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Oral Health Status and Oral Hygiene Knowledge, Attitudes, and Practices of Jail Inmates

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April Wendling

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Walden University
2016

Abstract

Oral Health Status and Oral Hygiene Knowledge, Attitudes, and Practices of Jail Inmates

by

April Lee Wendling

MS, University of Michigan, 2002

MPA, Golden Gate University, 1988

BS, Michigan State University, 1978

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Walden University

May 2016

Abstract

The oral health and hygiene of incarcerated populations, both in the United States and globally, is known to be poorer than that of the general population. This study examined the prevalence of dental caries and periodontal disease and the relationships between oral health status and the oral health knowledge, attitudes, and practices of jail inmates housed in a large metropolitan jail located in the midwestern United States. This cross-sectional study collected data from 100 inmates using a 21-item closed-ended questionnaire in addition to oral examinations conducted by the jail's dentist to determine the extent of dental caries and periodontal disease (DMFT and CPI scores) in this population. Neither oral health and hygiene studies nor studies of oral health knowledge, attitudes, and practices have been examined in U.S. jails. The conceptual frameworks of this study were the health belief model and social cognitive theory. The data were analyzed with the use of bivariate correlation tests, as well as binary logistic analyses. The results of this study revealed that the total number of correct answers on the oral health attitudes (OHA) questionnaire appeared to be the strongest predictor of high DMFT, with significance of 0.05 and an odds ratio of 1.522 (95% *CI* [1.000, 2.334]). In the analysis that included the total number of correct answers for the OHA questionnaire, years incarcerated was the strongest predictor of high CPI ($p = 0.027$), with an odds ratio of 0.340 (95% *CI* [0.131, 0.883]). This study advances social change by aiding in understanding the oral health status and oral health knowledge, attitudes, and practices of inmates – an underserved population. Results from this study can be used to assist jail administrators in understanding the types of dental care that is needed in correctional facilities.

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Dedication

This dissertation is dedicated first to my mother, Norma Russell, who believed in me more than anyone else and who always supported me, even in the most difficult times. It is also dedicated to my brother Stuart and my sister Aurora, my friends, and all my animals, especially to my cat Zane, who sat with me while I wrote this entire dissertation.

This dissertation is also dedicated to Mousa Pirouznia, the man who I would have loved to have had as my father.

Acknowledgments

This has been a long hard journey. There were many times when I wondered if I could complete it successfully. One thing is certain – I could not have completed it without the help of my Chair, Dr. Vasileios Margaritis. It is normal to acknowledge your Chair, but this acknowledgement is truly heartfelt. Dr. Margaritis was the luckiest part of my dissertation process and can't thank him enough.

I would also like to thank my committee member, Dr. Scott McDoniel for giving me valuable input and agreeing to be part of my team. Walden is to be acknowledged for helping me through many difficult times and letting me complete this PhD.

I must take the time to thank the Chief of Jails for giving me the OK to do this study and I can't find enough kind words to express my love, admiration, and appreciation to the jail's dentist and dental assistant. These wonderful women touch so many lives in ways that most people can never know and understand. And to my 100 inmates who took part in this study and taught me so many important things.

And finally to my dear friends Ed Smith, Michael Alcala, Sandy Lopez, Dr. Joyce Haver, and Barrett Hairston who have spent so much time listening to me talk about this dissertation. I owe you all so much!

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Chapter 1: Introduction to the Study

Introduction

At yearend 2012, the U.S. Department of Justice's Bureau of Justice Statistics (BJS) reported almost 7 million were supervised by the U.S. adult corrections system (Glaze & Herberman, 2013). On any given day in the United States, around 2 million people are either in jail or prison (Clear, 2007; Glaze & Herberman, 2013). This is a tenfold increase from 40 years earlier when the daily incarcerated head-count in the United States was approximately 200,000 (Clear, 2007).

Inmates in jails and prisons and people on probation or parole tend to be minorities, young, poor, uneducated, and often ill (Greifinger, 2006; 2007). They enter or leave jails and prisons needing important medical and dental attention (Freudenberg, 2001). These men and women have a high prevalence of communicable diseases that includes HIV/AIDS, tuberculosis, sexually transmitted diseases, methicillin-resistant *staphylococcus aureus* (MRSA), and viral hepatitis B and C (Greifinger, 2007). In addition to communicable diseases, inmates have high rates of mental illness and suffer with chronic diseases such as asthma, diabetes, and hypertension (Greifinger, 2007). Incarcerated populations are not included in the National Health and Nutrition Examination Survey (NHANES), which is a program of studies that started in the 1960s to assess the health and nutritional status of adults and children in the United States (CDC, 2014).

Inmates also suffer from poor oral health, a fact overlooked even by oral health professionals that are committed to social justice, who have consistently not included this

high-risk population as part of their agendas (Treadwell, Northridge, & Bethea, 2007). Inmates have poorer oral health than the general public, and incoming inmates to prison systems tend to have higher dental needs than inmates already in the prison system (Heidari, Dickinson, Wilson, & Fiske, 2007; Ringgenberg, 2011). Dental research on incarcerated people has reported extensive caries, with inmates having a significantly higher number of decayed and missing teeth and fewer filled teeth than members of the general population (Cunningham, Glenn, Field, & Jakobsen, 1985; Mixson, Eplee, Feil, Jones, & Rico, 1990; Salive, Carolla, & Brewer, 1989). Boyer, Nielsen-Thompson, and Hill (2002) reported inmates (male and female inmates combined) at the Iowa Medical Classification Center (IMCC) had 8.4 times the amount of untreated decay (but similar numbers of missing teeth) as non-institutionalized U.S. adults. Mixson et al. (1990) and Salive et al. (1989) reported African American inmates having a greater number of decayed teeth and fewer filled teeth than White inmates.

Clare (2002) examined the dental health status in a cohort of adult felons at admission (1996) and after three years of incarceration (1999) in North Carolina Department of Correction facilities. Clare reported a substantial reduction in the prevalence of caries. African American inmate caries reduction placed them near their national average (Clare, 2002). White inmate also saw a reduction in caries but their caries prevalence remained higher than their national average (Clare, 2002). Since dental diseases can only be resolved with professional treatment, Clare attributed this reduction in the prevalence of dental caries to restoration and the extraction of hopeless teeth during incarceration.

Periodontal disease studies in incarcerated U.S. populations are limited. Barnes, Parker, Fultz, Rees, and Lyon (1987) examined clinical and radiographic examinations of 637 male inmates and reported that 93% of the men needed preventive counseling, prophylaxes, and calculus removal. Barnes et al. (1987) also reported that young men needed less periodontal therapy than older inmates, and White inmates needed fewer segments of treatment than Latinos. African American and Latino inmates needed more preventive counseling and prophylaxis therapy than White inmates (Barnes et al., 1987).

In 1976, the U.S. Supreme Court issued a landmark decision in *Estelle v. Gamble* (1976) which ruled that prisoners were entitled to: (a) access to care for diagnosis and treatment; (b) a professional medical judgment; and (c) administration of the treatment prescribed by the physician. The National Commission on Correctional Health Care (NCCHC; 2008) lists dental care as an essential health service. Greifinger (2006) stated that more attention needs to be paid to inmates as public health sentinels; ignoring prevention, diagnosis, and treatment of dental and oral health conditions risks poisoning life for families and members of society (Greifinger, 2006). With the Department of Justice (2012) reporting almost 3% of the adult population in the United States--one in 34 U.S. adults--either in prison, jail, or at risk of incarceration because they are on probation or parole, the public health impact of dental care for incarcerated individuals is significant.

This study explored the amount of dental caries and periodontal disease in the inmate population of a large jail located in a large metropolitan area in the midwestern United States and the relationship between the oral health status and oral hygiene

knowledge, attitudes, and practices of jail inmates. In this chapter, I present the background, problem statement, research questions, and purpose of this study. I also present the study's theoretical foundation and research hypotheses, explain the significance of the study and its implications for social change, provide definitions of terms, and identify the study's limitations.

Background of the Study

Oral Health in America: A Report of the Surgeon General (U.S. Department of Health and Human Services, 2000) was a first of its kind report that focused exclusively on oral, dental, and craniofacial health. The purpose of this report was to alert Americans to how important oral health is to general health and well-being, and to inform a nation about the "silent epidemic" of oral diseases that plagues millions of children and adults in the United States (U.S. Department of Health and Human Services, 2000; 2010). This report include important findings that: a) oral health cannot be separated from general health and well-being, b) oral health means more than just having healthy teeth, c) great inequities and disparities exist regarding who suffers most from poor oral health, and d) poor oral health can cause needless pain and suffering in individuals that include financial, emotional, and social costs (U.S. Department of Health and Human Services, 2000). Poor oral health can have a deleterious effect on a person's self-image and self-esteem, impact social interactions, and interfere with vital functions such as breathing, eating, swallowing, and speaking (National Health Policy Forum, 2011). Poor oral health has also been linked to chronic illnesses such as diabetes, cardiovascular health, and skeletal bone health (U.S. Department of Health and Human Services, 2000).

Dental caries have been declining in the United States over the past two decades (Dye, Li, & Beltrán-Aguilar, 2012). Dye et al. (2012) also noted that tooth loss in the United States has been declining due to improved modern treatments, patient attitudes about tooth preservation, and better attention to preventing oral health diseases. While these major improvements have been seen in most Americans, inequities and disparities exist in some population groups classified by age, sex, income, race and ethnicity, and poverty levels (U.S. Department of Health and Human Services, 2000).

Untreated dental caries (tooth decay) has a prevalence that is almost twice as high for non-Latino African-Americans people (34%) compared with non-Latino White people (18%) (Dye et al., 2012). Non-Latino African Americans and Mexican-Americans had dental restoration prevalence that was significantly lower (62%) compared to non-Latino White people (80%; Dye et al., 2012). In 2009-2010 periodontal disease, an important public health problem in America that affects almost half of adults age 30 and over (64.7 million), also exhibited prevalence disparities (Eke, Dye, Wei, Thornton-Evans, & Genco, 2012). Men exhibited a higher prevalence of periodontal disease than women, 56.4% and 38.4% respectively (Eke et al., 2012). Mexican-Americans had the highest prevalence of periodontal disease at 66.7% compared to other races. Other groups that suffer a high prevalence of periodontal disease included current smokers (64.2%), adults living below the poverty level (65.4%), and adults with less than a high school education (66.9%; Eke et al, 2012).

The United States has the highest incarceration rate in the world; 25% of the world's incarcerated people are held in U.S. correctional facilities (Liptak, 2008). The

International Centre for Prison Studies (ICPS, n.d.) reported 2,228,424 people incarcerated in the United States in midyear 2012, an incarceration rate of 707/100,000. Clear (2007) reported that growth in imprisonment is not a random social phenomenon; the people we confine in the United States are disproportionately based on age, gender, race, and place. U.S. adults confined tend to be young (aged 18-44), male (nine-tenths of the prison population), African American (five times the rate of whites and twice the rate of Latinos), and from a low socioeconomic status (Clear, 2007). Greifinger (2007) reported the increasing correctional population in the United States is compounded by the increasing costs of medical care. These increases make it difficult to develop a responsible health care and public health system for inmates (Greifinger, 2007).

Each day in the United States around 34,000 inmates are released from jails, with approximately 238,000 inmates being released back into communities each week (Schmalleger & Smykla, 2011). Rice (2010) reported that most jail inmates are members of local communities, and that upon their release, over 90% will return to those same communities. Statistics of such magnitude point to an important public health opportunity that is being missed. The health, including dental and oral health, of incarcerated populations in the United States needs to be given serious consideration by the general population, and particularly by public health professionals. Since oral health impacts more than just the mouth, addressing the oral health of incarcerated people is critical to addressing overall health and the public health of communities (Treadwell et al., 2007); the benefits will extend to inmate's families, communities, and the United States as a whole.

Research examining the oral health of incarcerated people in the United States has been limited to examining the decayed, missing, and filled teeth (DMFT) scores of inmates in prison settings, and comparing these scores to the general population. Studies examining any connection of oral health status (e.g., DMFT and periodontal scores) to oral hygiene knowledge, attitudes, and practices of incarcerated populations are missing in the literature. Oral health studies that have been conducted in jails are scarce, likely due to the transient nature of jail populations. Jails are generally administered by cities or counties and house remand inmates or inmates with sentences less than one year. Studies conducted in a prison setting are easier because these state or federal run correctional facilities house felons serving sentences that are one year in length or greater. No studies have been found that address oral health knowledge, attitudes, and practices of inmates to their oral health status in a jail setting.

Limited investigations of the oral health of prisoners were conducted in the late 1960s and early 1970s with results reported in state dental association journals (Cunningham et al., 1985). More comprehensive studies on prisoners' dental disease prevalence stared in the 1980s and early1990s (Barnes et al., 1987; Cunningham et al., 1985; Mixson et al., 1990; Salive et al., 1989). All of these researchers investigated the prevalence of dental disease in prison populations, reporting on either the prevalence of decayed, missing, and filled teeth, or periodontal treatment needed (Barnes et al., 1987; Cunningham et al., 1985; Mixson et al., 1990; Salive et al., 1989). Cunningham et al. (1985), Mixson et al. (1990), and Salive et al. (1989) all found that prisoners had more missing, decayed, and unfilled teeth, and greater unmet dental needs than the general

population. These same researchers also discovered many of the disparities that exist in the oral health of the general population exist in the prison setting. African-American prisoners had a greater number of decayed teeth than White prisoners, especially those aged in their twenties and early thirties (Mixson et al., 1990; Salive et al., 1989). Whites in this same age range had significantly more filled teeth (Mixson et al.; Salive et al., 1989).

Barnes et al. (1987) examined the need for preventative dentistry counseling, prophylaxis, and calculus removal and periodontal therapy in an Iowa men's reformatory. Ninety-three percent of 637 recently incarcerated prisoners examined needed preventative counseling, prophylaxes, and calculus removal, with 32% requiring periodontal treatment (Barnes et al., 1987). White prisoners needed fewer segments of treatment than Latinos (Barnes et al., 1987).

Globally, the oral health status of incarcerated populations was found to be as poor as in the United States or worse, especially in developing countries. In studies of incarcerated populations outside the United States, prisoners had more decay, fewer restored teeth, more serious periodontal disease, and greater edentulism (loss of all teeth) than the general population (Decerle, Woda, Nicolas, & Hennequin, 2012; Dhanker, Ingle, Kaur, & Gupta, 2013; Heidari, Dickinson, & Fiske, 2008; Nobile, Flotta, Nicotera, Pileggi, & Angelillo, 2011; Osborn et al., 2003; Reddy, Kondareddy, Siddanna, & Manjunath, 2012). The oral health of incarcerated people has been shown to be poorer than the oral health of the general population in both developed and developing countries.

Oral health studies of incarcerated people tend to be prevalence studies that examine DMFT and periodontal scores of prisoners and compare these scores to those of the general population. In a study of prisoners in the Australian province of New South Wales, Osborn et al. (2003) also measured DMFT along with their periodontal scores, but also added oral health behavioral information such as the last time a prisoner visited the dentist, how often they brushed their teeth, and a prisoner's self-perception of treatment needs.

In Myanmar, Ogawa et al. (2003) conducted a pilot study of dental caries status of urban and rural populations in relation to knowledge, attitudes, and practices in oral health. Ogawa et al. (2003) considered it important to collect and analyze data concerning oral health knowledge, attitudes, and practices to evaluate whether certain oral health programs and activities are appropriate or efficient. These researchers found statistically significant correlations between the correct/incorrect responses to the questionnaires measuring oral health knowledge and attitude, and the mean number of DMFT (Ogawa et al., 2003).

Problem Statement

Inmates suffer from poorer oral and dental health than the general public (Boyer, Nielsen-Thompson, & Hill, 2002; Clare, 2002; Cunningham et al., 1985; Heng & Morse, 2002; Mixson et al., 1990; & Salive et al., 1989). In the developed world, the general population has seen improvements in oral and dental health over the past generation, likely due to fluoridated water, fluoride toothpaste, diet education, improved personal oral hygiene, regular visits to the dentist, and improvements in dental technology (Osborn

et al., 2003). While incarcerated populations suffer from poor oral and dental health, research is lacking as to why this is so. Correlations of dental knowledge, behaviors, and attitudes with decayed, missing, and filled teeth (DMFT) have been conducted with children, the elderly, students, and professionals, yet no study has examined this type of issue with incarcerated inmates (Ogawa et al., 2003; Shah, Wyne, Khawja, & Kola, 2013; & Zhu, Peterson, Wang, & Zhang, 2005).

Research on the oral and dental health of inmates in a jail setting needed to be conducted to determine accurate oral public health information. Understanding how to serve the oral and dental health needs of this underserved population is in the best interest of public health and public safety (Treadwell et al., 2007). In order to plan for the most effective public health interventions, it is crucial to know the oral epidemiology of jail inmates and understand their oral and dental health knowledge, oral health behaviors, and attitudes (Osborn, et al., 2003). By conducting this study, I addressed the gap in literature regarding the oral health issues in jail inmates and the oral hygiene knowledge, attitudes, and practices of incarcerated populations (Ogawa et al., 2003; Shah et al., 2013; Zhu et al., 2005).

Purpose of the Study

In this study, I examined the association between DMFT and periodontal scores of jail inmates and inmates' oral hygiene knowledge, attitudes, and practices. The questionnaire that I used to determine an inmate's oral hygiene knowledge, attitudes, and practices consisted of seven questions regarding oral hygiene knowledge about the prevention of dental caries and periodontal disease, seven attitude statements to

determine attitude towards oral health, and seven questions on oral health-related practices. There was only one correct response to each question or statement. I tallied a total knowledge score for each subject section, which ranged from zero to seven.

Research Questions

I developed the following research questions and tested the associated hypotheses:

RQ1: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their knowledge of basic dental and oral hygiene?

- *Null Hypothesis (H_01)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to knowledge questionnaires regarding oral health.
  Alternative Hypothesis (H_11): Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to knowledge questionnaires regarding oral health.

RQ2: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health attitudes?

- *Null Hypothesis (H_02)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health attitudes questionnaires regarding oral health.
  Alternative Hypothesis (H_12): Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation

to the number of correct responses to oral health attitudes questionnaires regarding oral health.

RQ3: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health practices?

- *Null Hypothesis ($H_0 3$)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health practices questionnaires regarding oral health.
- *Alternative Hypothesis ($H_1 3$)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to oral health practices questionnaires regarding oral health.

The independent variables were the scores on the oral knowledge, attitude, and practices questionnaires. The dependent variables were the DMFT and periodontal scores. The control variable was that all inmates surveyed had made appointments to see the jail's one dentist. Mediating variables were the race/ethnicity, age, number of years incarcerated, educational level, employment status before incarceration, income level within the past year, dental insurance before incarceration, and history of drug use of inmates.

Theoretical Framework

The theoretical framework for this study consisted of the two following theories: a) the Health Belief Model (HBM), and b) Social Cognitive Theory (SCT). Albert Bandura's SCT of self-efficacy states that people perform activities they find they can

manage and they avoid activities they are unable to cope with (Syrjälä, Knuuttila, & Syrjälä, 2001). In Bandura's model, adequate incentives and appropriate skills must be in place for an activity to be performed (Syrjälä et al., 2001). The HBM has been part of public health practice for over 50 years (DiClemente, Salazar, & Crosby, 2013). The HBM is a value-expectancy model premised on the understanding that a change in behavior will occur only when a gain is perceived after subtracting the cost of performing the behavior (DiClemente, Salazar, & Crosby, 2013). Greater detail on how these theories connect oral hygiene knowledge, attitudes, and practices of jail inmates to inmate oral hygiene status are provided in Chapter 2.

Nature of this Study

This study was quantitative in nature. The subjects were inmates that visited the jail's dentist over a specified six-month period. DMFT data and periodontal status was collected through oral examinations conducted by the jail's one dentist using dental mirrors and probes. Predictor/mediating variables associated with demographic data (e.g. age, race, and education level) were gathered by the jail's dentist on every inmate that sought dental services. Inmates answered a questionnaire instrument that consisted of: a) one section of questions regarding basic dental and oral health knowledge, b) one section of questions to determine attitudes about oral health, and c) one section of questions about oral health practices.

The oral examinations generated a mean DMFT score which I used as a guide to classify inmates into two groups: "high" DMFT and "low" DMFT for the purpose of assessing risk factors associated with DMFT score. Fejerskov and Kidd (2008) stated the

DMFT index is the most widely used of all dental indexes. It is an irreversible index that is only applied to permanent teeth. The DMFT for an individual can range from 0 to 32, if all 32 are to be counted. Because of the widespread removal of third molars in young adults in the United States and other developed countries, many researchers record a score for only 28 teeth (Burt & Eklund, 2005). For this study the third molars were not counted, so only 28 teeth were considered.

Periodontal diseases and tooth decay are the two biggest threats to dental health (CDC, 2011). Periodontal diseases, which are seen mostly in adults, are infections of the gums and bone that surround and support the teeth. The earliest stage of periodontal disease is gingivitis, where the gums can become red and swollen, and may bleed. If gingivitis is allowed to progress, it can develop into periodontitis and the gums can pull away from the tooth. As periodontitis progresses there can be bone loss and teeth can loosen and fall out.

In addition to the DMFT scores, I also requested that the jail dentist generate periodontal scores. No universal scale exists for the different states of periodontal disease, but for this study I selected the Community Periodontal Index (CPI), which is recommended by the World Health Organization (WHO, 2005), to generate periodontal scores as follows:

- Score 0: Healthy periodontal conditions.
- Score 1: Gingival bleedings.
- Score 2: Calculus and bleeding.
- Score 3: Shallow periodontal pockets (4 to 5 millimeters).

- Score 4: Deep periodontal pockets (6 millimeters or more).

Inmates were classified into two groups for the purpose of assessing risk factors associated with the periodontal score: “high” periodontal scores of 3 or 4, and “low” periodontal scores between 0-2.

Definitions of Terms

The following list defines important terms used in this study.

Community Periodontal Index (*CPI*): An indicator of periodontal status used by the World Health Organization (2005) that measures gingival bleeding, calculus, and periodontal pockets. CPI scores generated range from 0-4.

Dental caries: A term used to describe the results of the chemical dissolution (demineralization or decay) of the surface of a tooth (Fejerskov & Kidd, 2008).

Decayed, missing, and filled teeth (*DMFT*): Also known as the DMF Index. This index can be applied to the whole tooth (DMFT), or applies to all surfaces of the teeth (DMFS). The DMF Index was introduced in 1938 by H.T. Dean while investigating dental caries among children in Hagerstown, Maryland, and according to Fejerskov and Kidd (2008) this index is simple, versatile, statistically manageable, and reliable. At the present time, the DMF Index is the principle index used to describe the caries status of a population (Fejerskov & Kidd, 2008).

Edentulism: Tooth loss, especially the loss of all of one’s teeth. Edentulism is more prevalent in older people, although tooth loss does not have to be a natural part of aging. Burt and Eklund (2005) state that edentulism is strongly related to socioeconomic status.

Inmate/prisoner: A person confined to a jail or prison. Many times these terms are used interchangeably. In many parts of the United States, inmate is the term used for a person incarcerated in a jail while prisoner is used for a person incarcerated in a prison.

Jail: Locally operated (city or county) correctional facilities that confine people before or after conviction. Jail sentences are usually less than one year.

National Health and Nutrition Examination Survey (*NHANES*): NHANES is a unique program that combines interviews and physical examinations to assess the health and nutritional status of adults and children in the United States.

Oral health: The state of being free of: a) chronic oral-facial pain, b) cancers of the mouth and throat, and c) any disease that affects oral, dental, and craniofacial tissue (WHO, 2014). The oral health issues in this study include dental caries and periodontal disease.

Oral hygiene: Oral hygiene is the practice of keeping the mouth clean and healthy by brushing and flossing to prevent tooth decay and gum disease.

Periodontal disease: An infection of the gums and bone that surround and support the teeth that caused destruction of the hard and soft tissues that support the teeth (AAP, 2014). It is a disease that is seen mostly in adults (CDC, 2011). Gingivitis is the early stage of periodontal disease, when the gums can become red and swollen, and may bleed (Mayo Clinic, 2014).

Prison: A state or federal confinement facility that has custodial authority over adults sentenced to confinement.

Strengths, Limitations, and Weaknesses of the Study

The strengths of this study are as follows:

- DMFT and periodontal scores were consistent because the jail has only one dentist and one dental hygienist.
- Oral health questionnaires were administered to inmates as part of their examination and were collected as secondary data, eliminating inmates' feelings of distrust of being the subject of a study.

The limitations and weaknesses of the study were as follows:

- The participants in this study were limited to only inmates that visited the jail's dentist over a specified period of time. This raises concern with bias and the generalizability of the study.
- Inmates at the jail were a stratified group of subjects that were studied at one point in time. The effects of age or the passage of time versus the effects of extraneous sampling variables cannot be known (Portney & Watkins, 2009).
- Analyses of this convenience study are descriptive in nature, providing information only on the prevalence and characteristics of the oral health of jail inmates. Addressing causation issues is not possible.

Assumptions of the Study

This study was a cross-sectional convenience study of inmates incarcerated in a large midwestern jail who visited the jail's only dentist over a six month period of time. Self-reported data collected from inmates' answers provided on questionnaires may be subject to recall bias or inaccuracies. Portney and Watkins (2009) reported that research

has shown that self-reported measures are generally valid. The jail's dentist reported that inmates are forthcoming with her concerning their oral health in order to get the professional dental care need during their incarceration (jail dentist, personal communication, December 6, 2013). I assumed that the questionnaires in this study were used properly by the jail's dentist and hygienist, and that the inmates understood the purpose this study and their personal rights.

Scope and Delimitations of the Study

This study was a cross-sectional convenience study of inmates incarcerated in a large midwestern U.S. jail. These inmates were individuals who used the services of the jail's dentist and who willingly shared their oral health knowledge, attitudes, and practices. Every inmate was an adult (≥18 years-old), and understood and spoke English fluently, regardless their race or ethnicity.

Study Significance

This project was unique because it addressed the oral and dental health epidemiology of inmates in the jail setting, an under-researched population given that most studies of incarcerated populations in the United States have taken place in state or federal prisons (Boyer et al., 2002; Clare, 2002; Cunningham et al., 1985; Heng & Morse, 2002; Mixson et al., 1990; Salive et al., 1989). The results of this study can provide much-needed insights into the oral and dental health knowledge, behaviors, and attitudes of jail inmates who visit the institution's dentist. Oral health is much more than healthy teeth; it is so important because the mouth is an early warning system of health and disease in other parts of the body (Treadwell, Northridge, & Bethea, 2007). Without good

oral and dental health, activities such as speaking, smiling, and being able to convey a multitude of feelings and emotions through facial expressions may be lost to an individual (Treadwell et al., 2007). The findings of this study can prove valuable to oral public health professionals, dentists, and jail administrators for developing effective oral health and oral care programs of incarcerated populations.

Implications for Social Change

The Surgeon General's report *Oral Health in America* (U.S. Department of Health and Human Services, 2000) stresses that poor oral health can lead to conditions such as loss of self-image and self-esteem, anxiety, depression, and social stigma. These conditions can impact opportunities in education, careers, and a range of social relationships (U.S. Department of Health and Human Services, 2000). This reporte noted that poor oral health and acute dental conditions can cause restricted activity, bed days, and days of work lost to employed adults.

My study may provide valuable knowledge to public health planners regarding what interventions are needed to aid underserved populations, particularly in the correctional setting. Western (2006) reported that incarcerated people are predominately those with low human capital who tend to be undereducated, underemployed, and under-skilled. Greifinger (2007) states, "some deeply poor neighborhoods in major cities have as many as one-fifth or more of their adult male residents behind bars on any given day" (p. 15).

Jail administrators and community public health leaders may benefit from this study by gaining an understanding of how to develop the most cost effective oral health

programs while inmates are incarcerated and after they are released. A study of the oral health status of jail inmates along with an understanding of inmates' oral hygiene knowledge, behaviors, and practices may add to social change programs, particularly in metropolitan areas where there are large populations of underserved people in need of oral health services. This study may provide schools of social work and dental schools at universities near large population centers with valuable knowledge to assist in meeting the oral health needs of underserved populations.

Summary

In this chapter, I have introduced the subject of oral health in incarcerated people, and have explained how this study determined the relationship between the DMFT and periodontal scores of inmates and their oral hygiene knowledge, attitudes, and practices. Studies of the oral health of incarcerated populations have taken place in prison settings, but not in jail settings where the inmate populations are transient and among whom 90% will be returning to their communities (Rice, 2010). Past oral health studies of inmates have focused only on the prevalence of DMFT scores, comparing them to the general population. There is a gap in the literature concerning inferential studies to connect oral health status of inmates with oral health knowledge, attitudes, or behaviors. Gaining this type of knowledge will aid future oral public health researchers in developing programs to better serve the oral health needs of underserved populations.

In the next chapter, I review the literature regarding the HBM and SCT (self-efficacy) in addition to examining methods for capturing oral health knowledge,

behaviors, and attitudes. I also analyze and discuss the study's variables, providing the relevant references.

Chapter 2: Literature Review

Introduction

The primary purpose of this study was to investigate the relationship between the oral health status—dental caries and periodontal diseases—of inmates in a large midwestern U.S. jail and their oral hygiene knowledge, attitudes, and practices. Inmates in this setting are a vulnerable population with respect to oral health issues, likely because they are disproportionately African American and from low socioeconomic backgrounds, two key indicators of the likelihood for poor oral health (Treadwell et al., 2007). While oral health has been studied in prisons, oral health in jails has not been addressed in the literature. In this chapter, I examine the literature on the prevalence of dental caries and periodontal diseases in jail inmates, along with an inmate's oral health knowledge, attitudes, and practices.

Early studies on oral health of incarcerated populations date back to the 1960s, but these studies were small and limited to local areas such as the Detroit House of Correction (Ross, 1977). Studies conducted on the oral health of inmates in U.S. prisons in the late 1980s and throughout the 1990s demonstrated that inmates suffer from poorer oral health than the general population (Cunningham, et al., 1985; Mixson, et al., 1990; Salive, et al., 1989). Barnes et al. (1987) demonstrated that health disparities also exist within incarcerated populations, and found that African American and Latino inmates needed more preventive counseling and prophylaxis therapy than White inmates. While U.S. prison studies have examined the prevalence of dental caries with DMFT scores and the prevalence of periodontal disease in inmates, no U.S. studies of inmates have

addressed any oral health behavior components. However, in the early 2000s there were oral health studies conducted with prisoners outside of the United States that did address behavioral components (Osborn et al., 2003). Osborn et al. (2003), for instance, examined how often inmates in Australian prisons brushed their teeth and visited the dentist, and surveyed inmates on their self-perception of dental needs.

My review of literature on dental caries and periodontal diseases in inmates began with general internet searches using key terms such as: *dental caries in inmates/prisoners, periodontal disease in inmates/prisoners, inmate health, prisoner health, oral hygiene in inmates/prisoners, oral health in inmates/prisoners, oral practices in inmates/prisoners, oral health knowledge in inmates/prisoners, public health in incarcerated populations, self-efficacy in inmates/prisoners,* and *Health Belief Model (HBM).* I examined governmental websites including the National Institutes of Health (NIH), the Centers of Disease Control and Prevention (CDC), Healthy People 2010, Healthy People 2020, and NHANES for information on oral health and oral health in inmates. I also consulted the World Health Organization (WHO) website for information on oral health in incarcerated populations globally.

I accessed electronic scholarly sources, including electronic journal articles, from the Walden University Library and the University of Michigan's Taubman Health Sciences Library in Ann Arbor, Michigan. Electronic databases searched included EBSCO, ProQuest, Medline, Academic Search Premier, PubMed, PsycINFO, and Google Scholar. Before the Taubman Health Sciences Library converted to exclusively electronic access to scientific and medical journals, I accessed hard copies of journal articles. I also

searched the Walden University Library for PhD dissertations and Master's theses on oral health issues of inmates, and examined dissertations and theses granted by Walden University and other universities. I selected articles for review if they: a) addressed oral health and oral hygiene of incarcerated people, b) addressed the HBM or self-efficacy in relation to either oral health or inmates, and c) addressed this study's research questions and hypotheses or provided important historical insights to this study.

In addition to reviewing the scholarly literature, I also conducted interviews by telephone and email with dentists, public health researchers, and oral epidemiologists at universities and governmental organizations involved in oral health studies with inmates both inside and outside of the United States. All of these people willingly shared their thoughts and provided information from studies they conducted. These universities and governmental organizations included: the U.S. Federal Bureau of Prisons; University of Michigan's School of Dentistry and School of Public Health in Ann Arbor, Michigan; the Dental School and the National Center for Primary Care, Morehouse School of Medicine in Atlanta, Georgia; the University of Manchester in the United Kingdom; and the Université d'Auvergne Centre de Recherche en Odontologie Clinique in France.

This literature review focuses on dental caries and periodontal diseases of inmates incarcerated in jails and prisons located in the United States. and abroad. I examined literature regarding the prevalence of dental caries and periodontal disease along with the HBM and self-efficacy and oral health and hygiene research. Chapter 2 is divided into five parts: (a) the importance of oral health, (b) the HBM and self-efficacy in oral health research, (c) definitions and measurements of dental caries and periodontal diseases, (d)

dental caries and periodontal disease in the general U.S. population, and (e) dental caries and periodontal disease in correctional settings.

The Importance of Oral Health

The importance of oral health care cannot be overstated. In the United States, oral health care and general physical health care are viewed as separate entities (Treadwell et al., 2007). Sheiham (2005) has argued that this type of health care compartmentalization must cease since oral health affects not only a person's teeth and mouth but their general health, quality of life, and well-being. The Surgeon's General report *Oral Health in America* stressed that good oral health allows a person to speak, eat, smile, taste food, socialize, sleep properly, and work and go to school without experiencing pain, discomfort, or embarrassment (U.S. Department of Health and Human Services, 2000).

Delta Dental (2013) reported that well over 100 medical conditions, including some life-threatening conditions, can be detected in the early stages by a dentist. Research published over the past 15 years has provided clear evidence that poor oral health, especially periodontal disease, is linked to diseases such as diabetes, heart disease, and strokes (HealthyPeople.gov, 2014). Poor oral health in pregnant women has been associated with premature births and low birth weight (HealthyPeople.gov, 2014).

Cohen et al. (2011) and Davis, Deinard, and Maïga (2010) reported that the pain and infection of untreated dental caries is associated with visits to emergency rooms, especially by lower-income people, throughout the United States. While emergency room physicians can treat the pain and infections associated with extreme dental caries, they cannot address the underlying dental problems (Davis et al., 2010). This can lead to

repeat visits to emergency rooms by people who lack dental insurance (Davis et al., 2010).

The Definition and Measurement of Dental Caries and Periodontal Diseases

Dental Caries

Dental caries (a Latin word meaning rottenness), one of the most prevalent diseases in the world, results from a destructive process of chemical dissolution of a tooth's surface from metabolic events which take place in the biofilm (dental plaque) covering the affected area (Fejerskov & Kidd, 2008). In dental plaque, there are metabolically active bacteria, most commonly *Streptococcus mutans* and *Lactobacillus*. The enamel, dentin, and cementum of a tooth could be affected by these bacteria, resulting in cavitation and possible pulp infection. If this process continues, pulpal necrosis can take place. Dental caries can affect both the crown (visible part of the tooth) and the root of teeth (coronal and root caries, respectively).

In the 1930s, an index to measure either the prevalence or incidence of dental caries in a population was developed from extensive dental caries studies of children in Hagerstown, Maryland (Fejerskov & Kidd, 2008). According to Kidd (2005), prevalence is the proportion of a population affected by a disease at a particular time, while incidence is a measurement of the rate at which a disease progresses. In 1938, Klein, Palmer, and Knutson developed the DMF index, where "D" stands for decayed teeth, "M" stands for teeth missing due to caries, and "F" stands for teeth that had been previously filled (Burt & Eklund, 2005).

The DMF index is the most widely used instrument to assess dental caries (Fejerskov & Kidd, 2008). The DMFT for an individual can range from 0 to 32, if all 32 are to be counted. Because of the widespread removal of third molars in young adults in the United States and other developed countries, many researchers record a score for only 28 teeth (Burt & Eklund, 2005). Although the DMF index has been used for over 70 years and is simple and versatile, Burt and Eklund (2005) and Fejerskov and Kidd (2008) have noted that the following limitations need to be recognized:

- Teeth at risk to develop dental caries are not assessed with the use of DMFT index.
- Missing, untreated decayed, and restored teeth are equally recorded.
- When a tooth is lost due to periodontal disease or orthodontic reasons instead of loss due to caries, the use of this index is problematic.
- Sealed teeth must be excluded from the DMF index and be dealt with separately.
- There is no universal criterion for what is considered as a decayed tooth.

Periodontal Diseases

According to the Centers for Disease Control and Prevention (CDC; 2011), periodontal diseases are infections of the gums and bone which support the teeth. Gingivitis is the early stage of periodontal disease, and is a condition in which the gums can become red and swollen, and may bleed. As gingivitis becomes more serious, it can develop into periodontitis, and the gums can pull away from the tooth. As periodontitis

progresses, there can be bone loss and teeth can loosen and fall out. The two biggest threats to oral health are tooth decay and periodontal diseases (CDC, 2011).

The periodontal diseases usually start by the infection of the tissue which surrounds the tooth. Bacteria that stay on the teeth will initially form biofilm (plaque), which if not removed will harden to calculus (tartar). Dental plaque is the most important factor related to periodontal diseases, and factors such as smoking, certain systemic diseases such as diabetes and HIV, stressful life events, genetic disorders, and poor restoration contribute to plaque accumulation (Daly, Watt, Batchelor, & Treasure, 2002).

The traditional "progressive" disease model of periodontal diseases has been recently replaced by the "burst theory" (Daly et al., 2002). It was once thought that periodontal disease progressed by getting worst over time, but now it is believed that this disease has short "bursts" of activity followed by long periods of remission and healing (Daly et al., 2002). Burt and Eklund (2005) reported that 5% to 15% of people exhibit severe periodontitis with a high risk of tooth loss. Many factors are associated with periodontal diseases and presently the diagnostic criteria for periodontitis or severe periodontitis is not clearly defined (Fejerskov & Kidd, 2008; Daly et al., 2002). It is generally agreed that the more calculus on the teeth, the greater the amount of periodontal disease present (Daly et al., 2002). No universal scale exists for the different states of periodontal diseases. The Community Periodontal Index (CPI) described in Chapters 1 and 3 is recommended by the World Health Organization (WHO, 2005) and was used in this study to generate periodontal scores.

Periodontal diseases are an important public health concern because good oral health is critical to overall health. Public health measures to reduce periodontal diseases should include reducing plaque/calculus levels and smoking rates (Daly et al., 2002). Anti-plaque and anti-calculus toothpastes and rinses may play an important role in oral health promotion (Daly et al., 2002).

Theoretical Foundation

The theoretical framework for this study consists of the two following theories: a) the HBM and b) social cognitive theory (SCT). Health behaviors, including oral health behaviors, are complex and diverse (DiClemente, Salazar, & Crosby, 2013). It is important to realize no one theory, model, or variable can encompass every aspect of oral health behavior. Additional theories commonly associated with oral health include: a) Theory of Reasoned Action, b) Locus of Control, c) Transtheoretical Model and Stages of Change, and d) Sense of Coherence (Hollister & Anema, 2004). Self-efficacy, an important part of both HBM and SCT, states that people perform activities they find they can manage and they avoid activities they are unable to cope with (Syrjälä, Knuuttila & Syrjälä, 2001). This study will focus on self-efficacy issues regarding inmates.

The Health Belief Model

The HBM has been widely used as a conceptual framework in health behavior for six decades. Initially developed by a group of social psychologists in the 1950s, this value-expectancy model was used by the U.S. Public Health Service to explain the failure of the public to participate in programs to prevent and detect diseases, such as tuberculosis screenings (DiClemente et al., 2013; Glanz, Rimer, & Lewis, 2002). Since the 1950s, the

HBM expanded beyond addressing screening behaviors to include preventative actions, illness behaviors, and sick-role behaviors (Glanz et al., 2002). This model has been used to explore health behaviors such as sexual risk behaviors and the transmission of HIV/AIDS.

The HBM is a value-expectancy model in that a change in behavior will occur only when a gain is perceived after subtracting the cost of performing the behavior (DiClemente et al., 2013). People will take action against ill-health, a disease, or some other condition that threatens their well-being if they can conceive that they are susceptible, if they believe there are serious consequences to not responding, if the course of action can be shown to be beneficial to their susceptibility or condition, and the benefits of taking action outweigh the costs (Glanz et al., 2002). An important principle of this model is that better information allows individuals to make better decisions (Hollister & Anema, 2004). Glanz et al. (2002) lists the following six items as the key concepts of the HBM:

- Perceived susceptibility: An individual's belief that they are at risk of getting a condition. In the area of oral health this would be a person's belief that they are at risk for dental caries or periodontal disease.
- Perceived severity: An individual's belief about how serious a condition and its sequelae are. Does a person with dental caries or periodontal disease understand the severity of dental decay and the risk of permanent tooth loss due to periodontal disease?

- Perceived benefits: An individual's belief in the benefits of taking action to prevent or reduce the risk or serious impact of a condition. Does a person see benefits in taking action to reduce the risk of dental caries or periodontal disease?
- Perceived barriers: An individual's belief about the costs, tangible and psychological, of taking action. What are the person costs to an individual to maintain good oral hygiene?
- Cues to action: The strategies that activate an individual's readiness. What external cues trigger a person to take action against poor oral hygiene?
- Self-efficacy: The confidence an individual has to take action. Does a person believe in their ability to take the necessary steps to prevent or control dental caries and periodontal disease?

Figure 1 shows how each of the HBM key concepts are connected and how each concept is related to the likelihood of a person being engaged in a health-promoting behavior. Using this model can aid in understanding the relationship between self-efficacy and oral hygiene knowledge, attitudes, and practices with dental caries and periodontal disease outcomes in inmates.

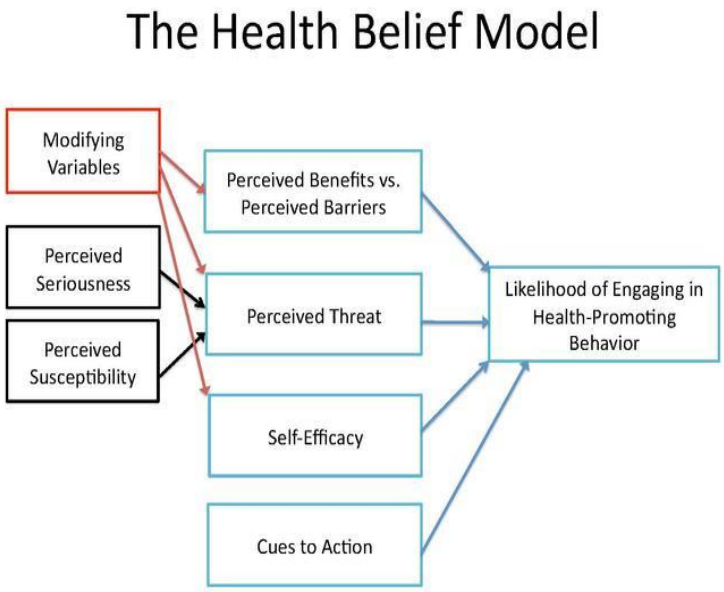

Figure 1. Diagram of the Health Belief Model. Taken from "A Population-based Study into Knowledge, Attitudes, and Beliefs (KAB) about HIV/AIDS," by M. Dadgarmoghaddam, M. Khajedaluee, and M. Khadem-Rezaiyan, 2016, Razavi International Medicine, 4(1) p. 3.

Hollister and Anema (2004) stress the the HBM is a staged theory; the decisions that will be made depend on previous decisions or beliefs. This model has been applied to oral health conditions such as early childhood caries. In this type of senario, a child's caregiver must believe: a) the child is at risk for dental caries, b) "baby" teeth are important to the child's health and dental caries poses a risk to these teeth, and c) dental caries can be prevented in baby teeth, d) action must be taken to limit the child's expose to fermentable carbohydrates, e) the child must be assisted in learning and practicing good oral hygiene (Hollister & Anema, 2004).

While the HBM is considered a strong model in predicting health behaviors, it does have limitations. Critics of this model believe that information by itself is not usually enough to change health behaviors (Hollister & Anema, 2004). While strong associations have been found between good oral health and HBM stages in cross sectional studies, longitudinal studies have not shown this kind of success with HBM principles (Hollister & Anema, 2004).

In this study, the HBM was used to determine the appropriate questions to include on the survey instrument was used. It is important to assess if an inmate felt susceptible to dental caries or periodontal diseases. It is also important to discover if an inmate understood the serious consequences that could result if action was not taken to address dental caries or periodontal diseases. This information was used to determine possible relationships between the oral health status and oral hygiene knowledge, attitudes, and practices of jail inmates.

Social Cognitive Theory

SCT is a revision of the Social Learning Theory (Hollister & Anema, 2004). Bandura's (1977) work in psychological models of behavior started in the classical learning theory of stimulus-response, later deveoping into a behavior model that incorporated cognitive processes that included social and observational components to learning and ultimately to self-efficacy. Self-efficacy is a person's conconfidence in their ability to perform a particular behavior and their ability to overcome barriers to that behavior (Glanz et al., 2002). Bandura's theory of self-efficacy stresses that an individual

with likely perform an activity they can manage but avoid those activities they believe they are unable to cope with (Syrjälä et al., 2001).

Bandura (1977) proposed a model explaining personal efficacy expectations to be derived from four principal sources: a) performance accomplishments, b) vicarious experience, c) verbal persuation, and d) physiological states. Figure 2 provides a visual representation of how self-efficacy is gained.

Figure 2. How Self-Efficacy is developed. Adapted from "https://wikispaces.psu.edu/display/PSYCH484/Spring+2013+Self-Efficacy+Case+Study.

Performance outcomes, or experiencing success is considered the most powerful method (Hollister & Anema, 2004). Performance outcomes relates to a person's accomplishments; previous successes increase expectatios of mastery while failures

lower expectations. Vicarious experiences, also refered to as modelling, are successful behaviors learned by the observation of other individuals or groups (Kakudate & Morita, 2012). Verbal persuation uses suggestive language to convince a person that they can perform a task successfully. Coaching and evaluative feedback are examples of verbal persuation. Physiological and affectives states, represented by either positive or negative physiological or emotional states is the fourth element which can influence self-efficacy in an individual.

Self-efficacy, in contrast to the HBM, has been reported to be an accurate predictor of oral health in both cross sectional and longitudinal studies (Syrjälä, Kneck, and Knuuttila, 1999; Syrjälä et al., 2001). Qualitative research conducted on dental attitudes by Syrjälä et al. (2001) indicated that dental attitudes and behaviors can be influenced by cognitive experiences, supportive and emotional dimensions, and childhood experiences. Hollister and Anema (2004) reported that self-efficacy was found to be protective against childhood caries. Syrjälä et al. (2001) reported that although their qualitative study was not generalizable, their results matched the Stewart, Strack, and Graves (1997) study where perceptions of self-efficacy were related to oral health behavior such as dental visits and tooth brushing. Dental self-efficacy was also found to be a determinant in oral health and hygiene in research conducted by Syrjälä et al., 1999) with diabetes patients.

Self-efficacy is not necessarily permanent and can be domain specific (Hollister & Anema, 2004). In the Pine et al. study (as cited in Hollister & Anema, 2004, p. 5), improvements periodontal patients showed in oral hygiene were lost over time. Hollister

and Anema (2004) reported that while an individual can have high expectations in the area of oral health, this same individual can have low self-efficacy in other health areas.

Studies on the health status and self-effacacy beliefs of inmates are limited. Loeb and Steffensmeier (2006) conducted such a study on 51 older (aged ≥ 50 years) prisoners at a Pennsylvania Department of Corrections facility. This was a pilot study that examined relationships between health status, self-efficacy beliefs, and behaviors. The findings from this study were not generalizable since this study was a convenience sample; however, the findings supported Bandura's Social Cognitive Theory. Loeb and Steffensmeier (2006) found inmates with greater self-efficacy in their health self-management abilites rated their health as better, engaged in greater number of health-promoting behaviors, and reported improved health since incarceration.

The SCT and self-efficacy was used in this study to determine the appropriate questions to include on the survey instrument. Since Bandura (1977) demonstrated self-efficacy can have important impacts on psychological states, motivation, and behaviors, it is important to assess if an inmate believed they had the capability to successfully manage their oral health issues. This information was used to determine possible relationships between the oral health status and oral hygiene knowledge, attitudes, and practices of jail inmates.

Dental Caries and Periodontal Disease in the General U.S. Population

In the past 40 years, oral health in U.S. adults has improved and there has been a reduction in the prevalence of dental caries, periodontal diseases, and tooth loss (Dye et al., 2007). However, this improvement has not been shared by all Americans and oral

health disparities remain across several high risk population groups (Dye et al., 2007). The most recent trends of the oral status of the general U.S. population were surveyed in 1988-1994 (NHANES III) and NHANES 1999-2004. The NHANES 1999-2004 (Dye et al., 2007) report lists the following oral health objectives:

- Evaluate trends in oral diseases and conditions.
- Assess efforts to prevent disease and disability.
- Monitor the oral health status of minority and underserved populations.
- Assess progress in meeting national health objectives.

However, incarcerated individuals were not included in NHANES III and NHANES 1999-2004 surveys.

Participants in the NHANES 1999-2004 oral health report are limited to age groups considered most critical for monitoring oral health and dental care: a) 2-11 years for youths, b) 12-19 years for adolescents, c) 20-64 years for adults, and d) 65 years and older (Dye et al., 2007). This literature review focuses on adults, only the subgroups of 20-34 years, 35-49 years, 50-64 years, and 65-74 years were examined. For adult populations, NHANES 1999-2004 has taken four objectives of the 17 main objectives of the Oral Health Focus area from *Healthy People 2010*, a document that compiles health promotion and disease prevention goals and objectives for the U.S. (Dye et al., 2007). These objectives included:

- 21-2: Reduce the proportion of children, adolescents, and adults with untreated dental decay.

- 21-3: Increase the proportion of adults who have never had a permanent tooth extracted because of dental caries or periodontal disease.
- 21-4: Reduce the proportion of older adults who have had all their natural teeth extracted.
- 21-5: Reduce periodontal disease.

For U.S. adults ages 20-64, the prevalence of adults that reported the condition of their teeth to be "excellent or very good" declined from 30% in 1988-1994 to 26% during 1999-2004 (Dye et al., 2007). For persons age 20-34, men, Latinos, non-Latino Whites, persons with more than a high school education, and adults not living in poverty, this was a significant decrease (Dye et al., 2007). The prevalence of both coronal caries and root caries declined from 1988-1994 to 1999-2004. Coronal caries declined from 95% in 1988-1994 to 92% during 1999-2004 (Dye et al., 2007). The age group with the largest decline in coronal caries was 20-34 year olds with a decline in prevalence of 6.5% (Dye et al., 2007). Root caries for all adults decreased from 19% in 1988-1994 to 14% during 1999-2004, with the greatest decline of 9% in adults aged 50-64 (Dye et al., 2007).

Regardless of age or poverty status, DMFT and decayed, missing, and filled surfaces (DMFS) scores for adults were lower in 1999-2004 compared to 1988-1994 (Dye et al., 2007). In adults aged 20-64, tooth retention increased and edentulism for similarly age adults decreased. Adult tooth retention went from 24 teeth in 1988-1994 to 25 teeth in 1999-2004 (Dye et al., 2007). Edentulism for similarly aged adults decreased from 6% to 4% over this same time period, with the age group 50-64 showed the greatest decrease in edentulism (Dye et al., 2007). From 1988-1994 to 1999-2004 there was a

significant decline among the adult age groups that reported visiting the dentist in the past year, 66% and 60% respectively (Dye et al., 2007). In 2012, the U.S. Health and Human Services (2014) reported 61.6% of adults aged 18-64 visited a dentist in the past year.

The U.S. Department of Health and Human Services (2014) data from 2005-2008 on untreated dental caries in adults aged 20-64 show the total adult population in this age group as 23.7% untreated caries. Males aged 20-64 have more untreated caries at 27.2% compared to females of the same age group at 20.2% (U.S. Department of Health and Human Services, 2014). In this same age group, non-Latino Whites had the lowest untreated caries at 19.3% and non-Latino African-Americans had 39.7% (U.S. Department of Health and Human Services, 2014). The highest group of untreated caries in the 2005-2008 time period in adults aged 20-64 was 52.7%, found in non-Latino African-Americans who were below 100% of poverty level (U.S. Department of Health and Human Services, 2014). This was an improvement for this group. In 1971-1974, non-Latino African-American ages 20-64 who were below 100% of poverty level had a 71.9% prevalence of untreated dental caries (U.S. Department of Health and Human Services, 2014).

Data revealed that from 1999-2004, 9% of all adults age 20-64 were affected by periodontal diseases where a person had at least one periodontal site with greater or equal to 3 mm of loss of attachment and greater than or equal to 4 mm of pocket depth (Dye et al., 2007). The occurrence of periodontal disease in this age group increased with age, 4% for the 20-34 age group and 12% for persons aged 50-64 (Dye et al., 2007). Among adults age 35-44, a significant decline, 22% in 1988-1994 to 16% in 1999-2004, occurred

in the prevalence of destructive periodontal disease where there is attachment loss greater than or equal to 4mm at one or more sites (Dye et al., 2007).

More recent investigations into periodontal disease revealed that one out of every two adults in the U.S. that are 30 years of age or older has periodontal disease (Eke, Dye, Wei, Thornton-Evens, & Genco, 2012). Eke et al. (2012) reported 2009 and 2010 NHANES data on periodontal disease, where 3,742 civilian non-institutionalized adults aged 30 and older showed over 47% of this sample (representing almost 65 million U.S. adults) had periodontitis. In this sample, the breakdown of mild, moderate, and severe periodontitis was 8.7%, 30.0%, and 8.5% respectively (Eke et al., 2012). Older adults aged 65 and older fared the worst with periodontal prevalence rates of 70.1%, with 64% having either moderate or severe periodontitis (Eke et al., 2012). This survey by Eke et al. (2012) demonstrated the evidence for a high burden of periodontitis in U.D. adults, but the periodontal burden is highest in men, Mexican-Americans, adults with less than a high school education, and adults below the poverty line.

Oral Health and Hygiene in Correctional Settings

Introduction

In the U.S., dental caries and periodontal disease has been examined in adult male and female inmates in prisons and in adolescents in juvenile detention facilities. Early oral health studies of incarcerated people from the 1960s and 1970s, such as the Ross (1976) study of the Detroit House of Corrections, were dental and oral health prevalence studies. These types of studied were only used to aid correctional administrators in planning budgets for the medical needs for their organizations. These early oral studies

on prisoners made no attempt to understand how incarcerated populations throughout the U.S. were impacted by dental and oral health issues or how the oral health and hygiene compared to the general U.S. population.

In the 1980s through the early 2000s, studies of the oral health of U.S. inmates were conducted only in state and federal prisons. City and county jails were not examined. Researchers from this time period focused primarily on the prevalence of DMFT of male prisoners, comparing the DMFT of prisoners with the DMFT of the general U.S. population using federal NHANES data.

Periodontal studies of prisoners were less common than dental caries studies. Barnes, Fultz, Rees, and Lyon (1987) studied periodontal disease in 637 male prisoners using clinical and radiographic examinations. Prisoners were sampled from four age groups, three ethnic groups, six crime-type groups, three residency groups, five intelligence groups, and first offenders and recidivists (Barnes et al., 1987). Important periodontal findings in this group of prisoners included: a) young men required less periodontal therapy than older inmates, b) Caucasian inmates required fewer segments of treatment than Latinos, c) sex offenders required less prophylaxes and calculus removal than other crime groups, and d) treatment requirements were not related to residency, recidivism, or intelligence quotient (Barnes et al., 1987).

Oral health and hygiene studies from the 1980s through the early 2000s tended not to focus on the female prisoner. Badner and Margolin (1994), Heng (2000), Heng and Morse (2002), and Heng, Badner, and Freeman (2006) were the exceptions. Badner and Margolin (1994) examined the oral health status of women housed at Rikers Island

Correctional Facility. Heng (2000), Heng and Morse (2002), and Heng et al. (2006) all researched dental caries in female prisoners in federal prisons located in New England.

U.S. Correctional Settings

The 1980s and 1990s. Prior to the 1980s, little data on dental disease in U.S. inmate populations existed. What literature existed was not comparable due to the wide diversity between correctional facilities and the lack of collective data sources on the dental needs of incarcerated people (Cunningham et al., 1985). This started to change in the 1980s and 1990s. Three studies on the dental and oral health of incarcerated people were conducted for the purpose of not only understanding the prevalence of DMFT in a single institution, but to compare prisoners' oral health with the general population of the U.S. (Cunningham, Glenn, Field, & Jakobsen, 1985; Mixson, Eplee, Feil, Jones, & Rico, 1990; Salive, Carolla, & Brewer, 1989).

NHANES III data from 1988-1994 reported the oral health of the general U.S. population improved from the previous 30 years (Dye et al., 2007). Edentulism and periodontitis declined for seniors and adults showed improvements in the prevalence of dental caries, tooth retention, and periodontal health (Dye et al., 2007). Reports on the oral health of non-institutionalized people were not provided. Researchers were curious to know if incarcerated populations shared in the oral health improvements seen in the general U.S. population.

The Cunningham et al. (1985), Mixson et al. (1990) and Salive et al. (1989) studies shared important aspects. These three studies were all conducted on male prisoners serving their sentences in either state or federal prisons. All were prevalence

studies that used the DMFT index to measure dental caries. Each of these studies found that prisoners had worst dental health than the general population in the United States. While all of these three studies collected demographic data such as age, race, length of sentence, and types of offences, none collected information on education levels, income, and past dental utilization.

Cunningham et al. (1985) examined dental disease prevalence in a prison population in Iowa of 99 males ranging in age from 18 to 30 years and compared the prison population's dental health to a non-prison population of 101 people from Iowa, also males, aged 18-30 years. The Cunningham et al. study's literature review found little data on dental disease in prison populations and chose to measure dental disease with the standard DMFT index. Cunningham et al. discovered that their prison population had almost three times has many decayed teeth but only half as many filled teeth as the non-prison population.

The Cunningham et al. (1985) study was conducted when there was little data on dental disease prevalence in prison populations. The researchers stated the DMFT index was used in the dental screening of prisoners but did not elaborate on how they obtained the DMFT scores. Radiographs were not used in obtaining their DMFT scores. Additionally, Cunningham et al. compared the DMFT scores of a prison population with DMFT scores of the general population of Iowa from the *Iowa Survey of Oral Health*. An analysis of how comparable the dental scores of their prison population are with the dental scores of the general Iowa population was not mentioned. This study was one of

the first scientific studies of dental and oral health in incarcerated populations and served as good base for similar studies that would follow.

Within five years of the Cunningham et al. (1985) study, studies followed detailing the dental and oral health of state prison system and federal prison system inmates. Salive et al. (1989) and Mixson et al. (1990) used the DMFT index to measure dental health. These two studies found the mean DMFT scores and conducted additional statistical analyses of inmate populations to determine that White and African American inmates showed different results, with African Americans inmates having more decayed teeth and White inmates having a higher percentage of filled teeth (Mixson et al., 1990; Salive et al., 1989). Both of these studies showed the number of missing teeth increased by age (Mixson et al., 1990; Salive et al., 1989). Mixson et al. (1990) reported that proportion edentulous was 5.2% for the 35-44 age group, 17.3% for ages 45-54, and 45.5% for ages 55-75.

The Salive et al. (1989) and Mixon et al. (1990) studies agreed that inmate populations, whether in state or federal institutions, had greater unmet dental needs than the general population. Salive et al. and Mixson et al. both found that the number of decayed teeth in inmate populations was inversely correlated with the length of incarceration. Recommendations from the Salive et al. and Mixon et al. studies included that longitudinal studies begin at initial incarceration to aid in assessing the effect of dental treatment and preventative programs on inmate dental and oral health. Salive et al. suggested further studies that compared local, state, and federal prisoners would be needed to investigate differences among these groups.

Studies regarding the oral health of incarcerated females were scarce. In 1971, Shapiro, Gallant, and Pollack (as cited in Badner & Margolin, 1994) reported on their study that compared the dental health profiles of two women's prisons in Maryland. In the mid-1990s, Badner and Margolin reported on the oral health of female inmates at the Rikers Island Correction Facility in New York. This study group consisted of 183 primarily African American women whose average age was 27.6 ± 5.8 years old. There was a high level of unmet dental needs with a mean DMFT score of 9.9, the percent D/DFT was 34.3, and percent M/DMFT was 27.4 (Badner & Margolin, 1994). Oral pain was a common complaint of almost one third of women in this study (Badner & Margolin, 1994).

The Badner and Margolin (1994) study was important not only because it focused on female inmates, but because it was one of the first glimpses into the oral health of a group of inmates held on remand that suffered from extreme poverty. These detained women were likely to be among the poorest of New York citizens; they hailed from inner-city neighborhoods that were plagued with violence, drug abuse, and poverty (Badner & Margolin, 1994). The dental history of many of these women consisted of only emergency dental care (extractions) and limited utilization of preventative or restorative dental services (Badner & Margolin, 1994).

The early 2000s. By the early 2000s, studies on the oral health of prisoners started to add more dimensions than only looking at the prevalence of dental caries by examining the DMFT index scores of male inmates. Boyer, Nielsen-Thompson, and Hill (2002) examined the oral health of both male and female prisoners in Iowa while Clare

(2002) followed up on the oral health of a cohort of adult felons after three years of incarceration in a North Carolina Department of Correction facility.

Boyer et al. (2002) conducted a dental caries and tooth loss in a cross sectional study on 174 Iowa prisoners, 149 males and 25 females, to determine if inmates have shared in oral health improvements of the 30 years prior. Boyer et al. (2002) attempted to reduce bias through a selection process where participants were drawn from the inmates screened by the dental hygienist and selected by asking every second, third, or fourth dentate inmate (98% of new inmates) admitted the day before to participate (Boyer et al., 2002).

Boyer et al. (2002) compared the oral health of the current Iowa prison population studied with the oral health status of non-institutionalized United States adults with data collected from 1988 to 1991. The Boyer et al. (2002) study also used the DMFT index and found the inmates were disparate from the general dentate United States adult population in untreated decay, but both male and female inmates were not disparate with the general population with regard to the number of missing teeth.

The Boyer et al. (2002) study compared the dental health of newly admitted male and female inmates in addition to comparing the dental health between different racial categories. Male inmates, on average, had more decayed teeth and surfaces of untreated decay than the female inmates (7.09 untreated decayed teeth and 15.3 surfaces of decay for males compared to 5.56 untreated decayed teeth and 14.4 surfaces of decay for females) (Boyer et al., 2002). Males averaged only 4.07 missing teeth while females averaged 5.12 missing teeth (Boyer et al., 2002). Combined, the inmates in the Boyer et

al. (2002) study had 8.4 times the amount of untreated decay compared with the dentate of non-institutionalized U.S. adults. Unlike earlier oral health studies on inmates, Boyer et al. (2002) examined and categorized decayed and missing teeth in individuals with 28 teeth or 32 teeth. A surprising finding from the Boyer et al. (2002) study that differed from earlier studies was Caucasian males had more decay than their minority counterparts.

While most oral health studies on prisoners focused on the prevalence of caries or inmates and how it compared to the general population, Clare (2002) examined a cohort of felons after three years of incarceration. Clare (2002) wanted to examine if prisoners were continuously incarcerated for a three year time period, and if it would be a reduction in the prevalence of dental caries, an improvement in periodontal health, and improvements urgent oral treatment needs. In 1999, Clare (2002) followed up on 257 inmates that were continuously incarcerated with the North Carolina Department of Corrections since this study began in 1996. The prisoners in this study showed a substantial reduction in the prevalence of caries, with Caucasian showing a greater decline than African Americans (Clare, 2002). Prisoners also showed improvements in periodontal health and urgent treatment needs (Clare, 2002). Even with these improvements though, remaining dental needs were still substantial (Clare, 2002).

For her Master's thesis, Heng (2000) examined the oral health of recently incarcerated females at the Federal Correctional Institute located in Danbury, Connecticut. Inmate's oral health was assessed by recording past and present dental caries and other unmet oral needs. Heng (2000) concluded that the female inmate

population she studied in Danbury, Connecticut had a high level of dental needs. The DMFT index was used and showed that 78% of this prison's population had one or more untreated, decayed teeth and 90% had one or more missing teeth (Heng, 2000).

What was surprising in the Heng (2000) study was Caucasians had highest means for missing teeth at 8.3, with Latinas second highest with a mean of 7.4 missing teeth and African Americans having the lowest mean missing teeth at 6.9. However, the difference at $p = 0.3$ was not significant (Heng, 2000). Eighty-three percent of this prison's population had one or more filled teeth with 12% having one or more impacted teeth (Heng, 2000). In Heng's (2000) female study population, almost half of the dental caries were untreated in the 18-29 age group with one-third of dental caries were untreated in the age group 40 and above. Unfortunately this improvement with age did not translate into improved oral health. These results were consistent with another study conducted at the Federal Correctional Institution at Danbury, Connecticut by Heng and Morse (2002).

Heng's (2000) conclusion was that inmates should be educated on behaviors that promote oral health, including oral hygiene instruction and diet counseling. She also stressed the importance of inmates understanding the relationship between pathogens and susceptible hosts in disease causation (Heng, 2000). No specifics were given on how such knowledge would be delivered to prisoners.

Incarcerated adults are not alone in suffering from poor dental and oral health. Adolescents in detention facilities have poorer dental and oral health than non-incarcerated adolescents in the general population. Bolin and Jones (2006) explored the oral needs of adolescents in large urban county juvenile detention facility using a

retrospective chart review. DMFT and additional oral health indicators were taken from selected charts. Charts were examined of 419 subjects, 24.6% female and 75.4% male, with an ethnicity of 45.1% African-American, 35.3% Mexican-American or Hispanic, 15.8% White, and 3.8% Asian or "other" (Bolin & Jones, 2006). In comparison to the national average of 20%, over 50% of the adolescent detainees had untreated decay and on any given day, 58 residents of the facility had moderate of high urgency dental care needs (Bolin & Jones, 2006).

Because this population was adolescents, only charts and notes were used to gather information. What is important to note about this group of children is at a young age, this incarcerated population is showing signs of poor dental and oral health in the same manner of adult incarcerated populations.

Mid 2000s and beyond. Following the early 2000s, dental and oral health studies about inmates in the U.S. seem to significantly reduce in number. While the U.S. sees a reduction in the studies of oral health of incarcerated populations, studies on this subject outside of the U.S begin to increase.

In conclusion, the status of dental and oral health in incarcerated populations in the U.S. has not been studied extensively. Most of the dental and oral health studies have been conducted on prisoners in state or federal institutions during the mid-1980s through the early 2000s. With exceptions such as Badner and Margolin (1994), Heng (2000), and Heng and Morse (2002), most of these investigations have focused on male prisoners. Virtually no studies are conducted on inmates in jails, probably due to the fact that most

jail inmates are confined for a much shorter term compared to either state or federal prisoners.

It is important to study the health of jail inmates, including their dental and oral health, since most will likely return to their communities. In a single year, the number of persons admitted to jail is between 10 million and 13 million. (Schmalleger & Smykla, 2011). Roughly 34,000 inmates are released from jail each day -- about 238,000 are released each week (Schmalleger & Smykla, 2011). While prisons have a much higher daily population than jails, they have a lower annual population. Schmalleger and Smykla (2011) stated: "it takes almost two years for the nation's state and federal prison population to turn over once; the jail population turns over almost 17 times each year" (p. 176). Clare (2002) reported improvement of dental caries and periodontal disease among prisoners who had served continually for three years in prison. Jails cannot make such a claim. In jails, the potential to make inroads for dental and oral health improvements in local communities is enormous.

Correctional Settings Located Outside the U.S.

Osborn et al. (2003) reported on the status of prison inmates in New South Wales (NSW), Australia. Osborn et al. (2003) conducted a cross-sectional stratified random sample of 789 prisoners, 657 males and 132 females. Inmates were stratified by sex, age, and aboriginality and face to face interviews were conducted to collect health information and risk factors (Osborn et al., 2003). A subset of 312 male prisoners and 22 female prisoners received an oral examination which a DMFT score to be calculated. Osborn et al. (2003) found that the perceived need for dental fillings was highest in females

compared with males and that being older than the median age of 36 was associated with a significant increase in the risk of a high DMFT score. Inmates with a history of injecting drug use also had a risk of a high DMFT score (Osborn et al., 2003).

The Osborn et al. (2003) study is an important contribution to oral health in incarcerated populations because it includes: a) both male and female inmates, b) 27 correctional institutions across NSW, c) extensive face-to-face interviews covering physical and mental health issues, d) oral examinations of a subset of 334 inmates using specified guidelines used by the National Oral Health Survey Australia (NOHSA), e) a cross-sectional age-stratified random sampling technique, f) extensive demographics on a total of 789 inmates, and g) questionnaires that captured inmate oral health behavioral information. The Osborn et al. study added information beyond being only a prevalence study of prisoners' DMFT status that compared inmate oral health to the oral health of the general population. The Osborn et al. study provided an early understanding of prisoners' oral health practices and knowledge of dental health and hygiene.

Osborn et al. (2003) collected information from prisoners about their visits to the dentist over a 12 month period, the number of times they brushed their teeth on the previous day, and their self-perception of need for dental treatment. Osborn et al. (2003) discovered the following about prisoner's oral health behavior and perceptions:

- Women prisoners were more likely to have visited a dentist than male inmates. Within a 12 month time period, 41% of females visited a dentist compared to 27% of males. Two percent of males reported never visiting a

dentist. A large percentage of prisoners (62%) reported a visit to the prison dentist was their most recent dental visit.

- Over 80% of prisoners reported they brushed their teeth the previous day. Fifty percent reported brushing their teeth twice on the previous day. Six percent reported they did not brush their teeth.
- Five percent of prisoners, all over 25 years of age, were edentulous.
- Ninety-six percent of prisoners under the age of 25 had been affected by dental caries. This was similar to those over 25 years old. Eleven percent suffered from root caries, with 17% of root caries occurring in prisoners over 40 years of age.

Osborn et al. (2003) stated that prisoners with poor perceptions of their oral health coupled with a lack of oral care may initiate a downward spiral that lead to a "self-fulfilling prophesy of poor oral health status.

Osborn et al. (2003) carried out logistic regression to determine factors associated with "low" DMFT (≤ 10) and "high" DMFT (> 10) scores. The researcher's univariate analysis revealed that a median age of 36 was associated with a significant increase in the risk of a "high" DMFT score (Osborn et al., 2003).

Nobile, Flotta, Nicotera, Pileggi, and Angelillo (2011) conducted a cross-sectional study in Calabria, Italy where 650 prisoners agreed to participate to assess self-reported health, quality of life, and access to health services in a sample of male prisoners. The authors reported their study to be the first attempt to address prisoner's self-reported health status in Italy. The prisoners had a high prevalence of self-reported diseases (82%)

compared to the lower values (13.1%) reported in the general Italian population or the Calabria population (15.7%). In this study, the top rated health issue in the correctional facility was dental problems – 56.1% of inmates rated this issue as their current symptom of disease. The second rated issue was arthritis or rheumatic pain at 40.2%. Only 2% of the examined prisoners had no history of dental caries (Nobile et al., 2011). Nobile et al. suggested there was a need for programs to improve oral health in this prison and that oral health can improve overall inmate health.

As with Osborn et al. (2003), Nobile et al. (2011) used logistic regression to identify major independent predictors to self-related health status and access to health services within the prison. Model 1 or self-rated health status respondents were rated as "poor" or "good/very good". Model 2 or access to health services in the prison were recorded as "sometimes/often/ very often" or "never/rarely". Independent variables consisted of age, marital status, education level, employment status before prison, smoking status, and incarceration information. Multiple logistic regression analysis showed older age groups in prison, those with a lower education level, those who either experiences negative feelings frequently or attempted suicide, or those who reported health problems upon entering prison, were significantly more likely to have a worst perception of their health status (Nobile et al., 2011).

While the oral health status of incarcerated persons is poor in the U.S., Australia, and other European countries, it is more dismal in developing countries such as India. In developing countries, it is unlikely that a health professional would choose to work in a prison system (Reddy, Kondareddy, Siddanna, & Manjunath, 2012). From October 2009

to March 2010, Reddy et al. conducted a cross-sectional study of the oral health status of 800 prisoners in seven central jails of Karnataka, India. All prisoners in this study were life imprisoned.

The design of the Reddy et al. (2012) study was conducted in a manner similar to the Osborn et al. (2003) study were the survey design consisted of a questionnaire and an oral exam. The questionnaire contained questions on general demographics, tobacco consumption, oral hygiene practices, imprisonment characteristics (sentence category and duration spent), and the availability and utilization of dental healthcare facilities (Reddy et al., 2012). Reddy et al., found that the prevalence of dental caries was 92.5% with a DMFT value of 5.26. This DMFT value was lower than studies conducted in the U.S., Australia, and Europe, likely the result of differences in the refined diet consumption of prisoners in developed countries (Reddy et al., 2012). Reddy et al. also discovered a large number of prisoners having missing teeth as a result of prison facilities extracting teeth because the conservation of teeth was not possible and 48.6% of prisoners had periodontal CPI scores of three or four. However, the low DMFT score reported by Reddy et al. is inconsistent with the high rate of missing teeth due to extraction. Reddy et al. does not adequately address this issue.

Dhanker, Ingle, and Gupta (2013) reported a prevalence of dental caries at 78.7%, an average DMFT of 4.79, and poor periodontal conditions in their cross-sectional study carried out on 870 inmates in the district jail of Mathura in India. According to Hiremath (as cited in Dhanker et al., 2013), the DMFT of inmates in Hindalga Central Prison in Belgavi-Kamataka in India was 5.22. Dhanker et al. (2013)

addressed that their average DMFT score was lower than the average DMFT scores of other researchers such as Badner and Margolin (1994), Cunningham et al. (1985), Heidari et al. (2007), Nobile et al. (2007), and Salive et al. (1989), but gave no hypothesis as to why this was the case other than state differences in diet between develop and developing nations. Dhanker et al. (2013) reported measuring the DMFT using the WHO Dentition Status and Treatment Need. Dhanker et al. and Reddy et al. (2012) rank inmates oral health as poor, with Reddy et al. reporting that inmates that served longer sentences showed higher percentage of dental caries, periodontal diseases, and prosthetic needs.

Bansal, Sogi, Veeresha, Kumar, and Bansal (2012) reported that prisoners of Haryana State (19 separate prisons) in India had similar numbers of decayed teeth to the general population but a lower number of filled teeth. These researchers also found the number of teeth missing and the need for tooth extraction to be high (Bansal et al., 2012). In the Mangalore District Jail in Karnataka, India, Dayakar, Shivprasad, and Pai (2014) conducted a cross-sectional study of 82 male inmates and reported the periodontal status of prisoners to be poor. Dayakar et al. (2014) reported the correlation between the CPI score and age was highly significant ($p = 0.002$).

Most international oral health studies of correctional populations have taken place in prison settings, the same as the U.S. studies. Heidari, Dickinson, Wilson, and Fiske (2007) and Decerle, Woda, Nicolas, and Hennequin (2012) were exceptions. Heidari et al. studied oral health in remand prisoners in London and Decerle et al. studied the oral health of inmates in three French jails. Although both of these studies were small and

utilized convenience samples, both explored oral health attitudes and behavior with inmates.

Heidari et al. (2007) studied 78 male remand inmates utilizing a convenience sample. An oral exam was conducted on each inmate that participated to determine a DMFT score, oral mucosal pathology, and periodontal status. A questionnaire, administered as a structural interview, was delivered to each inmate asking about their perceived oral health and general health status, past dental visits and treatments, and general oral health attitudes and behaviors (Heidari et al., 2007). Demographic data was also taken as well as information about alcohol consumption, tobacco smoking, drug use, and sugar intake (Heidari et al., 2007).

The participants in the Heidari et al. (2007) study reported that they highly valued their teeth because of mastication/function and social reasons such as smiling, talking, and working. Most inmates preferred the restoration of a tooth over extraction; however, front teeth were valued more than back teeth (Heidari et al., 2007). Forty-nine percent suffered from dental anxiety (Heidari et al., 2007). A large percentage (73%) reported visiting a dentist in the past year (Heidari et al., 2007). Seventy percent reported brushing their teeth twice a day (Heidari et al., 2007). Seventy-one percent of inmates in this study rated their oral health as poor (Heidari et al., 2007). One trait shared by all of the inmates was they did not like the toothbrushes and toothpaste provided by the jails (Heidari et al., 2007).

Like the Heidari et al. (2007) study, Decerle et al. (2012) studied a small group of male inmates in three French jails. This descriptive study consisted of 84 male inmates

that were divided into two groups determined by the length of incarceration: a short term group (≤ 2 years, 31 subjects, mean age 31 years old, SD 13 years) and a long term group (> 2 years, 53 subjects, mean age 43, SD 11 years) (Decerle et al., 2012). The focus for Decerle et al. was to measure overall oral health and specific indicators with inmates in three jails and compare results with different incarceration times.

Decerle et al. (2012) measured the dental caries experience using the DMFT index. The Global Oral Health Assessment Index (GOHAI) was the tool used by Decerle et al. to record overall oral health and some specific indicators. Logistic regression was used to analyze the GOHAI (dichotomized below and above 50). Results from this study showed that inmates incarcerated for more than two years reported that their oral health had deteriorated, with the long term inmates stating that they had trouble chewing (Decerle et al., 2012). Decerle et al. stated: "for these jails, a stable level of untreated caries and other forms of oral infection was maintained at the cost of degraded masticatory function" (p. 276). This result differs from oral health studies done on correctional populations in the U.S., such as Clare (2002), where increased rates of incarceration improved prisoner oral health.

In conclusion, globally, the oral health status of incarcerated populations is as poor as in the U.S. or many times poorer, especially in developing countries. In studies examined of incarcerated populations outside the U.S., prisoners had more decay, fewer restored teeth, more serious periodontal disease, more missing teeth, and greater edentulism than the general population.

Oral Health Knowledge, Attitudes, and Practices

Incarcerated populations. Studies on the oral health knowledge, attitudes, and practices of prisoners are scarce. Two recent studies that examined these issues include Akbar, Turner, Themessl-Huber, Richards, and Freeman (2012) and Riswanto, Agustina, and Wardani (2013). The Akbar et al. (2012) team of researchers evaluated the impact of an Oral Health Improvement Project on the oral health-related knowledge, attitudes, and behaviors of prisoners in a high-security Scottish prison. Akbar et al. (2012) reported this special project to be based on the following four key principles:

- Empowerment: This project created opportunities to support prisoners, visiting families, and prison staff to take responsibility for their oral health via informed choices.
- Partnership: The prison established partnerships with outside organizations in various prison settings.
- Sustainability: This project integrated oral health throughout various prison structures and systems.
- Equity: This project developed a best practices approach and improved understanding or prison dental services by service referrers (prison staff), providers (dentists), and users (prisoners).

Scottish prisons practice a ‘whole prison’ or ‘healthy settings’ approach for health promotion with prisoners (Akbar et al., 2012). Incarcerated populations in the United Kingdom suffer from dental disease up to four times greater than the general population therefore the promotion of oral health with prisoners is high priority in the Scottish prison

system (Akbar et al., 2012). The question the Akbar et al. study wanted to answer was as follows: “could an oral health improvement project nested in a health-promoting prison, which had adopted a common risk factor approach, increase oral health-related knowledge, modify attitudes and change oral health-related behaviours or prisoners?” (p. 170).

The Akbar et al. (2012) study was a non-probability convenience sample of 107 prisoners (59 intervention and 48 controls) ranging in age from 21 to 60 years that were separated into intervention and a control groups. The intervention group had been housed in an area of the prison separate from the control group. The intervention group of prisoners had been participating in the Oral Health Improvement Project from 2008 to 2011; the controls had no exposure to this project (Akbar et al., 2012). The gender of the prisoners was not addressed so the assumption is the prisoners were all male. Questionnaires collected information on a) prisoner’s age and length of imprisonment, b) a series of questions on awareness of nine oral health elements of the Oral Health Improvement Project, c) general oral knowledge on tooth brushing, fluoride toothpaste, smoking, and oral cancer, and d) oral health behavior questions on tooth brushing, healthy eating, and cigarette smoking (Akbar et al., 2012). No oral examinations were conducted on prisoners and their oral health records were not factored into this study. The statistical analysis of all completed questionnaires included frequency distributions, Chi-square analyses, *t*-tests, and ANCOVA (Akbar et al., 2012).

The results of the Akbar et al. (2012) study was the intervention group of prisoners had improved oral health-related knowledge compared to the controls, but the

intervention group had not been impacted by the Oral Health Improvement Project in the areas of health-related attitudes or behaviors. An important discovery was the length of time a prisoner had been incarcerated impacted their dietary behaviors and cigarette consumption (Akbar et al., 2012). Gartherer et al. (2005) and Morling (as citied in Akbar et al., 2012) state that prisoner boredom and stress along with restrictive practices have likely inhibited the delivery of health promotion in Scottish prisons.

Riswanto et al. (2013) conducted a study on the knowledge, attitude, and practices of prisoners' oral health a Class IIB prison in Garut, West Java in Indonesia. This descriptive study consisted of male and female inmates aged 35-44; research data was gathered using questionnaires on demographic data, 16 questions on oral health knowledge, 17 questions on oral health attitudes, and 17 questions on oral health practice (Riswanto et al., 2013). No oral examinations were conducted and no oral health information of a prisoner was factored into this study's statistical analyses. Descriptive statistics were obtained and oral health knowledge, attitudes, and practices were classified into three levels: good, quite, and poor (Riswanto et al., 2013).

The study results of Riswanto et al. (2013) varied greatly from Akbar et al. (2012). Riswanto et al. (2013) rated the oral health knowledge of prisoners aged 35-44 as good, reporting that 88.24% understood the reasons of gingival bleeding and the role of bad oral habits on oral health. Oral attitudes, such as brushing their teeth everyday (78.43%) and tooth brushing before going to bed (64.70%), were also rated as good in the Riswanto et al. study. Although 94.12% of the Indonesian prisoners stated they use a tooth brush and tooth paste to brush their teeth, the majority (94.12%) reported they don't

get fillings for their cavities; Riswanto et al. rated their oral practices as poor. Only 13.37% of prisoners use any dental service likely due to cost, anxiety, and access (Riswanto et al., 2013). The Prison of Class IIB Garut did not have oral health services; Riswanto et al. (2013) recommended basic oral health care services need to be provided in the prison to motivate better oral hygiene in prisoners.

Non-incarcerated populations. Outside of prisoners and inmates, oral health knowledge, attitudes, and practices have been conducted on many other groups of people. Rustvold (2012) examined the oral health knowledge, attitudes, and behaviors with at-risk females in two residential chemical dependency treatment programs where oral health intervention sessions lead to increases in oral health knowledge and behavior. High-to-severe dental anxiety was much higher in this study population of women compared to the general population (Rustvold, 2012).

Rustvold (2012) utilized three instruments in her study design: the Modified Dental Anxiety Scale (MDAS), the Rustwold Oral Health Knowledge Inventory (ROHKI), and the Oral Health Attitudes Questionnaire (OHAQ), with the ROHKI and OHAQ administered a second time as posttests three weeks after an oral health learning session. The MDAS instrument consisted of five questions that were score from 1 point (not anxious) to 5 points (extremely anxious) (Rustvold, 2012). The ROHKI consisted of 10 questions related to oral health conditions and self-care practices. The ROHKI asked questions such as ‘What is plaque?” and “What is gingivitis?” (Rustvold, 2012). The OHAQ was the instrument used to assess attitudes and behaviors relating to oral health

(Rustvold, 2012). An example of an OHAQ statement was: “I believe that only the dentist can prevent cavities” (Rustvold, 2012).

The Rustvold (2012) study had 51 female participants from two residential chemical dependency treatment centers that completed three pretest instruments, 38 women from the two centers completed oral health information classes, and 27 women completed the posttest instruments (Rustvold, 2012). Analyses consisted of descriptive statistics and bivariate analyses used to compare pretest and posttest results and to compare instruments, survey items, and groups (Rustvold, 2012). Inferential methods used included chi-square tests, Fisher’s Exact Test, *t* tests for difference of means, and two-proportion *z* tests (Rustvold, 2012).

The results of the Rustvold (2012) study revealed that 61% of women scored in the high-to-severe categories of dental anxiety. The women showed a solid basic understanding of oral health knowledge regarding dental plaque, gingivitis, tooth brushing and flossing, and effects of smoking on oral health (Rustvold, 2012). The greatest increase in oral health knowledge was shown on the ROHKI question that dealt with the optimal timing of sugar consumption, with only 22% of the women giving the correct response on the pretest compared with more than half giving the correct response on the posttest (Rustvold, 2012). Oral health attitudes captured in the OHAQ instrument showed improvement in the understanding of the importance of dealing with gingivitis and dental caries and the frequency of brushing one’s teeth at least twice a day (Rustvold, 2012). The Rustvold study demonstrated the importance or oral health education to a group of at-risk women. This study was important to a study on the oral health, attitudes,

and practices of jail inmates because a large percentage of jail inmates are an at-risk population (Greifinger, 2007).

Studies of oral health knowledge, attitudes, behaviors, and practices have been conducted on various groups around the world. Varenne, Petersen, and Ouattara (2006) examined the issue of oral health behavior in children and adults in urban and rural areas of Burkina Faso in Africa. Zhu, Petersen, Wang, Bian, and Zhang (2003; 2005) looked at this same issue in both children and adults in China. These three studies used questionnaires to assess the level of dental knowledge, attitudes, and behaviors of their target population. All three studies found there was a great need for local health authorities to strengthen oral disease and health promotion programs (Varenne et al., 2006; Zhu et al., 2003; 2005).

Students are a common group targeted for oral health studies. Baseer and Rahman (2014), Dagli, Tadakamadla, Dhanni, Duraiswamy, and Kulkarni (2008), and Komabayashi et al. (2005) studied oral health attitudes and behavior of female Saudi dental students, dental students in Britain and China, and dental students in India respectively. None of the students in these three studies were given oral examinations. All three of these studies measured oral attitudes and behavior with a self-administered questionnaire based on the Hiroshima University – Dental Behavior Inventory (HU-DBI) (Baseer & Rahman, 2014; Dagli et al., 2008; Komabayashi et al., 2005). The HU-DBI, developed by Kawamura, consists of twenty dichotomous responses (agree-disagree) and has been shown to have good test-retest reliability and is useful for understanding patients and predicting clinical outcomes (Komabayashi et al., 2005). All three studies

concluded that the oral health behavior of dental students needed to be improved in order to serve as a positive model for their patients and their community (Baseer & Rahman, 2014; Dagli et al., 2008; Komabayashi et al., 2005).

DMFT and oral health knowledge, attitudes, and practices/behaviors. The study of oral health in groups, including incarcerated populations, has evolved from simply collecting DMFT and periodontal information to adding questions about oral health knowledge, attitudes, and practices/behaviors. Since the mid-2000s, some investigators have investigated possible relationships between oral health and hygiene and oral health knowledge, attitudes, and practices/behaviors. Ogundele and Ogunsile (2008) examined this possible relationship in adolescents in a Local Government Area (LGA) of Oyo State, Nigeria. The subjects for the Ogundele and Ogunsile study were taken from 10 secondary schools; 700 students, both males and females, were selected but 637 completed the questionnaires.

The instruments for collecting data consisted of dental examinations, to determine the prevalence of dental caries, and a self-administered close-ended questionnaire (Ogundele & Ogunsile, 2008). The questionnaire Ogundele and Ogunsile used consisted of the following five sections:

- Section A: Demographic data
- Section B: Six dental health knowledge questions with yes or no answers
- Section C: Five questions related to dental health attitudes with responses on a four point Likert scale of strongly agree, agree, disagree, and strongly disagree

- Section D: Five questions dealing with dental health practices with a yes or no format for answers
- Section E: Results of the dental caries examination

According to the results of the Ogundele and Ogunsile (2008) study, the adolescents had low percentage occurrence of dental caries (6.1%) and a significantly high knowledge, positive attitude, and sound practices of dental health. Females of this study had more positive dental health attitudes and practices than their male counterparts (Ogundele & Ogunsile, 2008). The findings of this research indicated the occurrence of dental caries in this adolescent population in Nigeria was negatively correlated with dental health knowledge, attitudes, and practices (Ogundele & Ogunsile, 2008).

The relationship between dental caries status and oral health attitudes and behavior was examined by Levin and Shenkman (2004) in a group of 123 young Israeli army recruits (107 or 87% male and 16 or 13% female) between 18 and 19 years old. The study population was selected randomly from recruits who arrived at a military dental office for screening prior to their military service (Levin & Shenkman, 2004). The participant's response rate was 100% and there were no common backgrounds of the participant's regarding place of birth, education, or socioeconomic status (Levin & Skenkman, 2004). The instruments used for this study included dental examinations using the WHO caries diagnostic criteria for the DMFT scores and the decayed, missing, and filled surfaces (DMFS) scores, and the HU-DBI, used to determine dental health attitudes and behaviors (Levin & Skenkman, 2004).

Levin and Skenkman (2004) reported the following dental examination results:

- Sixteen participants (13%) were caries-free (DMFT = 0).
- Greater than one-third (45 participants or 36.6%) had no caries decay at the time of the examination (D = 0).
- Untreated dental caries scores averaged 2.68 (DT) and 4.62 (DS).
- Treated dental caries (the F factor) averaged 4.05 for DMFT and 6.30 for DMFS.
- F/DMF index averaged 55%, with D/DMF averaging 38%.

On the HU-DBI questionnaire, 28% of the participants reported bleeding gums, 63% reported that it was impossible to prevent gum disease with only tooth brushing, and 40% reported only going to the dentist when they had a toothache (Levin & Shenkman, 2004).

In the Levin and Shenkman (2004) study, seven out of the 20 HU-DBI items were found to have a statistically significant relationship with DMF scores of recruits ($p<0.05$); these items included the following:

- "I think my teeth are getting worse despite my daily brushing" (item 8). Agreement with this statement was strongly related to high DMF scores ($p<0.01$) as well as high D or untreated dental disease and F or treated dental disease ($p<0.015$).
- "My gums tend to bleed when I brush my teeth: (item 2). Agreement with this statement was correlated with high D and DMF scores ($p<0.05$).
- "I put off going to the dentist until I have toothache" (item 15). Agreement with this statement also related to high D/DMF (untreated dental disease) and F/DMF (treated dental disease) indices ($p<0.02$).

- "I use a child-sized toothbrush" (item 5). Agreement with this statement related to F and DMF scores ($p<0.05$).
- "I brush each of my teeth carefully" (item 9). Agreement with this statement related to F and DMF scores ($p<0.002$).
- "I have noticed some white sticky deposits on my teeth" (item 4). Agreement with this statement related to high DMF scores ($p<0.05$).
- "I use a toothbrush with hard bristles" (item 17). Agreement with this statement related to high D/DMF and F/DMF indices ($p<0.05$).

Levin and Skenkman (2004) found a statistically significant correlation between low DS and DT values and a high total HU-DBI score ($p<0.05$). Participant's positive oral health attitudes and behavior had low levels of dental disease (Levin & Skenkman, 2004).

Dental Service Delivery of the Jail Under Study

The jail in this study is located on the outskirts of a large midwestern U.S. city and houses almost 1,000 inmates. During this study the inmate population normally ranged from 700 – 800 inmates. Dental screening at intake consisted of asking an inmate if they had dental pain. Subsequent treatment was received only on request or in the case of an emergency such as an impacted wisdom tooth. Requests were prioritized and treatment for toothaches and impactions was almost always extraction of the tooth. Rarely is restorative work or cleanings, x-rays, or root canals done in this jail. Access to dental care depended on the severity of an inmate's problem. Emergency needs were given a priority over non-emergencies. The cost of dental care and the short term stays of most inmates make the kind of care that can be provided in prisons almost impossible to

provide. The jail in this study was served by only one dentist and one hygienist assistant. This jail system once had more dental staff and dental services but budget cutbacks reduced the dental staff to its present level.

The prioritization method used by the jail in this study is not unique. Ringgenberg (2011) found similar systems used in her study of looking at dental health data for the Iowa Department of Corrections (IDOC) inmate population. As the other studies of oral health needs in incarcerated population discussed so, Ringgenberg found that inmates had high levels of dental needs. Common prioritization methods used consist of rating inmate needs as Priority I, II, or III. Priority I are immediate or emergencies, with Priority II, the most common priority, indicating an inmate's name will be placed on the bottom of a list; as others are seen first the inmate moves up on the list until they are seen by a dentist or hygienist (Ringgenberg, 2011). Priority III indicates a condition that can wait (Ringgenberg, 2011).

The Ormes (1996) study examined the emergent, urgent, or routine dental treatment needs of prisoners in the Michigan Department of Corrections (MDOC) state prisons. MDOC provides dental screening for all inmates entering the system (Ormes, 1996). Unlike Michigan jails, the dental division of the MDOC provides fillings, extractions, root canal treatments, prosthetics (full and partial dentures) and cleanings (Ormes, 1996). As in the jail in this study and the IDOC, care is prioritized with emergency services scheduled immediately (Ormes, 1996). Routine dental care needs are done on a first come first serve basis (Ormes, 1996). Ormes found that inmates

incarcerated 0-2 years had a higher need for routine dental services than those incarcerated 2.1-3.8 years (p = .02).

Critique of Methods

The possible relationships between the oral health status of inmates incarcerated in a large metropolitan jail and their oral health knowledge, attitudes, and practices were examined in this study. The oral health status of inmates was determined by obtaining their DMFT and CPI scores. Based on these scores, inmates were classified into two groups: “high” DMFT and “low” DMFT and “high” periodontal scores and “low” periodontal scores. Logistic regression was used to determine factors associated with these “high” and “low” DMFT and CPI scores, as it was described in detail in Chapter 3.

This study was unique because it will go beyond determining only the prevalence of the oral health status of inmates, mostly dental caries and seldom periodontal status, and comparing the results to the general population as most U.S. studies of this nature have done (Cunningham et al., 1985; Salive et al., 1989; Mixson et al., 1990). Studies of oral knowledge, attitudes, and practices in oral health have been conducted on general population adults, students, and military personnel, but not conducted on incarcerated populations.

Studies of the Oral Health Status of Incarcerated Populations

Studies in the U.S. Studies of the oral health status of incarceration population in the U.S. were conducted in prisons, not jails, and were cross-sectional prevalence studies that determined the DMFT scores of inmates, comparing them to the general population. In each study the incarcerated population demonstrated poorer oral health than the

general population. The prison populations had a higher number of decayed and missing teeth and fewer filled teeth than the general population.

Cunningham et al. (1985) compared the DMFT Index scores of 99 male inmates (out of a possible 140 inmates) with those of 101 nonprison males that were randomly selected from the Survey of Oral Health. The prison population was a nonrandom, self-selected sample from one medium-security prison in Iowa. Only the inmates who expressed an interest in the study were selected. Information such as educational levels, income, past dental utilization, or behavioral factors known to be associated with dental disease prevalence was not collected. The statistics generated were only mean DMFT scores for the prison and nonprison populations in Iowa. This was appropriate since the research question for Cunningham et al. was to compare a prison population to a nonprison population in the same state.

The Salive et al. (1989) study was a similar study to Cunningham et al. (1985) study and was also conducted on male prisoners in a 1,800 bed, male, medium-security, long-term correctional facility. Dental examinations were conducted on 178 prisoners; each prisoner was examined by the same dentist. The Salive et al. study did not collect information on educational levels, income, and past dental utilization and behaviors. Salive et al. did track the ages and races of the prisoners in addition to their DMFT Index scores. Salive et al. did conduct more sophisticated statistical analysis consisting of chi-square and two-sample *t*-tests. Mantil-Haenzel odds ratios were determined, along with linear and multiple linear regression.

The study by Mixson et al. (1990) incorporated many of the same features of Cunningham et al. (1985) and Salive et al. (1989) but was a slightly more sophisticated study. The purpose of the Mixson et al. study was to obtain the DMFT Index scores of prisoners incarcerated in the U.S. Penitentiary at Leavenworth, Kansas (a federal correctional facility that housed up to 1,200 maximum security inmates) and assess age, race, number of years incarcerated, and number of visits to the prison dentist on this parameter of oral health. A random list of 299 prisoners was generated, with 191 prisoners agreeing to participate (16.3% of the then current population of 1,161). To determine if there were statistically significant differences between prisoners' age and racial group, the Student's *t*-test and Pearson chi-square analyses were used. Mixson et al. also used chi-square analyses to identify association among number of years incarcerated, utilization rate, and number of decayed teeth.

The early studies by Cunningham et al. (1985), Salive et al. (1989), and Mixson et al. (1990) were little more only prevalence studies that were the first looks at how the oral health status of incarcerated populations compared with the oral health status of the general population. No insight as to why this was so was examined in the U.S. Even U.S. studies conducted in the 2000s that examined the issue of dental caries and tooth loss in prisons did not examine oral health knowledge, attitudes, or practices. Boyer et al. (2002) compared dental caries and tooth loss in different groups of prisoners such as male/female, younger/older, and different racial groups. It took researchers outside of the U.S. to start examining predictors of why inmates suffered from poorer oral health than the general population.

Studies outside the U.S. Studies of the oral health of incarcerated populations outside of the U.S. were conducted after the year 2000 and built on the studies of Cunningham et al. (1985), Salive et al. (1989), and Mixson et al. (1990). These foreign studies, conducted in countries such as Australia, China (Hong Kong), Great Britain, Italy, and France, were generally smaller in size than their U.S. counterparts and examined more than just DMFT prevalence scores; some of these studies added CPI scores as part of their study. The researchers outside of the U.S. used questionnaires to surveyed prisoners and inmates about the impact of oral health on their quality of life, their self-perception of oral treatment needs, and oral health practices concerning their dental utilization and how often they brush their teeth. The statistical analyses used in some of the later foreign studies included logistical regression to determine possible relationships between the oral health status of inmates and factors such as duration of incarceration and prisoner age, similar to the data analysis plan suggested in my study.

More specifically, McGrath (2002) studied the prevalence of oral disease and its impact on the quality of 64 inmates, aged 60 years and older, at a Hong Kong detention facility. In this study the researcher conducted clinical oral examinations to determine DMFT and CPI scores and used a 14-item questionnaire, the Oral Health Impact Profile (OHIP-14) to assess the impact of oral health status on the quality of life (McGrath, 2002). McGrath used both DMFT and CPI scores to determine oral health status. OHIP-14 responses were put into a frequency distribution and a summary binary variable of the OHIP-14 was produced. The responses were then put into two groups: ‘reported at least one problem’ and ‘did not report any problem’ to an oral issue within the past year

(McGrath, 2002). Because of the small sample size of only 64 inmates, bivariate analysis was used but a multifactorial analysis was not done. McGrath reported the prevalence or oral disease to be high in this group of elderly inmates and this had a substantial impact on their life quality.

An example where logistic regression was used to determine factors associated with "low" and "high" DMFT scores was the Osborn et al. (2003) study of the oral health status of prison inmates in New South Wales, Australia. This cross-sectional study was a stratified random sample of 789 prisoners (657 males and 132 females) from 27 correctional facilities, all located in New South Wales (Osborn et al., 2003). A subset of 334 inmates (312 males and 22 females) between the ages of 18-77 years were given oral examinations to collect DMFT Index scores in addition to health surveys that included oral health behavior questions (Osborn et al., 2003). The subset of 334 inmates that received oral examinations where divided into two groups: 'high DMFT (>10) and 'low' DMFT (≤10). Logistic regression analyses was conducted for factors associated with a 'high' DMFT score (sex, age, aboriginal, drug injector). Logistic regression was the appropriate analyses to run in this case since Osborn et al. are predicting categorical outcomes ("low" and "high" DMFT scores) from both continuous and categorical predictors.

Logistic regression was used in a recent study of the oral health in three jails in France (Decerle et al., 2012). This observational study was small, consisting of 84 male prisoners that were divided into two subgroups: a) prisoners incarcerated for ≤ 2 years (31 males) and b) prisoners incarcerated >2years (53 males). The pool of prisoners were

drawn from all male prisoners that presented at the infirmary and prisoners scheduled for a dental consultation during the two months this study was conducted in addition to all new male prisoners (Decerle et al., 2012). Dental caries was measured with the DMFT index and the French validated version of the 12-item Global Oral Health Assessment Index (GOHAI) recorded a prisoner's assessment of their overall health and other specific indicators such as limiting the kinds of food, problems speaking, and worry about teeth, gums, or dentures (Decerle et al., 2012; Tubert-Jeannin, Riordan, Morel-Papernot, Porcheray, & Savy-Collet, 2003). Logistic regression analyses was used on the GOHAI (reported to have been dichotomized to below and above 50), with predictors being duration of incarceration, prisoner age, and number of functional teeth (Decerle et al., 2012). Decerle et al. reported that "logistic regression applied to the GOHAI did not show any significant factor" (p. 276).

Studies on Oral Health Knowledge, Attitudes, and Practices/Behaviors

Studies on the oral health knowledge, attitudes, and practices/behaviors in oral health have been conducted on populations as diverse as communities in Myanmar (Ogawa et al., 2003), Israeli army recruits (Levin & Shenkman, 2004), adults in China (Zhu et al., 2005), and adolescents students in Nigeria (Ogundele & Ogunsile, 2008). The size of these four studies ranged in size from 123 young Israeli army recruits (Levin & Shenkman, 2004) to 8,797 adults in China that were grouped into two age categories, 35-44 and 65-74 years of age (Zhu et al., 2005). All four of these studies had similar designs; DMFT Index scores were collected through clinical examinations and study participants answered survey questionnaires to determine their oral health knowledge, attitudes, and

practices/behaviors. In each study, dental caries prevalence was explored among a particular population of people to investigate what, if any, relationships existed between oral clinical indices and knowledge, attitudes, and practices/behaviors on oral health.

With the exception of Levin and Shenkman (2004), the researchers used oral health knowledge, attitude, and practices/behaviors questionnaires that were developed for their particular study. Levin and Shenkman used the Hiroshima University-Dental Behavioral Inventory (HU-DBI), developed by Kawamura. The HU-DBI is a 20-iten questionnaire with only agree/disagree responses (Levin & Shenkman, 2004). Levin and Shenkman reported they used a Hebrew version of this questionnaire that was translated from English and found to be valid in a previous study. Ogawa et al. (2003) developed a questionnaire that consisted of eight questions that dealt with the prevention of dental caries and periodontal disease, eight questions intended to determine attitudes towards oral health, and eight questions regarding oral health practices. All questions had only one correct response (Ogawa et al., 2003). Ogundele and Ogunsile (2008) and Zhu et al. (2005) had more extensive questionnaires that had multiple sections in multiple formats such as yes/no and Likert scale responses.

All four of the research teams used simple frequency tables and descriptive statistics such as means and standard deviations in addition to chi-square tests and bivariate and multivariate regression analyses (Levin & Shenkman, 2004; Ogawa et al., 2003; Ogundele & Ogunsile, 2008; Zhu et al., 2005). Levin and Shenkman use the nonparametric Mann-Whitney test to relate the different DMFT Index values with the HU-DBI responses. Although these four studies were conducted in different cultures with

different age groups represented, all of these researchers found that various aspects of poor oral health knowledge, attitudes, and practices were correlated with a higher level of dental disease (Levin & Shenkman, 2004; Ogawa et al., 2003; Ogundele & Ogunsile, 2008; Zhu et al., 2005).

Summary

This literature review examined the following issues: a) the importance of oral health to the health of the general population, b) the definitions of measurements of dental caries and periodontal diseases, c) the theoretical foundations of HBM and SCT and how they can be applied to oral health behaviors, d) dental caries and periodontal diseases in the general U.S. population, and e) oral health and hygiene in correctional settings in the U.S. and abroad. While dental caries and periodontal diseases impact peoples throughout the world, the burden of these conditions is disproportionately borne by those at the lower end of the socioeconomic spectrum, particularly incarcerated populations (Treadwell et al., 2007).

Incarcerated populations in the U.S. and throughout the world suffer poorer oral health than the general population (Treadwell et al., 2007). Studies on oral health in incarcerated populations have evolved from prevalence studies to aid in planning local prison budgets, to comparing the oral health of incarcerated populations to the general populations, to exploring incarcerated populations basic oral health knowledge and practices. Very few studies on inmates have examined the oral health of inmates in the jail setting. This research is vital to develop an understanding of the possible relationship

between the oral health and hygiene of jail inmates to their oral health knowledge, behaviors, and practices.

The methodology, inmate sample, instruments used, data collection, and data analysis of this study is discussed in Chapter 3. The challenges and limitations of such a study in a large jail located in a major metropolitan setting will also be discussed in this chapter.

Chapter 3: Research Method

Introduction

The purpose of this study was to examine the potential association between the oral health status of jail inmates and their oral health knowledge, attitudes, and practices. In Chapter 3, I describe the study's methodology, design, setting, population and sample, sample size, and survey instruments in addition to my data collection and analysis techniques. This chapter also includes a discussion of the ethical considerations I took to insure the wellbeing and ethical treatment of the participating inmates.

Research Design and Rationale

Research Design

I used a nonexperimental cross-sectional design in this quantitative study. This type of research design allows for the examination of a sample of a population at one point in time (Babbie, 2011). Mann (2003) stated that a cross-sectional study design is the best way to determine prevalence and is also useful in identifying possible associations that can be studied in more detail later using a cohort study or randomized controlled research design (Mann, 2003).

Studies about oral health in incarcerated populations are scarce. Unlike a prison population where inmates tend to have long sentences and longitudinal studies can be conducted, jail inmates have maximum sentences of one year and most are incarcerated for much shorter periods. In a jail setting, it is likely that an inmate can be tested only once. Portney and Watkins (2009) stressed that because subjects are only tested once, cross-sectional studies are not threatened by testing or history effects. Cross-sectional

studies also allow many outcomes and risk factors to be assessed, making this study design a valuable tool for public health planning and the generation of hypotheses (Levin, 2006). I determined that a cross-sectional design was appropriate for this study because examining the relationship between inmates' oral health and their oral health knowledge, attitudes, and practices is a new topic for this population, and the jail setting does not permit an extended surveillance of participants. The lack of temporality is an important weakness of a cross-sectional study design. Since exposure and outcome status are being observed at the same time, a researcher using a cross-sectional design cannot determine which occurred first.

Research Questions and Variables

The research questions that I developed for this study include:

RQ1: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their knowledge of basic dental and oral hygiene?

- *Null Hypothesis (H_01)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to knowledge questionnaires on oral health.

  Alternative Hypothesis (H_11): Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to knowledge questionnaires regarding oral health.

RQ2: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health behaviors?

- *Null Hypothesis (H_02)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health behaviors questionnaires of oral health.
  Alternative Hypothesis (H_12): Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to oral health behaviors questionnaires of oral health.

RQ3: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health attitudes?

- *Null Hypothesis (H_03)*: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health attitudes questionnaires of oral health.
  Alternative Hypothesis (H_13): Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to oral health attitudes questionnaires of oral health.

The independent variables were the scores on the oral knowledge, attitude, and practices sections of the survey questionnaire. The dependent variables were the DMFT and CPI Indexes scores. All inmates surveyed were from inmates that had appointments with the jail's dentist or filed a grievance requesting to see the jail's dentist. Mediating variables were age, gender, and race of the inmates.

Population and Sampling

This study took place at a large jail located on the outskirts of a major metropolitan U.S. city. At capacity, the jail holds approximately 1,000 inmates. The participants in this study did not have to be recruited because they were inmates who had requested appointments with the jail's dentist. Participants were male and at least 18 years old; the inmates had to understand and speak English fluently in order to participate in the study, regardless their race and ethnicity.

Sample Size

A convenience sample of approximately 100 male inmates was examined in this study. During this study the population of the jail ranged from 700-800 inmates. For a confidence level of 95% and a margin of error of 10%, I determined that the sample size needed to be 93 using the Raosoft Calculator (Raosoft.com, 2004). To achieve this number, the jail's dentist administered surveys over a six-month time period to inmates who had dental appointments.

Instruments of the Study

DMFT and CPI Indexes

The jail's dentist charted the DMFT and CPI Indexes of the approximately 100 inmates that visited the jail's dental clinic over a three-month time period. DMFT data and periodontal status were collected through oral examinations conducted using dental mirrors and probes. The oral examinations each generated a mean DMFT score (WHO, 1997), and using this score as a guide, I classified inmates into two groups for the

purpose of assessing risk factors associated with DMFT score: “high” DMFT and “low” DMFT. For this study only 28 teeth were considered; the third molars were not counted.

Periodontal scores were obtained using the Community Periodontal Index (CPI) recommended by the World Health Organization (WHO, 2005) and were used in this study to generate periodontal scores as follows:

- Score 0: healthy periodontal conditions
- Score 1: gingival bleedings
- Score 2: calculus and bleeding
- Score 3: shallow periodontal pockets (4 to 5 millimeters)
- Score 4: deep periodontal pockets (6 millimeters or more)

As with the DMFT scores, I classified inmates into two groups for the purpose of assessing risk factors associated with the periodontal score: “high” periodontal scores of 3 or 4 and “low” periodontal scores between 0 and 2.

DMFT and CPI Indexes from the oral examination of inmates were collected after IRB approval was obtained from both Walden University and the jail’s review board.

Survey Instrument

In addition to an oral examination to gather DMFT and CPI Indexes, demographic questions and a written survey were collected from the 100 inmates who visited the jail’s dentist over a six month time period. The survey consisted of three separate sections--oral health knowledge, oral health attitudes, and oral health practices-- with seven questions in each section, for a total of 21 questions. Survey data was collected only after I had

obtained Institutional Review Board (IRB) approval had been obtained from both Walden University (#04-03-15-0045543) and the jail's review board (#02-15-2015).

Demographic questions. Demographic questions asked as the normal part of an inmate's dental examination include factors such as age, race, and time incarcerated. Additional questions which I added included education level, employment status at the time of incarceration, annual income, and dental insurance status.

Oral health knowledge questions. I measured the oral health knowledge of inmates using seven multiple-choice questions, with each question having a choice of four answers, with only one correct answer. I included these questions to discover if the inmate was knowledgeable on issues such a plaque, gingivitis, sugar's role in dental caries, the importance of flossing, and the most important dental health habits. The seven oral health knowledge questions included the following (Appendix A):

- Sugar contributes to tooth decay because?
- What is plaque?
- Does fluoride in toothpaste make any difference to the health of your teeth?
- What is gingivitis?
- What is the truth about flossing?
- If you want to enjoy a sugary treat, when is the most "tooth-friendly" time to eat it?
- What are the two most important dental health habits?

Oral health attitudes questions. I measured the oral health attitudes of inmates using a total of seven statements, each of which had four possible Likert-like responses.

The responses included: (a) *I agree completely*, (b) *I agree partially*, (c) *I disagree partially*, and (d) *I disagree completely*. The seven oral health attitudes statements were (Appendix A):

- I believe that only a dentist can prevent cavities.
- I believe that if my parents have bad teeth, brushing and flossing will not help my teeth.
- I believe that tooth loss is a normal part of growing old.
- I believe that I am responsible for preventing the loss of my teeth.
- I believe dentures are less trouble than taking care of my natural teeth.
- If my gums bleed when I floss this usually means that I am hurting my gums and I should stop flossing my teeth.
- I believe visiting the dentist is only necessary when I am experiencing pain.

The HBM and SCT were important in selecting these statements. The seven statements above show the level of self-efficacy an inmate feels they have over their oral health situations.

Oral health practices questions. I explored the oral health practices of inmates by asking seven questions; each question had five possible answers, but only one correct answer. With these questions, I sought to discover the inmate's oral health practices; that is, what they actually did about their oral health as opposed their knowledge of oral health. The seven oral health practices questions included the following (Appendix A):

- How often do you brush your teeth?

- How often do you clean between your teeth (by dental floss, tooth pick, or interdental brush)?
- How often do you visit a dentist?
- How long to you spend brushing your teeth?
- How often do you replace your toothbrush?
- How hard are the bristles on your toothbrush?
- What beverage do you regularly drink the most in an average week?

Rustvold (2012) stated that the lack of oral health knowledge contributes to poor oral hygiene and poor nutritional choices which, in turn, can compound poor oral health. Rustvold examined the issues of low oral health knowledge and dental anxiety in at-risk woman in chemical dependency treatment programs to determine the success of educational interventions. To address one of her research questions dealing with the effects of health literacy and oral health knowledge and attitudes toward oral health, Rustvold created the Rustvold Oral Health Knowledge Inventory (ROHKI) and the Oral Health Attitudes Questionnaire (OHAQ). The ROHKI was a 10-question multiple-choice questionnaire that surveyed the factors considered by the American Dental Association (ADA) Center for Evidence-Based Dentistry and the dental literature to be essential for oral health knowledge and basic oral self-care (ADA Center for Evidence-Based Dentistry, 2014; Rustvold, 2012). Rustvold developed the ROHKI because, as Gong, Lee, Rozier, Pahel, Richman, and Vann's (2007) research showed, there were no existing methods for assessing oral health literacy. Many questions used on the ROHKI are

similar to those found on oral health quizzes on dental health websites such as MedicineNet (2014) and Delta Dental (n.d.).

Oral health attitude questions in this study were measured with the OHAQ. The OHAQ was created by Rustvold (2012) incorporated questions pertaining to the HBM and theory of planned behavior (TPB) and were taken from the 28-item Dental Coping Beliefs Scale (DCBS) from Wolfe, Stewart, and Hartz (1991). This study will only incorporate seven questions to keep the entire survey from becoming lengthy and address issues important to inmates.

Dr. Rustvold granted me permission to use to use portions of her ROHKI and OHKI instruments (see Appendix B). The last three questions listed above on the OHAQ were not part of Dr. Rusvold's instrument and I added them to this study's instrument to address important inmate practices.

Data Collection Procedure

Jail inmates are a protected class of people; to uphold ethical treatment and to protect the rights of the inmates in this study, there were no identifiers on the survey. Completion of the survey by the participant served as implied consent. Data will not be collected for this study until all proper approvals are received from Walden University and the jail's Institutional Review Board (IRB). No research with human subjects is allowed in the jail without prior written approval by the jail's IRB. The jail IRB, per policy number 1.06.01, examines every proposed human research study and consists of, at least, the following members on the review board:

- The jail division commander or representative

- The health services medical director
- An inmate or family member of an inmate
- A representative of the institution or entity requesting/conducting the research
- Representatives; not affiliated with and not immediate family of a person affiliated with the jail

Procedures

Data was collected from inmates during their visit with the jail's dentist. All dental appointments will take place during normal business hours Monday through Friday. This study was explained to each inmate before their dental appointment and before the survey instrument (paper copy) is distributed. I will answer any question(s) an inmate has about the research. Upon completion of the survey, the dental hygienist will conduct the oral examination and generate the DMFT and periodontal scores. The charting of the oral examination was kept with the survey instrument. No signatures or names were kept with either the oral examination chart or the survey.

Data Analysis

Demographic and survey questionnaire data was entered into the Statistical Package for Social Sciences (SPSS) statistical database. Demographic data such as age, race, sex, and income level was described with descriptive statistics such as frequencies, standard deviations, and means. The knowledge section of the survey consists of seven multiple choice questions with four possible answers, but only one correct answer. The maximum score for the knowledge section was seven points. Therefore, the independent

variable “knowledge of basic dental and oral hygiene” was used as continuous variable with 0 to 7 summary score for each participant.

The oral health attitudes section of the survey consists of seven questions and four possible answers: a) *I agree completely*, b) *I agree partially*, c) *I disagree partially*, and d) *I disagree completely*. Each question has one ‘correct’ answer. Depending on the nature of the question, *I agree completely or I agree partially* would be considered a ‘correct’ for some questions while *I disagree partially or I disagree completely* would be considered a ‘correct’ answer for other questions. The maximum score for the oral health attitudes section is seven points. Therefore, the independent variable “oral health attitudes” was used as continuous variable with 0 to 7 summary score for each participant.

The oral health practices/behaviors section of the survey consisted of seven question about oral health practices. Each question had five choices, with only one choice being the best choice and therefore the ‘correct’ answer. The maximum score for this section of the survey is seven points. Therefore, the independent variable “oral health practices/behaviors” were used as continuous variable with 0 to 7 summary score for each participant.

As far as the dependent variables are concerned, the DMFT score (continuous variable) for an individual can range from 0 to 32, if all 32 teeth are to be counted. Because of the widespread removal of third molars in young adults in the United States and other developed countries, many researchers record a score for only 28 teeth (Burt & Eklund, 2005). For this study only 28 teeth were considered; the third molars will not be

counted. For multivariate analyses, inmates were classified into two groups: “high” DMFT scores and “low” DMFT (the cut-off point will represent the last quartile of the DMFT frequency distribution) for the purpose of assessing risk factors associated with the DMFT score,

In addition to the DMFT scores, periodontal scores will also be generated. The Community Periodontal Index (CPI) is recommended by the World Health Organization (WHO, 2005) and was used in this study to generate periodontal scores as follows:

- Score 0: healthy periodontal conditions
- Score 1: gingival bleedings
- Score 2: calculus and bleeding
- Score 3: shallow periodontal pockets (4 to 5 millimeters)
- Score 4: deep periodontal pockets (6 millimeters or more)

Therefore, the dependent variable of periodontal score was used as continuous variable, which is the mean number of sextants by score per inmate, indicating the severity of the periodontal problem. For multivariate analyses, inmates were classified into two groups: “high” periodontal scores of 3 or 4 and “low” periodontal scores between 0-2 for the purpose of assessing risk factors associated with the periodontal score.

In Table 1 all the variables and levels of measurement of the study are presented, and in Table 2, the statistical tests which were applied for the study per research question are also described in detail.

Table 1

Variables and Level of Measurement

Variable	Level of Measurement
Gender	Nominal
Age	Continuous→ nominal*
Race	Nominal
Time Incarcerated	Continuous→ nominal*
Educational Level	Nominal
Employment Status	Nominal
Annual Income	Continuous→ nominal*
Zip Code	Nominal
Dental Insurance Status	Nominal

Note. For some analyses, these continuous data may be recorded into nominal

Table 2

Statistical Procedures per Research Question and Hypothesis

Research Question	**Hypothesis (H_a)**	**Variables**	**Statistical procedures/analysis**
RQ1: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their knowledge of basic dental and oral hygiene?	Dental caries and periodontal diseases scores of inmates show no relationship with the number of correct responses to knowledge questionnaires on oral health.	IV: knowledge of basic dental and oral hygiene. DV: DMFT and CPI scores. Mediating Variables (MV): inmates' demographics	Bivariate: if IV and DV are normally distributed: Pearson's r. If not normally distributed: Spearman's rho. Multivariate: binary logistic regression using as DV: high/low levels of DMFT and CPI scores and as predictors: DV and MVs.
RQ2: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health practices?	H_a: Dental caries and periodontal diseases scores of inmates show no relationship with the number of correct responses to oral health practices questionnaire.	IV: oral health and hygiene practices. DV: DMFT and CPI scores. MV: inmates' demographics	Bivariate: if IV and DV are normally distributed: Pearson's r. If not normally distributed: Spearman's rho. Multivariate: binary logistic regression using as DV: high/low levels of DMFT and CPI scores and as predictors: DV and MVs.
RQ3: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health attitudes?	H_a. Dental caries and periodontal diseases scores of inmates show no relationship with the number of correct responses to attitudes questionnaires on oral health	IV: oral health attitudes. DV: DMFT and CPI scores. MV: inmates' demographics	Bivariate: if IV and DV are normally distributed: Pearson's r. If not normally distributed: Spearman's rho. Multivariate: binary logistic regression using as DV: high/low levels of DMFT and CPI scores and as predictors: DV and MVs.

Threats to Validity

Trochim and Donnelly (2007) stated: "validity can be defined as the best available approximation to the truth of a given proposition, inference, or conclusion" (p. 20). Validity is commonly defined in four different ways: a) conclusion (or statistical conclusion) validity, b) internal validity, c) construct validity, and d) external validity (Trochim & Donnelly, 2007). Conclusion/statistical conclusion validity infers that two variables are related and the strength of that relationship can be known (University of South Alabama, n.d.). Construct validity makes inferences about the higher order constructs being investigated from the particular characteristics of a study (University of South Alabama, n.d.). Internal validity is the approximate truth about inferences about cause-effect or causal relationships (Trochim & Donnelly, 2007). External validity, assuming there is a causal relationship, is concerned with the generalizability of the investigated variables to different people, settings, times, treatment variables, and measurement variables (Trochim & Donnelly, 2007). These validity subcategories address specific methodological questions and are only operative when studying causal questions (Trochim & Donnelly, 2007).

Content/Construct/Face Validity

Content, construct, and face validity address the issue of how valid is the survey instrument that is being used in a study. DiClemente et al. (2013) state the most elementary validity techniques are face validity and content validity where a jury or panel of experts with the proper expertise determine if a scale measures the construct. Construct

validity deals with theoretical constructs and refers to the ability of some measure to perform in the way it is hypothesized to perform (DiClemente et al., 2013).

Studies that have examined the oral health knowledge, attitudes, and practices (behaviors) of groups such as students (Al-Omiri, Board, Al-Wahadni, & Saeed, 2006; Komabayashi et al., 2005; Lian, Phing, Chat, Shin, Baharuddin, & Che'Jalil, 2010; Neamatollahi, Ebrahimi, Talebi, Ardabili, & Kondore, 2011; Ogundele & Ogunsile, 2008; Sharda & Shetty, 2008), various adult subgroups (Ogawa et al., 2003; Osborn et al., 2003; Petersen, Aleksejuniene, Christensen, Eriksen, & Kalo, 2000; Rustvold, 2012; Sabbahi, Lawrence, Limeback, & Rootman, 2009; Zhu et al., 2005), and military personnel (Levin & Shenkman, 2004) have used survey questionnaires. The questionnaire instruments used have been validated through either pilot studies, a questionnaire that has been validated in previous studies (such as Peterson, 2000), and face validity (such as Rustvold, 2012).

A shorted version of Rustvold's ROHKI and OHAQ was used in this study. These questionnaire instruments were developed by the author to measure the oral health knowledge, attitudes, and behaviors of educational interventions with at-risk females. Rustvold (2012) stated her experience of working with the Oregon Women's Correctional Center around 2001 gave her extensive knowledge of the educational programs needed for inmates and was an important factor in developing her survey questionnaires. Rustvold (2012) also stated her ROHKI instrument was based on dental literature from the ADA Center for Evidence-Based Dentistry and the OHAQ instrument was taken from the Wolfe et al. (1991) 28-item Dental Coping Beliefs scale.

Statistical Validity

Statistical validity was established with the selection of the appropriate statistical tests that are listed in Table 2.

Internal Validity

It is critical that a study have internal validity and measure what it set out to measure. Common threats to internal validity in descriptive studies such as this cross-sectional study include: a) cause-effect, b) selection bias, and c) measurement error. In this study random sampling will not be implemented and the sample was only from the inmates who are scheduled to visit the jail's dentist. The inmates who visit the dentist typically have a dental issue but include men and women, all races, and a wide range of age groups.

Internal validity was to be established as much as possible by having an adequate sample of approximately 100 inmates. Accurate measures were made by the jail's single dentist on all inmates that participate in this study. Specific conclusions will not be drawn from the results obtained since this study is cross-sectional.

External Validity

External validity answers the question of how generalizable are the results of a study. This cross-sectional convenience sample of jail inmates will not be generalizable to the general population in the U.S., but the results of this study could be generalized to subpopulations of incarcerated populations in prisons and jails.

Protection of Inmate's Rights

It is paramount that human research studies not injure, physically or psychologically, the people being studied (Babbie, 2011). Creswell (2009) states researchers need to respect study participants and the sites for research, not put participants at risk, and respect vulnerable populations. Lott (2005) stresses that vulnerable population, such as children, the mentally ill, and prisoners are attractive to researchers precisely because of their vulnerability and it is paramount that these populations not be injured in any manner, even if they volunteer for a study.

Prisoners are intentionally made vulnerable, having lost their liberty due to some unlawful act (or sometimes only accused of an unlawful act). Once incarcerated, prisoners can be subjected to coercive conditions that may impose constraints on the degree of free decision making available to them (Lott, 2005). Prisoners and inmates actions are controlled by those administering or those employed in a correctional institution. Incarcerated people rely on guards and others in a correctional system for food, shelter, clothing, and other basic necessities (Lott, 2005).

Many times coercion is not necessary since prisoners may have no choices at all. History has recorded many atrocities committed against prisoners in the name of research. Proctor (as cited in Lott, 2005) reported on Nazi experiments where prisoners were forced to drink sea water and breathe dirty air for prolonged periods of time to determine the physiological effects of these actions on the human body. One infamous episode where prisoners were used in research took place during the Second World War in the U.S. Rothman (as cited in Arboleda-Flórez, 2005) reported that in the state of

Illinois, hundreds of prisoners were used in research to find effective methods for preventing and treating malaria. Adams and Cowan (as cited in Arboleda-Flórez, 2005) stated by the end of the 1960s, approximately 90% of phase 1 research in new drugs was conducted in prisoners.

Before this study could begin at the jail, IRB approvals were received from Walden University (#04-03-15-0045543) and the jail (#02-15-2015). No identifying information such as names or booking numbers were used during the collection of data for this study. Participation was voluntary and no compensation or major jail reward such as good time or early release was offered; however, each participant did receive an anti-shank thumb-grip tooth brush and a tube of toothpaste. Each inmate with a dental appointment was given the option to participate in the study. Inmates were given an information sheet that described the study, the name of the researcher, and the name of the university. An informed consent form and the survey was given to the inmate and completed before the beginning of the dental examination. Care was taken to pair an inmate's dental examination information with the survey information.

While the oral health knowledge, attitudes, and practices 21-question survey form asked personal questions regarding dental habits, none of these questions were designed to be of a sensitive nature likely to upset an inmate. An inmate will always have the option to not participate or to end participation anytime they are completing the survey. For data security, the data was maintained in a password-protected file on a password-protected computer. Only myself had access to data. All data was stored as described

above and will be destroyed upon completion of the study and statistical analyses, not more than five years after the data was collected.

Critique of Methods

The possible relationships between the oral health status of inmates incarcerated in a large metropolitan jail and their oral health knowledge, attitudes, and practices was examined in this study. The oral health status of inmates was determined by obtaining their DMFT and CPI scores. Based on these scores, inmates were classified into two groups: 'high' DMFT and 'low' DMFT and 'high' periodontal scores and 'low' periodontal scores. Logistic regression was used to determine factors associated with these 'high' and 'low' DMFT and CPI scores, as it was described in detail in Chapter 3.

This study was unique because it will go beyond determining only the prevalence of the oral health status of inmates, mostly dental caries and seldom periodontal status, and comparing the results to the general population as most U.S. studies of this nature have done (Cunningham et al., 1985; Salive et al., 1989; Mixson et al., 1990). Studies of oral knowledge, attitudes, and practices in oral health have been conducted on general population adults, students, and military personnel, but not conducted on incarcerated populations.

Studies of the Oral Health Status of Incarcerated Populations

Studies in the U.S. Studies of the oral health status of incarceration population in the U.S. were conducted in prisons, not jails, and were cross-sectional prevalence studies that determined the DMFT scores of inmates, comparing them to the general population. In each study the incarcerated population demonstrated poorer oral health than the

general population. The prison populations had a higher number of decayed and missing teeth and fewer filled teeth than the general population.

Cunningham et al. (1985) compared the DMFT Index scores of 99 male inmates (out of a possible 140 inmates) with those of 101 nonprison males that were randomly selected from the Survey of Oral Health. The prison population was a nonrandom, self-selected sample from one medium-security prison in Iowa. Only the inmates who expressed an interest in the study were selected. Information such as educational levels, income, past dental utilization, or behavioral factors known to be associated with dental disease prevalence was not collected. The statistics generated were only mean DMFT scores for the prison and nonprison populations in Iowa. This was appropriate since the research question for Cunningham et al. (1985) was to compare a prison population to a nonprison population in the same state.

The Salive et al. (1989) study was a similar study to Cunningham et al. (1985) study and was also conducted on male prisoners in a 1,800 bed, male, medium-security, long-term correctional facility. Dental examinations were conducted on 178 prisoners; each prisoner was examined by the same dentist. The Salive et al. (1989) study did not collect information on educational levels, income, and past dental utilization and behaviors. Salive et al. (1089) did track the ages and races of the prisoners in addition to their DMFT Index scores. Salive et al. (1989) did conduct more sophisticated statistical analysis consisting of chi-square and two-sample *t*-tests. Mantil-Haenzel odds ratios were determined, along with linear and multiple linear regression.

The study by Mixson et al. (1990) incorporated many of the same features of Cunningham et al. (1985) and Salive et al. (1989) but was a slightly more sophisticated study. The purpose of the Mixson et al. (1990) was to obtain the DMFT Index scores of prisoners incarcerated in the U.S. Penitentiary at Leavenworth, Kansas (a federal correctional facility that housed up to 1,200 maximum security inmates) and assess age, race, number of years incarcerated, and number of visits to the prison dentist on this parameter of oral health. A random list of 299 prisoners was generated, with 191 prisoners agreeing to participate (16.3% of the then current population of 1,161). To determine if there were statistically significant differences between prisoners' age and racial group, the Student's *t*-test and Pearson chi-square analyses were used. Mixson et al. (1990) also used chi-square analyses to identify association among number of years incarcerated, utilization rate, and number of decayed teeth.

The early studies by Cunningham et al. (1985), Salive et al. (1989), and Mixson et al. (1990) were little more only prevalence studies that were the first looks at how the oral health status of incarcerated populations compared with the oral health status of the general population. No insight as to why this was so was examined in the U.S. Even U.S. studies conducted in the 2000s that examined the issue of dental caries and tooth loss in prisons did not examine oral health knowledge, attitudes, or practices. Boyer et al. (2002) compared dental caries and tooth loss in different groups of prisoners such as male/female, younger/older, and different racial groups. It took researchers outside of the U.S. to start examining predictors of why inmates suffered from poorer oral health than the general population.

Studies outside the United States. Studies of the oral health of incarcerated populations outside of the U.S. were conducted after the year 2000 and built on the studies of Cunningham et al. (1985), Salive et al. (1989), and Mixson et al. (1990). These foreign studies, conducted in countries such as Australia, China (Hong Kong), Great Britain, Italy, and France, were generally smaller in size than their U.S. counterparts and examined more than just DMFT prevalence scores; some of these studies added CPI scores as part of their study. The researchers outside of the U.S. used questionnaires to surveyed prisoners and inmates about the impact of oral health on their quality of life, their self-perception of oral treatment needs, and oral health practices concerning their dental utilization and how often they brush their teeth. The statistical analyses used in some of the later foreign studies included logistical regression to determine possible relationships between the oral health status of inmates and factors such as duration of incarceration and prisoner age, similar to the data analysis plan suggested in my study.

More specifically, McGrath (2002) studied the prevalence of oral disease and its impact on the quality of 64 inmates, aged 60 years and older, at a Hong Kong detention facility. In this study the researcher conducted clinical oral examinations to determine DMFT and CPI scores and used a 14-item questionnaire, the Oral Health Impact Profile (OHIP-14) to assess the impact of oral health status on the quality of life (McGrath, 2002). McGrath (2002) used both DMFT and CPI scores to determine oral health status. OHIP-14 responses were put into a frequency distribution and a summary binary variable of the OHIP-14 was produced. The responses were then put into two groups: ‘reported at least one problem’ and ‘did not report any problem’ to an oral issue within the past year

(McGrath, 2002). Because of the small sample size of only 64 inmates, bivariate analysis was used but a multifactorial analysis was not done. McGrath (2002) reported the prevalence or oral disease to be high in this group of elderly inmates and this had a substantial impact on their life quality.

An example where logistic regression was used to determine factors associated with 'low' and 'high' DMFT scores was the Osborn et al. (2003) study of the oral health status of prison inmates in New South Wales, Australia. This cross-sectional study was a stratified random sample of 789 prisoners (657 males and 132 females) from 27 correctional facilities, all located in New South Wales (Osborn et al., 2003). A subset of 334 inmates (312 males and 22 females) between the ages of 18-77 years were given oral examinations to collect DMFT Index scores in addition to health surveys that included oral health behavior questions (Osborn et al., 2003). The subset of 334 inmates that received oral examinations where divided into two groups: 'high DMFT (>10) and 'low' DMFT (≤10). Logistic regression analyses was conducted for factors associated with a 'high' DMFT score (sex, age, aboriginal, drug injector). Logistic regression was the appropriate analyses to run in this case since Osborn et al. (2003) are predicting categorical outcomes ('low' and 'high' DMFT scores) from both continuous and categorical predictors.

Logistical regression was used in a recent study of the oral health in three jails in France (Decerle et al., 2012). This observational study was small, consisting of 84 male prisoners that were divided into two subgroups: a) prisoners incarcerated for ≤ 2 years (31 males) and b) prisoners incarcerated >2years (53 males). The pool of prisoners were

drawn from all male prisoners that presented at the infirmary and prisoners scheduled for a dental consultation during the two months this study was conducted in addition to all new male prisoners (Decerle et al., 2012). Dental caries was measured with the DMFT index and the French validated version of the 12-item Global Oral Health Assessment Index (GOHAI) recorded a prisoner's assessment of their overall health and other specific indicators such as limiting the kinds of food, problems speaking, and worry about teeth, gums, or dentures (Decerle et al., 2012; Tubert-Jeannin, Riordan, Morel-Papernot, Porcheray, & Savy-Collet, 2003). Logistic regression analyses was used on the GOHAI (reported to have been dichotomized to below and above 50), with predictors being duration of incarceration, prisoner age, and number of functional teeth (Decerle et al., 2012). Decerle et al. (2012) reported that "logistic regression applied to the GOHAI did not show any significant factor" (p. 276).

Studies on Oral Health Knowledge, Attitudes, and Practices/Behaviors

Studies on the oral health knowledge, attitudes, and practices/behaviors in oral health have been conducted on populations as diverse as communities in Myanmar (Ogawa et al., 2003), Israeli army recruits (Levin & Shenkman, 2004), adults in China (Zhu et al., 2005), and adolescents students in Nigeria (Ogundele & Ogunsile, 2008). The size of these four studies ranged in size from 123 young Israeli army recruits (Levin & Shenkman, 2004) to 8,797 adults in China grouped into 35-44 and 65-74 years of age (Zhu et al., 2005). All four of these studies had similar designs; DMFT Index scores were collected through clinical examinations and study participants answered survey questionnaires to determine their oral health knowledge, attitudes, and

practices/behaviors. In each study, dental caries prevalence was explored among a particular population of people to investigate what, if any, relationships existed between oral clinical indices and knowledge, attitudes, and practices/behaviors on oral health.

With the exception of Levin and Shenkman (2004), the researchers used oral health knowledge, attitude, and practices/behaviors questionnaires that were developed for their particular study. Levin and Shenkman (2004) used the Hiroshima University-Dental Behavioral Inventory (HU-DBI), developed my Kawamura. The HU-DBI is a 20-iten questionnaire with only agree/disagree responses (Levin & Shenkman, 2004). Levin and Shenkman (2004) reported they used a Hebrew version of this questionnaire that was translated from English and found to be valid in a previous study. Ogawa et al. (2003) developed a questionnaire that consisted of eight questions that dealt with the prevention of dental caries and periodontal disease, eight questions intended to determine attitudes towards oral health, and eight questions regarding oral health practices. All questions had only one correct response (Ogawa et al., 2003). Ogundele and Ogunsile (2008) and Zhu et al. (2005) had more extensive questionnaires that had multiple sections in multiple formats such as yes/no and Likert scale responses.

All four of the research teams used simple frequency tables and descriptive statistics such as means and standard deviations in addition to chi-square tests and bivariate and multivariate regression analyses (Levin & Shenkman, 2004; Ogawa et al., 2003; Ogundele & Ogunsile, 2008; Zhu et al., 2005). Levin and Shenkman (2004) nonparametric Mann-Whitney test to relate the different DMFT Index values with the HU-DBI responses. Although these four studies were conducted in different cultures with

different age groups represented, all of these researchers found that various aspects of poor oral health knowledge, attitudes, and practices were correlated with a higher level of dental disease (Levin & Shenkman, 2004; Ogawa et al., 2003; Ogundele & Ogunsile, 2008; Zhu et al., 2005).

Summary

In this study the potential relationship between the oral health status of jail inmates and inmate's oral health knowledge, attitudes, and practices were investigated. In Chapter 3, the manner of exploring oral health knowledge, attitudes, and practices of inmates was explored along with the explanations for the quantitative cross-sectional research design and convenience sampling methods. In this chapter, the survey questionnaire was described as was the methods used for collecting and analyzing the data that was collected.

Since studies of oral health in incarcerated populations are scarce, particularly in jail settings, a cross-sectional design was used that will capture the prevalence of the oral health of inmates (DMFT and CPI Indexes) and will identify possible associations than can be studied in the future. A convenience sample of approximately 100 inmates who were scheduled to visit the jail's dentist was employed because random sampling was not possible due to security reasons and the fast turnover of the jail population.

The research questions that were addressed in this study were clearly stated as were the null and alternative hypotheses. The independent variables (oral health knowledge, attitudes, and practices), dependent variables (DMFT and CPI Indexes), and mediating variables (age, gender, race, etc.) were identified. In Chapter 3, the methods of

collecting DMFT and CPI Indexes were explained. The survey instrument questions asked on oral health knowledge, attitudes, and practices were listed. Also discussed was the method of how this survey was administered and how inmate confidentiality was assured.

In this chapter, the statistical procedures per research question and hypothesis were addressed along with listing threats to internal, external, and construct validity issues. In chapter 3 is also a section that details how the ethical considerations of inmates that will participate in this study was managed. The focus of Chapter 4 is the findings of this study.

Chapter 4: Results

Introduction

I conducted this study to determine the potential relationships between an inmate's oral health knowledge, attitudes, and practices with their DMFT and CPI scores. The three research questions were inferential questions:

RQ1: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their knowledge of basic dental and oral hygiene?

$H_0$1: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to knowledge questionnaires of oral health.

$H_1$1: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to knowledge questionnaire of oral health.

RQ2: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health attitudes?

$H_0$2: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health attitudes questionnaire of oral health.

$H_1$2: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to oral health attitudes questionnaire of oral health.

RQ3: Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their oral health practices?

$H_0$3: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health practices questionnaire of oral health.

$H_1$3: Dental caries and periodontal diseases scores of inmates who visit the jail's dentist show a statistically significant correlation to the number of correct responses to oral health practices questionnaire of oral health.

In this chapter, I discuss the results of the study and offer a description of the data collection methods that I used.

The instrument that I developed and used for data collection was a closed-ended questionnaire and dental examination that included assessing an inmate's DMFT score and CPI score. The Raosoft (2004) sample size calculator recommended a sample size of 88 for a margin of error at 10%, a confidence level of 95%, and a population size 1000. The correctional facility used in this study had an 896-bed capacity. During this study, the inmate population varied from 700 to 800; with a sample size of 100, the margin of error ranged between 9.08% and 9.17%, indicating an adequate sample size. All 100 inmate dental examinations were conducted by the jail's one dentist, and the data was recorded by the jail's one dental assistant. Inmates that had scheduled appointments with the jail's dentist were given the opportunity to participate in this study, as were inmates who had written "kites" about a medical or dental condition. A kite is a term used in the correctional setting to indicate when an inmate is either making a request for something,

or is filing a grievance about a condition. Inmates that had appointments or had filed a medical or dental kite were seen by the jail's dentist and given an opportunity to participate in this study until 100 inmates had participated. Few inmates refused to participate.

Data Collection

The study site was one of three jails in this metropolitan correctional system. This jail had the ability to accommodate a large number of inmates requesting dental services. The inmates that participated in this study were all male. I had originally planned for female inmates to be included in this study as well, but before this study began, female inmates were relocated to another jail.

After obtaining approval from both the jail's IRB (#02-15-2015) and Walden University's IRB (#04-03-15-0045543), I instructed the jail dentist to ask inmates who requested dental services if they would participate in a study investigating possible relationships between their oral health (DMFT and CPI scores) and their oral health knowledge, oral health attitudes, and oral health practices. Before an inmate could participate, they were given a consent form to read and sign. If an inmate had questions about the study, their questions were answered by the jail's dentist, and they were given the option of asking me their questions directly. None of the inmates sought this option.

The data collection process, including recruitment, administration of questionnaire, and dental examinations, was conducted over a 6 month time period, from May 18, 2015-October 14, 2015, instead of the 3 months originally planned. This delay was due to fact that inmates asked to be provided an anti-shank toothbrush and a medium

tube of brand name toothpaste in exchange for their participation. It took two months to obtain the necessary permission and to find a party to donate the toothpaste, as required by jail policy. I was not allowed to finance the donation of toothpaste or anti-shank toothbrushes. Once these dental supplies were provided, the data collection process went smoothly.

Demographic and Descriptive Statistics of the Sample

The demographic characteristics of the inmate participants are presented in Table 3. All inmates in this study were male. The racial makeup of the 100 inmates was 49 African American (49%), 39 White (39%), 5 Latino (5%), 3 biracial (other than African American/White; 3%), 2 Native American/Alaska Native (2%), and 2 biracial (African American/White; 2%). There were 20 inmate participants between 18-25 years old (20%), 28 were between 26-35 years old (28%), 30 were between 36-45 years old (30%), and 22 were 46 years old or older (22%).

Out of 100 inmates, 39 (39%) listed lifetime incarceration to be less than one year. Twenty-nine (29%) stated that their lifetime incarceration was greater than 5 years, 14 (14%) listed their lifetime incarceration at between 1-2 years, and 18 (18%) listed their lifetime incarceration to be between 3-5 years. For educational level, the largest percentage of inmates (34%) listed themselves as high school graduates. Inmates with some high school (9^{th} grade up to 12^{th} grade without graduating) accounted for 31%, and inmates with some college accounted for 28%. Five percent of the inmates listed that they possessed a Bachelor's degree or above, and 2% listed only a junior high education.

At the time they were incarcerated, 52% of inmates reported being employed, and 50% reported having an income of less than $10,000. Nineteen percent (19%) reported an income of from $10,000-$19, 999, 11% reported an income from $20,000-$29,999, 8% reported an income from $30,000-$39,999, and 3% reporting an income from $40,000-$49,999. Income levels of $50,000 or greater were reported by 8% of inmates. Before being incarcerated, 56% of inmates reported having dental insurance. Out of 100 inmates, 38% reported drug use and 39% reported no drug use. The question of past drug use was left unanswered on the questionnaires of 23 inmates.

Table 3

Descriptive Statistics of the Participants of the Study

What is your race/ethnicity?	N	%
Black/African American	49	49
White	39	39
American Indian/Alaska Native	2	2
Latino	5	5
Asian	-	-
Biracial (Black/White)	*2*	*2*
Biracial (Other Than Black/White)	3	3

(*Table continues*)

What is your age group?	N	%
18-25	20	20
26-35	28	28
36-45	30	30
45+	22	22
In your entire life, how long have you been incarcerated?	N	%
Less than 1 year	39	39
1-2 years	14	14
3-5 years	18	18
Greater than 5 years	29	29
Where you employed at the time of your incarceration in the jail?	N	%
Yes	52	52
No	46	46
Missing responses	2	2

(*Table continues*)

Your annual income this past year	N	%
Less than $10,000	50	50
$10,000 to $19,999	19	19
$20,000 to $29,999	11	11
$30,000 to $39.999	8	8
$40,000 to $49,999	3	3
$50,000 or more	8	8
Missing responses	1	1
Do you have a history of drug use?	*N*	*%*
Yes	38	38
No	39	39
Missing responses	23	23
Did you have dental insurance before you were incarcerated?	N	%
Yes	56	56
No	44	44

Differences of DMFT and CPI indices in inmates by demographic parameters are presented in Table 4. African American inmates had a mean DMFT of 7.84 (SD 5.83) and a CPI mean number of sextants of 1.79 (SD 0.73). White inmates had a mean DMFT of 10.51 (SD 6.72) and a CPI mean number of sextants of 1.34 (SD 0.76). Native American inmates had a mean DMFT of 13.50 (SD 14.85) and a CPI mean number of sextants of 1.33 (SD 1.41), and Latino inmates had a mean DMFT of 6.40 (SD 4.62) and a CPI mean number of sextants of 1.37 (SD 0.84). Inmates that identified as biracial African American/White had a mean DMFT of 9.50 (SD 7.78) and a CPI mean number

of sextants of 2.25 (SD 0.35), and inmates that identified as biracial African American/Other had a mean DMFT of 16.00 (SD 10.58) and a CPI mean number of sextants of 1.34 (SD 0.94).

Inmates in the 18-25 year age group had a mean DMFT of 6.25 (SD 4.00) and a CPI mean number of sextants of 1.40 (SD 0.73), 26-35 year olds had a mean DMFT of 8.14 (SD 6.18) and a CPI mean number of sextants of 1.54 (SD 0.66), 36-45 year olds had a mean DMFT of 8.37 (SD 5.72) and a CPI mean number of sextants of 1.73 (SD 0.91), and the 46+ age group had a mean DMFT of 14.36 (SD 7.61) and a CPI mean number of sextants of 1.61 (SD 0.77).

Inmates with less than 1 year of incarceration in their life had a mean DMFT of 8.49 (SD 7.05) and a CPI mean number of sextants of 1.53 (SD 0.78), inmates incarcerated between 1-2 years had a mean DMFT of 8.07 (SD 6.02) and a CPI mean number of sextants of 1.41 (SD 0.60), inmates incarcerated between 3-5 years had a mean DMFT of 7.06 (SD 7.06) and a CPI mean number of sextants of 1.88 (SD 0.77), and inmates incarcerated greater than 5 years in their life had a mean DMFT of 12.03 (SD 6.60) and a CPI mean number of sextants of 1.53 (SD 0.83).

Inmates with a junior high education (7^{th} & 8^{th} grades) had a mean DMFT of 6.50 (SD 2.12) and a CPI mean number of sextants of 2.06 (SD 0.08), those with some high school (from 9^{th} grade up to 12^{th} grade) had a mean DMFT of 10.52 (SD 7.08) and a CPI mean number of sextants of 1.73 (SD 1.81), high school graduates had a mean DMFT of 8.53 (SD 6.30) and a CPI mean number of sextants of 1.56 (SD 0.77), inmates with some college had a mean DMFT of 9.14 (SD 6.86) and a CPI mean number of sextants of 1.37

(SD 0.78), and inmates with a Bachelor's degree or above had a mean DMFT of 7.00 (SD 5.34) and a CPI mean number of sextants of 1.87 (SD 0.56).

Inmates with incomes less than $10,000/yr. had a mean DMFT of 9.32 (SD 7.32) and a CPI mean number of sextants of 1.50 (SD 0.79), incomes listed as between $10,000-$19,999/yr. had mean DMFT of 8.42 (SD 6.05) and CPI mean number of sextants of 1.88 (SD 0.49), incomes between $20,000-$29,999/yr. had mean DMFT of 8.73 (SD 5.90) and CPI mean number of sextants of 1.68 (SD 0.61), incomes between $30,000-$39,999 had a mean DMFT of 10.13 (SD 6.31) and a CPI mean number of sextants of 1.64 (SD 0.51), incomes of $40,000-$49,999 had a mean DMFT of 8.67 (SD 8.33) and a CPI mean number of sextants of 1.61 (SD 0.79), and incomes of $50,000 or more had a mean DMFT of 10.75 (SD 5.42) and a CPI mean number of sextants of 1.22 (SD 0.95).

Inmates who were employed at the time of their incarceration had a mean DMFT of 8.37 (SD 5.76) and a CPI mean number of sextants of 1.60 (SD 5.76) and inmates that were not employed at the time of their incarceration had a DMFT of 9.33 (SD 6.46) and a CPI mean number of sextants of 1.57 (SD 0.83). Inmates that had dental insurance before they were incarcerated had a mean DMFT of 8.02 (SD 6.46) and a CPI mean number of sextants of 1.52 (SD 0.85) while inmates who did not have dental insurance before being incarcerated had a mean DMFT of 10.60 (SD 5.78) and a CPI mean number of sextants of 1.67 (SD 0.67). Inmates who identified as drug users had a mean DMFT of 9.37 (SD 7.11) and a CPI mean number of sextants of 1.54 (SD 0.76). Inmates who identifies as

non-drug users had a mean DMFT of 8.28 (SD 6.14) and a CPI mean number of sextants of 1.63 (SD 0.68).

Table 4

Differences of DMFT and CPI Indices in Inmates by Demographic Parameters. Mean Scores and Standard Deviations in Parenthesis.

Demographic factor	N	DMFT	N	CPI
Race				
African American	49	7.84 (SD 5.83)	48	1.79 (SD 0.73)
White	39	10.51 (SD 6.73)	38	1.34 (SD 0.76)
Native American	2	13.50 (SD 14.85)	2	1.33 (SD 1.41)
Latino	5	6.40 (SD 4.62)	5	1.37 (SD 0.84)
Biracial (African American/White)	2	9.50 (SD 7.78)	2	2.25 (SD 0.35)
Biracial (African American/Other)	3	16.0 (SD 10.58)	2	1.34 (SD 0.94)
Age Group				
18-25	20	6.25 (SD 4.00)	20	1.40 (SD 0.73)
26-35	28	8.14 (SD 6.18)	28	1.54 (SD 0.66)
36-45	30	8.37 (SD 5.72)	30	1.73 (SD 0.91)
46+	22	14.36 (SD 7.61)	19	1.61 (SD 0.77)
Years Incarcerated				
< 1 year	39	8.49 (SD 7.05)	37	1.53 (SD 0.78)
1-2 *years*	14	8.07 (SD 6.02)	14	1.41 (SD 0.60)
3-5 years	18	7.06 (SD 7.06)	18	1.88 (SD 0.77)
> 5 years	29	12.03 (SD 6.60)	28	1.53 (SD 0.83)
Education Level				
Jr. High (7th & 8th Grades)	2	6.50 (SD 2.12)	2	2.06 (SD 0.08)
Some High School	31	10.52 (SD 7.08)	29	1.73 (SD 0.81)
High School Graduate	34	8.53 (SD 6.30)	33	1.56 (SD 0.77)
Some College	28	9.14 (SD 6.86)	28	1.37 (SD 0.78)
Bachelor's Degree & Above	5	7.00 (SD 5.34)	5	1.87 (SD 0.56)

(*Table continues*)

Demographic factor	N	DMFT	N	CPI
Income Level				
< $10,000/yr.	50	9.32 (SD 7.32)	47	1.50 (SD 0.79)
$10,000- $19,000/yr.	19	8.42 (SD 6.05)	19	1.88 (SD 0.49)
$20,000-$29,000/yr.	11	8.73 (SD 5.90)	11	1.68 (SD 0.61)
$30,000-$39,000/yr.	8	10.13 (SD 6.31)	8	1.64 (SD 0.51)
$40,000-$49,000/yr.	3	8.67 (SD 8.33)	3	1.61 (SD 0.79)
$50,000 or more/yr.	8	10.75 (SD 5.42)	8	1.22 (SD 0.95)
Employed at the Time of Incarceration				
Yes	52	8.37 (SD 5.76)	52	1.60 (SD 0.74)
No	46	9.33 (SD 6.46)	45	1.57 (SD 0.83)
Dental Insurance Before Incarcerated				
Yes	56	8.02 (SD 6.46)	54	1.52 (SD 0.85)
No	44	10.70 (SD 6.54)	43	1.67 (SD 0.67)
Drug Use				
Yes	38	9.37 (SD 7.11)	36	1.54 (SD 0.76)
No	39	8.28 (SD 6.14)	38	1.63 (SD 0.68)

Table 5 presents the differences of DMFT and CPI indices in inmates by their basic knowledge of oral health. Seven basic oral health questions where presented to inmates with four possible answers. Only one answer was correct. For the question *Sugar contributes to tooth decay because?,* 39 inmates answered this question correctly and 56 gave incorrect answers for DMFT and 37 correct and 55 incorrect for CPI. Inmates who gave the correct answer had a DMFT score of 10.51 (SD 6.80) and a CPI mean number of sextants of 1.54 (0.73). Inmates who gave the incorrect answer had a DMFT score of 8.70 (SD 6.44) and a CPI mean number of sextants of 1.64 (SD 0.80).

The question *What is plaque?* was answered correctly by 77 inmates and answered incorrectly by 18 inmates for DMFT and 74 correct and 18 correct for CPI.

Inmates who answered correctly had a DMFT score of 9.64 (SD 6.84) and a CPI mean number of sextants of 1.58 (SD 0.73). Inmates who answered this question correctly had a DMFT score of 9.64 (SD 6.84) and a CPI mean number of sextants of 1.58 (SD 0.73). Inmates who answered incorrectly had a DMFT score of 8.61 (SD 5.64) and a CPI mean number of sextants of 1.68 (SD 0.94).

The question *What is gingivitis?* was answered correctly by 81 inmates and answered incorrectly by 14 inmates for DMFT and 78 correct and 14 incorrect for CPI. Inmates who answered this question correctly had a DMFT score of 9.77 (SD 6.84) and a CPI mean number of sextants of 1.56 (SD 0.81). Inmates who answered incorrectly had a DMFT of 7.57 (SD 4.91) and a CPI mean number of sextants of 1.84 (SD 0.47).

The question *Does fluoride toothpaste make any difference to the health of your teeth?* was answered correctly by 79 inmates and answered incorrectly by 16 for DMFT and 78 correct and 14 incorrect for CPI. Inmates who answered correctly had a DMFT score of 9.04 (SD 6.35) and a CPI mean number of sextants of 1.56 (SD 0.77). Inmates who answered incorrectly had a DMFT score of 11.44 (SD 7.72) and a CPI mean number of sextants of 1.84 (SD 0.74)

The question *What is the truth about flossing?* was answered correctly by 69 inmates and incorrectly by 26 for the DMFT and 67 correct and 25 incorrect for the CPI. The inmates who answered correctly had a DMFT of 9.51 (SD 6.24) and a CPI mean number of sextants of 1.52 (SD 0.74). Inmates who answered incorrectly had a DMFT score of 9.27 (SD (7.66) and a CPI mean number of sextants of 1.80 (SD 0.83).

The question *If you want to enjoy a sugary treat, when is the most "tooth-friendly" time to eat it?* was answered correctly by 20 inmates and answered incorrectly by 75 for DMFT and 20 correct and 72 incorrect for CPI. The inmates who answered correctly had a DMFT of 9.15 (SD 6.87) and a CPI mean number of sextants of 1.17 (SD 0.81). Inmates who answered incorrectly had a DMFT of 9.52 (SD 6.59) and a CPI mean number of sextants of 1.72 (SD 0.72).

The question *What are the two most important dental health habits?* was answered correctly by 45 inmates and incorrectly by 50 inmates for DMFT and correctly by 43 and incorrectly by 49 for CPI. Inmates who answered correctly had a DMFT of 9.53 (SD 6.90) and a CPI mean number of sextants of 1.56 (SD 0.78). Inmates who answered incorrectly had a DMFT of 9.36 (SD 6.41) and a CPI mean number of sextants of 1.64 (SD 0.77).

The distribution for the total numbers of questions answered correctly by inmates on the oral health knowledge portion of the study questionnaire is shown is Graph 1. Out of seven questions, the mean number of correct answers was 4.17 (SD 1.72). The largest group of inmates answered five questions correctly. Five inmates did not get any questions correct and six inmates got all seven oral health knowledge questions correct.

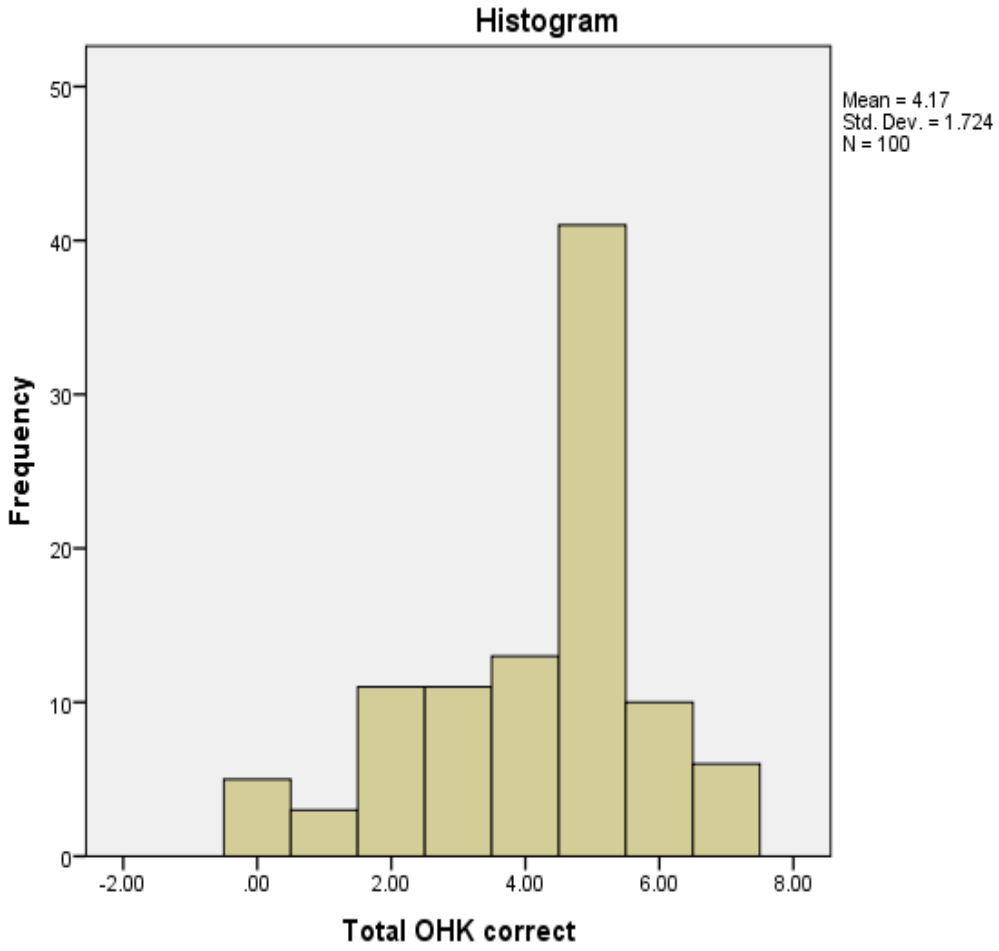

Figure 3. Histogram of total OHK correct.

Table 5

Differences of DMFT and CPI Indices in Inmates by Knowledge of Oral Health Parameters. Mean Scores and Standard Deviations in Parenthesis.

Question	N	DMFT	N	CPI
Sugar contributes to tooth decay because?				
Correct answer	39	10.51 (SD 6.80)	37	1.54 (SD 0.73)
Incorrect answers	56	8.70 (SD 6.44)	55	1.64 (SD 0.80)
What is plaque?				
Correct answer	77	9.64 (SD 6.84)	74	1.58 (SD 0.73)
Incorrect answers	18	8.61 (SD 5.64)	18	1.68 (SD 0.94)
Does fluoride in toothpaste make any difference to the health of your teeth?				
Correct answer	79	9.04 (SD 6.35)	78	1.56 (SD 0.77)
Incorrect answers	16	11.44 (SD 7.72)	14	1.84 (SD 0.74)
What is gingivitis?				
Correct answer	81	9.77 (SD 6.84)	78	1.56 (SD 0.81)
Incorrect answers	14	7.57 (SD 4.91)	14	1.84 (SD 0.47)
What is the truth about flossing?				
Correct answer	69	9.51 (SD 6.24)	67	1.52 (SD 0.74)
Incorrect answers	26	9.27 (SD 7.66)	25	1.80 (SD 0.83)

(Table continues)

Question	N	DMFT	N	CPI
If you want to enjoy a sugary treat, when is the most "tooth-friendly" time to eat it?				
Correct answer	20	9.15 (SD 6.87)	20	1.17 (SD 0.81)
Incorrect	75	9.52 (SD 6.59)	72	1.72 (SD 0.72)
What are the two most Important dental health habits?				
Correct answer	45	9.53 (SD 6.90)	43	1.56 (SD 0.78)
Incorrect answers	50	9.36 (SD 6.41)	49	1.64 (SD 0.77)
Total				
0 correct answers	5	6.20 (SD 5.07)	5	1.60 (SD 0.55)
1 correct answer	3	8.00 (SD 3.00)	3	2.44 (SD 0.66)
2 correct answers	11	9.18 (SD 7.37)	11	1.62 (SD 0.96)
3 correct answers	11	7.55 (SD 7.41)	10	1.90 (SD 0.64)
4 correct answers	13	10.15 (SD 5.60)	13	1.30 (SD 0.73)
5 correct answers	41	9.41 (SD 7.27)	39	1.65 (SD 0.77)
6 correct answers	10	11.80 (SD 6.58)	10	1.43 (SD 0.61)
7 correct answers	6	7.50 (SD 2.81)	6	0.97 (SD 0.87)

Table 6 presents the results for the difference of DMFT and CPI indices in inmates by attitudes about oral health parameters. According to the study, those who agreed completely that only a dentist can prevent cavities had a DMFT score of 9.57 (SD 5.67) and a CPI mean number of sextants of 1.70 (SD 0.99) and those who agreed

partially had a DMFT score of 7.25 (SD 5.47) and a CPI mean number of sextants of 1.92 (SD 0.89). The inmates who disagreed partially had a DMFT score of 10.16 (SD 8.87) and a CPI mean number of sextants of 1.66 (SD 0.61), while the inmates who disagreed completely had a DMFT of 8.92 (SD 5.84) and a CPI mean number of sextants of 1.48 (SD 0.75).

Those inmates who agreed partially that if their parents had bad teeth, brushing and flossing would not help their teeth had a DMFT score of 12.00 (SD 9.30) and a CPI mean number of sextants of 1.71 (SD 0.44). Inmates who disagreed partially had a DMFT score of 6.77 (SD 6.40) and a CPI mean number of sextants of 1.52 (SD 0.68) while inmates who disagreed completely with this statement had a DMFT score of 9.37 (SD 6.56) and a CPI mean number of sextants of 1.57 (SD 0.80). There were only two inmates who agreed completely with this statement.

Inmates who agreed completely that tooth loss is a normal part of growing old had a DMFT of 8.85 (SD 4.04) and a CPI mean number of sextants of 1.84 (SD 0.93) while those who agreed partially had a DMFT score of 7.53 (SD 5.99) and a CPI mean number of sextants of 1.66 (SD 0.55). Inmates who disagreed partially had a DMFT score of 8.88 (SD 6.11) and a CPI mean number of sextants of 0.58) while inmates who disagreed completely had a DMFT score of 10.14 (SD 7.75) and a CPI mean number of sextants of 1.44 (SD 0.90).

Inmates who agreed completely with the statement that they were responsible for preventing the loss of their teeth had a DMFT score of 9.16 (SD 6.56) and a CPI mean number of sextants of 1.60 (SD 0.80) while inmates who agreed partially had a DMFT

score of 9.80 (SD 7.08) and a CPI mean number of sextants of 1.55 (SD 0.73). There was only one inmate who disagreed partially with this statement and only one that disagreed completely.

Inmates who agreed completely that dentures are less trouble than taking care of natural teeth had a DMFT score of 8.00 (SD 4.24) and a CPI mean number of sextants of 1.92 (SD 0.36) while inmates who agreed partially had a DMFT score of 16.83 (SD 6.77) and a CPI mean number of sextants of 1.90 (SD 0.57). Inmates who disagreed partially had a DMFT score of 9.68 (SD 7.82) and a CPI mean number of sextants of 1.57 (0.70) while inmates who disagreed completely had a DMFT score of 8.41 (SD 5.92) and a CPI mean number of sextants of 1.57 (SD 0.82).

Inmates who agreed completely that if their gums bled when they flossed it meant they were hurting their gums and they should stop flossing had a DMFT score of 9.00 (SD 7.04) and a CPI mean number of sextants of 1.68 (SD 0.79) while inmates who agreed partially with this statement had a DMFT score of 8.11 (SD 7.42) and a CPI mean number of sextants of 1.92 (SD 0.65). Inmates who disagreed partially with this statement had a DMFT score of 10.21 (SD 7.22) and a CPI mean number of sextants of 1.46 (SD 0.73) while inmates who disagreed completely had a DMFT score of 8.87 (SD 5.70) and a CPI mean number of sextants of 1.53 (SD 0.84).

Inmates who agreed completely that visiting the dentist is only necessary when personally experiencing pain had a DMFT score of 12.67 (SD 6.47) and a CPI mean number of sextants of 1.59 (SD 1.11) while inmates who agreed partially had a DMFT score of 7.83 (SD 8.01) and a CPI mean number of sextants of 1.30 (SD 0.95). Inmates

who disagreed partially had a DMFT score of 8.06 (SD 5.00) and a CPI mean number of sextants of 1.83 (SD 0.70) while inmates who disagreed completely had a DMFT score of 9.27 (SD 6.87) and a CPI mean number of sextants of 1.56 (SD 0.75).

On the seven question questionnaire concerning oral health attitudes, 22 inmates got five questions correct while 21 inmates got four questions correct. Three inmates got zero questions correct and nine inmates answered all seven questions correctly in this section.

Table 6

Differences of DMFT and CPI Indices in Inmates by Attitudes About Oral Health Parameters. Mean Scores and Standard Deviations in Parenthesis.

Question	N	DMFT	N	CPI
I believe that only a dentist can prevent cavities.				
I agree completely	14	9.57 (SD 5.67)	14	1.70 (SD 0.99)
I agree partially	8	7.25 (SD 5.47)	8	1.92 (SD 0.89)
I disagree partially	25	10.16 (SD 8.87)	22	1.66 (SD 0.61)
I disagree completely	52	8.92 (SD 5.84)	52	1.48 (SD 0.75)

(Table continues)

Question	N	DMFT	N	CPI
I believe that if my parents have bad teeth, brushing & flossing will not help my teeth.				
I agree completely	2	- - - - - - - - - - -	2	2.43 (SD 1.09)
I agree partially	5	12.00 (SD 9.30)	4	1.71 (SD 0.44)
I disagree partially	13	6.77 (SD 6.40)	13	1.52 (SD 0.68)
I disagree completely	79	9.37 (SD 6.56)	77	1.57 (SD 0.80)
I believe that tooth loss is a normal part of growing old.				
I agree completely	13	8.85 (SD 4.04)	13	1.84 (SD 0.93)
I agree partially	17	7.53 (SD 5.99)	17	1.66 (SD .055)
I disagree partially	26	8.88 (SD 6.11)	26	1.66 (SD 0.58)
I disagree completely	43	10.14 (SD 7.75)	40	1.44 (SD 0.90)
I believe that I am responsible for preventing the loss of my teeth.				
I agree completely	77	9.16 (SD 6.56)	75	1.60 (SD 0.80)
I agree partially	20	9.80 (SD 7.08)	19	1.55 (SD 0.73)
I disagree partially	1	- - - - - - - - - - -	1	- - - - - - - - - - -
I disagree completely	1	- - - - - - - - - - -	1	- - - - - - - - - - -

(Table continues)

Question	N	DMFT	N	CPI
I believe dentures are less trouble than taking care of my natural teeth.				
I agree completely	2	8.00 (SD 4.24)	2	1.92 (SD 0.36)
I agree partially	6	16.83 (SD 6.77)	5	1.90 (SD 0.57)
I disagree partially	22	9.68 (SD 7.82)	20	1.57 (SD 0.70)
I disagree completely	69	8.41 (SD 5.92)	69	1.57 (SD 0.82)
If my gums bleed when I floss this usually means that I am hurting my gums and I should stop flossing my teeth.				
I agree completely	10	9.00 (SD 7.04)	10	1.68 (SD 0.79)
I agree partially	18	8.11 (SD 7.42)	17	1.92 (SD 0.65)
I disagree partially	33	10.21 (SD 7.22)	31	1.46 (SD 0.73)
I disagree completely	38	8.87 (SD 5.70)	38	1.53 (SD 0.84)
I believe visiting the dentist is only necessary when I am experiencing pain.				
I agree completely	6	12.67 (SD 6.47)	6	1.59 (SD 1.11)
I agree partially	6	7.83 (SD 8.01)	6	1.30 (SD 0.95)
I disagree partially	16	8.06 (SD 5.00)	16	1.83 (SD 0.70)
I disagree completely	71	9.27 (SD 6.87)	68	1.56 (SD 0.75)

(Table continues)

Question	N	DMFT	N	CPI
Total				
0 correct answers	3	10.00 (SD 3.61)	3	1.78 (SD 0.19)
1 correct answer	2	10.50 (SD 0.71)	2	2.25 (SD 0.83)
2 correct answers	11	9.36 (SD 5.16)	11	1.53 (SD 0.81)
3 correct answers	14	8.93 (SD 9.72)	12	2.13 (SD 0.56)
4 correct answers	21	8.48 (SD 7.34)	20	1.44 (SD 0.81)
5 correct answers	22	10.27 (SD 7.17)	22	1.45 (SD 0.61)
6 correct answers	18	8.67 (SD 5.10)	18	1.62 (SD 0.85)
7 correct answers	9	9.00 (SD 4.24)	9	1.26 (SD 0.99)

Table 7 presents the results of the differences of DMFT and CPI indices in inmates by practices of oral health parameters. The oral health practices section of the study questionnaire had seven questions with four possible answers. Only one answer was correct.

The question *How often do you brush your teeth?* was answered correctly 61 times for a DMFT score of 9.28 (SD 6.82) and 58 times correctly for a CPI mean number of sextants of 1.55 (SD 0.83). Thirty-eight inmates answered this question incorrectly for both DMFT and CPI scores resulting with a DMFT score of 9.16 (SD 6.40) and a CPI mean number of sextants of 1.64 (SD 0.69).

The question *How often do you clean between your teeth?* was answered correctly by 31 inmates for a DMFT score of 7.94 (SD 5.98) and a CPI mean number of sextants of 1.53 (SD 0.92). Sixty-eight inmates answered this question incorrectly for a DMFT score

of 9.82 (SD 6.86) and 65 inmates answered incorrectly for a CPI mean number of sextants of 1.62 (SD 0.70).

The question *How often do you visit the dentist?* was answered correctly by 18 inmates with a DMFT score of 7.67 (SD 5.05) and a CPI mean number of sextants of 1.40 (SD 0.80). Eighty-one inmates answered incorrectly for a DMFT score of 9.58 (SD 6.90) and 78 inmates answered incorrectly for a CPI mean number of sextants of 1.63 (SD 0.77).

How long do you spend brushing your teeth? was answered correctly by 45 inmates with a DMFT score of 8.82 (SD 6.31) and by 44 inmates with a CPI mean number of sextants of 1.67 (SD 0.74). Fifty-four inmates answered incorrectly for a DMFT score of 9.57 (SD 6.92) while 52 inmates answered incorrectly for a CPI mean number of sextants of 1.52 (SD 0.81).

How often do you replace your toothbrush? was answered correctly by 56 inmates for a DMFT score of 8.21 (SD 5.16) and a CPI mean number of sextants of 1.56 (SD 0.80). Forty-three inmates answered incorrectly for a DMFT score of 10.56 (SD 8.03) and a 40 inmates answered incorrectly for a CPI mean number of sextants of 1.62 (SD 0.76).

How hard are the bristles on your toothbrush? was answered correctly by 23 inmates for a DMFT score of 7.91 (SD 6.42) and a CPI mean number of sextants of 1.65 (SD 0.61). Seventy-six inmates answered incorrectly for a DMFT score of 9.63 (SD 6.68) and 73 inmates answered incorrectly for a CPI mean number of sextants of 1.57 (SD 0.83).

What beverage do you regularly drink in an average week? This question was answered correctly by 60 inmates for a DMFT score of 9.20 (SD 6.79) and by 59 inmates for a CPI mean number of sextants of 1.57 (SD 0.77). Thirty-nine inmates gave incorrect answers for a DMFT score of 9.28 (SD 6.45) and 37 inmates answered incorrectly for a CPI mean number of sextants of 1.62 (SD 0.79).

For this section of the seven question questionnaire on oral health practices, three inmates got zero answers correct and zero inmates got seven answers correct. Fifteen inmates got one answer correct, 23 inmates answered 2 questions correct, 18 inmates answered 3 questions correct, 29 inmates answered 4 questions correct, 9 inmates answered 5 questions correct, and 3 inmates answered 6 questions correct. The total number of question correct on the oral health practices portion of the study questionnaire is shown in Graph 2.

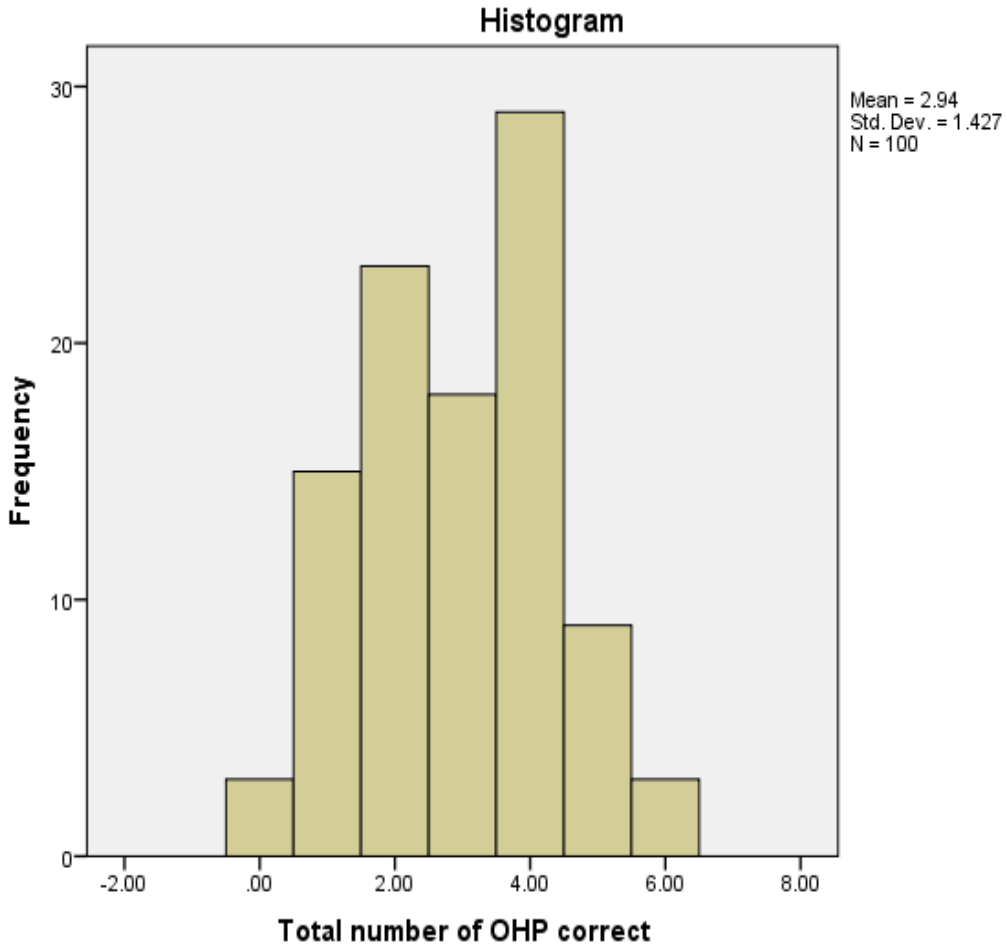

Figure 4. Histogram of total number of OHP answers correct.

Table 7

Differences of DMFT and CPI Indices in Inmates by Practices of Oral Health Parameters. Mean Scores and Standard Deviations in Parenthesis.

Question	N	DMFT	N	CPI
How often do you brush your teeth?				
Correct answer	61	9.28 (SD 6.82)	58	1.55 (SD 0.83)
Incorrect answers	38	9.16 (SD 6.40)	38	1.64 (SD 0.69)
How often do you clean between your teeth (by dental floss, tooth pick, or interdental brush)?				
Correct answer	31	7.94 (SD 5.98)	31	1.53 (SD 0.92)
Incorrect answers	68	9.82 (SD 6.86)	65	1.62 (SD 0.70)
How often do you visit the dentist?				
Correct answer	18	7.67 (SD 5.05)	18	1.40 (SD 0.80)
Incorrect answers	81	9.58 (SD 6.90)	78	1.63 (SD 0.77)
How long do you spend brushing your teeth?				
Correct answer	45	8.82 (SD 6.31)	44	1.67 (SD 0.74)
Incorrect answers	54	9.57 (SD 6.92)	52	1.52 (SD 0.81)

(Table continues)

Question	N	DMFT	N	CPI
How often do you replace your toothbrush?				
Correct answer	56	8.21 (SD 5.16)	56	1.56 (SD 0.80)
Incorrect answers	43	10.56 (SD 8.03)	40	1.62 (SD 0.76)
How hard are the bristles on your toothbrush?				
Correct answer	23	7.91 (SD 6.42)	23	1.65 (SD 0.61)
Incorrect answers	76	9.63 (SD 6.68)	73	1.57 (SD 0.83)
What beverage do you regularly drink in an average week?				
Correct answer	60	9.20 (SD 6.79)	59	1.57 (SD 0.77)
Incorrect answers	39	9.28 (SD 6.45)	37	1.62 (SD 0.79)
Total				
0 correct answers	3	8.00 (SD 3.46)	3	2.00 (SD 1.00)
1 correct answer	15	12.87 (SD 6.93)	14	1.57 (SD 0.65)
2 correct answers	23	9.78 (SD 8.38)	21	1.49 (SD 0.67)
3 correct answers	18	7.61 (SD 5.60)	18	1.69 (SD 0.99)
4 correct answers	29	8.31 (SD 5.50)	29	1.60 (SD 0.75)
5 correct answers	9	8.56 (SD 6.27)	9	1.28 (SD 0.92)
6 correct answers	3	7.67 (SD 6.43)	3	1.94 (SD 0.42)
7 correct answers	0	- - - - - - - - - -	0	- - - - - - - - - - -

Test of Normality

Before hypothesis testing for research questions 1-3, Shapiro-Wilk tests were performed for the mean DMFT scores and CPI mean number of sextant scores to determine normality. The Shapiro-Wilk test determined that all variables were not normally distributed. The *p*-value for the DMFT score was 0.002 and the *p*-value for the CPI score was 0.016. For the Shapiro-Wilk test, the hypotheses used in testing data normality are:

- *Ho:* The distribution of the data is normal
- *Ha:* The distribution of the data is not normal

Because the *p*-values for both the DMFT and CPI scores were < 0.05, the null hypothesis is rejected and the distribution of the data is not considered normal. Lack of normality required that the Spearman's *rho* test be used, according to the data analysis plan of Chapter 3.

Bivariate Correlations of Mediating Variables

The bivariate correlations of DMFT and CPI scores with age group, years incarcerated, education level, employment at the time of incarceration, income level, dental insurance before incarceration, drug use, and the total number of correct answers on the oral health knowledge, attitudes, and practices questionnaires are presented in Table 8.

Table 8

DMFT and CPI Average Correlations with Mediating Variables and Test Scores

			DMFT	CPI
Avg. Spearman's rho	*Age Group*	Correlation Coefficient	.347	.110
		p	.000	.282
		N	100	97
	Years Incarcerated	Correlation Coefficient	.208	.052
		p	.037	.615
		N	100	97
	Education Level	Correlation Coefficient	-.092	-.145
		p	.361	.157
		N	100	97
	Employed at Time of Incarceration	Correlation Coefficient	.065	-.037
		p	.526	.719
		N	98	97
	Income	Correlation Coefficient	.057	-.021
		p	.577	.841
		N	99	96
	Dental Insurance Before Incarceration	Correlation Coefficient	.237	.076
		p	.017	.458
		N	100	97
	Drug Use	Correlation Coefficient	-.062	.038
		p	.592	.747
		N	77	74
	Total OHK Correct	Correlation Coefficient	.112	-.175
		p	.266	.087
		N	100	97

(Table continues)

			DMFT	CPI
Avg. Spearman's rho	Total OHA Correct	Correlation Coefficient	.020	-.133
		p	.846	.192
		N	100	97
	Total OHP Correct	Correlation Coefficient	-.154	-.040
		p	.126	.700
		N	100	97
	Grand Total Test Score	Correlation Coefficient	.002	-.166
		p	.983	.105
		N	100	97

Correlations are significant between DMFT scores and the categories of age group ($p = 0.000$), years incarcerated ($p = 0.037$), and dental insurance before incarceration ($p = 0.017$). The correlation between the DMFT score and age group has a weak to moderate positive correlation coefficient of 0.347. The correlation between the DMFT scores and both years incarcerated and dental insurance before incarceration is weak. Both correlations are positive. The correlation coefficient for DMFT score and years incarcerated is 0.208. The correlation coefficient for DMFT score and dental insurance before incarceration is 0.237.

There is no significance between CPI scores and any mediating or test scores. There is indicative significance between CPI scores and total number of correct scores on the oral health knowledge test ($p = 0.087$). The correlation between the CPI score and total number of correct answers on the oral health knowledge test is weakly negative at - 0.175.

Binary Logistic Regression

DMFT Scores

Binary logistic regression was performed to determine the effects of an inmate's race, age, years of incarceration, education level, employment status at time of incarceration, income level, dental insurance before incarceration, drug use, and oral health knowledge, attitudes, and practices on an inmate's DMFT score. The results that are either significant or indicative of significance are listed in Table 9.

The binary logistic regression that included the total number of correct answers on oral health knowledge (OHK8) showed dental insurance before incarceration had an indicative significance[1] of 0.078. Binary logistic regression that included the total number of correct answers on oral health attitudes (OHA8) showed the OHA score had a significance of 0.05. This means that higher number of correct answers on oral health attitudes, results in lower DMFT levels (*OR*: 1.522, 95% *CI* [1-2.334]). Dental insurance before incarceration had an indicative significance of 0.062 for binary logistic regression that included the total number of correct answers on oral health practices (OHP8). No significance was shown on binary logistic regression that included the total number of correct answers on all three oral health questionnaires, a total of 21 questions. The strongest predictor of DMFT score was the significance of 0.05 for the OHP8.

[1] Indicative statistical significance reflects a *p* value between 0.051 to 0.100 (Stoddard, 2014)

Table 9

DMFT Binary Logistic Regression

Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	95% CI *LL*	95% CI *UL*
Table Incl. OHK8								
Dental Insurance Before Incarceration	-1.308	.742	3.113	1	.078	.270	.063	1.156
Table Incl. OHA8								
OHA8	.420	.218	3.717	1	.05	1.522	1.000	2.334
Table Incl. OHP8								
Dental Insurance Before Incarceration	-1.406	.754	3.478	1	.062	.245	.056	1.074

CPI Scores

Binary logistic regression was performed to determine the effects of an inmate's race, age, years of incarceration, education level, employment status at time of incarceration, income level, dental insurance before incarceration, drug use, and oral health knowledge, attitudes, and practices on an inmate's CPI score. The results that were either significant or indicative of significance are listed in Table 10.

The binary logistic regression that included the total number of correct answers on oral health knowledge (OHK8) showed years incarcerated had an indicative significance of 0.056. Binary logistic regression that included the total number of correct answers on oral health attitudes (OHA8) showed years of incarceration to be significant at 0.027. Years of incarceration had a significance of 0.05 for binary logistic regression that

included the total number of correct answers on oral health practices (OHP8). The total number of correct answers on all three oral health questionnaires, a total of 21 questions, showed significance at 0.039. The strongest predictor of CPI scores was the number of years incarcerated at $p = 0.027$ followed by the total number correct out of all three questionnaires on oral health knowledge, attitudes, and practices at $p = 0.039$.

Table 10

CPI Binary Logistic Regression

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
Table Incl. OHK8								
Years Incarcerated	-.768	.402	3.642	1	.056	.464	.211	1.021
Table Incl. OHA8								
Years Incarcerated	-1.079	.487	4.908	1	.027	.340	.131	.883
Table Incl. OHP8								
Years Incarcerated	-.786	.406	3.743	1	.050	.456	.206	1.010
Table Incl. Total Number of Correct Out of 21 Questions								
Years Incarcerated	-.976	.472	4.274	1	.039	.377	.149	.951

Research Question 1 Results

Is there a relationship between an inmate's oral health status (dental caries and periodontal diseases scores) and their knowledge of basic dental and oral hygiene? The null hypotheses states dental caries and periodontal diseases scores of inmates who visit

the jail's dentist show no relationship with the number of correct responses to knowledge questionnaires on oral health. Tables 11 and 12 depict the results of binary logistic regression between the dependent variables of DMFT scores and CPI scores respectively and the total number of correct answers on the oral health knowledge questionnaire (OHK8).

Table 11

Binary Logistic Regression Between the Total Number of Correct Answers on the OHK Questionnaire and Low and High DMFT Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHK8	-.087	.144	.366	1	.545	.916	.691	1.216

The null hypothesis cannot be rejected since $p = 0.545$, indicating that the DMFT scores of inmates show no relationship to the number of correct answers on the oral health knowledge questionnaire.

Table 12

Binary Logistic Regression Between the Total Number of Correct Answers on the OHK Questionnaire and Low and High CPI Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHK8	.042	.150	.080	1	.778	1.043	.777	1.401

The null hypothesis cannot be rejected since $p = 0.778$, indicating that the CPI scores of inmates show no relationship to the number of correct answers on the oral health knowledge questionnaire.

Research Question 2 Results

The null hypotheses states dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health attitude questionnaire (OHA8). Tables 13 and 14 depict the results of binary logistic regression between the dependent variables of DMFT scores and CPI scores respectively and the total number of correct answers on the oral health attitude questionnaire (OHA8).

Table 13

Binary Logistic Regression Between the Total Number of Correct Answers on the OHA Questionnaire and Low and High DMFT Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHA8	420	.218	3.717	1	.05	1.522	1.000	2.334

The null hypothesis is rejected since $p = 0.05$, indicating that the DMFT scores of inmates significantly decrease when we have an increased number of correct answers on the oral health attitude questionnaire.

Table 14

Binary Logistic Regression Between the Total Number of Correct Answers on the OHA Questionnaire and Low and High CPI Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHA8	.025	.158	.025	1	.874	1.026	.752	1.399

The null hypothesis cannot be rejected since $p = 0.874$, indicating that the CPI scores of inmates show no relationship to the number of correct answers on the oral health attitude questionnaire.

Research Question 3 Results

The null hypotheses states dental caries and periodontal diseases scores of inmates who visit the jail's dentist show no relationship with the number of correct responses to oral health practices questionnaire (OHP8). Tables 15 and 16 depict the results of binary logistic regression between the dependent variables of DMFT scores and CPI scores respectively and the total number of correct answers on the oral health practices questionnaire (OHP8).

Table 15

Binary Logistic Regression Between the Total Number of Correct Answers on the OHP Questionnaire and Low and High DMFT Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHP8	.127	.165	.596	1	.440	1.136	.822	1.568

The null hypothesis cannot be rejected since $p = 0.440$, indicating that the DMFT scores of inmates show no relationship to the number of correct answers on the oral health practices questionnaire.

Table 16

Binary Logistic Regression Between the Total Number of Correct Answers on the OHP Questionnaire and Low and High CPI Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
OHP8	-.117	.184	.404	1	.525	1.026	.890	1.275

The null hypothesis cannot be rejected since $p = 0.525$, indicating that the CPI scores of inmates show no relationship to the number of correct answers on the oral health practices questionnaire.

Summary

The purpose of the study was to assess the oral health knowledge, attitudes, and practices of inmates held in a large Midwestern jail in the U.S. Descriptive and inferential statistics were conducted to answer the three research questions.

Shapiro-Wilk tests were conducted to determine normality among the mediating variables. Non-parametric bivariate testing was performed to determine if there were differences in dental caries scores and periodontal disease scores among 100 inmates housed in a jail, located near a large metropolitan area that housed close to 1,000 inmates. Binary logistic regression was used to determine if any relationship existed between oral health status of inmates and their answers to questionnaires regarding their oral health knowledge, attitudes, and practices.

While no significant relationship was found between and inmates oral health status and number of correct answers on the oral health knowledge, attitudes, and practices questionnaires, weak to moderate correlations were found between an inmates DMFT score and their age, years incarcerated, and whether they had dental insurance before incarceration.

Binary logistic regression was performed to determine the effects of an inmate's race, age, years of incarceration, education level, employment status at time of incarceration, income level, dental insurance before incarceration, drug use, and oral health knowledge, attitudes, and practices on an inmate's DMFT and CPI scores. Indicative significant scores were found for DMFT and dental insurance before incarceration in the OHK8 table (0.078), and dental insurance before incarceration in the

OHP8 table (0.062), while there was a significant relationship between total number of correct answers oral health attitudes and DMFT scores (0.05), further, significant and indicative findings were found for CPI scores and years incarcerated.

The findings of the study are discussed in Chapter 5, including limitations, generalizability of the results, and recommendations for additional research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of the study was to assess the oral health knowledge, attitudes, and practices of inmates housed in a large midwestern metropolitan jail, in relation to their oral health status. I used a closed-ended questionnaire and dental examination to collect inmate data. This questionnaire includes standard demographic questions and 21 questions designed specifically to determine inmates' oral health knowledge, attitudes, and practices. Dental examinations conducted by the jail's one dentist were used to determine the oral health status (dental caries and periodontal diseases) of inmates.

Key Findings of the Study

The mean DMFT and CPI scores of the inmates were 9.20 (SD 6.60) and 1.58 (SD 0.78) respectively. The study consisted of 100 inmates, 49 of whom were African American, 39 White, and 12 were from other racial makeups. The average DMFT for African American inmates was 7.84 (SD 5.83), while the average DMFT for White inmates was 10.51 (SD 6.73). The two groups with the highest DMFT were Native American (two inmates) with an average DMFT of 13.50 (SD 14.85), and biracial (African American/Other; three inmates) with an average DMFT of 16.00 (SD 10.58). African American inmates had a CPI mean number of sextants of 1.79 (SD 0.73), while White inmates had a CPI mean number of sextants of 1.34 (SD 0.76). The highest CPI mean number of sextants was 2.25 (SD 0.35) from only two inmates who identifies as biracial (African American/White).

Older inmates, 46 years old or greater had the highest average DMFT at 14.36 (SD 7.61), while the youngest inmates aged 18-25 had the lowest average DMFT of 6.25 (SD 4.00). The CPI mean number of sextants was lowest in in the youngest inmates age 18-25 at 1.40 (SD 0.73). The 36-45 age group presented as the group with the highest CPI mean number of sextants at 1.73 (SD 0.91).

Inmates that reported being incarcerated for greater than five years had an average DMFT of 12.03 (SD 6.60). The length of incarceration did not vary the CPI mean number of sextants scores. An inmate having dental insurance before being incarcerated impacted both the average DMFT and CPI mean number of sextants. Inmates that had dental insurance before incarcerated had an average DMFT of 8.02 (SD 6.46) and a CPI mean number of sextants of 1.52 (SD 0.85). Inmates that did not have dental insurance before incarceration had an average DMFT of 10.70 (SD 6.54) and a CPI mean number of sextants of 1.67 (SD 0.67).

On the seven-question OHK questionnaire, the five inmates that answered zero questions correctly had the lowest DMFT of 6.20 (SD 5.07), while six inmates that answered all seven questions correctly had the second lowest DMFT of 7.50 (SD 2.81). Inmates with the highest CPI mean number of sextants were three inmates who answered only one question correctly, while the six inmates who answered all seven questions correctly had the lowest CPI mean number of sextants of 0.97 (SD 0.87). The remaining 86 inmates who answered between two and six questions correctly varied widely on DMFT and CPI indices.

I observed similar non-patterns with the seven-question OHA and OHP questionnaires. The highest DMFT score was 16.83 (SD (6.77) in a group of six inmates that partially agreed with the OHA statement, “I believe dentures are less trouble than taking care of my natural teeth.” In the OHP questionnaire, responses to the question “How often do you replace your toothbrush?” were split fairly equally, with 56 inmates answering this question correctly and 43 giving incorrect answers. The 56 inmates that answered this question correctly had DMFT of 8.21 (SD 5.16) and a CPI mean number of sextants of 1.56 (SD 0.80). The inmates that answered incorrectly had DMFT of 10.56 (SD 8.03) and a CPI mean number of sextants of 1.62 (SD 0.76). I observed no pattern of high or low DMFT scores or CPI mean number of sextants in the total number of correct answers in either the OHA or OHP questionnaires.

I correlated the DMFT and CPI scores with the total number of correct answers on the OHK, OHA, and OHP questionnaires, along with demographic information that included the categories of age group, years incarcerated, education level, employment at the time of incarceration, income level, dental insurance before incarceration, and drug use. The significant correlations with DMFT included: age group ($p = 0.000$), with a moderate positive correlation coefficient of 0.347; years incarcerated ($p = 0.037$), with a weak positive correlation coefficient of 0.208; and dental insurance before incarceration ($p = 0.017$), with a weak correlation coefficient of 0.237. The strongest correlation with CPI was the total number of answers correct on the OHK questionnaire which had an indicative significance of $p = 0.087$, and a weak negative correlation coefficient of -0.175.

To test the relationship between DMFT scores and CPI mean number of sextants and demographic information, oral health knowledge, attitudes, and practices, I conducted a binary logistic regression using a new two-level DMFT and CPI variable as the dependent variables and predictors because I found those variables significant in the bivariate tests. The strongest predictors of DMFT included dental insurance before incarceration and the total number of correct answers on the oral health attitudes questionnaire.

The total number of correct answers on the OHA questionnaire appeared to be the strongest predictor of high DMFT, with significance of 0.05 and an odds ratio of 1.522 (95% *CI* [1.000, 2.334]). The higher the number of correct answers on the OHA questionnaire, the lower the DMFT levels.

Dental insurance before incarceration had indicative significance of $p = 0.078$ with an odds ratio of 0.270 (95% *CI* [0.063, 1.156]) when binary logistic regression included the total number of correct answers in the oral health knowledge questionnaire. Dental insurance before incarceration had an indicative significance of $p = 0.062$ with an odds ratio of 0.245 (95% *CI* [0.056, 1.074]) when binary logistic regression included the total number of correct answers in the oral health practices questionnaire.

In binary logistic regression, predictors of high CPI showed indicative significant for the table that included the total number of correct answers for the OHK questionnaire and years incarcerated ($p = 0.056$). The strongest predictor of high CPI was the table that included the total number of correct answers on the OHA questionnaire and years incarcerated ($p = 0.027$), with an odds ratio of 0.340 (95% *CI* [0.131, 0.883]). The table

that included the total number of correct answers for the OHP questionnaire and years incarcerated showed significance at 0.050, while the table with the total number of questions correct in all three questionnaires (a total of 21 questions) and years incarcerated showed significance at 0.039.

Interpretation of the Findings

The results of the study showed that jail inmates had a higher number of decayed and missing teeth than the general population. This is in keeping with results reported by researchers in the 1980s and 1990s on incidence of dental caries in inmates in the U.S. prison system (Cunningham, et al., 1985; Mixson, et al., 1990; Salive, et al., 1989).

The National Institute of Dental and Craniofacial Research (NIDCR; 2014) reported that information taken from the National Health and Nutrition Examination Survey (NHANES) on oral health from 1999-2004 revealed that dental caries, both treated and untreated, in U.S. adults age 20 to 64 declined from the early 1970s. U.S. adults in this age group had an average of 3.28 decayed or missing permanent teeth. Latinos and lower income groups had more severe decay in permanent teeth, and African Americans, Latinos, and those with lower incomes had more untreated permanent teeth.

According to the NIDCR (2014) report, in the general U.S. population age 20 to 34 years, the mean number of decayed permanent teeth was 0.93 and the mean number of mission permanent teeth was 0.62. In this same age group, the mean number of filled permanent teeth was 4.61 and the mean DMFT was 6.16. In the age group 35 to 49 years in the general U.S. population, the mean number of decayed permanent teeth was 0.75 and the mean number of mission permanent teeth was 2.39, the average number of filled

permanent teeth was 7.78, and the mean DMFT was 10.91. In the age group 50 to 64 years, the mean number of decayed permanent teeth was 0.55 and the mean number of missing permanent teeth was 5.30, the mean number of filled permanent teeth was 9.20, and the mean DMFT was 15.05.

This study showed that for all inmates age 18-25 (the age brackets in the study differ slightly from the NHANES data), the mean number of decayed permanent teeth was 1.80 and the mean number of missing permanent teeth was 0.80. The mean number of filled permanent teeth was 3.65, and the mean DMFT was 6.25. For inmates age 26-35, the mean number of decayed permanent teeth was 3.36, the mean number of missing permanent teeth was 2.54, the mean number of filled permanent teeth was 2.29, and the mean DMFT was 8.14. For inmates age 36-45, the mean number of decayed permanent teeth was 3.63, the mean number of missing permanent teeth was 2.57, the mean number of filled teeth was 2.37, and the mean DMFT was 8.37. For the oldest group of inmates, age 46 and older, the mean number of decayed permanent teeth was 2.95, the mean number of missing permanent teeth was 7.81, the mean number of filled permanent teeth was 2.95, and the mean DMFT was 13.71.

The inmate population had more decayed and missing permanent teeth, fewer filled teeth, and a higher DMFT score than the general U.S. population. Age was the most important factor with decayed, missing, and filled teeth and the DMFT score. Fewer decayed teeth were found in the youngest age group (18-25), and greater numbers of decayed teeth were found in the age groups 26-35 and 36-45. The number of decayed

teeth was less in the age group 46-plus because the amount of missing teeth was much greater in this age group than in any of the other groups.

The CPI mean number of sextant scores in inmates also increased in each age group with a CPI score of 1.40 in ages 18-25, 1.54 in ages 26-35, 1.72 in ages 36-45, and 1.61 in ages 46-plus. Studies of periodontal health of incarcerated populations are scarce. Barnes et al. (1987) conducted one of the earliest studies that examined periodontal treatment requirements of recently incarcerated prison inmates. While no CPI scores were used in 1987, Barnes et al. (1987) reported that out of 637 male inmates, 93% of the men needed preventive counselling, prophylaxes, and calculus removal. Young inmates required less periodontal therapy than older inmates, and White inmates needed less periodontal therapy than either African American or Latino inmates (Barnes et al., 1987).

Periodontal health status among prison inmates was examined in a cross-sectional study conducted by Dayakar et al., (2014) at Mangalore District Jail in India. This study sampled 82 male inmates ages 18-60 and found the prevalence of periodontal disease was 97.5% (Dayakar et al., 2014). The majority of inmates in this study had a CPI score of 1 (bleeding on probing); 36.3% of inmates had a score of 2 (presence of deep calculus), and 13.8% of inmates had scores of 3 and 4 (pocket depth of more than 4 mm) (Dayakar et al., 2014). A CPI score of 0 (periodontal status was healthy) happened 2.5% of the time in this population (Dayakar et al., 2014). This study reported 5% of inmates with a CPI mean number of sextants score of 0; 19% of inmates with a CPI mean number of sextants score greater than 0 and ≤ 1; 53% of inmates with a CPI mean number of sextants score

greater than 1 and ≤ 2; 20% of inmates with a CPI mean number of sextants score greater than 2. Three inmates were edentulous.

Direct comparisons of CPI mean number of sextant scores in inmates and the general U.S. population is not possible; however, Eke et al. (2015) reported that the prevalence of periodontal probing depth increases with age in U.S. adults ≥ 30 years. The prevalence of periodontal probing depth ≥ 4 mm (a CPI score of 3) in U.S. adults ≥ 30 years was 32.3% in the 30 to 34 year age group, 39.2% in 35 to 49 year age group, 46.1% in age group 50 to 64, and 48.3% in age group ≥ 65 years (Eke et al., 2015). Burt and Eklund (2005) reported that although periodontitis is usually related to age in cross-sectional surveys, it is not a natural consequence of aging. In addition, over 70% of adults throughout the world are thought to have some degree of gingivitis or periodontitis and only a small proportion of persons (5%-15%) exhibit severe periodontitis (Burt & Eklund, 2005).

While the inmates in this study had poorer oral health than the general U.S. population, they had better oral health than many inmates outside of the United States. The mean DMFT for the 100 inmates in this study was 9.20 (SD 6.60). Osborn et al. (2003) reported a mean DMFT of 20.4 for prison inmates in New South Wales, Australia. Naidoo, Yengopai, and Cohen (2005) reported the prevalence or oral disease high in a South African prison, with the mean DMFT at 15.45 for 340 prisoners, 264 males and 76 females. Cavalcant et al. (2014) reported a mean DMFT index value of 19.72 for 127 male Brazilian prisoners held in a correctional facility in northeastern Brazil.

While this study found no significant relationship between an inmates oral health status and number of correct answers on the oral health knowledge, attitudes, and practices questionnaires, weak to moderate correlations were found between an inmates DMFT score and their age, years incarcerated, and whether they had dental insurance before incarceration. This study's finding differed from other researchers who examined dental caries and oral health knowledge, attitudes, and practices (or behaviors) in groups other than inmates.

Levin and Shenkman (2004) examined the relationship between dental caries and oral health attitudes and behavior in young Israeli adults and found that their study participants with low levels of dental disease had more positive oral health attitudes and behavior. Ogawa et al. (2003) also found statistically significant correlations between the correct/incorrect responses to knowledge and attitude questionnaires on oral health and the mean number of DMFT. In the Ogawa et al. study on dental caries in Myanmar, civilians who answered correctly on oral health knowledge and attitude questionnaires tended to have lower DMFT scores. A study of dental caries in adolescents in Nigeria showed that occurrence of dental caries among adolescents reduced with an increase in knowledge, positive attitude, and sound practices towards attaining dental health (Ogundele & Ogunsile, 2008).

Binary logistic regression revealed that indicative significant scores were found for DMFT and an inmate having dental insurance before incarceration in tables that included the total number of correct answers on the oral health knowledge and practices questionnaires. A significant relationship was found for DMFT and an inmate having

dental insurance before incarceration and the total number of correct answers on the oral health attitudes questionnaire. Significant findings were found for CPI scores on all three oral health knowledge, attitudes, and practices questionnaires and number of years incarcerated. The longer an inmate was incarcerated, the higher their CPI score was.

This study is the only known study to investigate relationships between oral health status and oral health knowledge, attitudes, and practices/behaviors in jail inmates. Similar topics have been researched by Osborn et al., Rustvold (2012), and Digra, Gupta, Arora, and Gupta (2015). Osborn et al. researched the oral health status of Australian prison inmates and discovered that the standard of past oral health care for this population was low. Part of the Osborn et al. study included oral health behavioral information of inmates such as: a) the length of time since the last visit to a dentist and b) a self-assessment of the inmate's oral health needs. Univariate analysis revealed that being older than the median age of 36 years was associated with a significant increase in the risk of a high DMFT score. Increasing age was also important in the multivariate model where age remained as the only significant independent predictor of a high DMFT score (Osborn et al., 2003). In this study DMFT also increased with the age of the inmate. The mean DMFT score for inmates age 18-25 was 6.25 (SD 4.00) and for inmates 46 plus it was 14.36 (SD 7.60).

The oral health knowledge and attitudes toward oral health and levels of anxiety among women in residential chemical dependency treatment programs was examined by Rustvold (2012). Rustvold demonstrated that after an educational intervention, positive outcomes in increases in oral health knowledge and behavior was the result. An important

aspect of the Rustvold study was that many of the women lacked access to regular preventive dental appointments and restorative care. Forty-four percent of the jail inmates in this study did not have dental insurance before they were incarcerated. The jail inmates that had insurance before incarceration had a DMFT score of 8.02 (SD 6.50). The 56% of inmates that did not have insurance before incarceration had a DMFT score of 10.70 (SD 6.54).

In the Ambala District, Haryana (India), oral health knowledge, attitude, and practice were measured in prison inmates by Digra et al. (2015). A total of 570 prisoners (518 males and 52 females) ages 18-88 years were given a 23-item closed questionnaire that asked questions similar to the 21-item questionnaire used in this study. In the Digra et al. study, knowledge of oral health, particularly gum bleeding and gingivitis was poor as it was in this study. Out of the seven OHK questions in this study, the mean number of correct answers was 4.17 (SD 1.72). The Digra et al. study also showed inmates to have negative oral health attitudes and practices. Out of the seven OHA and seven OHP questions in this study, the mean number of OHA questions was 4.31 (SD 1.71) and the mean number of OHP question was 2.94 (SD 1.43). Many of the prisoners in India and the inmates in this study only visit a dentist when they are in pain (Digra et al., 2015).

Limitation of the Study

One of the limitations of the study is that many consider inmates to be manipulative, cunning, untrustworthy, and dishonest (Tewksbury, 2005). Personal experiences with inmates in the jail setting revealed that inmates can be manipulative,

cunning, untrustworthy, and dishonest, especially with jail officers where there is many times an adversarial relationship between these two parties.

While conducting this study I observed a very different type of relationship inmates had with the jail's dentist and dental assistant. On many occasions the jail's dentist reported having to take additional time during the study to hear inmate's "confessions" of why they had poor oral hygiene. Emotions ran high on several occasions when inmates (all male) actually cried because they were embarrassed by how they let their oral health become so poor. This study prompted some inmates to ask the jail's dentist if there was any action they could take to reverse their poor oral hygiene. These men were concerned that no one would ever find them attractive again and that their chances of finding a relationship or a job had been permanently damaged. One inmate was so moved by the study that he provided a letter explaining his regrets about his life-long poor oral hygiene habits and asked the researcher to visit him so he could explain this situation.

Tewksbury (2005) explored how honest inmates were in writing personal ads seeking pen pals. This study showed that "personal information provided by inmates must be viewed with a healthy dose of skepticism" (p.34). Inmates tended to be inaccurate about personal information (Tewksbury, 2005). In addition, Tewksbury also discovered that two-thirds of inmate personal ads did not contain inaccurate information. Tewksbury's answer to "Do inmates tell the truth about themselves?": "some do sometimes" (p. 34). While there can be no actual proof that the study's inmates gave

honest answers to the questionnaires, I believe their answers were not more dishonest than any other study using this type of methodology.

Recall bias was another limitation to the study. The use of questionnaires makes it difficult to access the reliability of oral health variables, particularly with oral health attitudes and practices. Non-response was only an issue in the area of drug use where 23% of inmates did not answer this question.

This study only used male inmates in the jail system. Female inmates were to be a part of this study but before the study began, female inmates were removed from this particular jail. Most studies about oral health and inmates that included female inmates showed differences in male and female oral health. Osborn et al., examined the oral health status of prison inmate in New South Wales, Australia where 51.9% of male inmates had high DMFT compared with only 40.9% of female inmates.

Studies of oral health in female inmates are scarce and when such studies are done they usually focus exclusively on females. Badner and Margolin (1994) examined the oral health of women inmates at Rikers Island Correctional Facility and Heng (2000) examined the dental health of female inmates in a federal correctional facility. A study is needed where the oral health statuses of male and female inmates are examined with equal numbers of males and females being represented in either a prison or jail system.

This study was small with only 100 inmates and needs to be at least duplicated with a larger number of participants. In this way, the indicative statistically significant results obtained in this study could become significant. Nevertheless, the resulting post-hoc power analysis was satisfactory at > 0.91. This was determined using G* Power 3

calculator software (version 3.1.4) and logistic regression test, an alpha level of 0.05, and an odds ratio of 0.456 (for "years incarcerated" as predictor variable, while it was the weakest obtained significant *p* value, 0.05) as determined in data analysis (Chapter 4, Table 10).

The oral health of jail inmates needs to be expanded to additional areas outside the midwestern United States. A future study of this nature may want to include radiographs to detect interproximal caries. This study was not able to use radiographs due to budget constraints and therefore there was a possibility of overlooking caries between the teeth. A future study may also want to examine decayed, missing, and filled surfaces (DMFS) instead of just DMFT scores.

Recommendations for Future Research and Practice

This study has contributed to the literature by providing baseline information on the knowledge, attitudes, and practices of jail inmates in relation to their oral health status (DMFT and CPI) in a jail located in a large midwestern metropolitan setting. This population of people is generally overlooked by public health professionals (Greifinger, 2007). Additional studies are needed to investigate this same issue with female jail inmates, jail inmates of many different cultural and ethnic backgrounds, and to investigate this issue in jails large and small throughout the United States. This would make the results more generalizable.

The inmates in this study showed a wide variety of oral health knowledge, attitudes, and practices. There is a need to stress oral health education early in the education process and include some form of oral health education in the jail system. This

study can be used by both jail administrators to aid in the development of an oral health education program and by public health professionals involved in oral health education in juvenile correctional facilities.

Jail administrators can utilize this study as a starting point to better understand the great need for oral hygiene and dental care in the correctional setting and the appropriate staffing of dentists, dental hygienists, and dental assistants that are needed. Many kites (grievances) in jails are written about the need for dental care. The jail in this study was understaffed; there was only one dentist and one dental assistant for three jails. In the past there was a dentist and one dental hygienist for each of the three jails.

Implications for Social Change

The findings of this research have contributed to the literature by providing information on the oral health status and oral health knowledge, attitudes, and practices of jail inmates in a large jail in a midwestern city in the United States. While oral health studies have been conducted on inmates in a prison setting, oral health studies on inmates in a jail setting are scarce. Oral health studies that have been conducted in correctional settings, particularly in the United States., have been conducted in prisons not jails (Cunningham, et al., 1985; Barnes et al., 1987; Mixson, et al., 1990; Salive, et al., 1989). With the exception of Barnes et al. (1987), who examined the issue of periodontal disease in inmates, most researchers or oral health in the correctional facilities only examined DMFT scores of inmates and determined that dental caries in the prison setting was poorer than in the general population (Cunningham, et al., 1985; Barnes et al., 1987; Mixson, et al., 1990; Salive, et al., 1989).

Lincoln, Miles, and Scheibel (2007) stress the importance of correctional facilities being an important part of community health and public health collaborations. These researchers state: “Collaboration between public health and correctional agencies have evolved and are now an important venue of addressing the gaps in health care services for inmates” (p. 509). In jails, 70% of inmates are released within three days; however 20% will spend at least one month, 12% will spend at least two months, and 4% will spend more than six months (Schmalleger & Smykla, 2011). Most jail inmates are going to return to their communities and their time served in jail will provide an excellent public health opportunity to treat oral health issues and educate inmates where to get oral health treatment when they are released. The social change this study provides is an understanding of the oral health status and needs of an underserved population that has too long been neglected.

Conclusion

Good oral health is a part of good health. Efforts to improve public health and safety must include providing and improving the health care needs, including oral health needs, of our jail populations. Treadwell, Northridge, and Bethea (2007) stress that oral health is not only having healthy teeth, but being free or chronic oral-facial pain conditions, diseases such as throat cancer, and disorders that affect oral, dental, and craniofacial tissues that allow humans to be able to speak and smile, smell, taste, touch, chew, and swallow.

The purpose of this study was to fill the literature gap and identify if there were any relationships between the oral health knowledge, attitudes, and practices with the oral

health status of inmates in the jail setting in a large Midwestern city. Descriptive and inferential statistics were conducted along with binary logistic regression to examine if there were any relationship between DFMT and CPI scores and demographic information or oral health knowledge, attitudes, and practices. The results of the study showed the most important predictors of oral health in the inmate population of this study is age, whether an inmate had dental insurance before being incarcerated, and number of years incarcerated. This study has social change implications because it can provide important knowledge for public health professionals in planning oral health interventions for incarcerated populations and for jail administrators to plan for the oral health needs of jail inmates.

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Appendix A: Oral Health Knowledge, Attitudes, & Practices Survey

1. What is your Race/Ethnicity?
    - Black/African American
    - White
    - American Indian/Alaska Native
    - Latino
    - Asian
    - Biracial (Black/White)
    - Biracial (Other than Black/White)

2. What is your age group?
    - 18-25
    - 26-35
    - 36-45
    - 46+

3. In your entire life, how long have you been incarcerated?
    - Less than 1 year
    - 1-2 years
    - 3-5 years
    - Greater than 5 years

4. What is your highest educational level.
    - Elementary school (kindergarten up to 6^{th} grade)
    - Jr. high (7^{th} up to 8^{th} grade)
    - Some high school (9^{th} up to 12^{th} grade)
    - High school graduate
    - Some college
    - College graduate (Bachelor's degree and above)

5. Were you employed at the time of your incarceration in the jail?
    - Yes
    - No

6. Your annual income this past year.
    - Less than $10,000
    - $10,000 to $19,999
    - $20,000 to $29,999
    - $30,000 to $39,999
    - $40,000 to $49,999
    - $50,000 or more

7. Do you have a history of drug use?
    - Yes
    - No

8. Did you have dental insurance before you were incarcerated?
    - Yes
    - No

Oral Health Knowledge

1. Sugar contributes to tooth decay because?
    a. Sugar directly harms tooth enamel
    b. Sugar combines with proteins in saliva to create a hard layer on teeth
    c. Sugar is changed by bacteria into acid that harms tooth surfaces
    d. Only processed sugar (white sugar) contributes to tooth decay

2. What is plaque?
    a. The protective coat that naturally occurs on teeth
    b. A harmless substance that can be removed completely with brushing
    c. A germ-containing substance that collects on the surface of teeth
    d. A whitening substance that makes your teeth shine

3. Does fluoride in toothpaste make any difference to the health of your teeth?
    a. No, it makes no difference at all, and fluoride is now being phased out because it isn't safe
    b. Fluoride in toothpaste has hugely improved oral health by decreasing cavities
    c. It isn't dangerous, but toothpaste without fluoride is just as effective at preventing cavities
    d. Nobody really knows because there haven't been many studies in the area

4. What is gingivitis?
    a. Poor support of the bone that supports the teeth
    b. A condition where the teeth stain
    c. Inflammation of the gums that involves swelling and bleeding
    d. Another name for having several cavities at the same time

5. What is the truth about flossing?
    a. Flossing is bad for your teeth
    b. It is OK to floss, but you should stop immediately if your gums start bleeding
    c. Flossing is fine if it makes your mouth feel fresher but it doesn't improve the health of your mouth
    d. Regular flossing is an important part of your dental health routine and you shouldn't worry if your hums bleed a bit at first

6. If you do want to enjoy a sugary treat, when is the most "tooth-friendly" time to eat it?
    a. First thing in the morning or last thing at night
    b. Along with a meal
    c. As a snack on its own
    d. It doesn't make any difference

7. What are the two most important dental health habits?
    a. Brushing twice daily and rinsing with mouthwash after each brushing
    b. Brushing after every meal and using a water-pick device daily
    c. Brushing twice daily and flossing one a day
    d. Flossing every day and rinsing with mouthwash after each flossing

Oral Health Attitudes

1. I believe that only the dentist can prevent cavities.

☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

2. I believe that if my parents have bad teeth, brushing and flossing will not help my teeth.

☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

3. I believe that tooth loss is a normal part of growing old.

☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

4. I believe that I am responsible for preventing the loss of my teeth.

☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

5. I believe dentures are less trouble than taking care of my natural teeth.
☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

6. If my gums bleed when I floss this usually means that I am hurting my gums and I should stop flossing my teeth.
☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

7. I believe visiting the dentist is only necessary when I am experiencing pain.
☐I agree completely ☐I agree partially ☐I disagree partially ☐I disagree completely

Oral Health Practices

1. How often do you brush your teeth?
☐More than twice a day
☐Twice a day
☐Once a day
☐2-3 times a week
☐Less frequently

2. How often do you clean between your teeth (by dental floss, tooth pick, or interdental brush)?
☐Once a day or more
☐2-3 times a week
☐Once a week
☐Less frequently
☐Never

3. How often do you visit a dentist?
☐More than once a year
☐Once a year
☐Every two or three years
☐Less frequently
☐Only when incarcerated

4. How long to you spend brushing your teeth?
☐Less than 1 minute
☐1 minute
☐2 minutes
☐3-4 minutes
☐5 minutes or more

5. How often do you replace your toothbrush?
☐Every 60 to 90 days
☐Every 6 months
☐Every 6-12 months
☐Once a year
☐When the toothbrush loses it bristles

6. How hard are the bristles on your toothbrush?
☐Hard bristles
☐Soft bristles
☐Medium bristles
☐It doesn't matter
☐I use a toothbrush

7. What beverage do you regularly drink the most in an average week?
☐Soft drinks/sports drinks
☐Fruit juices
☐Bottled water
☐Tap water
☐Coffee, tea, or milk

Appendix B: Dr. Susan Rustvold Permission

Re: PhD candidate April Wendling
Susan Rustvold
Sat 4/23

Dear April,

I am delighted to extend permission for you to use the instruments I created and used in my dissertation research. One is the Rustvold Oral Health Inventory (ROHKI).

I do not recall the acronym used for the second instrument, and have been remiss in my failure to confirm it in a timely manner. You mentioned the acronym "OHKI" in your email.

You certainly have permission to use both.

All the best to you in your work.

Susan Rustvold

Sent from my iPhone

On Mar 14, 2016, at 4:36 AM, April Wendling <aprilwendling@[redacted]> wrote:

Dr. Rustvold:

We spoke on the phone around May or June in 2015. Our conversation was a good one and I hope you are doing well. You completed your dissertation in 2012 and I should be completing mine very soon.

I am in the final stages of my PhD where I researched the relationships of the oral health status of inmates at the Wayne County Jail in Detroit, Michigan with their oral health knowledge, attitudes, and practices. You agreed to let me use portions of your ROHKI and OHKI instruments you used in your dissertation. I want to include your permission as an Appendices in my dissertation.

Could you please send me your approval in an email?

Thank you for your help with this,

April Lee Wendling
[redacted]

Subject: Re: April Wendling [redacted]
From: susanrustvold@[redacted]
Date: Tue, 30 Sep 2014 16:27:16 -0700
To: aprilwendling@[redacted]

Very cool! I'll be glad to reply with permission.
Warm regards,
Susan

Sent from my iPad

On Sep 30, 2014, at 4:16 PM, April Wendling <……. > wrote:

Dr. Rustvold:

I hope this email finds its way to you. I thought I misplaced your email but found it (right where I thought I put it). Hope you are well. I will be writing you in the next couple of days asking for your permission to use your dissertation questionnaires. If you could write back giving me permission, I will be able to put that in my Appendix. I am very near completion with my Chapter 3 and hope to defend my proposal soon. I'll let you know of my progress.

Thank you,

April

April Lee Wendling
[redacted]