

A Thesis Presented to
The Faculty of Alfred University

An Epidemiological Study of Alfred University
Undergraduate Students' Oral Health Habits:
Changes in Habits and Behaviors in Response to the Transition of College Life

by

Elisabeth Estep

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Under the Supervision of:

Chair: Dr. Jean A. Cardinale

Committee Members:

Dr. Cheryld Emmons

Dr. Fred Farley

John del Campo, D.D.S.

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Abstract

College is a transitional period of young adulthood for many students, and there are limited studies that focus on how college affects students' oral health. The objectives of this study were to determine the current status of college students' oral health, to learn how much these students know about oral health care and prevention, and to see if these students' oral health habits and experiences change as they spend more time in college. A total of 100 Alfred University students participated in this study. At the time of data collection, these students have spent between one and five consecutive years in college. To gather information about students' current oral health and oral health changes since attending college, I used a combination of a self-reporting questionnaire and a photo-based observational oral exam. Data were analyzed using Minitab18 Statistical Software. As a whole, Alfred University students' oral health was shown to be most affected by signs of gingivitis, dental staining, and dental erosion. This study found that there is a general uncertainty among Alfred University students regarding oral health care and prevention. This study did not prove a linear relationship between consecutive years spent in college and changes in oral health habits. However, the fifth year demographic of students appears to cause a significant association between certain oral health variables and years spent in college. Further investigation into the fifth year student demographic could help deduce the reason behind this trend. This study will continue the discussion of oral health care at Alfred University for future generations through poster-based programming. The oral health habits that students develop while in college will likely influence their life-long oral and general well-being. Due to this, it is imperative that more research in the area of undergraduate student oral health is performed in the recent future.

Introduction

Oral health is a commonplace part of human life that is often taken for granted. The mouth is a window into the health of the human body as it can show signs of nutritional deficiencies, general infection, and systemic infection¹. Many people maintain their oral health by tooth brushing, flossing, and visiting the dentist; as a result they can often enjoy the benefits of positive oral health. Some people believe they should only see a dentist when they are in pain or think there is a dental problem. However, regular dental visits and routine dental hygiene can contribute to a lifetime of positive oral health. Dentistry is an exciting field that is always advancing through research. Because of this research, current oral health diagnosis and treatment are more refined than ever before.

The idea for me to investigate the oral health of college students was fostered by my desire to write a biology-based Honors Thesis that specifically relates to my personal career goals. Ever since I was fortunate enough to endure the process of orthodontics during my adolescent years, I became enamored with dentistry. Oral health care is a rewarding field that provides patients with appealing oral aesthetics and a positive quality of life. During the 2017-2018 Allen Term, I shadowed dentist John del Campo, D.D.S. at his general practice in Alfred, NY. I noticed that a number of college student patients came in for appointments during my time there. These patients confessed to del Campo that it had been more than six months since their last dental visit because of scheduling, convenience, and financial reasons. The phenomenon came to my attention that college student patients may be likely to skip out on preventive dental appointments which are imperative to their oral health status. I began to wonder if these students maintain their oral health habits once beginning college. Further, how does this transitional life experience impact college students' oral health as a whole?

Research performed in the oral health field often focuses on one of two age demographics: adults or children. For example, Melo et al. administered a nation-wide survey in Portugal to characterize the oral health status among the nation's general population of adults². The sample population included over a thousand individuals who were only identified as being older than fifteen years². This demographic includes a wide range of individuals without acknowledging the fact that an eighteen year old young adult might have noticeably different responses on the survey compared to an eighty year old subject. In the Journal of the Michigan Dental Association, Deppen published an article that specifically focuses on patients from age one to age six³. Pediatric dentistry is imperative because maintaining positive oral health is an integral part of children's overall health and development. Nonetheless, there are limited studies that focus on the specific transitional period of young adulthood often encountered during college years, especially with respect to oral health care.

The young adult demographic is important to study because college is transitional for many students⁴. University students can easily become preoccupied by the daily stresses of regular coursework, employment, extracurricular activities, and independent living⁵. Young adults are notorious for neglecting the maintenance of their oral health and general health due to poor oral health choices⁴. These poor oral health choices include: decreased brushing and flossing, consuming more sugar-sweetened beverages, smoking, and attending the dentist at an irregular frequency⁵. During this time of independence, college students form oral and general health behaviors that set a foundation for either long-term health advantages or an increased risk of future disease⁴.

Adults are generally more aware of how their oral health affects their oral health quality of life⁶. The longer oral health concerns go untreated, the more problems individuals are subject

to experience in the future⁶. An adult's oral health is a result of life-long habits and behaviors. Their current oral health could be seriously impacted by their young adult years⁷. This idea prompted me to choose my senior thesis research topic.

My primary intentions were to research current oral health statuses and habits of undergraduate Alfred University students while inquiring how these factors may have changed since they began college. I also found it valuable that my project initiated the discussion of oral health maintenance with my peers. By completing this study, I hoped that Alfred University students start to become more aware and active in their personal oral health care. This study investigates three major questions. First, what is the current status of Alfred University students' oral health? Next, how much do Alfred University students know about oral health care and prevention? Finally, do Alfred University students' oral health habits and experiences change as they spend more time in college? Originally, I hypothesized that enrolling in university negatively impacts the oral health of undergraduate students. The other two questions aimed to simply gather information about these students' oral health care experiences and knowledge.

As I began to endeavor this project, I looked into how to effectively study the processes which influence the dental health of a population. From an article published in 1959, Fulton discusses objective factors that should be considered while performing an epidemiological study⁸. These were group demographic characteristics, habitat of participants, and consideration of genetic transmission of certain dental traits⁸. Based on the nature of my research questions and the fact that I am not a licensed dental professional, I chose a less invasive path of data collection than Fulton advised.

I decided that the best way to gather the information I needed was to use a self-reporting questionnaire method. Crabtree et al. used a similar survey-method, and they warned about using

oral health phrases that were not easily recognizable to the general student body⁵. I designed this questionnaire to address common habits and experiences students may exhibit that signal poor oral health. Each one of these topics was followed by a question that asks whether the student has noticed a change in frequency of that habit or experience since attending college. Although we cannot truly know the state of each students' oral health before attending college, the generalized, anonymous self-reporting method was the most feasible option for data collection. The questionnaire also included two questions that targeted the students' oral health care knowledge. Additional to the survey, I decided to take photos of each participants' oral cavity to evaluate the presence of certain observable oral health features. Visible oral health features (inflammation, plaque build-up, etc.) can help distinguish between positive and negative oral health. Dental photography is popular among professionals because they can record and refer back to the oral health status of their patients at multiple angles when determining treatment methods⁹. As opposed to relying on subject-self-reporting, the photos I took allowed me to more accurately evaluate the current status of the students' oral health. Use images below as reference.

Evidence of Positive Oral Health

Evidence of Negative Oral Health



Figure 1. These photos are from participants of this study. Arrows indicate some examples of observable oral health features. Not all oral health features are marked with arrows.

Regardless of the findings from the data collected through my research appointments, I wanted to continue the discussion of oral health among college students. I recognized that the Alfred University Health & Wellness Center has an impact on students' learning about general and mental health through posters placed around campus. Amanda Khodorkovskaya, a Health and Wellness Coordinator, and Dr. del Campo, helped me create informational posters that educate college students on how to improve or maintain positive oral health habits (Appendices K through M). These posters grasp the idea that college students' current oral health habits can influence their general health in the future. Most importantly, these posters help spread knowledge of positive oral health habits for future generations of Alfred University students.

In the scheme of my entire thesis project, I am proud to have taken another step closer towards my future career in dentistry. Throughout this study, I have examined and contributed oral health research specific to the college-student demographic. Though this study does not specifically inquire about socioeconomic factors of all participants, it does initiate a topic of future research: do college students have adequate access to oral health care due to distance from home, schedule of semesters, and ability to coordinate trips to their dentist office during academic breaks? My hope is that the discussion initiated with my research helps remind future generations of Alfred University students to maintain positive oral health habits while in college and throughout their lives. Doing so will improve their oral and general health in the future.

Introduction to Dental Anatomy

In order to discuss the appearance and effects of poor oral health, it is important to first understand the basic anatomy of a healthy tooth and gum region. Enamel is the hardest outer layer of the tooth. Enamel is mostly made of the rock-hard mineral, calcium phosphate. Dentin is a hard tissue that underlies the enamel. There are microscopic tubes in dentin known as tubules. Dental pulp is the softer, living inner structure of teeth. Blood vessels and nerves run through the pulp of the teeth, and can be stimulated through the dental tubules once enamel is damaged. Cementum is the layer of connective tissue that binds the roots of the teeth firmly to the gums and alveolar process of the jaw bone. The crown of each tooth projects into the mouth. The root of each tooth descends below the gum line, into the jaw bone. The neck of the tooth is the area between the crown and root region. The gingiva, or gum tissue, is the part of the soft tissue in the mouth that covers the alveolar process. The gingival margin is the edge of the gingiva closest to the biting or chewing surfaces of the teeth. While teeth are the hardest substances in the human body, maintaining the structural integrity of healthy teeth and gums is vital to the teeth's ability to function¹⁰.

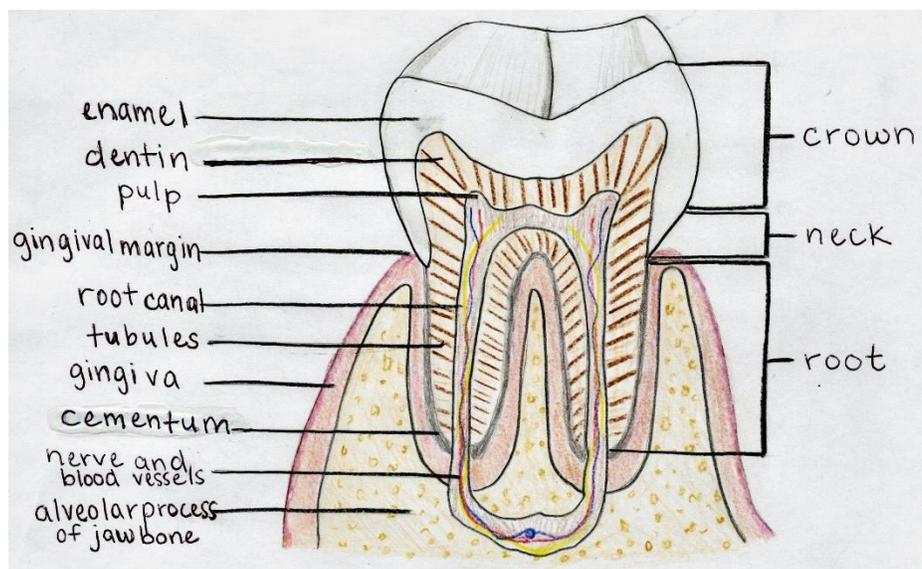


Figure 2. A cross-section of basic healthy dental and gingival anatomy.

Literature Review

A lifetime of oral health

At all ages, oral health significantly impacts quality of life. Aside from the notable pain and discomfort due to toothaches or gum sensitivity, oral health-related complications affect how people eat, exercise, sleep, socialize with others, and maintain emotional stability¹. The American Academy of Pediatric Dentists (AAPD) recommends that children begin their lifetime of dental care with an evaluation appointment when they are one year old. At this appointment parents should initiate an ongoing relationship between their child and dentist. The AAPD strongly suggests that parents continuously encourage comprehensive oral health habits at home; this is known as the ‘dental home’ concept¹. Maintaining positive oral health is an integral part of children’s overall health. High daily sugar intake and poor oral hygiene are major risk factors for the development of childhood dental caries. In 2014, dental caries were the most common chronic disease that a child could contract¹¹. Pediatricians often observe higher instances of morbidity associated with their patients’ dental caries or tooth decay¹¹.

A 2017 study investigated population trends in oral health using the United States National Health and Nutrition Examination Survey records from 1971 to 2012. The researchers found that most adults develop dental caries or periodontitis during their lifetime. Periodontitis is the chronic inflammation of tissue surrounding the teeth. Both dental caries and periodontitis are the most prominent, proximal causes of future tooth loss¹². In terms of overall health, Crabtree et al. found that when compared to people who report poor oral health habits, people who practiced excellent oral hygiene were significantly less likely to experience cardiovascular disease, strokes, high blood pressure, abnormal lipid levels and diabetes⁵.

Socioeconomic factors can have a significant impact on incidences of oral health complications. Rozier et al. noted that indicators of oral health become progressively worse, in terms of prevalence and severity, in a stepwise fashion as socioeconomic disadvantage increases¹². This leads to the discussion that social disparities due to family location, income, healthcare, and even literacy have a strong effect on the accessibility of oral health care. Oral health care accessibility for all ages is a prominent issue being combated by oral health care providers across the country¹².

College students' general & oral health

Generally, most college students fit into the young adult age demographic: the transition period between childhood and adulthood. This puts college students in an interesting position in regards to general and oral health habits. Depending on a number of factors, college students have the potential to alter their adolescent health habits while they are attending college. Research shows that students often stick with the health habits that they solidify during college as they fully transition into adulthood⁴. This could indicate that college students' who have poor oral health habits are more likely to continue the same poor habits in the future. Doing so may lead to an increased risk of oral health complications for the student after they graduate.

In theory, a university class schedule provides students with enough structure to keep a health-maintenance routine⁶. However, when students are introduced into a university environment, they have the freedom to create their own personal schedules. This can cause students to be overstressed, tired, busy, and they do not maintain certain facets of general⁴. Just because a college student has structured class schedule does not mean that they are following a regimented health routine. A longitudinal study at Penn State University followed 608 college students throughout their college career. Researchers found lacking general health habits among

the participants⁴. Study reports found that critical health behaviors, including fruit and vegetable consumption and physical activity, were not at optimal levels throughout students' college careers⁴. The transitional period of young adulthood during college is important to study because the general health behaviors that students form during this time of independence set the foundation for either long-term health advantages or an increased risk of disease in the future⁴.

A limited number of researchers follow how university-life affects college students' oral health. Maqsood et al. believe that the daily undergraduate class schedule pattern could easily provide a routine for students to keep up habits like brushing and flossing⁸. However, students often experience heightened stress and form unhealthy habits like sporadic sleep patterns which may severely affect the patterns of their oral health care⁵. Students' anxiety associated with dental care can also play a role in their maintenance of oral health care. The term 'dental anxiety' refers to the specific stress response a patient has towards dental situations¹. Dental anxiety affects the ability for dental professionals to accomplish treatment successfully, and also causes students to avoid dental treatment altogether¹³. Maintaining positive oral health habits is important in terms of preventing caries, periodontitis and tooth loss as well as general health issues like heart disease. Furthermore, practicing good oral hygiene helps a students feel good which contributes to their social image and self-esteem¹⁴.

Overall, a college student's oral health status is representative of their preventative oral self-care and behaviors leading up to their matriculation in college¹⁵. Their oral health could also be highly influenced by the transitional, less-structured, and stressful university lifestyle⁷. At this point, there are few oral health studies published that survey the specific demographic of college students. Presently in the United States, a large percentage of college students begin their undergraduate education immediately after finishing high school, and live on campus in

university residence halls⁴. However it must be noted that this “standard college experience” is not identical for all students. Some students begin college later in life as adults, some live in off-campus housing, and some commute to campus from their family home. These considerations of student demographics were taken into account as the study was designed. Overall, this research gauges Alfred University students’ current oral health statuses, and investigates how students’ current oral health and oral health habits may have changed since attending college.

Observable oral health traits

Observable oral health traits can be powerful indicators of morbidity, poor oral hygiene risk, and past dental care. While surveys are important to determine how a population believes their oral health habits have changed over time, self-reporting is not always accurate. Analyzing observable oral health traits can help gather visible information of each individual’s oral health and consequently, their oral health habits. A discussion follows of each observable oral health trait considered in this study. These traits are in order of increasing severity, and impact on the individual’s past, present and future oral health.

Striations on interior lip tissue can be observed in the form of oral lichen planus (OLP). OLP is a chronic inflammatory disease characterized by bilateral white striations or lesions that develop on mucosal surfaces, including the lips, tongue and gums. OLP is an autoimmune disease in which the body’s cytotoxic T cells trigger programmed cell death of the basal cells in the oral epithelium. This cell death presents itself as lesions in the oral epithelium. OLP can cause discomfort in individuals when eating and drinking extremely hot or cold, acidic, coarse, or spicy foods. If left untreated, the striations can develop into ulcers which cause pain even when not eating or drinking. According to Sandhu et al., OLP onset and progression has been definitively associated with stressful life events¹⁶. Also, this disease is chronic, so once it is

contracted it can never be eliminated; however, it can be controlled with prescribed therapy treatment¹⁶. Severe observable striations may indicate an individual's experience with stress, and even an absence of professional dental care.

Dental translucency is the observable result of a chemical breakdown of enamel (the thin outside layer on teeth)¹⁷. Dental translucency has numerous possible causes. Dental translucency can increase with age due to enamel degradation associated with senescence¹⁷. Translucency can also be caused by acid erosion¹⁸. Acid erosion commonly occurs due to acidic beverage consumption (such as soda) and acid reflux¹⁹. These acids have low-pH values which demineralize and soften the tooth¹⁹. This demineralization of enamel is permanent and makes the enamel on teeth more susceptible to physical damage and decay¹⁹. Dental translucency shows possible evidence of consuming high amounts of acidic beverages or other health conditions like acid reflux.

Staining and discoloration of dental surfaces has primarily become a topic of aesthetics in the field of dentistry²⁰. The two types of dental staining, extrinsic and intrinsic, are visually similar to the untrained eye, but have different causes. Extrinsic staining occurs on the outside, enamel layer of the tooth²⁰. Extrinsic staining can be influenced by a number of factors including poor tooth brushing techniques, tobacco products, and colored food and drink intake²¹. This extrinsic form of dental staining can be easily corrected through prescription and over-the-counter whitening products. Intrinsic staining is dental discoloration below the outside enamel surface²⁰. An intrinsic stain occurs when stain-causing particles work through the exterior of the tooth and accumulate within the tooth enamel. The intrinsic type of staining typically occurs as teeth develop during childhood and is less easily corrected²⁰. This is because the whitening products used must be more powerful to penetrate the exterior enamel layer. Dental staining and

discoloration may indicate an individual's past and present oral hygiene and consumption of stain-inducing products.

Dental fluorosis occurs when dental enamel has been overexposed to fluoride²². Fluoride is a naturally-occurring mineral that is known to prevent and control dental caries²². For this reason, routine fluoride exposure is encouraged by dental professionals. However, if used more than the recommended amount, dental fluorosis can occur²². This excessive fluoride contact causes increased porosity levels (hypomineralization) in the tooth structure²³. In some cases, fluorosis causes the enamel to appear opaque. In more severe cases, brown blotches can appear on the tooth surface²³. Although fluorosis can be cosmetically treated, the damage to the enamel is permanent²². Common causes of fluorosis include consuming fluoridated drinking water during childhood, ingestion of fluoride toothpaste, and use of fluoride tablets²³.

Dental plaque is the sticky film of bacteria that naturally inhabit the surfaces of the teeth and tongue¹. The bacteria in this biofilm adhere to the crevices and surfaces of the teeth which constitute the oral health microbiome. In a healthy mouth, the environmental conditions allow for the bacteria to interact harmlessly with the teeth without causing problems. However, high dietary intake of sugar and amylase-susceptible carbohydrates can cause bacteria that can tolerate acidic environments to predominate the dental plaque¹¹. *Streptococcus mutans* is a common pathogenic bacteria in this process because of its ability to ferment sugars, produce acid, and decrease the pH of the dental plaque¹¹. This process causes enamel demineralization and will result in cavity formation as bacteria decay the tooth³. Pathogenic bacteria in dental plaque can easily be removed with routine tooth brushing, flossing, and dental cleanings¹¹. If not removed on a regular basis, dental plaque growth is clearly visible on dental and gingival surfaces. Plaque

build-up is the most principle cause of cavity formation and gum irritation, and can indicate more severe oral health problems in the future²⁴.

Decalcification of enamel appears as chalky, white spot lesions on the tooth surface²⁵. Enamel decalcification is mainly caused by overexposing the tooth surfaces to acidic environments. The acid present in food, beverages, and pathogenic dental plaque have the ability break down the minerals of the enamel. This creates thousands of microscopic holes in the tooth which gives the affected tooth a chalky-white appearance²⁵. Instances of white spot lesions are aggravated by poor oral hygiene because the dental plaque and acidic residues left on the teeth are not being routinely removed. This issue is common among individuals undergoing orthodontic treatment because it is more difficult to properly clean the tooth surfaces under and around metal wires and brackets²⁵. When dental plaque and acidic residues are left on the teeth because of inadequate dental cleaning, enamel decalcification may be observed.

Dental fillings are one of main ways to restore a tooth damaged by decay back to its normal function and shape²⁶. To give a filling, a dentist must remove the decayed tooth material, clean the affected area, and then fill the cleaned out cavity with a filling material²⁶. In the past, easily visible silver amalgam was the most popular material used to fill cavities during treatment. More recently, dental composites have taken over in popularity. Dental composites are a polymer-based material that contains finely ground reinforcing glass or silica and can aesthetically mimic natural teeth²⁶. By closing off spaces where bacteria can enter, a dental filling helps prevent further decay²⁶. While not all fillings are noticeable to the naked eye, observable dental fillings help indicate an individual's poor oral health status due to the occurrence of dental decay.

A visible indication of poor oral hygiene is the presence of gingivitis. Gingivitis is the inflammation of gum tissue surrounding the teeth, and is often characterized by red or swollen gums that bleed while attempting to brush or floss²⁴. Gingivitis is caused by the natural accumulation of microorganisms around the border shared by teeth and gums that come to fruition as dental plaque²⁷. If left untreated, gingivitis can advance to periodontitis²⁸. Periodontitis is represented by increased dental plaque accumulation, bacterial imbalance, and periodontal pocket formation²⁷. A periodontal pocket is caused when more space forms between the gum tissue and the teeth resulting in more space for bacteria to grow²⁸. Eventually, periodontitis can lead to gum recession, tissue destruction, and loss of the bone which holds the teeth in place. This natural succession of periodontal disease occurs in stages and requires early intervention by a dental professional²⁸. Daily tooth brushing and flossing helps remove the plaque that causes gingivitis and helps reverse the early stages of gingivitis over time¹¹. Visibly red and swollen gums can indicate poor oral hygiene as well as various stages of the periodontal disease progression.

Cracked teeth are a common representation of patient oral health status. Small cracks in teeth are often asymptomatic and can be more easily diagnosed using a magnifying device²⁹. When a crack runs from the biting surface of the tooth down into the soft, inner tissue, it becomes painful. Sometimes dental fractures go below the gum line and into the tooth root, and can split into pieces if not treated. The type of pain often associated with large fractures is often the same pain associated with dental caries (decay), pulpal pathology, or periodontal disease²⁹. This can be problematic for a dentist's diagnosis and may delay proper treatment methods. A number of factors can cause dental crack formation such as extreme tooth grinding, large fillings that weaken the tooth structure, chewing or biting on something hard, a blow to the chin or jaw,

and periodontal disease (if there has been bone loss)²⁹. Poor oral health maintenance and caries may accelerate the rate of fracture by weakening tooth structure²⁹. Observable cracked teeth can lead to the death of the tooth's nerve, infection, and possible abscess growth. Cracked teeth should be treated quickly so as not to require root canal treatment or tooth extraction in the future²⁹.

Tooth loss is the eventual outcome of the two most common dental diseases: periodontal disease and dental caries²⁸. Lifestyle has a large impact on adult tooth loss. Routine tooth brushing helps remove the pathogenic dental plaque that can lead to decay, cavities, and periodontal diseases. The harmful chemicals in cigarettes and chewing tobacco are known to increase oral cancer and tooth loss risks²⁸. Poor nutrition can also affect tooth loss. Teeth need a number of essential nutrients, such as calcium, vitamin D, phosphorus, potassium, and vitamin C, to stay strong. A diet that lacks these nutrients leads to an increased risk for decay, breakage, and tooth loss²⁸. Foods high in acid, sugar, and carbohydrates are also shown to increase the plaque on your teeth, eventually leading to cavities and weakened teeth. In their 2018 study, Koka and Gupta found that there is a positive correlation between missing tooth count and all-cause and cardiovascular disease mortality³⁰. This relationship must be viewed in the broader context of the individual's nutrition, socioeconomic strata, education level and overall access to care³⁰. When an individual has lost a permanent tooth due to decay or periodontal disease, it may indicate that their oral health is not well-maintained.

Lip sores commonly present themselves as blister-like lesions on the soft lip tissue which can spread to other areas in the mouth. When a patient complains about a soreness in their mouth, an oral health professional should investigate the patient's oral cavity for ulcers, blisters, white patches or any other abnormalities³¹. Lip and mouth sores can have several origins

ranging from minor causes to serious illnesses. Oral sores are most commonly caused by physical or chemical trauma (biting lip, chewing tobacco, etc.)³¹. Then the ulcer is perpetuated by the growth of bacteria or viruses which can lead to infection. Lip sores could also signal the development of oral cancer which could have serious damage to the patient's oral and general health³¹. This is why lip sores should be a top priority for dentists to investigate.

Other signs of poor oral health

While poor oral health can be displayed by a number of different observable factors, dental hypersensitivity and teeth grinding are other indicators of poor oral health.

Dentin hypersensitivity is the pain experienced from exposed dentin in response to chemical, thermal, tactile or osmotic stimuli³². The most accepted theory of why exposed dentin causes pain is the hydrodynamic theory. This theory proposes that stimuli applied to exposed dentin will cause movement of dentinal fluid within the tooth. This fluid movement stimulates mechanoreceptors near the base of hollow tubes within the dentin to activate nerve fibers and trigger a pain response³³. Some factors that may cause dentin hypersensitivity are enamel loss, gingival recession, erosion (intrinsic and extrinsic), periodontal disease, and excessive tooth brushing³². Experiencing dental hypersensitivity can be an indicator of several oral health related issues, and can be treated with the assistance of professional dental care.

Bruxism, or teeth grinding, is a habit prevalent in about a third of adults and typically occurs subconsciously or while asleep³⁴. Frictional forces applied from teeth grinding cause tooth wear and destruction³⁵. This increases the individuals' probability of developing dentin hypersensitivity, dental caries, and needing restorative procedures³⁶. Bruxism has long been held as a physical manifestation of stress and anxiety, but can also be due to poor sleep hygiene³⁶.

Those affected by bruxism are often advised to wear a mouth guard while sleeping to protect their teeth from damage. Reporting instances of bruxism may indicate an increased risk of developing other oral health problems.

Beverage consumption that influences oral health

Habitual consumption of certain beverages such as coffee, tea, sports drinks, energy drinks, and carbonated soft drinks can have a detrimental effect on oral health.

Coffee and tea consumption are two of the main habits that can induce tooth staining and discoloration. Research has shown that secondary metabolites in these beverages such as tannins, caffeine, tartaric acid and phenols are predominantly responsible for this staining and discoloration³⁷. Caffeine is also associated with an increase of periodontal diseases, decreased bone mineral density, increased risk of fractures and negative influence on calcium retention³⁸. Consuming coffee and tea on a regular basis may negatively affect a person's oral health.

Sports and energy drinks are designed to prevent dehydration and replenish energy. These types of drinks are popular among athletes who exercise frequently, and often cause a decreased flow of saliva. Saliva is important because it acts a buffer for acid-producing bacteria in the mouth. Losing that saliva buffer causes oral bacteria to proliferate at a higher rate³⁹. Sports and energy drinks are made to quench this thirst during exercise, but are typically acidic and high in sugar¹⁸. This creates a susceptible environment for enamel demineralization and further dental decay³⁹. Regular consumption of sports drinks and high energy drinks can potentially lead to dental erosion and caries⁴⁰.

Consuming carbonated soft drinks is known to be associated with tooth decay. The main concerns with these beverages are their carbonation, pH, and sugar content²⁰. The carbonation

and low pH erode surfaces of the teeth not covered by dental plaque. The microorganisms in the dental plaque feed on the fermentable sugars that coat the teeth which generate more acid to form caries¹⁸. Research has shown that children are more adversely affected by regular soda consumption since their teeth are still developing¹⁸. Diet sodas were developed to reduce the caloric intake associated with soft drinks and use artificial sweeteners not metabolized by oral bacteria. However, both regular and diet soft drinks contain phosphoric acid and citric acid which erode the dentition¹⁸. High consumption of carbonated sodas can indicate a higher risk of developing oral health problems.⁴¹

Oral health care & prevention

There are common habits and practices that should be performed in order to care for oral health maintenance and prevent oral disease development.

Mechanical removal of bacterial plaque through tooth brushing remains the primary method for controlling supra-gingival accumulations⁴². Pediatric dentists recommend that a child should begin tooth brushing after their first tooth eruption and continue throughout the remainder of their life⁴³. To maintain good dental health, dentists recommend that individuals brush their teeth two times a day⁷. Individuals who brush their teeth infrequently are proven to be at greater risk for carious lesions than those who brush more frequently⁴⁴.

Flossing in between teeth is another important oral self-care technique to remove dental plaque. Flossing helps reach the interdental areas, which cannot be reached by a toothbrush. These areas are more likely to accumulate hard plaque deposits which can lead to development of gingival lesions and caries⁴². Flossing stimulates an area of the gum tissue that is not cleaned by a tooth brush. This stimulation can cause gingival bleeding in individuals who have

gingivitis²⁷, and it is often a deterrent for those attempting to floss. In general, flossing is widely considered to be a difficult and time-consuming process; due to this, it is often avoided altogether. However, many are unaware that gingivitis is a dental condition that can be reversed with consistent oral hygiene practice (tooth brushing and flossing). Flossing is an easy way to help reduce the risk of developing gingivitis.

Using oral mouthwashes and rinses have become another customary oral self-care routine used to freshen breath⁴⁵. Usually mouthwashes are antiseptic solutions intended to reduce the microbial load in the oral cavity. Mouthwashes containing fluoride can help protect teeth against acids produced by plaque bacteria if used after brushing and flossing⁴⁶. Other chemicals, such as chlorhexidine, can be prescribed as a mouth rinse after oral surgery because of its strength in controlling dental plaque⁴⁵. Using oral mouthwashes as part of a larger oral health care routine can be beneficial for most individuals. However, using oral mouthwashes in place of brushing and flossing will not help protect against oral diseases to the same degree.

Regular dental cleanings and oral health check-ups are an important part of preventive health care, especially for adolescents⁴⁷. Currently, most dental practices or clinics follow a standard model of how these appointments take place. During a dental cleaning a dental hygienist will clean the patient's teeth and check for cavities or other alarming signals⁴⁸. During a preventative oral health checkup, a dentist will evaluate the patient's risk for developing other oral health problems, check their face, neck and mouth for abnormalities, initiate diagnostic procedures and determine treatment plans if needed⁴⁸. Routinely attending each one of these appointments is imperative to the patient's oral and overall health; most dentists recommend these appointments happen every six months⁴⁹. It must be noted that some dental practices combine both of these appointments in the same visit for convenience purposes while others

schedule each appointment separately. This could potentially cause uncertainty regarding the purpose of each appointment for the patient.

Fluoride is known to play a major role in dental caries prevention. Community water fluoridation has been deemed an effective and safe means of preventing dental caries, even though it has raised public objections regarding safety and autonomy¹⁵. The American Dental Association recommends that all individuals receives topical fluoride treatment in addition to drinking fluoridated water and using over the counter fluoridated toothpastes²². Regardless of caries risk, these fluoride treatment programs typically provide fluoride treatment to children in the form of varnishes, gels, foams, and rinses⁴⁶. In certain impoverished areas, school-based fluoride programs are offered to children with high caries risk⁴⁶. This exposure to fluoride as a means of caries prevention is vital to children's current and future oral health well-being²².

Even though oral health is undoubtedly important at all ages, the college student demographic may be at a potential risk for developing poor oral health and oral hygiene habits. This could affect the oral quality of life these students experience for the remainder of their adult lives. By analyzing photos and questionnaire responses, this study gathers observable oral health data, and self-reported information regarding how college impacts undergraduate students' current oral health and oral health habits.

Methods

Oral health questionnaire & photo checklist development

Both the oral health questionnaire and the photo checklist were designed to gauge the oral health status and habits of the research participants.

The oral health questionnaire used in this study is presented in Appendix A. The questionnaire includes a demographics section and an oral health section. Most questions required participants to circle the response that best applied to them while some questions prompted them to write in their own responses. Responses were coded in general groups based on all responses given. The demographics section of the questionnaire asked the participant's age, sex, consecutive years spent in college, and major or intended major. The demographic section also asked the participant's student status (part time or full time) and living situation during each year spent in college (on campus, off campus without a parent or guardian, and off campus with a parent or guardian). The oral health section questions ask about the participant's current frequency of a habit or experience followed by a question asking about how this habit or experience may have changed since attending college.

In addition to the oral health questionnaire, a checklist was developed to observe oral health traits from photos of each participant. Appendix B presents the checklist used for observing the photos. The observable oral health traits I looked for are displayed in Table 1 below. The criteria I used to designate the presence of each oral health variable are next to the corresponding trait. Each observable oral health variable on the checklist inquired the presence of that oral health trait (yes, no or unsure). In the case that I was uncertain whether to designate presence or absence of a trait, I compared the photos to online reference images. I used the

“unsure” response when the photo itself was insufficient or the participant could not properly insert the cheek retractor to fully observe that oral health variable.

Table 1. Criteria used to identify each observable oral health trait.

Observable Oral Health Trait	Criteria for Observations
Lip Sore(s)	One or more visible blister-like, red sores on lip tissue.
Broken/Chipped Teeth	Visible chips or breaks in dental enamel causing noticeably uneven dental anatomy.
Red/Puffy Gums	A more pronounced red color and swollen texture in one or more areas of the gingival margin.
Food Caught in Teeth	Visible food particles in between teeth.
Plaque Build-up	Colorless to pale yellow deposits visible on gum or teeth surfaces. Primarily looked for deposits around the gingival margin.
Decalcification	White spots visible on tooth surfaces. Often located in the middle of the crown.
Missing Teeth	One or more visible gaps in typical tooth arrangement. An absence of a tooth that should be present.
Fillings	Visible silver, gold, or amalgam fillings on tooth surfaces. Did not attempt to distinguish composite fillings using participant photos.
Fluorosis	Opaque paper-white streaks visible on teeth for mild fluorosis. More severe cases develop brown spots in the enamel. Randomly distributed.
Staining/Discoloration	Noticeable darkening or discoloration of teeth pigmentation as a whole. Compared to a paper-white color.
Translucency	Observable loss of opaqueness of teeth. Usually visible on the biting edges of frontal teeth.
Lip Striations	Any visible series of linear marks on lip tissue. Including lines formed from dry, cracked lips.
Orthodontic Appliances	Observable metal fixtures, wires, brackets, or elastic bands situated in the oral cavity at the time of the photo.

Subject recruitment & study sites

A total of 100 enrolled Alfred University undergraduate students aged 17-24 years were recruited as research participants (Table 2). There were reported participants from all four

undergraduate colleges at Alfred University: School of Art & Design, Inamori School of Engineering, College of Liberal Arts & Sciences, and College of Business. In this study, consecutive years spent in college was the primary demographic of further investigation. This was because it is the demographic best related to the research question; as opposed to simply looking at age. Participants were distributed between a minimum of one and a maximum of five consecutive years spent in college (Table 3).

Table 2. Age distribution of 100 undergraduate Alfred University students aged 17-24 years included in the study.

Age (years)	Number of individuals
17	2
18	29
19	27
20	20
21	12
22	7
23	2
24	1
TOTAL	100

Table 3. Distribution of individuals in terms of consecutive years spent in college and reported sexes.

Consecutive years spent in college	Male	Female	Other	Number of individuals
1	8	23	--	31
2	10	18	2	30
3	10	9	1	20
4	2	8	--	10
5	8	1	--	9
TOTAL	38	59	3	100

-- Zero participants from the age class reported being a member of that sex.

All research appointments were held on Alfred University campus and were compliant with the provisions of the Human Subjects Research Committee. Initially, participation with this

study was only sustained through individually scheduled appointments held in the Science Center Room 303 or in the Biology Clubhouse if the prior room was occupied. This method resulted in low attendance and not enough subject participation. Instead, the protocol was changed to increase subject engagement. The most effective way to recruit subjects to participate in the research was to set up the appointment materials in highly-trafficked areas around campus (such as residence halls, dining halls and libraries). Specifically the other areas utilized were Moskowitz Hall, Tefft Hall, Herrick Library, Powell Campus Center and MidKnight Express. Participation was incentivized by placing every participant's name into a drawing to win one of four \$25.00 Amazon gift cards once research concluded. This drawing was performed by Alfred University Dean of Students Norm Pollard on Friday, December 7, 2018.

Survey administration & oral examinations

Beginning each research appointment, participants received an informed consent document (Appendix C). Each participant wrote their full name on a 5" by 7" index card and placed the card into a designated container for drawing later. For safety, I wore disposable nitrile gloves to hand one disposal, plastic, adult-sized cheek retractor (Dental Corporation of America, West Chester, PA) to the participant. If they needed assistance, I instructed them on the easiest way to insert the cheek retractor. I took three photos of each subject, while not including any identifiable facial features (Appendix E). A Canon PowerShot ELPH 180 Digital Camera was used to take all participant photos. The subject removed the cheek retractor, and I disposed of it with the gloves I was wearing into a Biosafety Level 2 waste container. This method of disposal protects researchers that work with pathogenic agents associated with human diseases that pose a moderate health hazard. The subject completed the oral health questionnaire and received a debriefing statement document (Appendix D) upon departure.

Data management

All written, digital and electronic data and materials were housed and locked in Science Center 327 when not in use. All digital photos were uploaded to a secure password-protected research laptop, cropped if needed to exclude identifiable features, and used to gather observations using the photo checklist while in the security of that office space. All written data from the photo checklists and the oral health questionnaires were further uploaded into a password-protected internet accessible server for future access while off-campus.

Statistical analysis

Statistical analyses were performed using Minitab Statistical Software⁵⁰. Thirteen variables from the observational photo checklist were assessed for association between consecutive years spent in college using the Chi-square test and a p-value < 0.05 was considered to be statistically significant. Out of the 59 possible variables to take from the oral health questionnaire, 33 variables were selected for further analysis. The responses from the chosen variables were not normally distributed using the Anderson-Darling test (all p-values < 0.005). This called for the use of the non-parametric Spearman correlation analysis to assess the association between consecutive years spent in college and each oral health variable.

Results

Observable current oral health status

Descriptive statistics were gathered from the photos taken of all 100 participants. Table 4 lists these observable oral health traits in order of high to low priority that a dental professional may approach them with treatment. The ‘overall’ column refers to the total number of participants who showed a presence of each observable oral health trait followed by that total broken down by percentage per class year. Broken or chipped teeth were the only traits found to be significantly associated with consecutive years spent in college from a Chi-Squared test for association.

Table 4. Consecutive years spent in college vs. the presence of an observable oral health trait.

Observable Oral Health Trait	% Presence Per Class Year					
	Overall	Consecutive Years ^a Spent in College				
		1	2	3	4	5
Lip Sore(s)	3.0	3.2	3.3	5.0	0.0	0.0
Broken/Chipped Teeth*	22.0	41.9	10.0	20.0	10.0	11.1
Red/Puffy Gums	94.0	90.3	96.7	95.0	90.0	100.0
Food Caught in Teeth	7.0	9.7	10.0	0.0	0.0	11.1
Plaque Build-up	54.0	58.1	63.3	50.0	40.0	33.3
Decalcification	22.0	16.1	16.7	30.0	20.0	44.4
Missing Teeth	4.0	7.1	0.0	10.0	0.0	0.0
Fillings	6.0	6.5	3.3	10.0	0.0	11.1
Fluorosis	13.0	9.7	10.0	20.0	10.0	22.2
Staining/Discoloration	83.0	83.9	80.0	80.0	80.0	100.0
Translucency	41.0	35.5	50.0	30.0	40.0	55.6
Lip Striations	2.0	0.0	3.3	5.0	0.0	0.0
Orthodontic Appliances	2.0	0.0	6.7	0.0	0.0	0.0

^a Sample size for years 1 through 5 are as follows: 31, 30, 20, 10, and 9 respectively.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Chi-Squared test.

Red pigmentation represents the varying percentages of participants who presented that trait.

Reported current oral health status & habits

Table 5 presents the following percentages of study participants who reported performing or experiencing the following oral health variables occasionally or every day. This represents their current overall status of oral health.

Table 5. Total percentage of study participants who report experiencing this oral health variable occasionally or every day.

Oral health experiences	Participants (%)
Soreness or tenderness in gums	67.3
Bleeding gums after brushing and/or flossing	83.0
Hypersensitivity	65.7
Clench jaw, grind teeth or experience a sore jaw	63.0
Consume coffee or tea	81.0
Consume sports drinks	80.0
Consume energy drinks	26.0
Consume regular soda	75.0
Consume diet soda	33.0

Participants also reported the frequency of their preventative oral health habits (Table 6).

This is listed based on what a dentist may advise their patients to do to maintain a healthy oral wellbeing.

Table 6. Total percentage of study participants who report the frequency of each preventative oral health habit.

Preventative oral health habits	Participants (%)
Brush teeth two or more times a day	62.0
Floss at least once a day	32.0
Use oral health mouthwash at least once a day	32.3
Dental cleaning within the past six months	61.1
Dental cleaning <u>every</u> six months	67.3
Oral health checkup within the past six months	65.6
Oral health checkup <u>every</u> six months	63.3
Participated in fluoride treatment program during youth	60.0

Reported knowledge of oral health care & prevention

Two questions from this questionnaire investigated the study participants' knowledge and certainty of their own oral health care and prevention. Overall, 19% of participants were unsure if they had participated in a fluoride treatment program during their youth. 31% of participants were unsure of the difference between a dental cleaning and a preventative oral health check-up. Total percentages of responses can be viewed in Appendix F.

Significant associations between reported oral health & consecutive years spent in college

The chosen oral health variables from the questionnaire were run through a Spearman correlation for non-parametric data. These statistical analyses tested the association between the oral health variable in question and consecutive years spent in college. Table 7 shows that current daily mouthwash-use was found to be significantly associated with consecutive years spent in college. Table 8 shows that the frequency of dental cleanings was found to be significantly associated with consecutive years spent in college. Table 9 shows that the change of diet soda consumption, coffee or tea consumption, teeth sensitivity, bruxism, flossing, and mouthwash-use since attending college all showed significant association with consecutive years spent in college. All other data tables did not show a significant association between contained oral health variables and consecutive years spent in college.

Upon review, the participant responses from those in their fifth consecutive year spent in college were causing the correlation to read as significant. Responses from first through fourth year college students were relatively similar to each other. I averaged first through fourth year student responses together to compare with responses from fifth year students. Unaltered tables without averaging can be viewed in Appendices G through J.

Table 7. Comparison of participant responses of current oral health habits and experiences: an average of first through fourth year students vs. fifth year students.

Current Oral Health Variable	Participants (%)					
	First through Fourth Year Students ^a			Fifth Year Students ^a		
	Never	Occasionally	Every day	Never	Occasionally	Every day
Sore Gums	33.4	64.5	2.1	11.1	88.9	--
Bleeding Gums	16.1	74.4	9.5	11.1	88.9	--
Hypersensitivity	32.1	63.8	4.1	22.2	77.8	--
Bruxism	35.1	52.9	12.0	22.2	66.7	11.1
Coffee/Tea	15.2	50.4	34.4	--	88.9	11.1
Sports Drinks	19.9	67.8	12.3	22.2	66.7	11.1
Energy Drinks	71.1	28.1	0.8	55.6	44.4	--
Regular Soda	22.3	62.6	15.1	44.4	44.4	11.1
Diet Soda	62.5	37.5	--	88.9	11.1	--
	<1 a day	1 a day	2+ a day	<1 a day	1 a day	2+ a day
Brushing	3.7	30.6	65.7	--	55.6	44.4
Flossing	66.6	29.3	4.1	80.0	10.0	--
Mouthwash*	73.4	21.7	4.9	22.2	55.6	22.2

^a Sample sizes for first through fifth year students are as follows: 31, 30, 20, 10 and 9 respectively.

-- Zero participants from the age class reported performing this activity at this frequency.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

Table 8. Comparison of participant responses of their most recent and the average frequency of dental cleanings and oral health checkups: an average of first through fourth year students vs. fifth year students.

Most recent	Participants (%)					
	First through Fourth Year Students ^a			Fifth Year Students ^a		
	≤6 mos.	7-12 mos.	>12 mos. / unsure	≤6 mos.	7-12 mos.	>12 mos. / unsure
Dental cleaning	60.8	14.6	24.6	62.5	12.5	25.0
Oral health checkup	66.1	14.7	19.2	62.5	12.5	25.0
Frequency	Every 6 mos.	Every 7-12 mos.	<Every 12 mos.	Every 6 mos.	Every 7-12 mos.	<Every 12 mos.
Dental cleaning*	62.0	15.4	22.6	66.7	22.2	11.1
Oral health checkup	60.1	19.2	20.7	62.5	25.0	12.5

^a Sample sizes for first through fifth year students are as follows: 31, 30, 20, 10 and 9 respectively.

-- Zero participants from the age class reported performing this activity at this frequency.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

Table 9. Comparison of participant responses of how oral health habits and experiences may have changed since attending college: an average of first through fourth year students vs. fifth year students.

Changes in Oral Health Variables	Participants (%)					
	First through Fourth Year Students ^a			Fifth Year Students ^a		
	Decreased	Not Changed	Increased	Decreased	Not Changed	Increased
Sore Gums	3.8	95.4	0.8	11.1	66.7	22.2
Bleeding Gums	9.6	78.3	12.1	33.3	44.4	22.2
Hypersensitivity*	2.1	82.8	15.1	--	55.6	44.4
Bruxism*	1.6	81.4	17.0	--	44.4	55.6
Coffee/Tea*	15.6	43.3	41.1	--	44.4	55.6
Sports Drinks	16.9	62.9	20.2	11.1	55.6	33.3
Energy Drinks	9.1	78.5	12.4	11.1	77.8	11.1
Regular Soda	21.0	49.7	29.3	11.1	66.7	22.2
Diet Soda*	13.3	74.6	12.1	--	88.9	11.1
Brushing	11.6	67.3	21.1	11.1	66.7	22.2
Flossing*	16.8	57.5	25.7	--	55.6	44.4
Mouthwash*	15.4	69.8	14.8	--	33.3	66.7
Dental cleaning	24.1	74.7	1.2	33.3	44.4	22.2
Oral health checkup	21.7	76.8	1.5	37.5	37.5	25.0

^a Sample sizes for first through fifth year students are as follows: 31, 30, 20, 10 and 9 respectively.

-- Zero participants from the age class reported performing this activity at this frequency.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

Discussion

This study examines the current observable oral health traits of a sample of Alfred University undergraduate students. At the same time, the study investigates the students' current oral health habits and experiences and asks how these factors may have changed since they began college. This was achieved through the use of a photo-based observational oral exam and a self-reporting questionnaire. It was hypothesized that enrolling in university negatively impacts the oral health of college students. Alfred University students' seem to be most affected by signs of gingivitis, dental staining, and other risk factors for dental erosion and caries development. I discovered there may be a general uncertainty among Alfred University students regarding oral health care and prevention. I also found that the population of students who have spent five consecutive years in college seems to be the main cause of significant associations between certain reported current and changed oral health variables and years spent in college.

Observable current oral health status

In this study, I observed the current oral health status of college students by looking for the presence of certain oral health traits in photos of their teeth. The presence of broken and chipped teeth was the only observable oral health that was found to be significantly associated with consecutive years spent in college. This is most likely due to 41.9% of first year students reporting the presence of this trait (Table 4). It is unknown why the first year students presented more broken or chipped teeth compared to the other class years. This could possibly be related to poor oral health maintenance, but it could also be related to student lifestyle or other demographic differences. These differences may include the possibility that first year students consume harder foods that are more likely to chip their teeth. Another possible difference could be that first students may play more direct contact sports that could lead to more blows to the

head and face region which can break their teeth. It must be kept in mind that this study only looks at a single cross section of Alfred University students at one point in time. In the end, determining the actual cause of this significant relationship was beyond the control of this study.

A majority of Alfred University students exhibit signs of gingivitis and either extrinsic or intrinsic staining factors. The observable oral health traits with the highest presence in all participants were swollen gums and dental staining (Table 4). Swollen gums were indicated by a more pronounced red color and swollen texture in one or more areas of the gingival margin. Dental staining was indicated by a noticeable darkening or discoloration of teeth pigmentation as a whole. The data also alludes to the fifth year student's overall poor oral health status as 100% of fifth year students surveyed presented swollen gums and staining (Table 4). This supports my hypothesis that spending more years in college can negatively impact oral health.

Data from the oral health photos indicates that students are using poor oral self-care techniques (inconsistent tooth brushing and flossing), and not removing of dental plaque accumulation. More than half participants presented colorless to pale yellow deposits on gum or teeth surface (Table 4). Students may also be subject to risk factors causing dental erosion such as acidic beverage consumption. Forty-one percent of participants presented translucency which was indicated by observable loss of opaqueness of their teeth (Table 4). This provides evidence that Alfred University undergraduate students present signs of oral health distress. This can imply that college students' are not always practicing positive oral health habits which can damage their oral health now and in the future.

There are a number of observable oral health traits presented in low amounts among all class years (Table 4), and there could be several reasons behind this. For example, undergoing orthodontic treatment during college is not customary in American culture, and could be why

only two participants wore orthodontic appliances at the time of their research appointments. As another example, national trends indicate a likelihood that more than six study participants have had a dental filling during their lifetime. However, I was only able to observe silver amalgam or gold dental fillings that were easily visible from participant photos. Fillings that match tooth color have become more prominently used in modern dentistry²⁶. This makes it more difficult for an untrained person, like myself, to accurately identify all sites of dental fillings. While the other majority absences of observable oral health traits could be due to positive oral health of the participants, it must be noted that a large number of factors contribute to observable oral health. Investigating all possible confounding variables could not be achieved by the scope of this project and will be addressed later.

Reported current oral health status & habits

Through a questionnaire I collected information on how students self-report their own current oral health experiences and hygiene habits. Self-reported data indicates a large number of participants could be affected by gingivitis, enamel loss, and dental erosion. Over half of all students reported that they experience gum soreness, bleeding gums after brushing and/or flossing, hypersensitivity, and bruxism occasionally or every day (Table 5). Similarly, a large majority of participants also reported that they are at risk for developing staining, dental erosion and caries. This is due to the fact that more than half of all participants reported that they consume coffee and/or tea, sports drinks, and regular soda occasionally or every day (Table 5). This is further evidence that college students' are experiencing signs of poor oral health, and they are practicing poor oral health habits that can lead to more oral health problems in the future. Diet soda and energy drinks were the only two beverages with occasional or every day consumption from less than half of all participants (Table 5). However, this might not have a

major positive impact because of high overall consumption of other beverages that are equally damaging to oral health.

In general, study participants reported mediocre oral self-care habits. For standard oral self-care prevention, all participants should be brushing their teeth with toothpaste at least twice a day and flossing at least once a day⁴². In terms of reported oral health self-care, 62% of all participants reported that they brush their teeth with toothpaste two or more times a day (Table 6). While this majority may be encouraging, only 32% of participants reported flossing at least once a day (Table 6). Less than half of participants report using mouthwash at least once a day (Table 6). While using oral health mouthwashes can be beneficial for oral health, its use has not been deemed a requirement among all dental professionals⁴⁵. This means that not all surveyed college students are currently practicing the recommended standard methods of oral self-care. These poor oral hygiene habits have the possibility of being instilled as lifelong habits for college students and can negatively impact their future oral health.

Data indicates that a large number of study participants do not routinely visit the dentist for either cleanings or oral health checkups. All of the questions inquiring about students' dental appointment attendance at the recommended standard frequencies (cleaning and oral health checkups) had responses below 68% (Table 6). This indicates that majority of surveyed college students are not having routine teeth examinations and cleanings by a dental professional. Further, it means that these students are missing out on crucial step of oral health care that is imperative for preserving positive oral health and avoiding oral health problems. It must also be noted that there are some discrepancies regarding dental appointment attendance among Alfred University students. This is because more students reported that they receive a dental cleaning every six months than students reported having actually been to the dentist within the past six

months. The reverse was true for oral health checkups. This helps support the key finding of the next section that there is general uncertainty regarding preventative oral health care among college students.

Reported knowledge of oral health care & prevention

Through the self-reporting questionnaire, I intended to gain insight into college students' knowledge of oral health care and prevention. Student participants indicated that they are uncertain of what preventative oral health care they receive. Fluoride treatment during childhood development is crucial for preventing caries; those who do not have this treatment could be at a higher risk for dental decay in the future²². Table 6 shows that 60% of participants reported having participated in a fluoride treatment program during their youth. However, data indicates that 21% of participants reported never participating in a fluoride treatment program, and 19% of participants were unsure whether or not they had ever participated in a fluoride program. After question #18 in the oral health questionnaire (Appendix A), 31% of participants indicated that they were unsure of the difference between a dental cleaning and an oral health checkup. This evidence of confusion could possibly be a result of participants who have never properly learned the reason behind the oral health care process during childhood. This could be common in participants who have simply followed what their parent, guardian and/or dentist has instructed them to do. Or it could be that a dental professional has never properly explained the importance of the different types of dental appointments or fluoride treatment during these students' lifetimes. In any case, uncertainty regarding oral health care can implicate that the surveyed college students may not actively maintain a stable oral health care routine in the future because they simply do not understand how it can negatively affect their oral health.

Reported current oral health & consecutive years spent in college

I utilized the oral health questionnaire to compare students' current oral health habits and experiences to the number of consecutive years they have spent in college. For the remaining data taken from the oral health questionnaire, I decided to average the responses of the first through fourth year students to compare to the responses of the fifth year students. I noticed that for a majority of cases, the fifth year class was the deviating variable in terms of percentages compared to the other classes. Doing this helps in drawing ultimate conclusions from the collected data.

Current mouthwash use and dental cleaning appointment frequencies were the only current oral health practices that were significantly associated with consecutive years spent in college. A majority of fifth year students reported using mouthwash once a day while the majority of other students reported using mouthwash less than once a day (Table 7). This was an unexpected finding and could be because fifth year students find using mouthwash to be more convenient than brushing and flossing. It is also possible that the fifth year students are unaware that mouthwash-use alone is not an adequate substitute for brushing and flossing. This is because mouthwash does not mechanically clean the plaque accumulation off of dental surfaces. The data surrounding current dental cleaning appointment attendance was an anomaly, and was not significant due to the fifth year student demographic (Table 8). A large proportion of first year students reported having a dental cleaning every six months which most likely caused this difference in trend (Appendix J). This is most likely due to the fact that this group of students were only in their first semester of college at the time of study participation. Hypothetically, if the first year students had a dental cleaning right before coming to school, it is likely they would report that they still have a dental cleaning every six months.

There are other important trends taken from current oral health practices and experiences related to consecutive years in college. The fifth year student population reported that they consume more coffee and/or tea compared to the average responses from all other class years (Table 7). This could be due to specific participant preferences, or the possibility that fifth year students seek more caffeinated beverages in order to increase alertness while attempting to complete their undergraduate career. The concept behind the reason why college students are in their fifth year of college is discussed more in depth later. This finding provides further evidence that spending more years in college can have a negative impact on oral health habits.

The fifth year students reported that they currently experience more sore gums, bleeding gums, hypersensitivity and bruxism than the average of all other students (Table 7). This indicates fifth year students are at a higher risk for gingivitis, oral pain from sensitivity, and dental erosion from grinding their teeth. Also, higher instances of bruxism could indicate higher levels of stress or poor sleep hygiene among the fifth year student demographic. This further supports the idea that oral health and oral health habits can be negatively affected by spending more years in college.

In terms of current oral self-care habits, fifth year students reported having poor oral health habits. The majority of fifth year students reported that they only brush their teeth once a day, and 80% of these students reported flossing less than once a day on average (Table 7). As the previous section indicated that all fifth year students use mouthwash once a day, it is also possible that the fifth year students do not know that mouthwash does not provide the same benefits of removing dental plaque that tooth brushing and flossing do. This possible misconception could mean that this group of students do not understand the importance of their oral self-care habits which could mean they are less likely to improve the habits in the future.

Substituting a tooth brush and floss with mouthwash for a long period of time has the potential to cause serious oral health problems such as increased dental caries, and the development of periodontitis.

The fifth year student population reported more signals of poor oral health compared the average of all other students. Even though the fifth year students report that they are visiting the dentist at a comparable frequency to their peers, their oral self-care practices can be questioned. These students are brushing and flossing less than the average of other students and use mouthwash more which could indicate a simple trend of desire for convenience among their class.

Reported changes in oral health & consecutive years spent in college

With the same self-reporting method, I endeavored to learn more about students' changes in their oral health habits and experiences after spending more years in college. I did this by including a follow-up inquiry after each oral health question that asks how that variable may have changed since attending college. There were more significantly associated reported oral health variables that changed for students since attending college than their current reported oral health variables. The variables significantly associated with consecutive years in college are hypersensitivity, bruxism, coffee and/or tea consumption, diet soda consumption, flossing, and mouthwash use (Table 9). Upon reflection of the data, I noticed that all fifth year students reported that they either increased or did not change the frequency of these six variables since attending college. Depending on the oral health variable in question, these reported trends could have positive or negative implications for the fifth year students. For example, not decreasing flossing or mouthwash use since attending college can seem like a positive oral health trend. At the same time, increasing or not changing hypersensitivity, bruxism, coffee and/or tea and diet

soda consumption since attending college can seem like a negative oral health trend. It is necessary to look further than statistical significance before deeming the importance behind what the data is presenting.

Apart from statistical significance, these data display a trend of changes in oral health habits for fifth year students. A majority of fifth year students reported that both coffee and/or tea consumption and bruxism increased for them since attending college (Table 9). This could be because fifth year students have experienced more instances requiring consumption of caffeinated beverages for alertness. These circumstances could cause poor sleep hygiene and more stress leading to bruxism. This supports the idea that the fifth year students' oral health habits may be negatively affected by spending more consecutive years in college. These majority increases in coffee and/or tea consumption and bruxism will affect the fifth year students' oral health in the future.

Compared to the average of all other students, fifth year students reported a higher percentage of their class having increased experiences of sore gums, bleeding gums, and hypersensitivity since attending college (Table 9). The fact that a higher proportion of fifth year students reported increasing these oral health variables since attending college recognizes a decline in dental care from the fifth year class. Possible reasons behind this are elaborated later. This can help further support how spending more years in college negatively affects the fifth year students' oral health.

While fifth year students' changes in brushing habits since attending college were comparable to the average of other students, their reported flossing and mouthwash use were not. The fifth year students reported more of an increase in mouthwash and flossing habits than their peers (Table 9). This increase in mouthwash use may indicate that using mouthwash is a more

convenient method to freshen breath compared to tooth brushing for fifth year students. Also, even though this data shows fifth year students reported an increase in flossing habits, the previous section states that 80% of these students floss less than once a day (Table 7). Even though positive progress for flossing is encouraging, the fifth year students' reported flossing habits are still not at the standard recommended frequency of once a day. This reinforces the idea that the fifth year students' oral health habits are not adequate to properly clean their teeth. This means that their teeth have less protection against dental diseases such as tooth decay and gingivitis.

Finally, a higher percentage of fifth year students reported that they have decreased their attendance to dental appointments since beginning college compared to the average of all other students (Table 9). Attending fewer dental appointments since starting college is a strong indicator that the fifth year students are not receiving adequate oral health care by a dental professional. This could mean that attending college has had a negative effect on the oral health of these students.

As a whole, fifth year students reported being subjected to a number of negative changes regarding oral health habits since attending college; oftentimes at higher percentages compared to an average percentage of all other classes. Overall, it is possible that the fifth year students have a better perspective on how their oral health has changed since beginning college because that have spent more time working towards an undergraduate degree. Other possibilities for the differences in fifth year students' responses are explored in areas for future study.

Limitations

A major limitation of this study was the unequal sample sizes between class years. It was difficult to compare the oral health factors and habits of each of the consecutive years spent in college without converting the sample groups into percentages. Even then, it is necessary to keep in mind that there were only nine students in the fifth year class being compared to an average between classes made up of ninety-one other students. If each class group had an equal number of students to compare to, there would have been a far better representation of overall changes in oral health since beginning college.

The self-reporting method of data collection is another lacking area of this study. It is nearly impossible for the self-reporting method to always accurately identify the individual's experiences. This method of data collection can also produce conflicting responses. For example, some participants reported that they have not visited a dentist in more than a year, but that they also do not have any cavities. These participants cannot be certain about their current level of tooth decay unless they see a dental professional. It is possible that these students are assuming there is not a problem with their oral health if there is no physical sign or pain. This is not always the case, and the self-reporting method draws attention to these misconceptions. Nevertheless, without the ability to obtain official dental records from all participants, self-reporting is the best way to collect similar data.

Oral health questions omitted from final analysis

Several topics included in the questionnaire were intentionally omitted from data analysis for various reasons. Smoking cigarettes and chewing tobacco are known to increase the risk of caries and oral cancer development³. Use of medications that cause dry mouth can also increase

caries growth because it decreases flow of saliva that buffers the growth of cariogenic bacteria³. However in this study, only seven students reported that they smoke, four reported they chew tobacco, and four reported they use medications that cause dry mouth. Due to low positive responses for these variables, it did not make sense to analyze them in relation to consecutive years spent in college.

Fill-in questions from the questionnaire about participants' oral surgeries, past orthodontic treatment, and history of water source prior to college were also intentionally omitted from analysis. In an attempt to guide participants towards a standardized response, example responses in parentheses were included following each question in the questionnaire. In spite of this, there were an incredible amount of diverse responses to each of the questions that did not fit well into standardized categories. I was not willing to lose accuracy of participant experiences by generally categorizing these responses, and they were not included in final analysis.

In order to answer the research questions, I deemed that age, academic major and living situation during each year of college were expendable demographic factors for analysis. Specifically, I chose to analyze consecutive years spent in college instead of age because people start college at different points in their lives. Time spent in college was the main independent variable my research questions intended to investigate; consequently, age was only collected for demographic data. Similarly, academic major was not a part of the research questions and was collected to mainly ensure that I had surveyed a wide-variety of students on campus. Living situation during each year of college did not help answer the research question. This variable was not included in final analysis, but was included in areas of future study.

Areas for future study

I would like to understand why the fifth year student demographic caused significant associations between oral health and consecutive years spent in college. I hypothesize that it is a result of a number of factors. The fifth year student group was primarily made up of male students; one female student was reported spending five consecutive years in college. Research has shown that female students have better oral hygiene habits than male students⁵¹. It is possible that the male fifth year students might not be as attentive to their oral health as their female counterparts.

Perhaps the significant association between oral health and consecutive years spent in college is a result of the fifth year students' living situations. At the time that fifth year students completed the survey, five students were living off campus without a parent, and four students were still living on campus. This indicates that all fifth year participants were living independently from parents or guardians during the academic school year. This independence could potentially influence the maintenance of oral health self-care habits. More research is needed to determine if living situation plays a role in student's oral hygiene habits. It should be noted, however, that almost all students surveyed live independently. The only exceptions to this would be the few students who indicated that they live off campus with a parent. For this reason, living situation may not be what is causing the significance.

Conceivably, different academic majors of fifth year students could play a role in the significant association between oral health and consecutive years spent in college. A majority of surveyed fifth year students were engineering majors, two were science majors and one was an athletic training major. Academic major has yet to show a significant relationship to oral health habits in published research. However, it would be interesting to investigate whether common

personality types associated with different majors influences students' inclination to maintain oral hygiene habits.

It is important to consider the reasons why students may need to take five years to complete their undergraduate education. Typically, students take a maximum of four years to graduate with a Bachelor's degree from Alfred University. Students that are in their fifth year of college may be in that situation because their high academic goals cannot be completed in four years. For example, engineering students at Alfred University have the opportunity to participate in co-op experiences in which they take a semester to work in industry or at a research organization. It is common that these high-achieving students need to stay at least an extra semester at Alfred University in order to complete the classes they missed while gaining valuable work experience. For another perspective, students may be in their fifth year of college because they did not have success in passing the required courses they needed to graduate on time. In either view, students that need to take a fifth year to complete their undergraduate degree may be experiencing high levels of academic-associated stress. Chiang et al. argued that stress during adolescence is associated with heightened inflammation⁵². To reiterate relevant findings of this study, 100% of fifth year students presented inflamed gum tissue from the photo-based observational oral exam. Also, compared to the average of all other students, fifth year students reported a higher percentage of their class having increased experiences of sore gums, and bleeding gums which are common indicators of gingivitis. This evidence of inflammation in the fifth year class supports that the stress associated with the fifth year of undergraduate university may be playing a role in the fifth year students' oral inflammation. This stress and inflammation can seriously impact the overall oral health of fifth year students and may influence the significant associations found in this study.

Socioeconomic status of the fifth year students could also considerably impact the oral health and oral hygiene habits of fifth year students. Socioeconomic class is known to be linked to a wide variety of health problems⁵³. This is because factors such as family education, income, and occupation create socioeconomic disparities which directly affect a patient's ability to afford health care¹². Access to affordable dental insurance can improve oral health in low-income populations, but does not always guarantee reduction in oral health disparities. Various external factors such as geographic isolation, ethnic differences in social and cultural values, and cultural and socioeconomic changes that have strongly affected diet can also affect oral health⁵³. More information is needed in order determine whether the social standing of fifth year students has had an impact on their oral health and oral hygiene habits since attending college.

Another area of further investigation could question whether college students have adequate access to oral health care during the academic year. From verbal discussions with participants during research appointments, I discovered common reasons why college students might forego visiting the dentist. Some of these reasons include travel distance from home, missing class, ability to coordinate trips to their dentist office during academic breaks, and lack of dental insurance coverage. Using a similar self-reporting method, college students could report on the exact reasons why they might not maintain consistent dentist appointments during college. Knowing this information might be helpful in explaining why the oral health of college students has the potential to diminish throughout their time at university. Additionally, universities may be able to incorporate dental health care services in some capacity to their on-campus health services. Ideally, these services would help fulfill the students' lack of oral health care during the transitional period of college.

Passive oral health programming

For the final piece of this research project, I generated educational oral health posters to be used as standard programming through the Alfred University Health and Wellness Center for future years on campus. Typically, college students do not have guardians in their immediate presence to remind them to maintain their oral hygiene⁴⁹. As a whole, the college student demographic has a busy schedule, is more inclined to take risks, and lacks on-campus dental health care services. Combining these circumstances establishes a dangerous environment for the present and future of college students' health⁴⁹. Positive oral hygiene promotes positive oral and general health of an individual, especially in lieu of consistent dentist appointments¹. The three education oral health posters produced as a result of this study can be viewed in Appendix K through M. These posters focus on daily tooth brushing, consistent flossing, and avoiding mouthwash are the primary method of oral hygiene. By raising public awareness with about ways to prevent dental diseases, Alfred University students will hopefully have a better chance to halt future progression of oral diseases.

Conclusions

As a whole, the oral health statuses of Alfred University students' are most affected by evidence of gingivitis, dental staining, and dental erosion. This increases students' risk of developing periodontal disease and dental caries. Alfred University students may not be as knowledgeable as they should be regarding oral health care practices. This may contribute to uncertain and inconsistent responses involving oral health care and prevention questions in the survey. This research does not necessarily present a linear relationship between consecutive years spent in college and changes in oral health habits. However, the fifth year student surveyed appear to generate several significant associations between certain reported oral health variables

and years spent in college. Further investigation into the fifth year student demographic could help deduce the reason behind this trend. This study will continue the discussion of oral hygiene at Alfred University for future generations through poster-based educational oral health programming. The oral health habits that students develop while in college will likely influence their life-long oral and general well-being. Due to this, it is imperative that more research in the area of undergraduate student oral health is performed in the recent future.

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Appendix A.

Subject # _____

DEMOGRAPHIC & ORAL HEALTH QUESTIONNAIRE

It is helpful for me to know more about the participants contributing to this research. Please answer the following questions honestly and to the best of your ability. Please note that this data is collected for reporting purposes only; all information will be aggregated in a statistical program. This data will not be used to identify you as an individual. *If you have any questions regarding phrasing of the question or relevance of an answer, please ask the questionnaire proctor.*

Demographics:

1. What is your current age? _____

2. Sex (please circle one):

Female

Male

Transgender

3. How many consecutive years have you spent in college? _____

4. Please use the chart below to indicate your student status and living situations during the years you have spent in college.

***Mark in the chart below with X's:

Years spent in college	Part time	Full time	On-campus housing	Off campus with NO Parent/Guardian	Off Campus with a Parent/Guardian
	<i>Please mark one or the other per year.</i>		<i>Please mark only one of these options per year.</i>		
1 st year					
2 nd year					
3 rd year					
4 th year					
5 th year					
6 th year					

If you must choose more than one option in each section for a single year, please explain why here: _____

5. What is your major, intended major or are you undecided? _____

Oral Health (please circle one option for each question that best matches your habits):

6. Consider your consumption of flavored energy drinks (Monster, Red Bull, Full Throttle, etc.):

- A. Currently, I consume these types of drinks _____.
 Never Occasionally Every day
- B. Since attending college, I have _____ the frequency of this habit.
 Decreased Not changed Increased

7. Consider your consumption of sports drinks (Gatorade, Powerade, etc.):

- A. Currently, I consume these types of drinks _____.
 Never Occasionally Every day
- B. Since attending college, I have _____ the frequency of this habit.
 Decreased Not changed Increased

8. Consider your consumption of non-diet carbonated sodas (Coke, Pepsi, Sprite, etc.):

- A. Currently, I consume these types of drinks _____.
 Never Occasionally Every day
- B. Since attending college, I have _____ the frequency of this habit.
 Decreased Not changed Increased

9. Consider your consumption of carbonated sodas with less sugar (Diet Coke, Diet Pepsi, Coke Zero, etc.):

- A. Currently, I consume these types of drinks _____.
 Never Occasionally Every day
- B. Since attending college, I have _____ the frequency of this habit.
 Decreased Not changed Increased

10. Consider your consumption of coffee and/or tea:

- A. Currently, I consume these types of drinks _____.
 Never Occasionally Every day
- B. Since attending college, I have _____ the frequency of this habit.
 Decreased Not changed Increased

11. Consider your consumption of medications that cause dry mouth:

A. Currently, I consume these types of medications:

Never Occasionally Every day

B. Since attending college, the frequency of this has _____ for me.

Decreased Not changed Increased

12. Consider the frequency at which you smoke tobacco and/or other plant products:

A. Currently, I smoke these types of products _____.

Never Occasionally Every day

B. Since attending college, I have _____ the frequency of this habit.

Decreased Not changed Increased

13. Consider your use of chewing tobacco:

A. Currently, I use this type of product _____.

Never Occasionally Every day

B. Since attending college, I have _____ the frequency of this habit.

Decreased Not changed Increased

14. Consider the frequency at which you brush your teeth with toothpaste.

A. Please describe this habit by indicating how often, what time of day, and when you brush relative to food/drink (other than water) consumption.

An example response: 2 times a day. Once in the morning before breakfast and again before I go to bed. Sometimes I have snack after brushing my teeth in the evening.

B. In a broad sense, since attending college I have _____ the frequency of this habit.

Decreased Not changed Increased

15. Consider the frequency at which you floss the areas between your teeth.

A. Please describe this habit by indicating how often, what time of day, and when you floss relative to food/drink (other than water) consumption.

An example response: Once a day, right before I go to bed.

B. In a broad sense, since attending college I have _____ the frequency of this habit.

Decreased Not changed Increased

16. Consider the frequency at which you use oral health mouthwashes.

A. Please describe this habit by indicating how often, what time of day, and when you use mouthwash relative to food/drink (other than water) consumption. If yes, please indicate what brand.

An example response: Once a day, right before I go to bed. I use Colgate

B. In a broad sense, since attending college I have _____ the frequency of this habit.
 Decreased Not changed Increased

17. Consider the frequency at which you have a routine teeth cleaning at a dentist office:

A. When was the last time that you had a routine teeth cleaning? _____

B. How often do typically get your teeth cleaned (ex. Every 6 months, every few years, never, etc.)? _____

C. Since attending college, I have _____ the frequency of these cleanings.
 Decreased Not changed Increased

18. Consider the frequency at which you have a preventative oral health checkup at a dentist office:

A. When was the last time that you had an oral health checkup? _____

B. How often do typically have an oral health checkup (ex. Every 6 months, every few years, never, etc.)? _____

C. Since attending college, I have _____ the frequency of these oral health checkups.
 Decreased Not changed Increased

_____ **Please mark here with an 'X' if you are unsure how a routine teeth cleaning differs from a preventative oral health checkup.**

19. Consider the number of adult teeth you have had filled due to decay:

A. I have had _____ fillings in permanent teeth due to decay.

0 1-4 5 or more

B. Since attending college, my number of necessary fillings to due to decay has _____.
 Decreased Not changed noticeably Increased

26. Consider the frequency at which you experience pain in your teeth/gums after consuming something sweet, hot or cold:

- A. Currently, I experience this sensitivity _____.
 Never Rarely Occasionally Every day
- B. Since attending college, this has _____ for me.
 Decreased Not changed Increased

27. Consider the frequency at which you experience chronic bad breath:

- A. Currently, I experience chronic bad breath _____.
 Never Rarely Occasionally Every day
- B. Since attending college, this has _____ for me.
 Decreased Not changed Increased

28. Consider the frequency at which you consciously clench your jaw, grind your teeth or experience a sore jaw:

- A. Currently, I clench my jaw, grind my teeth or experience a sore jaw _____.
 Never Rarely Occasionally Every day
- B. Since attending college, this has _____ for me.
 Decreased Not changed Increased
- C. Have you ever been provided preventive treatment for any of these conditions in the form of a mouth guard to wear while sleeping?
 No Yes N/A

29. For the majority of your life prior to college, what was the source of your drinking water (well water, city water, bottled water, etc.)?

- A. In a broad sense, I received my drinking water from _____.
- B. Was this water conditioned in any way (such as fluoridation, water-softening, filtration, etc.)?
 Yes No Unsure
 If yes, please specify the way in which it was conditioned: _____

30. Have you had fluoride treatment prevention in the past (at a dentist, a school-based program, or another public location)? Over the counter fluoride toothpastes and mouthwashes are not included in this category.

- Yes No Unsure

Appendix C.

Informed Consent

You are invited to participate in a research study regarding the oral health of Alfred University students and how their oral health habits may have changed since attending college. If you are an undergraduate level student at Alfred University, you qualify as a viable participant for this study. This study is being conducted by undergraduate student Elisabeth Estep for completion of her Biology Honors Thesis.

Background Information

Maintaining oral health is a factor of university life that often falls to the wayside. This especially true if quality oral hygiene habits were not properly cultivated during adolescence. My project aims to consider the hypothesis that living away from home while completing an undergraduate degree can negatively affect oral health.

Procedures

If you agree to participate in this study, you will be asked to place a set of smooth plastic cheek retractors in your mouth, place a blindfold over your eyes and nose, and have three digital photos taken of your mouth. You may ask to see these photos after they are taken. These photos will be analyzed later with a simple checklist for observable features. A blank copy of this checklist is available for viewing upon request. Next, you will be asked to complete a written survey of your current oral health habits and how these habits may have changed since coming to college. The duration of this appointment time is approximately 20 minutes.

Risks and Benefits of Being in the Study

There is a chance that you will experience some minor discomfort from inserting and removing the plastic cheek retractors due to the stretching of your lip tissue. However, these research procedures will in no way cause you physical harm. We understand that oral health can be considered an intimate topic. If you have any questions regarding a topic in the survey, you will have the opportunity to ask me a private setting. If you are in need of dental advice, you may contact local dentist John del Campo, D.D.S. You are free to discontinue your participation at any time during the study.

By participating fully in this study, your name will put into a drawing to win a \$25 Amazon gift card. Each participant will have an equal chance of winning a gift card.

Confidentiality

All records and materials of this study will be kept on a password protected research laptop and stored securely in a locked drawer inside the locked office of Dr. Jean Cardinale in the Science Center. The digital photos taken will only ever be associated with your chronologically assigned subject number, and there will be no major identifying features of your face visible. If I cannot identify a certain oral feature in a photo Dr. del Campo is available to aid me in reaching conclusions for data collection. If you choose to not participate all of your data will be deleted, destroyed and your number will be voided.

Voluntary Nature of the Study

Your decision to participate in this study will not affect your current or future relations with Alfred University, and if you choose to participate you reserve the right to withdraw at any time without penalty.

Contacts and Questions

If you have any questions about this study please contact the following individuals to discuss potential concerns confidentially.

- | | |
|---|---|
| <ul style="list-style-type: none"> - Elisabeth Estep- Principle Investigator
(607) 765-9457, eme3@alfred.edu - Dr. Jean Cardinale- Faculty Advisor
(607) 871-2205, cardinale@alfred.edu
Division of Biology, Science Center 327, Alfred University | <ul style="list-style-type: none"> - John del Campo, D.D.S.- General Dentist
(607) 587-8838
49 Hillcrest Drive, Alfred, NY 14802 |
|---|---|

Statement of Consent

I have read the above information and consent to participate in the study.

Signature

Date

Print

Appendix D.

Debriefing

Thank you for participating in my research study for my Biology Honors Thesis!

Oftentimes, research performed in the oral health field either focuses on a large age range of adults or of children instead of focusing on the transitional period of early adulthood. However according to Small et al., the transitional period of young adulthood is important to study because the general health behaviors that college students form during this time of independence sets the foundation for either long-term health advantages or an increased risk of disease in the future (2013). University students can easily become preoccupied by the daily stresses of regular coursework, employment, extracurricular activities and the fact that they may no longer live under the watchful eyes of their parents or guardians (Crabtree et al. 2016). This correlates to the idea that some young adults neglect the maintenance of their oral health along with inconsistent general health habits as Small et al. discusses (2013). This inconsistency of oral health habits can be exhibited by behaviors including but not limited to brushing and flossing less, consuming more sugar-sweetened beverages, smoking, irregular dental cleanings and checkups, and experiencing more stressful situations in general (Crabtree et al. 2016).

Basically, maintaining oral health is a factor of university life that can be commonly neglected. My research intends to investigate how undergraduate students' oral health statuses compare to their behaviors before attending university.

If you have any further questions about the contents of this study or your individual participation please contact the following individuals to discuss information confidentially.

- Elisabeth Estep- Principle Investigator
(607) 765-9457, eme3@alfred.edu

- Dr. Jean Cardinale- Faculty Advisor
(607) 871-2205, cardinale@alfred.edu
Division of Biology, Science Center 327, Alfred University

- John del Campo, D.D.S.- General Dentist and Thesis Committee Member
(607) 587- 8838
49 Hillcrest Drive, Alfred, NY 14802

Appendix E.

The desired mouth positions with cheek retractors for subjects.



Position One



Position Two



Position Three

Appendix F.

Table 10. Association between consecutive years spent in college and participant-reported participation in a fluoride treatment program in their youth.

		Participants (%)		
		Fluoride Treatment Program		
Responses		Yes	No	Unsure
Years ^a	1	61.3	22.6	16.1
	2	63.3	13.3	23.3
	3	65.0	20.0	15.0
	4	40.0	50.0	10.0
	5	55.6	11.1	33.3

^a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

Yes -Participants report participating in a fluoride treatment program.

No - Participants report not participating in a fluoride treatment program.

? - Participants report being unsure if they ever participated in a fluoride treatment program.

Table 11. Association between consecutive years spent in college and participant-reported knowledge of the difference between a dental cleaning and an oral health check-up.

		Participants (%)	
		Cleaning vs. OH Checkup+	
Responses		Sure	Unsure
Years ^a	1	74.2	25.8
	2	73.3	26.7
	3	80.0	20.0
	4	30.0	70.0
	5	55.6	44.4

^a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

Sure -Participants report being sure of the difference between a dental cleaning and an oral health check-up.

Unsure -Participants report being unsure of the difference between a dental cleaning and an oral health check-up.

+ -Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Chi-Squared test.

Appendix G.

Table 12a. Association between consecutive years spent in college and participant-reported current oral health habits and experiences.

Participants (%)													
Current Oral Health Habits													
		Energy Drinks			Sports Drinks			Regular Soda			Diet Soda		
Responses		N	O	ED	N	O	ED	N	O	ED	N	O	ED
Years ^a	1	74.2	25.8	--	16.1	64.5	19.4	22.6	54.8	22.6	54.8	45.2	--
	2	90.0	6.7	3.3	23.3	66.7	10.0	16.7	70.0	13.3	70.0	30.0	--
	3	70.0	30.0	--	20.0	70.0	10.0	40.0	55.5	5.0	85.0	15.0	--
	4	50.0	50.0	--	20.0	70.0	10.0	10.0	70.0	20.0	40.0	60.0	--
	5	55.6	44.4	--	22.2	66.7	11.1	44.4	44.4	11.1	88.9	11.1	--

Table 12b. Association between consecutive years spent in college and participant-reported current oral health habits and experiences.

Participants (%)													
Current Oral Health Habits													
		Coffee/Tea			Sore Gums			Bleeding Gums			Hypersensitivity		
Responses		N	O	ED	N	O	ED	N	O	ED	N	O	ED
Years ^a	1	22.6	58.1	19.3	23.3	76.7	--	19.3	71.0	9.7	40.0	60.0	--
	2	23.3	43.3	33.3	55.2	41.4	3.4	20.0	76.7	3.3	43.3	50.0	6.7
	3	15.0	50.0	35.0	25.0	70.0	5.0	15.0	70.0	15.0	25.0	75.0	--
	4	--	50.0	50.0	30.0	70.0	--	10.0	80.0	10.0	20.0	70.0	10.0
	5	--	88.9	11.1	11.1	88.9	--	11.1	88.9	--	22.2	77.8	--

Table 12c. Association between consecutive years spent in college and participant-reported current oral health habits and experiences.

Participants (%)					
Current Oral Health Habits					
Bruxism					
Responses	N	O	ED		
Years ^a	1	38.7	48.4	12.9	
	2	46.7	43.3	10.0	
	3	35.0	50.0	15.0	
	4	20.0	70.0	10.0	
	5	22.2	66.7	11.1	

a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

N –Participants report never performing this habit or experiencing this oral health variable.

O –Participants report occasionally performing this habit or experiencing this oral health variable.

ED –Participants report performing this habit or experience this oral health variable every day.

-- Zero participants from the age class report performing this habit at this frequency.

Appendix H.

Table 13. Association between consecutive years spent in college and participant-reported current daily brushing, flossing and mouthwash habits.

Participants (%)										
Current Oral Health Habits										
		Brushing			Flossing			Mouthwash*		
Responses		<1	1	2+	<1	1	2+	<1	1	2+
Years ^a	1	6.5	29.0	64.5	64.5	29.0	6.5	76.7	20.0	3.3
	2	3.3	33.3	63.4	66.7	33.3	--	66.7	26.7	6.6
	3	5.0	40.0	55.0	85.0	15.0	--	70.0	20.0	10.0
	4	--	20.0	80.0	50.0	40.0	10.0	80.0	20.0	--
	5	--	55.6	44.4	80.0	20.0	--	22.2	55.6	22.2

a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

<1 -Participants report performing this activity less than once a day on average.

1 -Participants report performing this activity once a day on average.

2+ -Participants report performing this activity 2 or more times a day on average.

-- Zero participants from the age class reported performing this activity at this frequency.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

Appendix I.

Table 14a. Association between consecutive years spent in college and participant-reported oral health habits and experience changes since attending college.

Participants (%)													
Oral Health Habits Change													
		Energy Drinks			Sports Drinks			Regular Soda			Diet Soda*		
Responses		D	NC	I	D	NC	I	D	NC	I	D	NC	I
Years ^a	1	3.2	80.6	16.1	22.6	48.4	29.0	32.3	41.9	25.8	19.4	77.4	3.2
	2	3.3	93.3	3.3	10.0	73.3	16.7	26.7	56.7	16.7	13.3	86.7	--
	3	10.0	80.0	10.0	15.0	60.0	25.0	25.0	50.0	25.0	10.5	84.2	5.3
	4	20.0	60.0	20.0	20.0	70.0	10.0	--	50.0	50.0	10.0	50.0	40.0
	5	11.1	77.8	11.1	11.1	55.6	33.3	11.1	66.7	22.2	--	88.9	11.1

Table 14b. Association between consecutive years spent in college and participant-reported oral health habits and experience changes since attending college.

Participants (%)													
Oral Health Habits Change													
		Coffee/Tea*			Sore Gums			Bleeding Gums			Hypersensitivity*		
Responses		D	NC	I	D	NC	I	D	NC	I	D	NC	I
Years ^a	1	25.8	54.8	19.4	6.9	93.1	--	6.5	87.0	6.5	3.4	89.7	6.9
	2	6.7	63.3	30.0	3.3	93.3	3.3	6.7	86.3	6.7	--	96.6	3.4
	3	10.0	35.0	55.0	5.0	95.0	--	5.0	90.0	5.0	5.0	75.0	20.0
	4	20.0	20.0	60.0	--	100.0	--	20.0	50.0	30.0	--	70.0	30.0
	5	--	44.4	55.6	11.1	66.7	22.2	33.3	44.4	22.2	--	55.6	44.4

Table 14c. Association between consecutive years spent in college and participant-reported oral health habits and experience changes since attending college.

Participants (%)													
Oral Health Habits Change													
		Bruxism*			Brushing			Flossing*			Mouthwash*		
Responses		D	NC	I	D	NC	I	D	NC	I	D	NC	I
Years ^a	1	6.5	80.6	12.9	12.9	74.2	12.9	29.0	58.1	12.9	19.4	74.2	6.5
	2	--	80.0	20.0	3.3	80.0	16.7	13.3	66.7	20.0	16.7	66.7	16.7
	3	--	85.0	15.0	10.0	55.0	35.0	5.0	65.0	30.0	5.3	68.4	26.3
	4	--	80.0	20.0	20.0	60.0	20.0	20.0	40.0	40.0	20.0	70.0	10.0
	5	---	44.4	55.6	11.1	66.7	22.2	--	55.6	44.4	--	33.3	66.7

a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

D -Participants report decreasing the performance of this habit or experiencing this oral health variable less since attending college.

NC - Participants report not changing the performance of this habit or experiencing this oral health variable at the same frequency since attending college.

I - Participants report increasing the performance of this habit or experience this oral health variable more since attending college.

- Zero participants from the age class reported performing this activity at this frequency.
- * Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

Appendix J.

Table 15a. Association between consecutive years spent in college and participant-reported factors involving their dental cleanings.

Participants (%)										
Dental Cleanings										
		Most Recent			Frequency*			Change		
Responses		&	#	@	6	12	X	D	NC	I
Years ^a	1	62.1	24.1	13.8	86.2	3.4	10.4	9.7	90.3	--
	2	62.1	13.8	24.1	66.7	13.3	20.0	16.7	83.3	--
	3	58.9	10.5	31.6	55.0	15.0	30.0	20.0	75.0	5.0
	4	60.0	10.0	30.0	40.0	30.0	30.0	50.0	50.0	--
	5	62.5	12.5	25.0	66.7	22.2	11.1	33.3	44.4	22.2

Table 15b. Association between consecutive years spent in college and participant-reported factors involving their oral health checkups.

Participants (%)										
Oral Health Checkups										
		Most Recent			Frequency			Change		
Responses		&	#	@	6	12	X	D	NC	I
Years ^a	1	63.0	22.2	14.8	74.1	7.4	18.5	10.7	89.3	--
	2	67.9	14.3	17.9	60.7	25.0	14.3	14.3	85.7	--
	3	66.7	11.1	22.2	61.1	11.1	27.8	11.8	82.3	5.9
	4	66.7	11.1	22.2	44.4	33.3	22.2	50.0	50.0	--
	5	62.5	12.5	25.0	62.5	25.0	12.5	37.5	37.5	25.0

a Sample sizes for years 1 through 5 are as follows: 31, 30, 20, 10 and 9 respectively.

& -Participants report having a dental cleaning or oral health check-up 6 months ago or less.

-Participants report having a dental cleaning or oral health check-up 7 months to a year ago.

@ -Participants report having a dental cleaning or oral health check-up more than a year ago or are unsure.

6 -Participants report having a dental cleaning or oral health check-up every 6 months on average.

12 -Participants report having a dental cleaning or oral health check-up every year on average.

X -Participants report having a dental cleaning or oral health check-up more than every year on average or without a routine.

D -Participants report decreasing their dental cleanings and oral health check-ups since attending college.

NC - Participants report not changing their dental cleanings and oral health check-ups since attending college.

I - Participants report increasing their dental cleanings and oral health check-ups since attending college.

* Statistically significant ($p < 0.05$) association between consecutive years spent in college using a Spearman correlation for non-parametric data.

-- Zero participants from the age class reported performing this activity at this frequency.

Appendix K.

Brush your teeth with
fluoride toothpaste for . . .

2 minutes



2 times a day



**It's the best way to
prevent cavities!**

ONLY TAKE CARE OF THE TEETH YOU WANT TO KEEP

Appendix L.

Remember to FLOSS



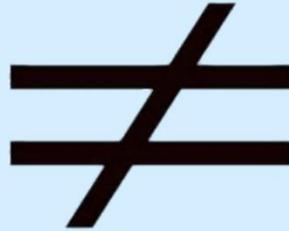
DAILY

Cleaning in between
teeth helps keep them
healthy!

ONLY TAKE CARE OF THE TEETH YOU WANT TO KEEP

Appendix M.

USING MOUTHWASH



BRUSHING TEETH



Mouthwash with fluoride
should **supplement** a daily
brushing and flossing routine;
not replace it!

ONLY TAKE CARE OF THE TEETH YOU WANT TO KEEP

ACKNOWLEDGEMENTS

This project would not have been possible without the help and support of several people. First, I would like to thank all of my committee members for their advice and expertise on my written work. Thank you to Dr. Jean Cardinale for being my primary advisor on this project for three consecutive semesters. Special thanks to John del Campo, D.D.S. for offering his professional consultation to help generate oral health questionnaire and observable oral health checklist. I would also like to thank Dr. Cheryld Emmons for advising me on the statistical analysis portion of this study. Thank you, also, to all of my student research participants who graciously donated their time and provided me with data to complete this project. Finally, I would like to thank my family for supporting me throughout every aspect of my life; I would not have been able to pursue a career in dentistry without their encouragement, love, and support.