education, income) and existing comorbidities (CVD, diabetes). Comorbidities are relevant because they have an impact on the HRQoL for the CKD patient.

Research Design and Rationale

The variables in this study were the independent variable of the presence of PD, the dependent variable HRQoL, and the confounding variable of poor mental health days. Also identified in this study are predictor variables of Poor Physical Health (POORHLTH), kidney disease (CHCKIDNY), and other variables related to HRQoL such as mental health (MENTHLTH= mental health status not good in the past 30 days)

and physical health (PHYSHLTH = physical health not good in the past 30 days). The following variables of CKD, MENTHLTH, POORHLTH, and PD were the variables primarily used for this study. PD was identified by the variable RVTETH3 (representing the presence of PD).

The research design for this study included the use of descriptive and inferential statistical analyses to organize and predict the health behaviors of the targeted population. Different statistical analyses were used to answer the following research questions:

RQ (1): Is there a statistical significance in the HRQoL of kidney disease patients with no presence of PD and the HRQoL of those kidney disease patients presenting with PD as indicated by loss of teeth?

Correlational analysis was performed to show if such significance exists and if so the strength of said statistics (Frankfort-Nachmias & Leon-Guerrero, 2018). The hypotheses for RQ1 were as follows:

H_0: There is no statistical significance in the predicted outcome of the HRQoL of patients diagnosed with both kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

H_1 : There is a statistical significance in the HRQoL of patients diagnosed with kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

The correlational analyses would only account for the presence of chronic kidney disease (CKD) and its impact on the HRQoL. An additional test of multiple regression would allow for the presence of another predictor variable. To answer the second research question the multiple regression analyses test would be needed and this would allow for another predictor variable to be added.

The second research question is stated as:

RQ2: Is there statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and less than 30 reported days of depression (mental health) after being diagnosed with CKD?, with the hypotheses for RQ (2) being :

$H_0$2: There is no statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and less than 30 reported days of depression (mental health) after being diagnosed with CKD.

$H_1$2 : There is a statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and less than 30 reported days of depression (mental health) after being diagnosed with CKD.

Use of the multiple regression analyses with the one-way ANOVA (analysis of variance) gives the researcher the ability to test for significance of difference between the mean scores of two or more groups across one or more variable. In this study the use of ANOVA gives the difference between the number of days of mental health not being good, the presence of PD and CKD, and their impact on the HRQoL of the CKD patient.

RQ2 has been answered and supported by the data obtained through the statistical analyses which were performed using IBM SPSS Statistics 25. Multiple regression analyses were used to test the effect of the independent variables (e.g., presence of gum disease-PD, depression- mental health status not good, presence of kidney disease- CKD) on the value for the dependent variable (HRQoL) of the CKD patient (Frankfort-Nachmias & Leon-Guerrero, 2018). The targeted population in the 2016 BRFSS dataset represented those individuals experiencing PD and CKD. This population was chosen because they represent a large segment of the able-bodied working-class citizens in the U.S.. All participants were contacted via landline and cell-phone surveys and were chosen randomly. The research design for this study was aligned with the procedures used in the social sciences to summarize and tell a story about the data represented by sets of numbers (Frankfort-Nachmias & Leon-Guerrero, 2018).

Data Collection and Analysis

The data collected in the 2016 BRFSS were analyzed using the IBM Statistical Package for the Social Sciences (SPSS) Version 25. Correlational testing (bivariate and partial) was used to answer RQ1: Is there a relationship between the HRQoL(DV) of participants with kidney disease who also have gum disease (IV) when compared with those participants with kidney disease and no gum disease? The correlation test was to determine if a relationship existed between two variables where in this study the HRQoL is the dependent variable (DV) and the gum disease is the independent, or predictor variable (IV). Regression analysis (multiple linear) was used to answer the RQ2: Is there

a difference in the HRQoL of the participants with kidney disease, no gum disease present and has reported days of depression and those participants with kidney disease, gum disease present and less than 30 reported days of depression after being diagnosed with CKD? Regression analysis was performed because it was the most correct method to answer the RQ2 since there are more than one predictor variables (gum disease and days of depression) and one dependent variable (HRQoL).

Methodology

The data in the 2016 BRFSS database was viewed to determine the presence of all of the identified variables needed to conduct this study. All of the necessary variables were present in the database and it was decided to pursue the study with said variables. A smaller dataset consisting of a 20% random sampling (N = 96,787) was created from the larger database (N = 486,303) to make it simpler to run the analyses. The random probability sampling was performed using the IBM SPSS Version 25 by taking 20% of the original dataset. Each question in the survey which was pertinent to the research questions were highlighted and checked for use in the statistical analyses. The larger and original dataset (BRFSS 2016) was used which provided data collected from each of the 50 U.S. states including the District of Columbia and the three (3) U.S. territories. Information from the 2016 BRFSS was published in October 2018 and was made available through the CDC website using the search term BRFSS. The survey was performed by trained interviewers who coded and reported answers from the survey

participants. The data collection took place via landline and cell phone between January and December 2016. Survey participants were randomly recruited by telephone with respondents' age having to be at least 18 years. The random sample which was chosen as 20% has a standard deviation almost equal to that of the larger data set which results in an effect size that is relatively small. Table 1 displays the group statistics of those chosen for the target population of this study and the results of the Independent Samples *t* test (in Table 2) displays the results from which the effect size can be calculated. The effect size was calculated by using the equation of the mean of both the sample size and the larger data set divided by the standard deviation (assuming the SD of both sample and larger data set are equal). The resulting effect size is small (0-.20). The alpha level (α) was chosen at .05 with a confidence interval (CI) of 95% and $p < 0.05$. All of the survey responses were accepted as being valid and generalizable. These results are demonstrated by the use of the Independent-Samples *t* test as displayed in Table 2 and the following equation determining Cohen's *d* which identifies effect size (0-.20 = small effect size, 0.50 = medium, 0.80 = large).

To understand the analysis the focus is on the second row of the test where the t = 3.519 and the value of the df (degrees of difference between the two groups) = 1825.379. The analysis does show significance at the level of .000. The equation to determine Cohen's *d* is as follows: $2 \times 3.519 / \sqrt{1825.379} = 0.0077$, calculating for a small effect size.

Table 1

T-Test

Group Statistics

	NUMBER OF PERMANENT TEETH REMOVED	N	Mean	Std. Deviation	Std. Error Mean
NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD	1	29483	59.91	37.357	.218
	2	12331	53.50	36.876	.332
(EVER TOLD) YOU HAVE KIDNEY DISEASE?	1	29483	1.98	.331	.002
	2	12331	1.96	.446	.004

Table 2- ***Independent Samples Test***

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD	Equal variances assumed	19.958	.000	16.072	41812	.000	6.415	.399	5.632	7.197
	Equal variances not assumed			16.158	23384.088	.000	6.415	.397	5.637	7.193
	Equal variances assumed	198.078	.000	3.967	41812	.000	.016	.004	.008	.023

(EVER TOLD) YOU HAVE KIDNEY DISEASE?	Equal variances not assumed	3.519	18245.379	.000	.016	.004	.007	.024

Because of the small effect size, it can be concluded that there is none or at least, truly little probability of there being a Type II or β error among the sample size taken from the larger population and that there is generalizability in this study. With the effect size being so small then the study can be said to have enough power to reject the null hypotheses and accept the hypotheses that the presence of PD (Number of Permanent Teeth Removed or RMVTETH) can and does have an impact on the HRQoL of the CKD patient. The additional variable of mental health status not being good (MENTHLTH) also contribute to the HRQoL of the CKD patient and has a measurable effect on the predicted outcome of the HRQoL.

Population

The demographics of the target population (N = 96,787) are persons between the ages of 45-64 years (both males and females), diagnosed with CKD and not diagnosed with CKD, have lost teeth due to gum disease, and have days of mental health issues fewer than 30 days after being diagnosed with CKD. The total participants were selected through a random probability sampling from the secondary data set of the 2016 BRFSS. Race/ethnicity, socioeconomic status, education, and income levels were not computed as part of the variables in this study.

Sampling & Sampling Procedures

Inclusion criteria for the participants in this study had to adhere to the following guidelines:

1. All participants (male and female) regardless of gender or race
2. Must be between the ages of 45-64 years old
3. Each participant selected would have been told they have kidney disease and have had a minimum of three teeth or more extracted due to gum disease
4. Have responded to the survey question asking the number of days of depression within the past 30 days
5. Responded to the survey question asking their self-reported health status (i.e., poor, fair, good, excellent) which is representative of their HRQoL.

Participants were excluded from this study if they meet these criteria:

1. Were not between the ages of 45-64 years old
2. Have not been told they have kidney disease
3. Have not been told they have either chronic condition (kidney disease or gum disease)
4. Have not had any teeth extracted because of gum disease

Data Analysis Plan

The data collected in the 2016 BRFSS was analyzed using the IBM Statistical Package for the Social Sciences (SPSS) Version 25. Correlational testing (bivariate and partial) was used to answer RQ1: Is there a relationship between the HRQoL(DV) of

participants with kidney disease who also have gum disease (IV) when compared with those participants with kidney disease and no gum disease? The correlation test was to determine if a relationship existed between two variables where in this study the HRQoL is the dependent variable (DV) and the gum disease is the independent, or predictor variable (IV). Regression analysis (multiple linear) and one-way ANOVA testing was used to answer the RQ2: Is there a difference in the HRQoL of the participants with kidney disease, no gum disease present and has less than 30 reported days of depression and those participants with kidney disease, gum disease present and less than 30 reported days of depression after being diagnosed with CKD? Regression analysis and ANOVA were performed because they were the most correct method to answer the RQ2 since there are more than one predictor variables (gum disease and days of depression) and one dependent variable (HRQoL). The CI of 95% and the probability value, $p < 0.05$, will be used to interpret the results of the findings.

Threats to Validity

The threat to internal validity may occur due to responses from the survey participants which are not truthful and cannot be verified or confirmed as such. The measurement of the extent of the PD is predicated upon the number of lost teeth due to gum disease as was told to the survey participant by a dental professional. The level of severity of PD will not be assessed based on the number of lost teeth but only indicated as being present. The sample size of the participants responding to the 2016 BRFSS can be identified as representative of the population at large as this survey is the largest

survey system worldwide and is considered a standard in tracking behavioral health (www.cdc.gov/brfss). Therefore, the results of the study were viewed as generalizable with no threat to external validity. The Institutional Review Board (IRB) approved the use of the data set for this study confirming that the collection of the data met all ethical standards. The approval number for this study is 06-17-20-0693980.

Summary

Section 3: Results and Findings

Introduction

The purpose of this study was to determine if there is statistical significance in the presence of PD on the outcome of the HRQoL for the CKD patient. The research questions are:

RQ1: Is there a statistical significance in the HRQoL of kidney disease patients with no presence of PD and the HRQoL of those kidney disease patients presenting with PD as indicated by loss of teeth?

H_0: There is no statistical significance in the predicted outcome of the HRQoL of patients diagnosed with both kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

H_1 : There is a statistical significance in the HRQoL of patients diagnosed with kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

RQ (2): Is there statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period?, with the hypotheses for RQ (2) being :

$H_0$2: There is no statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period.

$H_1$2 : There is a statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period.

The study topic addressed the statistical significance of the presence of PD on the days and when there are no challenges of less-than-optimal mental health days over a 30-day period. Less than optimal mental health days that are more than 30 days would suggest the patient needs a mental health screening for depression and/or mental health conditions. This section will present the results of the statistical analyses used to test the hypotheses, provide the demographics and descriptive statistics of the sample population and its' relation to the larger data set, and analyze the findings of the statistical analyses utilized with the presentation of tables produced by the tests results.

Data Collection of Secondary Data Set

Data for this study was taken from the 2016 BRFSS. The 2016 BRFSS (Behavioral Risk Factor Surveillance Survey) is the largest health behaviors survey conducted continually by the Centers for Disease Control and Prevention since its

inception in 1984. The survey is conducted and data collected from all 50 US states, the District of Columbia, and the three US territories with over 400,000 interviews completed yearly by trained interviewers. Data was entered into the BRFSS dataset using the Ci3WinCATI data entry module software. The data was collected from January - December 2016 and the results were published in August 2017 via both landline and cell phone usage. Survey participants had to be a minimum age of 18 years with no other specific criteria for inclusion in the survey. The response rates of the participants for both landline and cell phones were as follows: mean = 46.7%, median = 47.1%, maximum= 65%, and a minimum = 30.7%. There were no discrepancies in the intended and planned use of the results of the 2016 BRFSS.

Baseline descriptive and demographic characteristics of the survey participants for this study showed that the 43.31% were males and 56.68% were females with a majority of the population identified as Black. Educational levels were a high school diploma or GED, and average maximum income at $20,000, and a 4% rate of unemployment for one year or more. The tables shown demonstrate that the majority of the sample population may be considered to have low socioeconomic status and more likely to be unemployed once the medical condition has been diagnosed. Educational level may also be a factor in the medical/oral health literacy of the sample population in this study and may account for the lack of early diagnosis and treatment of both CKD and PD. The descriptive statistics (age, gender, race) of the probability sample of participants (N = 96,787) is shown in Table 3. Other descriptive statistics for income level, education,

race, and employment status are displayed in Table 4 along with the value assigned as expressed in the BRFSS codebook.

Table 3 ***Demographics – Age, Sex***

Descriptive Statistics

	Age 45-64	RESPONDENT S SEX
Valid	35558	96787
Missing	61229	0
Mean	2.7017	1.57
Median	3.0000	2.00
Std. Deviation	1.09245	.503

Male = 1 Female = 2

Table 4 ***Demographics (Race, Income, Employment, Education)***

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EDUCATION LEVEL	96786	1	9	4.91	1.074
INCOME LEVEL	96015	1	99	19.15	30.892
EMPLOYMENT STATUS	96773	1	9	3.96	2.881
COMPUTED RACE-ETHNICITY GROUPING	96787	1	9	2.04	2.291
Valid N (listwise)	96012				

(BRFSS Codebook Values for the demographics can be found in the appendix)

The characteristics of this sample also represent those persons who meet the study criteria of being between the ages of 45-64 years, have been diagnosed with kidney disease, and have had at least three permanent teeth extracted. PD is represented by the removal of at least three permanent teeth. A diagnosis of PD was not characterized by the survey's respondents and the removal of at least three permanent teeth is more likely to be a result of the identification PD being present. The sample population used for this study is a probability sampling and is representative of the total population surveyed in the 2016 BRFSS. A 20% random sampling was chosen instead of a 10% because of the large size of the secondary dataset that was used. The random sampling (N= 96.787) is proportional to the total survey participants (N=486,303) and therefore the results of the findings would be generalizable. There were no covariates used in this study only the dependent variable of HRQoL and the independent variables of PD (represented by Number of Permanent Teeth Removed or RMVTETH3) and MENTHLTH (related to HRQoL).

Results

The statistical tests performed in this study were the correlational analysis, multiple regression and one- way ANOVA, and the independent samples test. In the following tables all of the results of the statistical tests will be displayed. Results will be interpreted using the CI of 95% and a probability value of $p < 0$. The effect size has been calculated as small but will still have an impact on the population at large in reference to the costs of care and expected decrease in hospitalization rates, mortality, and morbidity rates.

RQ1: Is there statistical significance in the HRQoL of patients diagnosed with kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease?

H_0: There is no statistical significance in the predicted outcome of the HRQoL of patients diagnosed with both kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

H_1 : There is a statistical significance in the HRQoL of patients diagnosed with kidney disease and PD and the HRQoL of those patients only diagnosed with kidney disease.

Correlational testing was done and showed a significance at the .000 level which identifies that there is a difference in the presence of PD on the outcome of the HRQoL of the CKD patient. RQ1 refers to whether there is a difference when there is PD present in the patent diagnosed with CKD as opposed to those patients who have only been diagnosed with CKD. The results of the correlational analysis in Table 5 clearly shows the Pearson's correlation at .033 when PD is present and a correlation at .035 (Table 5) when there is no presence of PD. Although the difference may appear small it is still significant when looking at the difference statistically. Because of these results the null hypotheses of RQ1 can be rejected and the accept the H1 of RQ1. The RQ1 is addressed and answered by the results of the correlational testing showing a statistical significance present when PD has been diagnosed in the CKD patient thereby the null hypotheses can be rejected. Table 5 shows the correlational analysis test identifying a relationship

between the presence of PD and kidney disease. There is a statistical significance of .000 where correlational significance is shown at the 0.01 level. The probability value associated with this analysis is $p < 0.05$ and the level shown is lower than 0.05.

Table 5 ***Correlational Analysis***

Correlations

		NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD	(EVER TOLD) YOU HAVE KIDNEY DISEASE?
NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD	Pearson Correlation	1	.035**
	Sig. (2-tailed)		.000
	N	96787	96787
(EVER TOLD) YOU HAVE KIDNEY DISEASE?	Pearson Correlation	.035**	1
	Sig. (2-tailed)	.000	
	N	96787	96787

**. Correlation is significant at the 0.01 level (2-tailed).

Comparison of the results from Tables 5 & 6 show a difference between the presence of PD in CKD patients and those diagnosed with CKD but no PD. Examination of the statistics in Table 5 endorses the rejection of the null hypothesis and supports the proposed theory that the presence of PD in CKD patients does have an adverse effect on the HRQoL for the CKD patient.

Table 6 displays a correlation in the partial correlation analysis between the presence of PD and reduced number of reported days of physical health not being good.

The variable (PHYSHLTH) is representative of the HRQoL of the CKD patient and is specific to the age group (45-64 years) of the target population. The independent variable of PD was added to the correlational analysis to see if there was a statistical difference when the CKD patient had PD present and what difference, if any, this would have on the HRQoL of the CKD patient. In Table 4 the results show there was a statistical difference when PD was present albeit was small there is still a statistically significant difference and it had an effect on the HRQoL.

Table 6 ***Correlational Analysis***

Partial Corr

Correlations

Control Variables			(EVER TOLD) YOU HAVE KIDNEY DISEASE?	NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD
NUMBER OF PERMANENT TEETH REMOVED	(EVER TOLD) YOU HAVE KIDNEY DISEASE?	Correlation	1.000	.033
		Significance (2-tailed)	.	.000
		df	0	96784
	NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD	Correlation	.033	1.000
		Significance (2-tailed)	.000	.
		df	96784	0

This partial correlational analysis shows the relationship between the presence of kidney disease and the number of days of physical health (PHYSHLTH) that is not considered good. The variable PHYSHLTH is representative of the HRQoL of the CKD patient and is important in measuring the overall health outcome of the patient in relation to their hospitalization rates and cost of care. The result of the analysis shows significance as displayed in Table 5 at the level of .000 which is lower than the *p* value of 0.01 where $p < 0.05$ and the statistical evidence presented here bears that out. Pearson's correlation has been calculated at 1 which shows a strong correlation between the variables of the presence of PD and poor physical health (representative of the HRQoL) of the CKD patient.

The RQ2: Is there statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period?, with the hypotheses for RQ (2) being:

$H_0$2: There is no statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period.

$H_1$2 : There is a statistical significance in the outcome of the HRQoL of the CKD patient diagnosed with PD and reported days of depression (mental health) over a 30-day period.

To answer the RQ2 the statistical test of regression analysis was utilized and the results are presented in Tables 7-9. In Table 7 the independent variables of PD (represented by

Number of Permanent Teeth Removed or RMVTETH3) and reported days of depression over a 30- day period (represented by Number of Days Mental Health Not Good) are entered as predictor variables. The dependent variable of PHYSHLTH (representative of HRQoL) is entered to predict whether or not it is affected by the presence of the independent variables, Number of Permanent Teeth Removed or RMVTETH3, and Number of Days Mental Health Not Good and to what extent is there significance.

Table 7

Regression Analysis

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	NUMBER OF PERMANENT TEETH REMOVED, NUMBER OF DAYS MENTAL HEALTH NOT GOOD, (EVER TOLD) YOU HAVE KIDNEY DISEASE?[b]	.	Enter

a. Dependent Variable: NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD

b. All requested variables entered.

Table 7 shows the variables which were entered for the analysis and Tables 8 & 9 display the results of the multiple linear regression analysis and the level of significance.

Regression analysis shows the predictability of the outcome that exists as a result of the relationship between the variables. This analysis allows a prediction about the outcome of the HRQoL of the CKD patient based on its relationship to the variables that were entered in Table 7 (MENTHLTH, PD, and CKD). The results in Table 8 displays the correlation coefficient (Pearson's *r)* and the *PRE* (prediction errors) which is the R square. The results show that for every 6.8% variation in the number of days the physical health is not good (PHYSHLTH) it can be attributed to the presence of PD and MENTHLTH, thereby affecting the HRQoL of the CKD patient. These results definitively answer RQ2 by presenting evidence that there is a statistical significance in the outcome of the HRQoL of the CKD patient when PD is present.

The discussion relating to the presence of PD is important and is all the more relevant when viewing the results of the ANOVA (analysis of variance) test in Tables 8 & 9. The values show a significance at the .000 level and clearly supports the rejection of the null hypothesis for RQ2. A 6.8% difference in the variability of the HRQoL that can be attributed to the presence of PD is significant enough and the statistical analysis shows that to be true supporting the alternative hypothesis and rejecting the null.

Table 8

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.261[a]	.068	.068	35.768

a. Predictors: (Constant), NUMBER OF PERMANENT TEETH REMOVED, NUMBER OF DAYS MENTAL HEALTH NOT GOOD, (EVER TOLD) YOU HAVE KIDNEY DISEASE?

In Table 9 below, the significance is shown to be at the .000 level which is also lower than the $p < 0.05$ value. Both tables display that there is significance at the .000 levels as demonstrated in the results of the multiple linear regression and ANOVA analyses. This analysis of variance (ANOVA) allows for the comparison of independent variables (PD and Number of days Mental Health Not Good) with a dependent variable (CKD patient). This analysis will test for any significance of comparison of variance between the two groups with variance within the groups (Frankfort-Nachmias & Leon-Guerrero, 2018). The results show a significance at the .000 level which is below the chosen p value of 0.05. None of the research previously identified in this study showed a correlation between the presence of PD, mental health status, and HRQoL for the CKD patients. The focus of this study was to identify a correlation between the aforementioned variables and demonstrate the association between the presence of PD and decreased HRQoL of the CKD patient.

Table 9

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9049135.787	3	3016378.596	2357.762	.000[b]
	Residual	123818331.667	96783	1279.340		
	Total	132867467.453	96786			

a. Dependent Variable: NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD

b. Predictors: (Constant), NUMBER OF PERMANENT TEETH REMOVED, NUMBER OF DAYS MENTAL HEALTH NOT GOOD, (EVER TOLD) YOU HAVE KIDNEY DISEASE?

In Table 10 below, the same information is given after completing the analysis showing that the HRQoL (PHYSHLTH) of the CKD patient is affected by mental status (2.54%) and the presence of PD (8.98%), showing a significance for both variables with p =.000 (which is below the 0.05 chosen p value). The results of this analysis also demonstrate there is a statistically significant difference when the variable of mental health not being good is added as a predictor variable in the outcome of the HRQoL of the CKD patient. This result allows for the rejection of the null hypothesis and acceptance of the alternative.

Table 10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	33.618	.704		47.762	.000
	NUMBER OF DAYS MENTAL HEALTH NOT GOOD	.254	.003	.247	79.566	.000
	(EVER TOLD) YOU HAVE KIDNEY DISEASE?	3.204	.328	.030	9.783	.000
	NUMBER OF PERMANENT TEETH REMOVED	.898	.035	.079	25.433	.000

a. Dependent Variable: NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD

As with any statistical testing, the effect size is important in establishing if there is a real difference between the sample size and the target population. Tables 9 & 10 above display the T-test and an Independent Samples Test. These tests were done to determine the probability that the sample population is representative of the larger population that was surveyed in the 2016 BRFSS and was chosen independently from normal populations (those persons who meet the criteria for inclusion in this study). The tests also allow the researcher to determine what the effect size would be and what, if any significance would be shown. The independent samples test shows significance at .000 determining there is an exceedingly small effect size and no difference across the groups when comparing the means of the variables indicated. There is significance shown in the

test results at the .000 level in Table 10 and therefore it can be assumed that the sample population is representative of the larger population surveyed.

Summary

The preceding results of the statistical analyses that were performed definitively showed a correlation between the presence of PD in the CKD providing a basis for the hypotheses of PD affecting the HQRoL of the CKD patient. All of the analyses that were performed showed a level of significance ($p < 0.05$) in the correlation between the presence of PD and the effect on the HRQoL of the CKD patient. The results of the analyses displayed supportive evidence of rejecting the null hypotheses and accepting the stated theory that PD does in fact alter the HRQoL of the CKD patient. The analyses examining the additional variable of mental health status also demonstrated an effect on the HRQoL as well as the presence of PD. There can be no mistake that the addition of poor mental health status has a negative effect on the predicted outcome of the HRQoL of the CKD patient as seen in the statistical evidence provided. The HRQoL is further compromised and decreased with the addition of poor mental health status is added as a factor in predicting health outcomes. Both PD and poor mental health status have a negative effect for the predicted outcome of the HRQoL of the CKD patient and that does affect hospitalization, morbidity and mortality rates, and the overall cost of care. The stated research questions and hypotheses were indeed supported and accepted by the results of the statistical analyses performed.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Is there any statistical significance in the presence of PD and its relative impact on the HRQoL for the CD patient and if so, is that significance further advanced by the presence of a poor mental health status for that same patient? In both research questions the null hypotheses can be rejected because of the supportive evidence provided by the results of the statistical tests performed. This study was done to offer additional evidence showing a correlation between PD and CKD and how PD can affect and have an impact on the HRQoL for the CKD patient. The literature review conducted for this study did not provide any relevant and current information on the impact of PD and its' effect on the HRQoL of the CKD patient. Previous studies (Kiany et al., 2013; Bandal, Pandey & Asthana, 2014; Sharma et al., 2017) have shown that early diagnosis and treatment of PD can decrease the levels of the inflammatory markers which have been identified as being present in both CKD and PD. Controlling and/or reduction of inflammatory mediators has a positive impact by reducing morbidity and mortality rates in the CKD patient (Sharma et al., 2017). A reduction in mortality/morbidity rates coincide with a reduction in hospitalization rates, decreased costs of care, and increased positive patient outcomes. Nguyen et al. (2018) reported a clear and consistent association between the severity of the CKD and the HRQoL of the CKD patient. Their findings were consistent with

previous research and studies centered around the link between HRQoL and the disease progression of the CKD patient.

Interpretation of the Findings

The results of the statistical analyses that were performed, multiple linear regression and correlation), demonstrated a significance in the hypothesized relationship between PD and CKD when examining the inflammatory processes present in both diseases. The presence of oral health diseases can adversely affect the quality of life producing pain, lack of interest in self-care because of oral dysfunction and discomfort exacerbated by the presence of PD (Baker et al, 2016). In studies conducted by French et al, (2018) the results clearly show that PD is a major causative factor in tooth loss while demonstrating that there is a correlation between the presence of PD and other systemic inflammatory conditions. This study result was supported by a NHANES (National Health And Nutritional Examination Survey) study reporting 47% of adults over age 30 experience a form of PD. This same age group is a small portion which is representative of the target population chosen for this study. The target population (ages 45-64 years) in this study accounts for approximately 13% of the total US population (www.cia.gov/library) and of this total the incidence rate of CKD is 10.4 per 1,000 persons (www.nccd.cdc.gov/ckd) and estimates that 17% of all US adults within the target population have been diagnosed with CKD. Severe PD affects 14% of adults ages 45-64 years (www.cdc.faststats).

In the correlational tests (refer to Table 6) where the results show that the presence of PD and mental health status not being good account for a 6.8% change in the outcome

related to HRQoL for the CKD patient. These results show a definite correlation between the presence of PD and the manifestation of a less than optimal mental health status. The outcome of the analyses performed demonstrate that the HRQoL can be predicted by the occurrence of the variables of PD and mental health status. In an earlier study the prevalence of depression in CKD patients was shown to range from 21.4% - 39.3%, and negatively impacted the quality of life for the CKD patient leading to increased hospitalization, morbidity, and mortality rates (Schick-Makaroff et al, 2018) further supporting the results of the analysis shown in Table 8. The presence of decreased mental health status (depression) is a common denominator among CKD patients with an estimated 25-50% of those patients reporting depressed mental health status (Siou-Hung Tsai et al., 2015) and in a subsequent study by Jhee et al. (2017) depression was reported to be the most common psychological factor among KD patients. Review of previous studies examining the effect of depressed rates of mental health status on CKD patients (Schick-Makaroff et al, 2018, Siou-Hung Tsai et al, 2015) reveal a distinct commonality in the presence of depression among CKD patients with negative impact on quality of life for these patients. In the study by Siou-Hung Tsai et al (2015) the results showed a marked increase in proinflammatory cytokines, reduction of serum albumin concentration (affects body tissue repair, chronic inflammation is a causative factor), and an association between depression and malnutrition in the CKD patient specifically. The results of the regression analysis support the results of this study and those of the study conducted by

Gemmell et al, (2016). This particular study reported that poor HRQL has a propensity to be much lower in the CKD patient with increased hospitalization and mortality rates.

Most often the CKD patient reports a low adherence to medications and dietary guidelines as recommended by their health care providers. Depression as well as anxiety were found to be common in CKD patients than in the general population leading to lower non-compliance with treatment, increased hospitalizations, mortality and morbidity rates, and decreased quality of life (Yucens et al., 2019). It is not surprising to find that a patient's depressive state of mind has a large impact on how much attention the patient gives to the management of the disease process and the declining interest in being an active participant in self-care (Wang et al., 2019).

The HRQoL is an important and measurable variable that is utilized to account for costs of care, predicting health outcomes, and making evidence-based decisions for management of the disease process (Wang et al., 2019).

Maravalan et al. (2017) identified socioeconomic, educational attainment, and income levels as heavy influencers in determining the outcome of the HRQoL of the CKD patient. Lack of access to care (both medical and dental) and not receiving early diagnosis to help prevent/retard the progression of disease, play an important role in whether or not the CKD patient is at an increased risk of PD (Kim et al, 2017). Oral disease has been noted as the 'silent killer' amongst adults in the US (Satcher & Nottingham, 2017) and oral conditions such as PD can adversely affect the CKD patient's quality of life resulting in pain, discomfort as a daily occurrence, (Broadbent et al, 2016)

and allow the CKD patient to feel a loss of control over their health. Referring to the SCT framework described as one of the theoretical foundations of this study, the CKD patient needs to have a sense of control which will allow for improved health outcomes by increased self-management of their disease conditions.

Patients with CKD are more likely to show a less than desirable HRQoL when compared with the general population. Studies by Nowak & Choncol (2018) and Nguyen et al. (2018) both found that CKD patients are a higher risk of decreased HRQoL as the severity of the inflammation associated with the disease increases. PD is a low-grade chronic inflammatory process which has been shown to have an association with CKD. This association has been studied by Grubbs et al. (2016) where the pathogens found in PD enter the bloodstream and can induce kidney dysfunction via triggering the immune system's response to inflammation and initiating a cascade of inflammatory mediators. Evidence supporting PD pathogens being present and active in atherosclerotic cardiovascular disease has been stated (Nazir, 2017) in addition to studies revealing prevalence rates (29-64%) of PD in CKD patients when compared to patients not diagnosed with CKD (Araujo et al, 2015). The discussion relating to the presence of PD is important and is all the more relevant when viewing the results of the ANOVA (analysis of variance) test in Tables 8 & 9.

Support for the interpretation of the findings produced by the analyses can be found in the study by Tasmoc et al. (2017). In this study the CKD patients had a higher prevalence of PD than those patients without kidney disease. Studies by Mihai et al.

(2018) and Tasdemir et al. (2018) identified PD as a low-grade inflammatory process and a hallmark of CKD, involved in the development of all-cause mortality. Both studies recognized this type of inflammation as being a central part of the progression of kidney disease. Inflammation and oxidative stress were also shown to be linked as prominent characteristics of CKD in a study by Sharma et al. (2017). The study demonstrated that both CKD and PD share the same inflammatory biomarkers of TNF-α, IL-6, and increased levels of CRP. The increased levels of CRP and IL-6 support evidence of how the periodontal inflammatory processes exacerbate the systemic burden via the acute-phase and oxidative stress pathways.

Previous studies by Nowak & Choncol, (2018) showed evidence of a relationship between inflammation in chronic dialysis patients and adverse clinical outcomes. This study and others (Toraz et al., 2014; Grubbs et al, 2016) continued to press the issue of how the presence of inflammation adversely impacts the health outcomes for the CKD patient. The studies also reiterate the message of controlling and reducing the inflammatory mediators to reduce and/or eliminate the inflammation that leads to continued dysfunction and impairment of the affected organs. Tasdemir et al. (2018) concluded in their study that chronic inflammation is a risk factor for the CKD patient and that the presence of PD in the CKD patient is a source of such chronic inflammation. This same study also indicated that the TNF-α cytokines which are associated with the severity of inflammation are reduced once periodontal therapy for PD has been completed. This information continues to support the evidence of an association between

the presence of PD and chronic systemic inflammatory conditions. The studies that were presented and discussed here provide and support evidence of the need for collaboration between the medical and dental professions. Particular attention should be paid to reviewing blood pressure and other vital signs as it relates to the presence of systemic conditions. Patients should be screened on a regular basis for chronic systemic conditions whether they are being treated by a medical or dental professional. PD affects a large portion of the population and has been identified as being the common factor in CKD patients (Kim et al. 2017). This association between PD and CKD patients should be enough to signal to health care providers to screen patients for systemic conditions regularly. According to the World Health Organization (WHO) edentulism is seen as a poor health outcome affecting both oral and general health status including a negative effect on the quality of life (Hewlett et al, 2015). PD is the major cause of tooth loss (French et al, 2018) and has a major impact on the social well-being of the patient. The close association between the presence of PD and CKD indicates that early treatment of PD could be a method of reducing the risk of the progression of CKD because PD is preventable with treatment options that demonstrate a reduction in the pathogens causing continued inflammation (Grubbs et al, 2016). Increased collaborative efforts can only enhance the patients' health care and provide the patient with a true sense of being treated as 'whole'. Collaborative health care can be the difference between early diagnosis and treatment and late intervention due to late diagnosis resulting in less than optimal health outcomes.

For many patients, a diagnosis of a chronic condition can be both devastating and paralyzing. Depending on what the prognosis is a patient can find themselves in a state of uncertainty not knowing how the disease will affect them, how are they going to move forward, and will their life be forever changed and if so, to what extent? The health care provider is the person who can assist the patient in navigating the pathways to extend or maintain an optimum health status. The patient's prognosis is tied to when they receive the diagnosis (early or late), extent or severity of the disease/condition, and whether or not the patient is ready to partner with their health care provider in deciding on treatment options. When a patient becomes depressed or despondent about their health status then it becomes more difficult to improve that patient's overall well-being. Depression and lack of self-efficacy affects the patients' HRQoL on several different levels. The concept of HRQoL is multidimensional consisting of a patent's perception of how they are functioning in relation to their physical, psychological, and social well-being (Gemmell et al., 2016). Studies by Siou-Hung Tsai et al.(2015), and Schick-Makaroff et al.(2018) have concluded that depression and lack of self-efficacy negatively impact clinical outcomes and leads to increased hospitalizations, mortality and morbidity rates and poorer quality of life for the patient.

Relating self-efficacy to the SCT framework provided in this study shows a direct connection to how improving the CKD patient's self-management of their condition can improve their health outcome. In a study by Havas, Douglas & Bonner (2018) the authors concluded that when the patient displays effective self-management of their disease state

by adhering to dietary and nutritional guidelines, taking medications as directed, and cessation of smoking, then their health outcomes are positively impacted. The patient changes their health behaviors and signals a change in their perception of how much control they do have in managing their health.

One of the constructs in the framework provided in this study is social capital. Social capital is considered one of several different social determinants of health and is viewed as a factor in determining health outcomes (Coll-Planas et al., 2018). When a patient believes their health is good, have stable oral health (absence of disease), and believe they are in control of their overall health, their participation in social networks increases. The patient's participation in a social network provides an opportunity for the psychosocial mechanisms of trust, support, and increased self-efficacy which in the end has an impact on their health (Lee & Jung, 2018). Increased participation of the patient in social networks and organizations (i.e., family networks, circle of friends) can and does influence health behaviors (Wong et al., 2018). Social support for improved health and a positive change in health behaviors are part of the psychosocial construct that is identified in the SCT framework in this study. The CKD patient's personal satisfaction with his/her health and life is overshadowed by their perception of how much control they have over the physical symptoms of the disease (Kafkia Vehvilainen-Julkunen & Sapountzi-Krepia, 2017).

Limitations of the Study

The random sampling taken from the larger data set does not present any limitations to generalizability to the larger population. The survey data that was collected was done through trained interviewers and the surveys were conducted the same with all interviewers. The validity of the study is based on the fact that these surveys are conducted on a yearly basis throughout the US. It is assumed that the answers which were given by the respondents to the questions were truthful and valid as there was no opportunity to perform physical and dental examinations on each person nor were mental health assessments completed except to ask the respondent how they felt their mental health status was at the time of the survey. The secondary data set (2016 BRFSS) is considered to be trustworthy, reliable, and valid.

Recommendations

One particularly important aspect of patient involvement in their care/treatment plan is the patient's ability to understand the diagnosis and how it is communicated from the provider to the patient (Abelsson et al., 2020). Early intervention is essential in slowing disease progression and giving the health care provider a number of treatment options that may not have been available if the diagnosis was made late in the disease progression. This early intervention can be a product of routine health care visits to the patient's medical and/or dental provider. Regular visits to a health care provider can establish better communication and trust between the provider and the patient, increase

patient health literacy and involve the patient as a partner in determining their health trajectory (Pinheiro, Zagar & Reeve, 2017). The medical profession needs to be more involved by simply performing a cursory oral exam as part of their general health exam to determine if there is a need for dental care. This can result in early diagnosis of oral diseases and will help compensate for the lack of access to dental care for many (Martin & Simon, 2019). It would be recommended to have medical professionals provide their patients with a list of dental care providers to encourage the patient to seek a permanent dental home. This would be a referral list of dental offices/practitioners who are available at locations where the patient can have easier access and perhaps be offered a payment plan for dental care as needed.

Studies have shown there to be an established relationship between oral health and systemic health due to common risk factors (Hewlett et al., 2015; Andreeva et al., 2018) promoting the interrelationship of medical and dental health care providers. The collaborative efforts of both professions would serve to provide true comprehensive care for their patients and achieve early detection and intervention leading to a bidirectional referral network working to affect change not only in early detection and treatment but also to decrease costs of care (Myers-Wright & Lamster, 2016). Previous research investigating the link between atherosclerotic heart disease and PD has resulted in a collaborative effort between the cardiologist and the dental team (Bale et al., 2017). Patients awaiting cardiac surgery are required to get clearance from their dentist before receiving any surgical interventions.

Involving medical professionals to perform cursory dental exams would make a difference. These cursory exams would allow the health care provider to check for signs of bleeding gum tissue and identify teeth that are loose and extruding. Loose teeth that are painful and sensitive to the touch do not allow the patient to eat a proper diet and obtain nutrients that are vital to maintaining good health. Poor oral health is directly associated with a reduced variety of diet, inadequate intake of micro and macronutrients, and an increased risk of malnutrition (Andreeva et al. 2018). Vitamin D deficiency affects the regulation of immune and inflammatory processes and were shown to be quite low in patients experiencing chronic inflammatory diseases such as CKD. Vitamin D is indicated to have an anti-inflammatory effect and will produce higher serum levels in CKD patients who have reduced inflammation (Norris et al., 2018). The correlation between decreased vitamin D levels and increased inflammatory states was supported by a previous study showing vitamin D deficiency played a significant role in activating inflammation (Mansouri et al., 2017). Oh et al., (2017) noted in their study that vitamin D deficiency not only resulted in a decrease in the glomerular filtration rate (GFR) in the CKD patient but also showed signs that it may affect the HRQoL for the CKD patient. PD does result in loss of teeth and supporting tissues which are necessary for full functioning dentition. Patients who are edentulous or have less than a full complement of teeth are prone to poor food quality, decreased intake of fruits and vegetables, and are more likely to have issues with obesity, diabetes, and cardiovascular diseases (Komagamine et al., 2016).

The medical profession has already adopted a practice of requiring patients to have a pre-surgical dental exam and complete any necessary dental treatment prior to having any cardiac or joint replacement surgeries. The precursory step of a dental exam and clearance allows the dental team the opportunity to provide needed treatment and therapy to decrease/eliminate the pathogens responsible for oral diseases, namely PD, which have also been known to be a cause of mortality/morbidity in CVD (Bales et al., 2017). It is necessary to increase collaborative efforts between the medical and dental professions to foster an environment for early detection and treatment, increase positive health outcomes, and improve the patients' oral health status. Improved health outcomes can lead to decreased financial burden on the patient, their family, and the managed care programs which are funded in part by the federal health care system.

There should be continued emphasis and research exploring the relationship between oral health and systemic disease. This study focused primarily on the impact of PD on chronic kidney disease but there may be other implications of how much of an effect PD may or may not have on ither systemic illnesses. As expressed earlier in this study the WHO has noted an increase in PD worldwide as the incidence of diabetes mellitus and oral disease has increased exponentially. This study was limited in that it added only one other variable of mental health. There has been previous research examining the relationship between oral health (specifically PD), and systemic diseases and what possible impact it may have on the patient's overall health. These studies (Cotiĉ, 2017; Fiorillo, 2019; Johnston, Martin & Archer, 2020) have concluded that ther

is enough evidence to assert an association does exists and further research should be continued in that direction.

Research to explore the full impact of PD and other oral diseases on the patient's well-being would aid in improving the HRQoL for all patients experiencing any systemic illness and decrease hospitalization, morbidity, and mortality rates. This decrease would in turn affect the overall cost of care and increase positive patient outcomes. The results of this study may also provide a basis for lobbying of inclusion of dental insurance as part of overall health insurance eliminating a financial barrier of access to care.

Patients being seen in medical offices for monitoring of systemic illness should be screened for oral diseases and then referred for diagnosis and treatment. Likewise, patients being treated for dental care should have their vital signs (blood pressure, BMI assessment, pulse, and respiratory rates) checked and monitored at each visit. Referrals to the patient's primary care for further assessment should be given to the patient when these stats for the vital signs are less than optimal. The collaborative efforts of both professions would serve to provide early detection and treatment options, avoiding extensive and expensive care.

Implications for Social Change

This study has shown the relationship between the presence of a low grade, chronic, inflammatory disease such as periodontal disease and its' effect on the health-related outcomes for the quality of life for the chronic kidney disease patient. The study

results show a significant relationship between PD and CKD and demonstrates the need for continued research to examine how the low-grade, chronic inflammatory process of PD contributes to a decreased HRQoL. Changes to how patients are diagnosed and treated early on in their disease state can have positive social impacts including increased self-efficacy, increased employment, better socioeconomic status, improved oral health, and improved overall health.

Lack of access to care for many adults has created oral health disparities/inequities to the likes of which led the former surgeon general, Dr. David Satcher, to declare in his 2000 Oral Health in America report that oral disease is "the silent epidemic" of disparities in oral health (Satcher & Nottingham, 2017). Poor oral health is a significant factor in exposing social and health inequities and continues to be a source of underemployment, low self-esteem, pain and discomfort, and low economic capacity (Martin & Simon, 2019). Low economic capacity and self-esteem can be directly tied to the target population of this study. Persons within the age group of 45-64 years of age have lived to more than half their life expectancy yet they are a majority in the labor force (www.cia.gov). This large group of adults are able to be a part of the workforce, increasing the GDP for the country, and play a vital role in the social process of their communities. Increased health and oral literacy rates are desirable to achieve community health and provide the necessary interventions to create and maintain healthy communities across the country. The creation of a platform that addresses the disparities

and health inequities many of our underserved communities experience can have a positive impact on the suffering experienced by those with chronic diseases such as CKD.

Early diagnosis and treatment for inflammatory conditions (i.e., PD) that are risk factors for other systemic illnesses should be addressed especially for the 45-64-year-old persons targeted in this study. Seventeen percent of those persons within this age range have been diagnosed with CKD and of this group 14% have been diagnosed with severe PD. The percentages increase significantly, almost doubling for those aged 65-74 years . (www.cdc.faststats). If PD is diagnosed early enough in the CKD population and provided with treatment options known to be effective against the progression of the inflammatory process, the number of CKD patients affected by PD may be dramatically affected and reduced and in turn may reduce the progression of the kidney disease.

The results of the statistical analyses done in this study revealed the significance of how much of an impact PD has on the HRQoL for the CKD patient. The HRQoL is a measurable outcome that is closely monitored by healthcare administrators to aid in determining the effectiveness of treatment modalities of chronic diseases. HRQoL is a critical measure of the CKD patient's total well-being and is used by the CMS to assess the efficacy of interventions (Queeley & Campbell, 2018). These statistics present an ever-increasing financial burden on the US government and the healthcare systems with an annual expenditure of $30 billion to provide care for the CKD patient on dialysis (Queeley & Campbell, 2018).

Evidence supporting the association between oral and systemic health has been presented earlier in this study (Araujo et al., 2015; Grubbs et al., 2016; Sharma et al., 2017) and bears witness to the debilitating effect that non-treatment of the PD has on the CKD patient. Myers-Wright & Lamster (2016) concluded that many oral and systemic diseases share common risk factors accounting for two-thirds of adults are faced with multiple chronic diseases. The revelation of PD as a focus for being a risk factor in renal dysfunction in the CKD patient via the inflammatory process (Thompson et al., 2017) should garner the attention of the medical community when examining methods of controlling chronic diseases. Early diagnosis and proper treatment of PD can serve to mitigate the causes of morbidity and mortality in CVD (Bale et al., 2017). This can occur if both the medical and dental communities are allied in their commitment to provide comprehensive care to their patients, recognizing the need to do their due diligence to inform, educate, and treat their patients with the attitude of treating the patient as a whole and not just treating the acute symptoms.

Access to basic oral health care is not only limited to CKD patients but is universally acknowledged as a problem for many communities, particularly those of color and the underserved (Gomaa et al., 2017). Emergency room visits related to dental care has not decreased but instead has increased since Dr. Satcher's declaration (Potter, 2019). Lack of access to care and treatment are reflected in the number of emergency room visits and even cases of death due to untreated oral disease. One such case occurred in 2007 in Prince George's County, Maryland where a 12-year-old boy died of untreated

tooth decay which led to brain infection and ultimately death. His life could have been saved by having the decayed teeth extracted but because his family had no dental coverage it was difficult to find a dentist who would provide care (Harper et al., 2019). This was a prime example of the underserved not being served at all. The untimely death of this 12-year-old does not represent the target population in this study but it brings attention to the harsh reality of the morbid outcome of untreated dental diseases. Undiagnosed oral disease and untreated decay result in pain and discomfort on a daily basis which can often lead to opioid addiction and substance abuse. Oral health literacy has to be improved and that can begin with a collaborative effort between the medical and dental professions encouraging their patients to seek both medical and dental care on a routine and regular basis. The oral cavity is considered a gateway to systemic health and should be treated as such.

Access to oral health care should not be considered as a tertiary care item but as a primary concern. The loss of teeth not only affects a person's masticatory functions but also impacts their social well-being and self-esteem (Nazir, 2020). Physical appearance plays an important role in how one is accepted by others in social networks and in society in general (Lee & Jung, 2018). For most adults, a healthy smile and outward appearance, particularly for those in the workforce, can signal increased opportunities for employment and social networking. Healthy teeth and a beautiful smile are generally accepted as welcoming and attractive. An unattractive smile can be the difference between employment and not being able to have a steady income. Untreated tooth decay and

disease can lead to loss of social activity and engaging in social networks. This can result in diminished quality of life as it applies to a person's socioeconomic status throughout their life (Varenne, 2015). Increased access to dental care and early diagnosis and treatment of disease can alter the trajectory of a patient's quality of life. Oral health is essential to overall general health and has plays an important role in a person's well-being.

Patients are encouraged to have dental exams prior to any cardiac or joint replacement surgical interventions as a result of that research but it has not led to major changes in accessing dental care but has continued to be overlooked in the larger picture (Martin & Simon, 2019). Persons with painful and untreated oral conditions are less likely to be employed, have low self-esteem, and generally do not engage in social networking activities. The underserved are those individuals who lack the financial resources needed to access and obtain care and are the same individuals who are also unemployed but are able-bodied. Poor health and painful oral conditions impede and sometimes block the pathway to gainful employment and social networking. The age group this study focused on was 45-64 years which represents a large segment of the adult population. According to the CDC statistics approximately 17% of US adults in this age category have been diagnosed and are being treated for CKD (cdc.gov/faststats). This age group also represents a large portion of adults who could have an impact on the labor force. The CDC also reports that 17% of adults in the 45-64 yrs age group are low-income wage earners and most often do not have health or dental insurance

(cdc.gov/faststats). Lack of health/dental insurance is a barrier to access of care and most often leads to increased disease conditions and poor health outcomes. Gomaa et al(2017) noted in their study that persons with higher incomes and education are least likely to suffer from chronic diseases and have a higher health literacy than those persons of low-income wage earners. This discrepancy in health literacy plays an important role in accessing care. Early diagnosis and treatment of a disease can be the difference between poor and good health outcomes. Often oral lesions are the first evidence of a systemic disease (Thompson et al., 2017) and as such oral health, specifically PD, should be screened for in every adult patient. Of the 17% a fourth of these respondents are unemployed or have been for more than a year, adding to the numbers of unemployed workers. An increased labor force can translate to increased GNP production which can lead to increased socioeconomic status and improved health outcomes. Improved health outcomes can show a decrease in hospitalization and mortality/morbidity rates.

Reduction in systemic illness can have a significant financial impact by cutting the expenditures for health care costs. Many individuals with CKD also experience at least one other comorbid condition with diabetes, CVD, and hypertension being the most common that serves to increase their inflammatory status. PD has been identified as a low-grade chronic inflammatory process which also contributes to this condition and the findings of this study support the evidence of a correlation between the presence of PD and a decrease in the HRQoL for the CKD patient. Reduction in the HRQoL measures does affect the cost of care. Consider that less than 1% of the population diagnosed with

CKD and ESRD are covered under Medicare but their cost of care accounts for more than 7% of the total Medicare expenditures (Linn & O'Neal, 2018). The findings of the correlational analysis and ANOVA tests show that for every 6.8% change in the HRQoL of the CKD can be attributed to the presence of PD should warrant more attention to early diagnosis and treatment of oral disease, specifically PD.

The intersection of oral health and general health are heavily impacted by policies and legislation that do not consider oral health as an important component of general health (Varenne, 2015). The integration of these two health components should be based on common risk factors. When discussing periodontal disease tooth loss and dental decay combined with chronic inflammation negatively impact the HRQoL of any patient (Haag et al., 2017). The data provided by researchers (Martin et al., 2020; Fiorillo, 2019) examining the implications of oral diseases on systemic conditions and overall health should furnish the foundation of design interventions which address the lack of oral health care among children, adults, and the medically compromised (disabled patients). Failure to address the oral health needs of these underserved populations can lead to a decreased labor workforce and an increase in overall health care costs. Follow through on the recommendations made in this study could have a positive impact on how our society functions and cares for all its' citizens. Possible positive social impacts on our society can be summarized in five basic areas and cn be connected to early diagnosis and treatment at the outset resulting in:

- decreased disease incidence

- increased access to care
- improved mental health status
- opportunity for better economic status, and
- improved overall health

The possible positive social impact created by making a change in how our citizens are able to navigate the health care system, receive necessary care, and be more involved in their daily care can have lasting effects.

Conclusions

In the past several months soon after the outbreak of the current pandemic, this country has seen the eruption of protests across the states which has been likened to the protests during the Vietnam war era. The issues at the center of the protests were focused on social injustice, inequities in the law enforcement and the legal system, and a lack of equitable distribution of this country's wealth. Social justice is inclusive of health care (which includes oral health, mental health, and vision care), adequate and affordable housing, access to healthy food, access to gainful employment, and the right to live a decent life. Following through on the recommendations brought forth in this study may not lead to the improvement of the aforementioned issues but it may result in better optimization of the health care system.

Addressing the lack of oral health care for the CKD patient would have similar implications in social change and health outcomes as it would for all patients. Improved

oral health increases health literacy by educating the patient about the relationship between oral and general health. Improved health outcomes and overall general health can result in increased self-efficacy which can provide an opportunity for a change in behavior leading to better self-management of diseases (Havas, Douglas & Bonner, 2018). Better self-management leads to more positive health outcomes, decreased hospital visits, and increased production in the workforce which in turn affects the economy. Decreased unemployment will in turn help boost a sagging economy and provide better living for those at the bottom of the socioeconomic chain. Reductions in food insecurity, homelessness, and incidents of domestic violence may lead to a reduction of stress and anxiety and better mental health. The current pandemic that we find ourselves in has exposed and brought to the surface society's shortcomings and ills which some people would rather ignore while begging for a return to the 'old days when things were great'. But great according to whom?

The question of whether health care is a right or a privilege can be debated over and over but it does not address the issue of access to care which affects early diagnosis and meaningful treatment interventions. Oral health is a primary component of general health and should be a central part of any health care initiative. Oral diseases are among the most common of non-communicable diseases and are preventable. Lack of treatment can and will affect a person throughout their lifetime because of the pain and dysfunction caused by the disease process (Varenne, 2015). To ignore oral health is to set aside a significant part of a person's well-being and self-esteem. To ignore oral health is to

ignore a person's presence and their social capital. Legislators and policymakers who decide what is funded would not hesitate to have their oral health needs attended to because they have the means to do so. Oral pain and discomfort simply would not be tolerated. For those individuals who have the financial means and the access to care may have some difficulty understanding why others are lacking what they see as routine and affordable. But yet, have done extraordinarily little to affect change in the social ills of the day as evidenced by continued protests and disagreements over policy and procedure.

PD affects nearly 50% of the global population and the incidence of this disease continues to rise. Nazir (2017) concluded that nearly 30-60% of CKD patients were more likely to develop some form of PD and those patients had a 35% increased risk of mortality when compared to CKD patients without any form of PD. In a study by Myers-Wright & Lamster (2016) the authors concluded that there was strong supporting evidence of relationship between oral health and systemic health that also share common risk factors. The same study observed and determined that a savings of $42.4 million could be achieved by early diagnosis and treatment of chronic illnesses of which PD is a known risk factor and shares the same inflammatory mediators that have been identified in other systemic chronic diseases. These conclusions in the aforementioned research does offer a compelling reason to recognize and establish that there is a bidirectional relationship between PD and chronic inflammatory diseases such as CKD.

It would be prudent to provide comprehensive care for those individuals who are the underserved, the underemployed, and the disenfranchised to effectively combat

chronic illness and prevent the rise in incidence of inflammatory diseases. Attention to early diagnosis and treatment for oral diseases should be a primary concern for improving overall health and reducing illness and disease. Health starts from the oral cavity (Fiorillo, 2019). Reduction in systemic chronic diseases would lead to a reduction in the financial burden on the healthcare system and the cost of care. It would also contribute greatly to improved health outcomes, increased patient compliance, and better patient self-management of chronic conditions such as CKD.

Statistics reported by the CDC show that 6 in 10 adults in the US have a chronic disease and 4 in 10 adults have been diagnosed with 2 or more chronic diseases (www.cdc.gov). These statistics show that over half of the US adult population have some form of chronic illness. Health care should be a basic human right and not a commodity that is only accessible to those who have the financial means to receive it. If we are truly willing to protest and fight for equality among every person in this country then we should be prepared to do what is necessary to move forward with actions that will bring about change. We must ask ourselves, ‘what am I willing to do to change the landscape’?

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Appendix A: Behavioral Risk Factor Surveillance Survey 2016

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