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ORAL HEALTH AND AWARENESS AT THE UNIVERSITY OF
SOUTH DAKOTA

by

Hannah Hofmaier

A Thesis Submitted in Partial Fulfillment
Of the Requirements for the
University Honors Program

Department of Health Science
The University of South Dakota
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The members of the Honors Thesis Committee appointed
to examine the thesis of Hannah Hofmaier
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ABSTRACT

Oral Health and Awareness at The University of South Dakota

Hannah Hofmaier

Director: Erik Mutterer

A correlation exists between one's oral health and overall general health. However, research suggests that college students participate in behaviors that compromise their oral health. Studies have shown that many college students forgo a healthy diet, and many increase their tobacco and alcohol use in college. There is a decline in the frequency of college students receiving an annual dental exam and cleaning. A survey was distributed at the University of South Dakota (USD) to explore the possible relationship between a college lifestyle and oral health at a public, Midwestern university. The survey was intended to better understand the oral health of students and their oral health risk factor usage, as well as determine awareness of the USD dental hygiene clinic. By better understanding the current practices of college students, the hope is that changes can be made to improve the oral health of students. Additionally, increasing awareness of the effects of oral health on the body, as well as dental hygiene services available, can be beneficial in educating students. With college being formative years for one's health habits, it is essential that students practice proper oral hygiene.

KEYWORDS: Oral Health, College Students, Survey, Midwestern University, College Lifestyle

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CHAPTER ONE

Introduction

Proper oral hygiene can significantly impact one's quality of life and wellbeing as the mouth and oral cavity serve as a gateway to the rest of the body (Petersen, 2003). Oral infections, especially periodontal infections, have been associated with several health problems, such as diabetes and heart conditions (U.S. Department of Health and Human Services, 2000). Despite the significant impact oral health can have on general health, many people underestimate its importance.

The behaviors exhibited by many college students can pose risks to their oral health. Tobacco use, alcohol consumption, poor diet, and high stress levels are often associated with a college lifestyle (Lemaster & Maready, 2014). These health behaviors have previously been shown to poorly affect oral health. (Dewald et al., 2016) The Journal of Health Disparities conducted a National College Health Assessment to investigate the dental health practices of college students. The assessment found a decline in the percentage of students who reported having an annual dental exam and cleaning from the fall of 2006 to the spring of 2013 (Dewald et al., 2016). Additionally, the assessment found that the percentage of students receiving an annual dental exam declined following freshmen year (Dewald et al., 2016).

That idea that a college lifestyle can negatively impact oral health is explored in this research thesis, which focuses on the University of South Dakota. First, a literature review outlines the correlation between oral health and overall health as well as the oral health habits of college students. The thesis is then tested using an online survey of undergraduate and graduate students at the University of South Dakota. The survey

evaluates the oral health practices of USD students and their usage of oral health risk factors. By understanding the oral hygiene habits and behaviors of students at the University of South Dakota, a more tailored plan of action can be taken to educate students on the risks of unhealthy behavior and its tie to health outcomes.

CHAPTER TWO

Correlation between Oral Health and Overall Health

The importance of one's oral health is evident through its interrelationship with general health and quality of life (Petersen, 2003). Periodontal disease has been linked with several health issues, including diabetes and heart disease. Therefore, practicing proper oral hygiene and visiting the dentist regularly could assist in improving systemic health conditions.

Diabetes

A bidirectional relationship has been established between diabetes and periodontitis, the severe form of periodontal disease (Casanova et al., 2014). Periodontitis is associated with an increased risk of poor glycemic control in diabetic patients, as well as increased prevalence of diabetes related complications. On the other hand, studies have shown an increased risk for periodontitis in individuals with diabetes. Patients with diabetes are estimated to have a 2-3 times greater risk for developing periodontitis than individuals without diabetes (Casanova et al., 2014).

The American Academy of Periodontology (AAP) defines periodontal disease as “an inflammatory disease that affects the soft and hard structures that support the teeth” (AAP, 2019, para. 2). Periodontal disease begins in the early stages as gingivitis when harmful bacteria are present in the mouth, and the gums become swollen and inflamed. As the disease progresses into periodontitis, the gums recede from the teeth as gum tissues are destroyed (AAP, 2019). Periodontal disease is highly prevalent in the United

States. Data from the 2009 and 2010 National Health and Nutrition Examination Survey found that 47.2% of US adults aged 30 years or older have some form of periodontal disease (CDC, 2015).

Periodontitis has been shown to have a negative impact on diabetes by increasing the risk of poor glycemic control, as well as increasing the risk for diabetes related health complications. The level of glucose bound hemoglobin (HbA1c) in the blood is a reflective measure of how well the diabetes is being managed (Casanova et al., 2014). The American Diabetes Association reports that diabetes is diagnosed in individuals with an HbA1c level of greater than or equal to 6.5% (American Diabetes Association, 2016). Early evidence of the hypothesis that periodontitis could affect glycemic control came from studies of the Gila River Indian Community (Preshaw et al., 2011). The studies found that diabetic individuals with severe periodontitis at the start of the study had an increased risk of poor glycemic control (HbA1c >9.0%) at the time of follow up. An additional five-year study of non-diabetic individuals found that those with the most severe form of periodontitis at the start had a fivefold greater increase in HbA1c by the end of the study than those with no periodontitis, indicating a potential relationship between severe periodontitis and an increased risk for diabetes (Preshaw et al., 2011).

Periodontitis has also been associated with diabetes related health complications, including kidney disease. Studies of the Gila River Indian Community found an association between periodontitis and microalbuminuria development in those with type 2 diabetes (Preshaw et al., 2011). Diabetes is the leading cause of kidney failure in the United States, and detection of albumin in the urine can be an early sign of kidney damage (Fraser & Haldeman-Englert, 2019). The studies found that incidences of

albumin in the urine was twice as high in those with moderate periodontitis, 2.6 times as high in those with severe periodontitis, and 2.6 times as high in those who were edentulous, or without teeth, compared to those with no or mild periodontitis (Preshaw et al., 2011). Additionally, the incidences of end stage renal disease were 2.3 times as high for those with moderate periodontitis, 3.5 times as high for those with severe periodontitis, and 4.9 times as high for those who were edentulous compared to those with no or mild periodontitis (Preshaw et al., 2011).

Several studies have been conducted on the effects of periodontitis treatment on glycemic control in diabetic individuals. The finding is consistent in that treating periodontitis is associated with a 0.4% reduction in HbA1c (Casanova et al., 2014). A study by the American Journal of Preventative Medicine found that patients with type 2 diabetes had lower medical costs and fewer hospitalizations after receiving periodontal treatment than those who did not receive periodontal treatment (Jeffcoat et al., 2014).

Heart Disease

A correlation has also been established between oral health and heart health. Several studies have associated periodontal disease with heart disease. Research has found that individuals with periodontal disease are almost twice as likely to have heart disease than those without periodontal disease (Gregg, 2017).

One proposed mechanism by which periodontal disease could be associated with heart disease is through inflammation. Periodontal disease is associated with increased inflammatory responses in the body. Previous research suggests that as oral bacteria enter

the body and travel through it, a similar systemic inflammatory response is activated, leading to inflammation in the arteries (Trettenero, 2018 & Gregg, 2017).

When a plaque-filled artery becomes inflamed, clot formation is possible, which can obstruct blood flow to the heart and brain. Studies have shown strong similarities between the amount of inflammation of the gums and the amount of inflammation in major arteries (Trettenero, 2018). Additionally, a study published in the American Heart Association Journal, *Circulation*, analyzed the clots and blood samples from 101 people in the throes of a heart attack. The study found that “78.2% percent of the clots had oral pathogens that cause these abscesses and 34.7% of the clots contained bacteria found in periodontal disease” (Trettenero, 2018, para. 4).

A study by Dr. Hasturk (2018), a periodontist of the Forsyth Institute, and her colleagues tested rabbits to explore the link between oral health and heart health. All the rabbits were fed diets high in cholesterol to imitate human heart disease. Some of the rabbits were then infected with bacteria associated with periodontal disease. Those rabbits infected with the bacteria developed atherosclerotic plaques that were less stable and more likely to cause a heart attack, as well as had higher levels of inflammation in the blood than the rabbits who were not infected with the periodontal disease bacteria (Harvard Health Publishing, 2018).

To follow up, Dr. Hasturk and her colleagues treated the rabbits with an oral liquid containing resolvin molecules believed to help stop inflammation. The oral liquid treatment was found to prevent periodontal disease in those rabbits infected with the bacteria, as well as lower inflammation and atherosclerosis. This study reveals the

potential benefits that treating periodontal disease may have on heart disease by reducing overall inflammation in the body (Harvard Health Publishing, 2018).

Recommendations

Proper oral hygiene can play a significant role in preventing periodontal disease. The AAP states that brushing the teeth, flossing at least once a day, and swishing with mouthwash are ways to remove plaque and prevent periodontal disease. Additionally, the AAP outlines several risk factors for periodontal disease, including risk factors associated with college students, including smoking and tobacco use, stress, and poor nutrition and obesity (AAP, 2019). Because periodontal disease and oral infections have strong implications for systemic diseases and overall health, it is imperative that college students practice proper oral hygiene and understand the risks.

CHAPTER THREE

College Lifestyle and Oral Health Habits

Several behaviors associated with poor oral health, including poor diet and tobacco and alcohol use, are often exhibited by college students (Lemaster & Maready, 2014). With newfound independence from their parents or guardians, college students may abandon previous healthy habits. Despite the risks college students pose on their oral health, dental health is often excluded from campus medical services for students (Dewald et al., 2016).

Diet

Individuals transitioning into college often shift their eating habits as they begin to live independently (Abraham et al., 2018). Recent studies have been consistent in the finding of poor eating habits of many college groups. Studies on various college campuses found that many college students tend to choose the food they eat based on convenience, taste, time, and price rather than nutritional value (Abraham et al., 2018 and Murad, 2017). Data collected from the University Life Study, a longitudinal study of college students to understand their health behaviors over seven semesters, found that few college students ate the recommended servings of fruits and vegetables each semester. The study also revealed that students' consumption of fruits and vegetables decreased throughout college (Small et al., 2012).

A survey conducted by Oregon State University researchers of 582 college students, most of which were first year students, found that both male and female students were not regularly eating the proper amount of fruits and vegetables. The

researchers found that male students had an average of five servings of fruits and vegetables each week, and female students had an average of four servings of fruits and vegetables each week (Oregon State University, 2011).

A survey conducted at a private university in San Antonio, Texas explored added sugar consumption among college students. The researchers found that less than 10% of students surveyed responded that they did not consume sugar-sweetened beverages on a regular basis, while the majority of participants reported consuming sugar-sweetened beverages at least one time per day or several times per week. The majority of students surveyed also reported that they do not pay attention to the sugar content in the drinks they consume (Murad, 2017).

The poor dietary habits of college students can not only have negative implications for their general health, but their teeth and gums as well. A balanced diet is associated with a state of oral health (Scardina & Messina, 2012). In particular, the high added sugar content seen in the diet of many college students is harmful to one's oral health. The American Dental Association (ADA) states that foods such as candy, cookies, cakes, muffins, and chips can be harmful to one's oral health because of the sugar content, which can adhere to the teeth. The added sugar can lead to tooth decay, as oral bacteria feed off the sugars and release decaying acids into the mouth (ADA, 2019). Additionally, previous research conducted in isolated communities with a traditional lifestyle and diet consisting of low sugar consumption found very low levels of dental caries (Scardina & Messina, 2012).

Tobacco and Alcohol

The prevalence of traditional cigarette use has declined significantly among young adults aged 18-24 years, the age range of the majority of college students, over the past decade (Cooper et al., 2017). However, college marks a time of transition for many students, who may choose to try various tobacco products. Previous research has found that students have a greater acceptance for newer tobacco products than traditional cigarettes (Noland et al., 2016).

Electronic cigarette, or e-cigarette, usage is highest among young adults. A focus group study conducted at a Midwestern university investigated the attitudes that college participants had regarding e-cigarettes. The researchers reported that participants seemed less aware of the health risks associated with e-cigarettes compared to traditional cigarettes and many participants designated e-cigarette use as part of their social experiences (Katz et al., 2019). College students are typically more accepting of public e-cigarette and hookah use than cigarette or cigar use (Noland et al., 2016).

Attending college is associated with increased alcohol consumption. The National Survey on Drug Use and Health provided data regarding the drinking habits of college students. The survey found that “young adults aged 18 to 22 who were enrolled full time in college were more likely than their peers who were not enrolled full time (i.e., part-time college students and persons not currently enrolled in college) to report current, binge, or heavy drinking.” (Substance Abuse and Mental Health Services Administration, 2014, p. 40). Likewise, more than one-third of college students reported heavy drinking within the past 2 weeks.

The tobacco and alcohol habits of college students can negatively impact their oral health. The ADA outlines the ways tobacco can affect oral health. Cigarette smoking has a variety of negative effects on oral health, including recession of the gums, oral cancer, periodontal disease, and oral lesions. Smokeless tobacco use also increases one's risk of oral cancer and oral mucosal lesions, and can cause conditions such as periodontal disease, tooth loss, and erosion of the enamel (ADA, 2019). The use of e-cigarettes also poses a threat to one's oral health. Propylene glycol, a nicotine carrier product found in e-cigarettes, produces breakdown products which are harmful to the enamel and soft tissue in the oral cavity. Additionally, vegetable glycerin and flavorings found in the e-liquids in e-cigarettes have been shown to increase microbial adhesion to enamel, leading to tooth decay (Froum & Neymark, 2019).

Alcohol is a known risk factor for oral cancer (Priyanka et al., 2017). Alcohol abuse can also lead to gingival tissue irritation and dehydration. This dehydration can be problematic, as bacteria and plaque build-up are not washed away by saliva, which can lead to periodontal disease. (Khairnar et al., 2017).

Oral Hygiene Habits

The Journal of Health Disparities conducted the National College Health Assessment to better understand the dental health practices of college students in the United States. The findings of the assessment revealed a decline in the percentage of students who reported having an annual dental exam and cleaning from the fall of 2006 to the spring of 2013. The assessment also found that the percentage of students receiving an annual dental exam declined following freshmen year (Dewald et al., 2016).

Because many students experience independence for the first time in college, the college years are seen as an important time to establish positive health habits (Crabtree et al., 2016). Stress, limited access to oral hygiene products, and lack of time could possibly contribute to the oral hygiene habits of students. However, more research is needed to understand the habits of college students.

CHAPTER FOUR

Rationale

The findings of the literature review revealed the correlations between oral health and general health, and the significance of understanding the oral health of college students. Therefore, a survey was distributed at the University of South Dakota to explore the possible relationship between a college lifestyle and oral health at a public-Midwestern university. The survey was intended to better understand the oral health of students and their oral health risk factor usage, as well as determine awareness of the USD dental hygiene clinic.

By better understanding the current practices of college students, the hope is that changes can be made to improve the oral health of students. Additionally, increasing awareness of the effects of oral health on the body, as well as dental hygiene services available, can be beneficial in educating students. With college being formative years for one's health habits, it is essential that students practice proper oral hygiene.

CHAPTER FIVE

Methods

Materials

The survey was created de novo by the author and approved by the Institutional Review Board (IRB) at the University of South Dakota (USD). It was conducted online via Google Forms. The IRB approval can be found in Appendix A. The survey was made up of 45 questions: 44 multiple choice questions and one short answer question. The multiple choice questions provided options for participants to choose the answer that most applied to them. The short answer question prompted a question and included a space for participants to record their answer. None of the questions were required.

The first section of the survey attempted to understand the oral hygiene habits of participants based on their experiences between the ages of 1-14 years old. The results of this section were used for comparison with the following sections to gauge changes in oral hygiene practices. In this section, multiple choice questions asked participants about habits such as visiting the dentist, brushing and flossing, sealants and cavities, as well as their influences in going to the dentist.

The next section used multiple choice questions to understand the oral hygiene habits of participants based on their experiences between the ages of 15-18 years old, the time frame when the majority of participants would be enrolled in high school. Again, this section asked participants about oral hygiene habits, but also included questions regarding how frequently participants used tobacco, consumed alcohol, consumed soda or other sugary drinks, as well as drank water.

The third section asked participants about their experiences since starting college at USD. This section again asked similar questions as the previous sections to gauge changes in oral hygiene behavior. Participants were also asked about their current housing and dining situation at USD. A short answer question was also used for participants to share reasons they had seen a dentist in the past year.

The final section asked participants about their awareness of the dental hygiene clinic located on the University of South Dakota campus. Participants were also asked if they had ever visited the USD dental hygiene clinic. Finally, participants were asked about their awareness of oral health risk factors and disease.

Procedure

The survey was distributed to undergraduate and graduate students at the University of South Dakota via email and Facebook. The invitation to complete the survey included a brief description of the purpose of the survey, contact information for the principal investigator, and a link to access the survey.

Students who accessed the link were directed to the Google Forms survey via a secure connection and were presented with an IRB approved informed consent statement. The informed consent statement can be found in Appendix B. Acceptance of informed consent was implied if the participant continued and answered the first question. No identifying data were collected to ensure that all responses were anonymous.

CHAPTER SIX

Results

Participants

Participants were 479 students (98 males and 381 females) at the University of South Dakota who voluntarily completed the online survey. Data collected from demographic questions revealed that the largest age group represented was 18-22 years old (n=219), however other age groups included were 23-27 years old (n=124), 27-31 years old (n=51) and over 31 years old (n=85). The majority of participants identified as white (n=431) but other racial and ethnic groups represented included African-American (n=5), Asian/Pacific Islander (n=14), Latino or Hispanic (n=14), Native American (n=8) and other (n=7).

The largest academic standing group represented were graduate students (n=244) followed by undergraduate seniors (n=70), undergraduate juniors (n=65), undergraduate freshmen (n=45), undergraduate sophomores (n=40), and undergraduate 5+ year students (n=14). Almost all participants were not international students (n=470), however 7 international students participated in the survey. Additionally, participants were asked to indicate the population size of their hometown and participants included groups from populations of 0-3000 (n=135), 3,000-7,000 (n=52), 7,000-15,000 (n=76), 15,000-25,000 (n=35), 25,000-250,000 (n=131), 250,000-1 million (n=39), and over 1 million people (n=10).

Table 1 describes the participants included in the study:

Table 1 – Participant Demographics

	Count (n=479)	Percentage (%)
Gender		
Male	98	20.5
Female	381	79.5
Age (years)		
18-22	219	45.7
23-27	124	25.9
27-31	51	10.6
Over 31 years of age	85	17.7
Racial or Ethnic Identity		
African-American	5	1
Asian/Pacific Islander	14	2.9
White	431	90
Latino or Hispanic	14	2.9
Native American	8	1.7
Other	7	1.5
Current Academic Standing		
Freshman	45	9.4
Sophomore	40	8.4
Junior	65	13.6
Senior	70	14.6
5+ Years	14	2.9
Graduate	244	51
International Status		
International Student	7	1.5
Not an international student	470	98.5
Hometown Population		
0-3,000	135	28.2
3,000-7,000	52	10.9
7,000-15,000	76	15.9
15,000-25,000	35	7.3
25,000-250,000	131	27.4
250,000-1 million	39	8.2
1 million+	10	2.1

Survey Data

The purpose of the study was to understand if a relationship exists between a college lifestyle, specifically at the University of South Dakota, and oral health. The survey aimed to evaluate the oral health practices of USD students, evaluate oral health risk factor usage, and test for significant interactions between oral health risk factor usage and oral health. The survey also assessed awareness of the dental hygiene clinic on the USD campus.

The key findings of the survey regarding the oral health practices of USD students were (1) the percentage of participants who visited a dentist twice a year declined from childhood to high school to college, with only 51.4% of USD student participants receiving two dental check ups in the past year (2) only 20.3% of participants reported that they floss daily (3) 37% of participants said that their gums have bled when brushing or flossing in the past month and (4) the most common reason (besides a routine check up or cleaning) that participants reported for having to visit a dentist in the past year was cavities. Participants were given the opportunity to share their reasons for visiting a dentist in the past year and responses are provided in Figure 1.

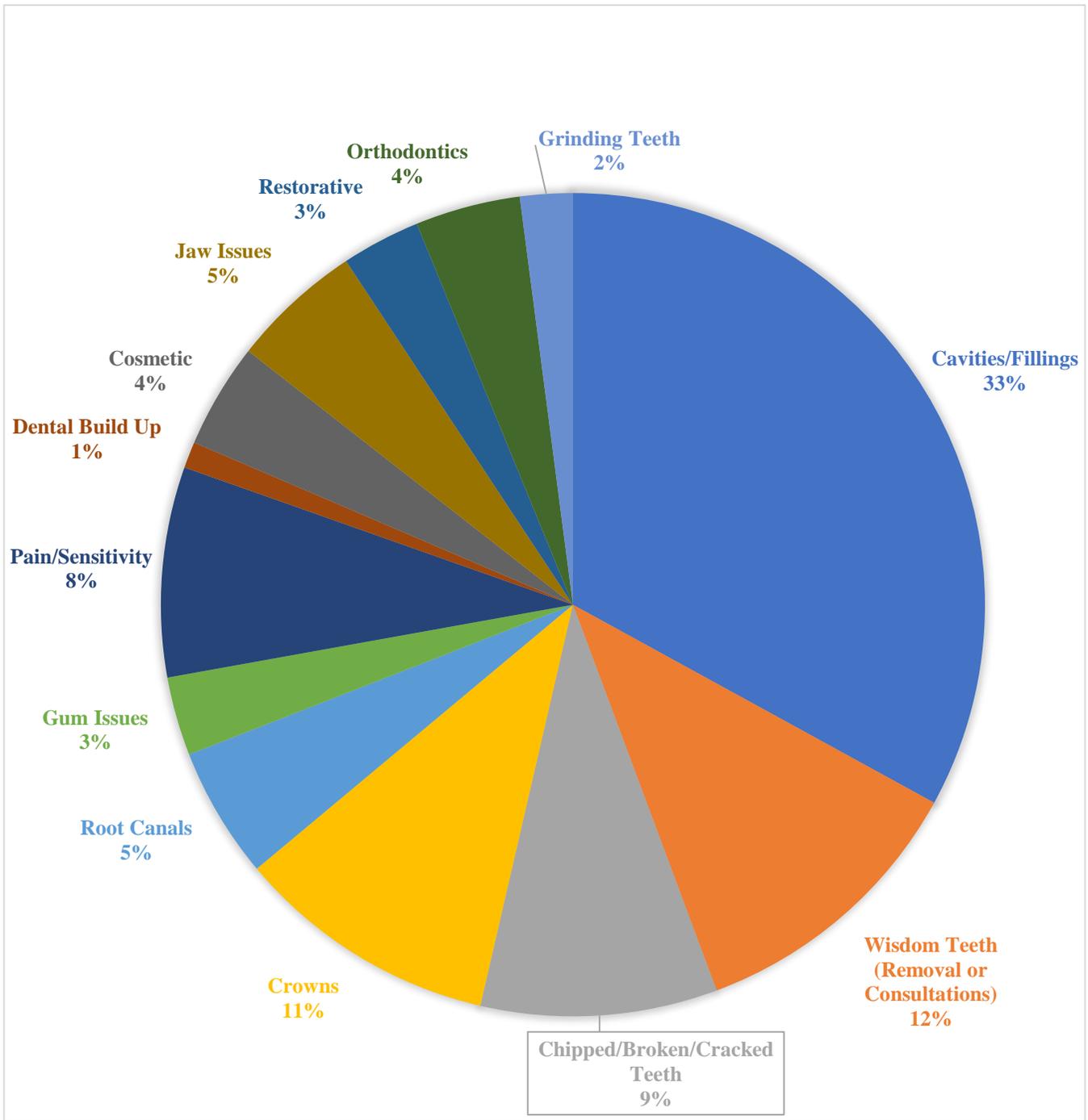


Figure 1. Reasons for visiting a dentist in the past year

In conjunction with evaluating the oral health practices of USD students, the survey included questions to gauge how prevalent the use of tobacco and alcohol is among students. A key finding of the survey was that the vast majority of participants reported that they never use smokeless tobacco (n=467, 97.5%), never smoke cigarettes (n=431,90.2%), and never vape e-cigarettes (n=434,90.8%), indicating that tobacco use is not especially frequent on the USD campus. Although tobacco use was low among participants, the survey found that 46% of participants (n=220) consume alcohol weekly.

Since previous research has suggested the risks that tobacco use, alcohol consumption, and poor diet pose for oral health, several χ^2 tests of Independence and Fisher's Exact Tests were then conducted to test for associations between these factors and oral health indicators. The χ^2 tests of Independence and Fisher's Exact Tests were conducted using the IBM SPSS software. No significant interactions were found between frequency of tobacco use, frequency of alcohol consumption, and number of healthy meals consumed each week with number of cavities since starting college, whether or not the participant's gums had bled in the past month, and whether or not they had visited a dentist for a reason other than a routine check up in the past year.

A χ^2 test of Independence was calculated to examine the relation between the frequency of soda and other sugary drink consumption and whether or not the participant's gums had bled when brushing or flossing in the past month. A significant relation was found $\chi^2(3, N=478)=16.50, p<0.05, V=.186$. Participants who consumed at least one soda or sugary drink per month were more likely to have their gums bleed when

brushing or flossing in the past month.

A χ^2 test of Independence was also calculated to examine the relation between the number of glasses of water participants drink per day and whether or not the participant's gums had bled when brushing or flossing in the past month. A significant interaction was found $\chi^2(3, N=478)=16.158, p<0.05, V=.184$. Those who reported drinking more glasses of water per day were less likely to report that their gums had bled when brushing or flossing in the past month.

Additionally, the survey compared where participants eat the majority of their meals, on or off campus, with the number of cavities they have had since starting college using a Fisher's Exact Test. A significant interaction was found ($p<.0001$). Participants who eat the majority of their meals off campus had more cavities since starting college than those who eat the majority of their meals on campus.

Additionally, the survey found that only 53% of participants are aware of the dental hygiene clinic available on campus, and only 13.4% of participants have ever visited the clinic. A χ^2 test of independence was calculated comparing whether or not the participant was majoring in a health related field and if they are aware of the dental hygiene clinic. A significant interaction was found $\chi^2(1, N=479)=4.968, p<0.05, V=.102$. Those participants majoring in a health related field were more likely to have been aware of the dental hygiene clinic.

CHAPTER SEVEN

Discussion

Oral health can serve as an important indicator for overall health and wellbeing. Attending college is often the first time young adults experience independence and resume a newfound responsibility for managing their oral hygiene. Therefore, it is important for young adults to develop proper foundational oral hygiene habits throughout their childhood and adolescence that they can continue to practice throughout their college years.

The goal of this study was to examine the possible relation between attending college at the University of South Dakota and the oral health of students. The survey attempted to assess the oral health practices of students and compare these to the oral health practices they used growing up. The survey also attempted to understand how prevalent the use of oral health risk factors and behaviors are at USD and compare these results to indicators of poor oral health. Additionally, awareness of the dental hygiene clinic on the USD campus was assessed.

Regarding the oral health practices of USD students, the percentage of participants who visited a dentist twice a year declined from childhood to high school to college, with only 51.4% of USD student participants receiving two dental check ups in the past year. This finding is consistent with the The American College Health Association-National College Health Assessment Findings which found a decline in the percentage of students who reported having an annual dental cleaning exam and cleaning from the fall of 2006 to the spring of 2013 (Dewald et al., 2016). A variety of possible reasons exist as to why the percentage of participants who visited a dentist twice a year is

declining. A study on behalf of the American Dental Association Health Policy Institute (HPI) found that for adults ages 18 through 34, the top three reasons for not visiting a dentist are not needing dental work, cost, and lack of time (Yarbrough et al., 2014). Although more research needs to be done to determine the reasons for the decline among USD students, these reasons likely apply.

Stress may also be a reason for the decline in visits. Attending college can expose students to many stressful situations. A study by Harvard Medical School researchers at Brigham and Women's Hospital that included more than 67,000 college students found that "three out of four students reported experiencing at least one stressful life event in the last year" (Younghans, 2018, para. 7). The stressful life events in the study included "academics, career-related issues, death of a family member or friend, family problems, intimate relationships, other social relationships, finances, health problem of family member or partner, personal appearance, personal health issues and sleep difficulties" (Younghans, 2018, para. 6). This stress could potentially lead students to forget and miss dental appointments, as well as ignore a regular healthy oral hygiene routine, as their focus is elsewhere.

Additionally, the vast majority of participants reported that their parents or guardians were their biggest influence on whether or not they visited the dentist between the ages of 1-14 (n=463, 96.7%) and between the ages of 15-18 (n=452, 94.4%). Because of this, it is possible students may experience anxiety taking initiative and seeking out dental care independently of their parents. However, insufficient information was found in the current literature regarding the influence that parents and guardians may have on

their children's dental care. Despite the reason, it is imperative for students to visit a dentist biannually.

Another finding of the survey was that only 20.3% of participants floss their gums daily. However, the percentage of participants who reported flossing daily increased between the ages of 1-14 to the ages of 15-18 and since starting college, suggesting that attending college at USD did not correlate with a decline in flossing daily. Nevertheless, the small percentage of students following the ADA's recommendation of flossing daily is concerning (ADA, 2017). Tooth brushing has been found to only clean the flat surfaces of the teeth. Therefore, interdental cleaning, through techniques such as flossing are necessary to remove plaque from interdental areas, as these areas are at an increased risk for microbial plaque accumulation and periodontal lesions (Claydon, 2008).

Another major takeaway of the survey was that 37% of participants' gums have bled when brushing or flossing in the past month. The ADA (2019) reports several reasons the gums may bleed. Brushing the teeth too hard can cause the gums to bleed, as well as flossing irregularly, as the gums are not used to cleaning between the teeth. Bleeding gums can also be a sign of gingivitis, the early stage of periodontal disease. It is essential that students brush and floss their teeth correctly and daily to prevent the gums from bleeding. If the gums are bleeding regularly, students should consult a dentist to prevent or diagnose any underlying conditions (ADA, 2019).

A significant relation $\chi^2(3, N=478)=16.50, p<0.05, V=.186$ was found between how frequently the participant consumes soda and other sugary drinks and whether or not their gums had bled when brushing or flossing in the past month. Those participants who consumed at least one soda or sugary drink per month were more likely to have had their

gums bleed when brushing or flossing in the past month. Added sugar intake through sugar sweetened beverages has been previously linked to dental caries and tooth decay and loss (Kim et al., 2017). Added sugar consumption has also been associated with periodontal disease (Lula et al., 2014) Although a significant relation was found, participants are drinking soda and other sugary drinks less frequently now than in high school, suggesting that attending college at USD is not related to an increase in soda and sugary drink consumption.

Figure 2 summarizes the differences in frequency of soda and other sugary drink consumption from high school to college.

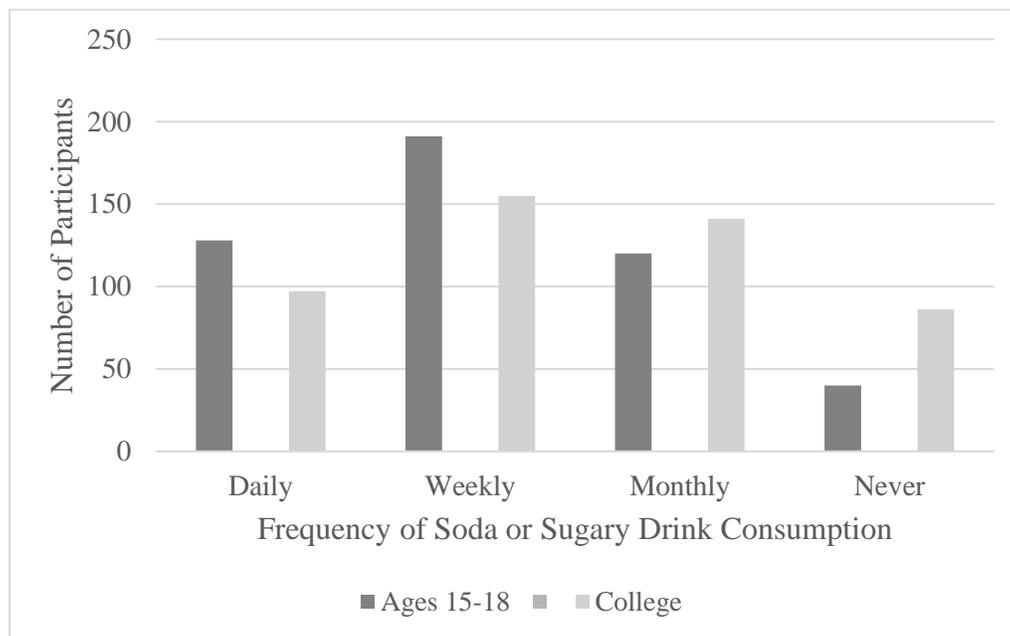


Figure 2. Differences in soda and sugary drink consumption between the ages of 15-18 and since starting college.

A significant relation was also found between the number of glasses of water the participant drank per day and whether or not the participant's gums had bled when

brushing or flossing in the past month. Those participants who reported drinking more glasses of water per day were less likely to report that their gums had bled when brushing or flossing in the past month. The ADA reports several reasons drinking water is beneficial for dental health. Drinking water assists in washing away leftover food and residue that cavity-causing bacteria feed off of, and fluoridated water helps to prevent cavities (ADA, n.d) The survey results were promising in that participants are drinking more glasses of water per day since starting college at USD than between the ages of 15-18.

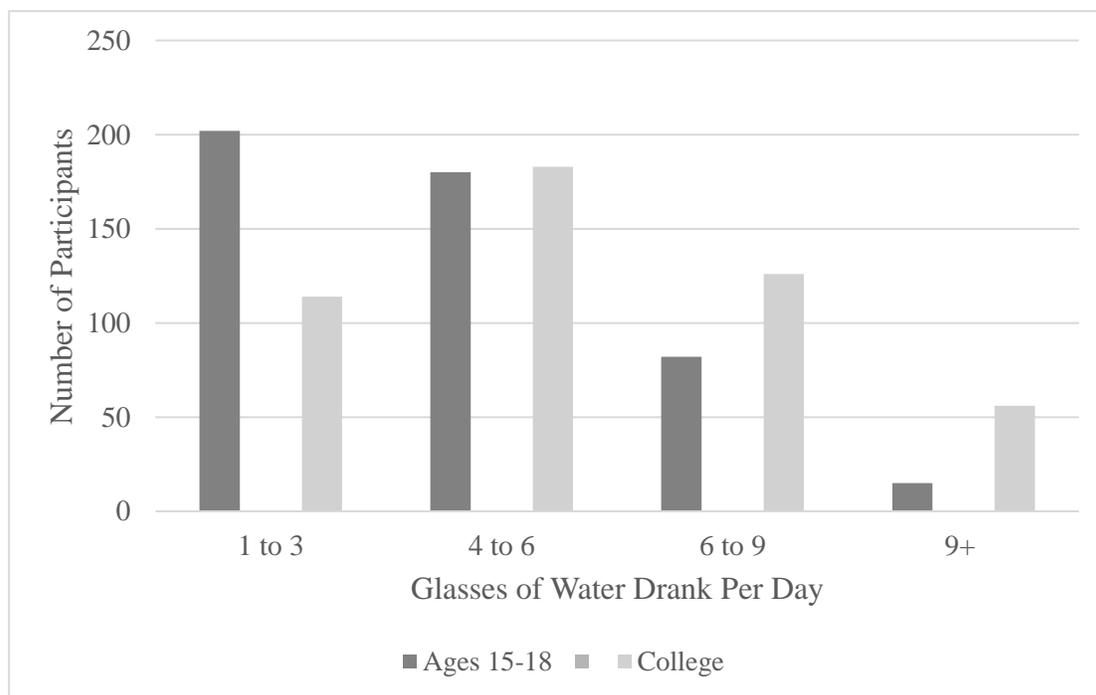


Figure 3. Differences in glasses of water consumed per day between the ages of 15-18 and since starting college.

When assessing tobacco and alcohol use, the survey found that the majority of participants never use smokeless tobacco, smoke cigarettes, or vape electronic cigarettes. This finding was promising considering the risks tobacco use poses for oral cavity and

oral pharyngeal cancer. According to a 2016 Center for Disease Control (CDC) report, cigarette smoking was highest in the Midwest, with 19 of every 100 adults being current smokers (CDC, 2018). The fact that the majority of participants never use tobacco is encouraging at a Midwestern university. This finding was also consistent with the CDC report which found that current cigarette smoking was lowest among adults with a graduate degree, indicating that those with higher levels of education may be more likely to be non-smokers (CDC, 2018). When examining the relation between tobacco use (smokeless tobacco, smoke cigarettes, or vape electronic cigarettes) and oral health indicators (number of cavities in college, bleeding gums, and if participants had seen a dentist in the past year for a reason besides a check up), no significant interactions were found.

Although tobacco use among USD students appeared to be low, weekly alcohol consumption is prevalent among students, with 46% of survey participants consuming alcohol weekly. However, no significant interactions were found between the frequency of alcohol consumption and oral health indicators. Nonetheless, it is critical that students are educated on the risks alcohol consumption poses on their oral health. Attending college increases students' risk for alcohol consumption. Several factors specific to a college environment increase risk for alcohol consumption, including communal living, flexibility in academic schedules, and university specific events (Merrill et al., 2016).

According to the National Survey on Drug Use and Health, "58.0 percent of full-time college students ages 18–22 drank alcohol in the past month compared with 48.2 percent of other persons of the same age." (NIAAA, 2018, p. 2). Alcohol abuse can lead to gingival tissue irritation as well as dehydration. This dehydration can be problematic,

as bacteria and plaque build-up are not washed away by saliva, which can lead to periodontal disease. Alcohol consumption is also considered to be a potential risk factor for oral cancer (Khairnar et al., 2017).

When comparing where participants eat the majority of their meals, on or off campus, with the number of cavities they have had since starting college, the survey found that participants who eat the majority of their meals off campus had more cavities since starting college than those who eat the majority of their meals on campus. Although those who eat the majority of their meals off campus reported having more cavities, these results were inconclusive. Further research is needed to understand the dietary habits of off campus students.

The survey also found that awareness of the dental hygiene clinic was not extensive, with only 50.3% of participants being aware of the clinic, and only 13.4% of participants having ever visited the clinic. Additionally, participants with health related majors were more likely to have been aware of the dental hygiene clinic. The following services are offered at the University of South Dakota Dental Hygiene Clinic (University of South Dakota, 2019).

- Blood pressure, pulse and respiration
- Dental x-rays
- Denture and partial care
- Fluoride treatments
- Impressions and study models
- Mouthguards
- Nutritional counseling

- Oral cancer screening
- Oral hygiene instruction
- Pain management
- Pit and fissure sealants
- Root planing and antimicrobial placement
- Teeth bleaching
- Teeth cleaning
- Tobacco intervention
- Tooth desensitization
- TMJ assessment

Research Limitations

The student survey has potential limitations. Regarding the frequency of soda and sugary drink consumption among participants, the survey was limiting in that participants were only given the choices of daily, weekly, monthly, or never to describe their consumption. Giving participants the opportunity to further describe their soda and sugary drink consumption, for example by asking how many times a day they consume soda and if they consume it only at meals rather than throughout the day, would have provided valuable information. The ADA suggests that drinking sugary beverages in one sitting, such as with a meal, rather than sipping them throughout the day is better for the teeth, as this limits the acid attacks on the teeth (ADA, 2019).

Additionally, while tobacco use and alcohol consumption both individually provide risks for oral cancer, combined exposure to alcohol and tobacco elevates one's

risk for oral and pharyngeal cancer significantly (Pelucchi et al., 2006). The survey did not include questions asking participants about their combined alcohol and tobacco exposure. Furthermore, it is possible that responses to the survey questions asking participants about their tobacco use could be skewed, as it is unknown whether participants consider electronic cigarettes to be tobacco products.

The survey question “Are you aware of the dental hygiene clinic available on USD’s campus?” could be open to interpretation by participants. It is possible that participants may have been aware that there is a dental hygiene clinic on the USD campus, but may have been unaware of the services available. This question could have been broken into several more specific questions to better understand if participants are aware of the location of the clinic, aware that students can receive services there, and aware of the services provided at the clinic.

CHAPTER EIGHT

Solutions

Considering the integral role oral and dental health plays in overall health and wellbeing, it is essential that students at the University of South Dakota are educated and aware of the importance of oral health. It is also important that students are aware of risks associated with poor oral health. By increasing awareness of dental services on and around USD's campus, as well increasing access to oral hygiene products, students may improve their oral health.

The first step in improving the oral health of students is through education. Public service announcement flyers could be made to educate students on the importance of oral health. These flyers might include oral health statistics, oral health risk factors, and recommendations for improving one's oral hygiene. The flyers could be hung up in buildings on campus, as well as dorm hallways. Another way to educate students on oral health and hygiene is hosting guest speakers on USD's campus, such as local dentists or dental hygienists.

Furthermore, increasing awareness of the dental hygiene clinic on USD's campus is critical as only 53% of survey participants are aware of the dental hygiene clinic available to students on campus, and only 13.4% of those who completed the survey have ever visited the clinic. By increasing awareness, students will be more apt to receive a dental cleaning. One way to raise awareness of the dental hygiene clinic is having dental hygiene students speak to introduction level courses and provide students with business cards that include the hours and location of the dental hygiene clinic. This would allow underclassmen to have an easy reference that they can keep with them throughout college

for when they are in need of a dental cleaning. Additionally, dental hygiene students could participate in tabling in the Muenster University Center to speak with students about the dental hygiene clinic and promote the services offered there.

In addition to increasing student awareness of the USD dental hygiene clinic, the university could partner with dental offices in Vermillion, SD. By establishing relationships with community dental offices, USD would have the ability to pass along their contact information to students, making the process of finding a dentist away from their hometown easier. This is especially important for USD students who are from far away, as they are not able to visit their hometown dentist as frequently.

To help improve flossing among students, as well as decrease cavities, the University of South Dakota could provide students with oral hygiene products. An oral hygiene product drive could be held annually, in which community members and surrounding dental offices would donate toothbrushes, toothpaste, and floss. These products could be redistributed to students, who may have financial difficulties purchasing them on their own.

Chapter Nine

Conclusion

The significance of oral health is often underestimated. The correlation between oral health and general health elevates the importance of practicing proper oral hygiene. The risky health behaviors of college students, including poor diet and tobacco and alcohol use can provide a challenge to maintaining good oral health at a time when developing foundational habits is crucial.

In order to improve the oral health of college students, the current oral health practices of students must be understood. Changes in oral hygiene habits from childhood to high school to college must also be addressed to determine the role that newfound independence may play. The diet of students, as well as their tobacco and alcohol usage must also be evaluated, as these behaviors contribute to oral health conditions, among them tooth decay, periodontal disease, and oral cancer.

Moreover, it is critical to increase student awareness of dental hygiene services. Dental care is often excluded from campus based student health plans. By making students more knowledgeable to the services available in their community, they are more likely to be proactive regarding their oral health, and less likely to wait until they go home to receive dental care. By better understanding the current state of oral health in college students and increasing awareness of dental hygiene services available, it is hoped that students may improve their oral health.

Appendices

Appendix A

IRB Approval



October 24, 2018

The University of South Dakota
414 E. Clark Street
Vermillion, SD 57069

PI: Turgeon-Drake, Jamie

Co-PI: Mutterer, Erik

Student PI: Hofmaier, Hannah

Project: Oral Health and Awareness at the University of South Dakota

Review Level: Exempt 2 **Risk:** No more than minimal

USD IRB Project Approval Period: October 24, 2018 - October 22, 2021

Continuation or Closure due: 14 days before the IRB expiration date of October 22, 2021

Approved items associated with your project:

Survey

Consent Statement

Advertisement

Dear Jamie Turgeon-Drake,

The study submission for the proposal referenced above has been reviewed and approved via the procedures of the University of South Dakota Institutional Review Board .

All updates and revisions to this protocol must be requested with an amendment

form. The proposed revisions may not be implemented until the amendment has been approved.

Any research-related injuries (physical or psychological), adverse events, or unanticipated problems encountered during the conduct of this research study need to be reported to the IRB within 5 days of it occurring or the PI being notified of it.

You have approval for this project through October 22, 2021. When this study has been completed, please notify the Office of Human Subjects Protection. If you wish to continue the study, a continuation application must be submitted at least 14 days prior to the expiration date.

If you have any questions, please contact: humansubjects@usd.edu or (605) 677-6184.

Sincerely,

A handwritten signature in black ink that reads "Ann Waterbury". The signature is written in a cursive, flowing style.

Ann Waterbury, MBA, CIM
Director, Human Subject Protection Program
University of South Dakota
(605) 677-6067

Appendix B

Student Survey Informed Consent Statement

UNIVERSITY OF SOUTH DAKOTA Institutional Review Board Informed Consent Statement

Title of Project: Oral Health and Awareness at the University of South Dakota

Principle Investigator: Jamie Turgeon-Drake, Beacom Hall 321, Vermillion, SD 57069
(605) 677-3902 jamie.turgeon-drake@usd.edu

Other Investigators: Erik Mutterer, East Hall 120 Vermillion, SD 57069
(605) 658-5966 erik.j.mutterer@usd.edu

Carissa Regnerus, East Hall 120, Vermillion, SD 57069
(605) 658-5962 carissa.regnerus@usd.edu

Hannah Hofmaier, 120 Old Main, Vermillion, SD 57069

Purpose of the Study:

The purpose of this research study is to understand the correlation between a college lifestyle and oral health and increase awareness of dental hygiene services in Vermillion, South Dakota.

Procedures to be followed:

You will be asked to answer 44 questions on a survey. The questions are in two formats: multiple choice and short answer. Multiple choice questions will provide choices and you will need to choose the best answer. Short answer questions will have a question and space to record your answer.

Risks:

There is some minimal risk in participating in this study. This survey will ask about alcohol and tobacco use prior to being of age. However, since this survey is anonymous and collects no identifying information there will be no way to link your responses to you.

Benefits

You may not benefit personally from participating in this research project however:

- You might learn more about yourself by participating in this study.
- You might realize that others have had similar experiences as you have.
- The information collected may help to increase awareness of dental hygiene services.

Duration:

It will take about 10 minutes to complete the survey.

Statement of Confidentiality:

The survey does not ask for any information that would identify who the responses belong to. Therefore, your responses are recorded anonymously. If this research is published, no information that would identify you will be included since your name is in no way linked to your responses.

All survey responses that we receive will be treated confidentially and stored on a secure server. However, given that the surveys can be completed from any computer (e.g., personal, work, school), we are unable to guarantee the security of the computer on which you choose to enter your responses. As a participant in our study, we want you to be aware that certain "key logging" software programs exist that can be used to track or capture data that you enter and/or websites that you visit.

Right to Ask Questions:

The researchers conducting this study are Jamie Turgeon-Drake, Erik Mutterer, Carissa Regnerus, and Hannah Hofmaier. If you have questions, concerns, or complaints about the research please contact Jamie Turgeon-Drake at (605) 677-3902 during the day.

If you have questions regarding your rights as a research subject, you may contact The University of South Dakota- Office of Human Subjects Protection at (605) 677-6184. You may also call this number with problems, complaints, or concerns about the research. Please call this number if you cannot reach research staff, or you wish to talk with someone who is an informed individual who is independent of the research team.

Compensation: You will not receive compensation for your participation

Voluntary Participation: You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled.

You do not have to answer any questions you do not want to answer.

For this study you must be 18 years of age older to consent to participate in this research study.

Completion and return of the survey implies that you have read the information in this form and consent to participate in the research.

Please keep this form for your records or future reference.

V 4.29.14

Appendix C

Student Survey

Demographic Questions

- What is your gender?
 - Male
 - Female
 - Other
- What is your age?
 - 18-22 years
 - 23-27 years
 - 27-31 years
 - 31 years or older
- To which racial or ethnic group(s) do you most identify?
 - African-American
 - Asian/Pacific Islander
 - White
 - Latino or Hispanic
 - Native American
 - Other
- What is your current academic standing?
 - Freshman
 - Sophomore
 - Junior
 - Senior
 - 5+ Years
 - Graduate Student
- Are you an international student?
 - Yes
 - No
 - Choose not to respond
- What is the population size of your hometown?
 - 0-3,000
 - 3,000-7,000
 - 7,000-15,000
 - 15,000-25,000
 - 25,000-250,000
 - 250,000-1 million
 - 1 million+

Please answer the following questions based on your experiences between the ages of 1-14 years old.

- Growing up, did you visit a dentist at least twice a year?
 - Yes
 - No
- How often did you brush your teeth?
 - Once a day
 - 1-2 times a day
 - 2+ times a day
- How often did you floss your teeth?
 - Daily
 - Weekly
 - Monthly
 - Never
- Did you ever have sealants placed on your teeth? Sealants are a thin protective coating placed on back chewing teeth to prevent cavities.
 - Yes
 - No
- How many cavities did you have?
 - 0
 - 1-3
 - 4-6
 - 6+
- Growing up, what was the biggest influence on whether or not you visited a dentist?
 - Parents/Guardians
 - Friends
 - School
 - Other

Please answer the following questions based on your experiences between the ages of 15-18 years old

- How often did you use smokeless tobacco?
 - Daily
 - Weekly
 - Monthly
 - Never

- How often did you smoke cigarettes?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often did you vape E-Cigarettes?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often did you consume alcohol?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often did you consume soda/other sugary drinks?
 - Daily
 - Weekly
 - Monthly
 - Never
- On average, how many glasses of water did you drink a day?
 - 1-3
 - 4-6
 - 6-9
 - 9+
- How often did you brush your teeth?
 - Once a day
 - 1-2 times a day
 - 2+ times a day
- How often did you floss your teeth?
 - Daily
 - Weekly
 - Monthly
 - Never
- How many times per year did you you receive a dental cleaning/check-up?
 - Twice a year
 - Once a year
 - Never

- In high school, what was the biggest influence on whether or not you visited a dentist?
 - Parents/Guardians
 - Friends
 - School
 - Other
- In high school, what was the main reason you went to the dentist?
 - Dental issues
 - Routine check ups

Please answer the following questions based on your experiences since starting college.

- How often do you use smokeless tobacco?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often do you smoke cigarettes?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often do you vape E-Cigarettes?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often do you consume alcohol?
 - Daily
 - Weekly
 - Monthly
 - Never
- How often do you consume soda/other sugary drinks?
 - Daily
 - Weekly
 - Monthly
 - Never
- On average, how many glasses of water do you drink a day?
 - 1-3
 - 4-6
 - 6-9
 - 9+

- Do you currently live on campus?
 - Yes
 - No
- Where do you eat a majority of your meals?
 - On campus dining
 - Off campus
- On average, how many healthy meals do you eat per week?
 - 0-3
 - 3-6
 - 6-9
 - 9+
- How often do you brush your teeth?
 - Once a day
 - 1-2 times a day
 - 2+ times a day
- How often do you floss your teeth?
 - Daily
 - Weekly
 - Monthly
 - Never
- In the past month, have your gums bled when you were brushing or flossing your teeth?
 - Yes
 - No
- In the past year, how many times did you receive a dental cleaning/check-up?
 - Once
 - Twice
 - Never
- At your last dental check-up, were you screened for oral cancer? An oral cancer screening is when the dentist examines the mouth, face, and neck for abnormalities.
 - Yes
 - No
- In the past year, have you visited a dentist for a reason other than a routine check-up?
 - If yes, please explain
- Have you ever visited a dentist in Vermillion, South Dakota?
 - Yes
 - No

- Are you majoring in a health related field?
 - Yes
 - No

Awareness

- Are you aware of the dental hygiene clinic available on USD's campus?
 - Yes
 - No
- Have you ever visited the USD dental hygiene clinic?
 - Yes
 - No
- Were you previously aware of the risk of tobacco and alcohol for oral cancer?
 - Yes
 - No
- Are you aware that gum disease may be a sign of undiagnosed systemic disease?
 - Yes
 - No

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