Evaluation of Demographic and Health-Related Factors Associated with Dental Caries Among Florida Patients

By

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CERTIFICATE OF APPROVAL

Honors Thesis

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Abstract

Introduction: The prevalence of dental caries and its burden on the general population remains a significant public health issue. Although damages brought by dental caries can decrease the quality of life of affected individuals, risk factors are not well understood. The objective of this study is to assess the dental caries status of Florida dental patients and evaluate demographic and health-related factors associated with dental caries. **Methods:** We utilized the DMFT (Decayed, Missing, Filled, Teeth) Index to examine dental caries status of 207 dental patients in Florida. ANOVA and Bivariate linear regression analyses were conducted to explore the association between dental caries and factors such as age, gender, diabetes mellitus, high blood pressure, and high cholesterol. **Results:** Increased likelihood of dental caries was found among older patients ($R^2 = 0.31426$, $p < 0.0001$) and females ($F = 7.4797$, $p > 0.0068$). Additionally, dental caries was significantly associated with adverse health conditions such as high blood pressure and high cholesterol. Notably, we did not observe a significant relationship between dental caries and diabetes. **Discussions:** Our study indicates specific subgroups at increased likelihood of dental caries in Florida. Health care professionals and policymakers should consider the role of demographic factors and underlying health conditions in dental caries.

1. INTRODUCTION

The Anatomy of Human Teeth

Human teeth are the most distinctive and hardest substance in the human body. A typical human adult has 32 teeth: four incisors, two canines, four premolars, and six molars in both the upper (maxillary) and lower (mandibular) jaws. The shape and position of each type have evolved to attend to their specialized functions (Black, 1897).

The incisors, commonly known as the front teeth, are chisel-shaped and possess edges for cutting food. The canines have sharp and pointed edges for gripping and tearing food. The premolars have at least two cusps and function to chew and grind large chunks of food to smaller masses. The molars, located posteriorly, are multi-cuspid and triangular in shape. The molars serve the same function as the premolars but they are larger and stronger.

The structure of a tooth is highly complex. A tooth has four tissues: enamel, dentin, cementum, and pulp. The enamel is the hard, white, highly mineralized, outermost covering of the crown of a tooth. The process of demineralization through enamel destruction can cause enamel wear and may later lead to dental caries. With minerals like hydroxyapatite, a high-crystalline form of calcium phosphate, the enamel functions to protect the human teeth from dental caries (Cevc et al., 1980). The enamel does not regenerate since it contains no living cells.

The cementum is another specialized, avascular bone-like tissue that covers the surfaces of a tooth root. It is composed of approximately 55% organic material and 45% inorganic material, mainly calcium salts like hydroxyapatite (Kim et al., 2013). The cementum functions to maintain the proper position of the tooth and replace the loss of tissue due to wear. The cementum can regenerate with limited capacity.

Similarly, the dentin is also able to self-repair and regenerate. The dentin forms the body and crown of a tooth. It functions to support the enamel and transmit impulses to the dental pulp tissue. It does this via an odontoblast process, which reacts to the transmission of stimuli through the microporous enamel (Kidd & Fejerskov, 2004). There are numerous pores running across the surface of the tooth within the dentin and when exposed, it can lead to sensations of hot and cold sensitivity.

The pulp is another unique, unmineralized dental tissue that works closely with the dentin. It is the part of the tooth that provides vitality with the integral components of nerves, blood vessels, and connective tissue. The odontoblasts, or specialized cells within a pulp, can differentiate into dentin. A healthy pulp can compensate for dentin loss due to dental caries, fractures, or an open restoration margin (Yu & Abbott, 2007).

The pulp resides within the pulp chamber. In response to the destruction of the chamber, microorganisms and their toxins can come in contact with the pulp. If left untreated, dental diseases like dental caries can affect the pulp to become irritated or infected. The infection can spread via blood flow and lead to pulp necrosis, infection, tooth loss, or oral sepsis.

Role of Saliva

Saliva is vital to the integrity of the teeth and soft tissue repairs in the oral cavity. The physiochemical properties of saliva including flow rate, pH, buffering capacity, ion reservoir for calcium and phosphate, antimicrobial enzymes, and secretion rate play a huge role in remineralization and stopping dental caries development (Prabhakar & Dodawad, 2009). Moreover, the calcium and phosphate ions in saliva naturally get deposited into the voids of a demineralized enamel to repair any damaged mineral crystals before tooth decay occurs. However, higher sugar consumption can cause the decay process to continue beyond repair.

If salivary components are in a balanced amount, the mineral composition of tooth structure will have the needed buffering capacity to resist the process of demineralization and microbial attacks. Otherwise, a favorable environment for bacteria will be created for dental caries to occur.

Dental Caries

Dental caries (dental decay) is a type of structural damage in the tooth. The World Health Organization (WHO, 2017) reports dental caries as the most common non-communicable disease in the world. Untreated caries in permanent teeth was the most prevalent disease out of 291 oral health diseases evaluated for the Global Disease 2010 Study (Marcenes et al., 2013). Individuals are susceptible to dental caries throughout their lifetime.

Some forms of dental caries are easier to detect than others due to variations in size and location on the surface of the tooth. A dentist usually relies on visual and tactile inspection or a radiograph to diagnose dental caries (Gomez, 2015). Visually, a chalky white spot on the tooth's surface may indicate the demineralization of the enamel for new carious lesions. As the decay progresses, it turns to a brown-colored lesion and eventually turns into cavitation. Grayish-colored lesions can also appear at the level of the dentin. In advanced stages, caries can seep through open cavities on the enamel and dentinal layers, and eventually reach the pulp.

Using the tactile technique, a dentist uses a dental explorer or a spoon excavator instrument to differentiate a decayed surface from a normal tooth structure. Many times, a dentist combines the two techniques, also called the visual-tactile examination, to further assess the presence of surface deposits and the roughness of the enamel (Gomez, 2015) .

With radiographs, a dentist can verify the visual and tactile diagnosis of dental caries, especially dental caries that are located in between the teeth (interproximal areas). The formation of caries due to demineralization appears radiolucent on an x-ray film. This is because the lesion attenuates the x-ray beam less than the healthy tooth structure.

It is not uncommon for a dentist to underestimate or misinterpret dental caries seen on an x-ray. In some cases, entities like overlapping radiolucencies, developmental defects in the enamel, and cervical burnouts appear similar to dental caries but are very different from dental caries (Secgin & Arhun, 2016).

Etiology of Dental Caries

Four main criteria are required for caries formation: a tooth surface, caries-causing bacteria, fermentable carbohydrates, and time.

There are five surfaces of a tooth: distal, occlusal, buccal, mesial, and lingual. Different surfaces of the tooth can collect plaque more than the others. Sites with lower rates of salivary flow like the molar fissures are at a disadvantage because these areas have a tendency to slow the clearance of bacteria and have a reduced supply of calcium for tissue repair (Jawed et al., 2012). In addition, the interproximal sites in between two teeth as well as areas above or below the gum line are also retention sites for plaque bacteria.

Streptococcus mutans, *Streptococcus sobrinus,* and *Lactobacilli* are the major etiological agents of dental caries (Aas et al., 2008). These pathogenic bacteria live in a plaque, sticky and cream-colored film produced by saliva. They also metabolize sugary foods undigested in the mouth and dietary sugars such as sucrose and fructose. The byproduct is lactic acid, which negatively shifts the pH in the mouth and allows the dissolution of hydroxyapatite mineral in the enamel. These bacteria are resistant to the adverse effects of low pH levels. Due to this, the acidic environment allows the tooth to be vulnerable to decay as bacterial action from acid causes demineralization of the tooth. The localized destruction of the enamel as the process progresses over time can worsen if left untreated and lead to dental caries formation. Severe dental caries often causes infection and excruciating pain.

Caries formation has other risk factors that can lead to a diseased state. Many sets of extrinsic determinants such as age, gender, and underlying health conditions that can potentially affect the oral cavity are constantly being investigated. The association of diabetes mellitus with dental caries is also currently being recognized, however, lacking in consensus.

Several studies discovered that diabetic patients, when compared to non-diabetic patients, have an increased prevalence of dry mouth and salivary dysfunction (Lasisi & Fasanmade, 2012; Sreebny et. al, 1992; Sandberg et al., 2000). Diabetes mellitus could provide an indirect association with dental caries since saliva is needed to maintain the health of a tooth.

Insufficient production of saliva by the salivary glands can cause dry mouth (Sreebny & Schwartz, 1997). The effect can decrease the capacity of saliva to buffer toxic bacteria in the mouth and allows plaque to stay on tooth surfaces longer. It is crucially important for clinicians and researchers to have a thorough understanding of diabetes and the sensation of dry mouth because reduced salivary flow rate can potentially encourage the prevalence of dental caries.

Diabetes Mellitus Overview

Diabetes mellitus, commonly known as diabetes, is a chronic, metabolic disease that occurs when there are high levels of blood sugar in the body due to either a deficiency of insulin secretion, insulin action, or both (American Diabetes Association [ADA], 2013). The WHO (2018) reported an increase from 108 million diagnosed diabetic individuals from 1980 to 422 million in 2014 and 1.6 million deaths directly caused by diabetes in 2016.

Diabetes is initially classified into two main types - type 1 and type 2. There are also other subtypes of diabetes such as type 1.5 (latent autoimmune diabetes in adults) and type 3 (related to Alzheimer's disease), in which two studies found to share similar features with type 1 and type 2 diabetes (Stoever & Palmer, 2002; Suzanne, 2014) .

In type 1 diabetes, the human body does not produce insulin. This form of diabetes occurs mainly in juveniles and accounts for only 5-10% of the diabetic population (ADA, 2013). People who are diagnosed with type 1 diabetes need to administer insulin in their body every day to survive because cellular-mediated autoimmune destruction of the pancreatic β-cell is constantly occurring in their pancreas. In type 2 diabetes, the body uses insulin improperly. Type 2 diabetes is the more prevalent type, which accounts for 90-95% of the diabetic population (CDC, 2017). Both type 1 and type 2 diabetes present numerous possible long-term complications.

Insulin is a hormone secreted by the pancreas that regulates blood sugar by converting the glucose obtained from food into the cells of the body for energy. When insufficient insulin or improper use of insulin occurs, glucose stays in the blood and does not reach the cells. The cells of vital organs in the body are not able to utilize this energy source, resulting in serious health complications. Several studies found that cases of diabetes have led to cardiovascular diseases, neuropathy, retinopathy, and nephropathy disorders, oral complications, and death for the most severe cases (Kannel & McGee, 1979; Brown & Asbury, 1984; Obrosova et al., 2010; Molitch et al., 2004; (Al-Maskari et al., 2011). In addition, the CDC (2020) reports people with diabetes are most likely to have adverse conditions such as high blood pressure and high low-density lipoproteins (LDL) levels, also known as the bad cholesterol.

Extremely high levels of blood sugar, or also known as hyperglycemia is a defining characteristic of diabetes. This causes a reduced salivary flow rate during periods of poor metabolic control of diabetes. When hyperglycemia occurs, glucose leaks into the oral cavity and facilitates the growth of aciduric bacteria that tolerates a highly acidic environment and acidogenic bacteria that produce high amounts of acid (Siudikiene et al., 2006). An increase in bacterial activity can strongly influence higher levels of acid production and pose greater risks for tooth wear and caries lesion development.

Xerostomia

Diabetes is known to influence marked dysfunction of the secretory capacity of the salivary glands, which leads to either a change in saliva function or a reduction in the salivary flow rate (Panchbhai et al., 2010). For most people, the effect may cause the subjective sensation of xerostomia or dry mouth. A study found that the estimated universal prevalence of xerostomia among diabetic patients is between 34% and 51% (Mata, 2004).

Ivanovski et al. (2012) examined the composition of saliva in diabetic patients and found a significant correlation between the degree of xerostomia and glucose levels in saliva. The researchers concluded diabetes as a disease that causes xerostomia based on their results.

The effect of xerostomia can vary. A study found that patients with xerostomia were at a higher risk for developing dental caries than patients without the condition (J Can Dent Assoc., 2011). Xerostomia can also lead to difficulty in eating, speaking, swallowing. Due to the loss of saliva, it can also increase an individual's susceptibility to other oral infections and impair wound healing in the oral cavity.

Supporting Studies

To date, DMFT (Decayed, Missing, Filled, Teeth) index is one of the most commonly used indices in epidemiologic surveys to evaluate a person's lifetime caries experience in permanent dentition (Anaise, 1984). The DMFT index may be utilized to further understand the risk-factors associated with dental caries, attributing to the prevalence of dental caries.

Study I. The DMFT index amongst workers of sweets and cable factories, ages 35 to 44 years old, in Tehran, Iran were compared using the Statistical Package for the Social Sciences software (Akrad et al., 2006). The results showed that the mean DMFT in sweets factories was about 12.59 $\pm$ 6.5 and about 9.7 $\pm$ 5.4 in cable factories. In both factories, the participants free of caries were less than 1%. ANOVA analysis supported a significant relationship between dental caries and the type of work. Researchers added that consumption of sweets and neglect in oral hygiene can be considered of significant importance in the prevalence of dental caries.

Study II. Another study conducted by Singh et al. (2016) randomly selected 100 patients of the Gandhi Dental College and Hospital Jammu and divided them into diabetic and non-diabetic groups based on their fasting blood sugar (FBS). Researchers then analyzed the salivary contents of each patient from both groups by collecting 3-5 mL of saliva samples. Pearson and ANOVA analysis showed higher DMFT and FBS values in diabetic patients. The flow rate of saliva and levels of calcium and pH tends to be much lower as well. This present study is relevant because it sheds further light on the impact of salivary factors on dental caries formation.

Study III. Similarly, a study by López et al. (2003) amongst twenty diabetic and twenty one control children investigated the physical and biochemical characteristics of saliva. The total sugars, glucose, and urea levels were much greater in diabetic children. The calcium values were also significantly lower. The relation to oral health and DMFT indices were also determined and diabetic children showed to have a much higher DMFT value compared to those control children, despite a lower sugar intake. This study further supports the indirect association of diabetes and dental caries through the involvement of salivary components and diminished flow rates.

2. MATERIALS AND METHODS

To add to the consensus with regards to the prevalence of dental caries, part of this thesis conducted a retrospective study to determine whether diabetes, age, gender, or underlying health issues have a significant relationship with dental caries among dental patients. The study did not violate any protected health information (PHI) of patients as listed under the Health Insurance Portability and Accountability Act (HIPAA Journal, 2017). Because of the anonymous retrospective chart reviews, the approval of the Institutional Review Board (IRB) was not required for this study.

Study Sample

A total of 207 patient charts from one center in Florida were reviewed for this study. The study was composed of 127 females and 80 males. The youngest patient was 5 years old and the oldest patient was 97 years old. A total of 17 out of 207 were diabetic, 51 out of 207 had high blood pressure, and 45 out of 207 had high cholesterol.

Decayed, Missing, and Filled Teeth (DMFT) Index

The DMFT index allows one to quantify dental caries in an individual based on the sum of the total number of decayed, missing, and filled teeth due to caries and estimate how much of the dentition has been affected by dental caries (WHO, n.d.). A score of 0 means there is no effect (patient has intact dentition), while a score of 32 means that all teeth are affected by dental caries. We utilized the DMFT index of each patient to measure the total number of affected teeth due to dental caries in each patient. Only patients with full-mouth chartings were included patients in the study.

The following components and special rules of DMFT index acquired from the WHO (n.d.) are as follows:

- D = decayed teeth due to untreated caries
- M = missing teeth due to caries or any other reasons
- F = filled teeth due to restorations for caries treatment
- No tooth may be counted more than once.
- If a tooth has both a caries lesion and filling, it is calculated as D only.
- If a tooth has a secondary or recurrent decay or a temporary filling, it is calculated as D.
- If a tooth has only chalky spots, stains, fissures, it is not calculated as D.
- If a tooth is unerupted, extracted due to trauma, periodontal disease, or indicated for extraction, it is calculated as M.
- If a tooth has more than one permanent restoration due to caries, such as a crown or a bridge, it is calculated as F.
- If a tooth is restored due to cosmetics, such as a special crown or veneer, it is marked as a present tooth.

PracticeWorks Dental Software

The PracticeWorks dental software was used to navigate among patient's charts and access information on which teeth are decayed, missing, or filled (Figure 3). Furthermore, the images from intraoral, extraoral, and x-rays for each patient were easily accessible to view the teeth marked as decayed (D) (Figure 4).

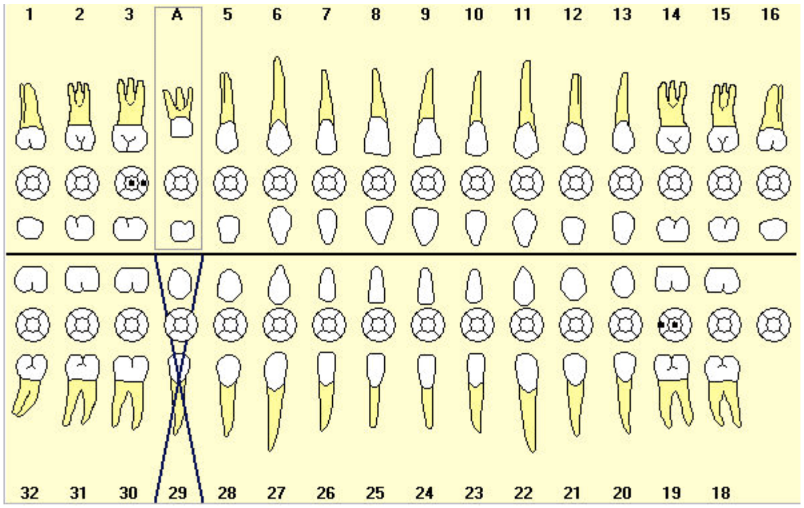
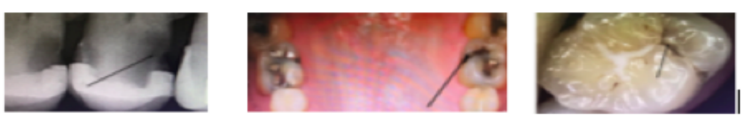


Figure 3: Chart preview from PracticeWorks dental software. Tooth #3 and #19 were marked as decayed (D) shown by black dots on the occlusal and mesial surfaces, while Tooth #29 was marked as a missing tooth (M) shown by a cross-off symbol. Usually, a filled tooth (F) would be indicated by a tooth filled in blue color. This chart was not included in the study. Image source: http://www.dmdproject.com/research.html



(a) (b) (c)

Figure 4: Image preview from PracticeWorks dental software. The arrow on each tooth confirms the diagnosis of dental caries via two-dimensional x-ray (a), extraoral image (b), and intraoral image (c). The images do not belong to any patients in this study but were obtained from the software used in this study.

JMP 13 Analytical Data Statistics Software

We used JMP 13 Analytical Data Statistics Software to record data and evaluate if a significant relationship exists between dental caries and risk-associated factors including age, gender, high blood pressure, and high cholesterol. We analyzed the differences using Bivariate linear regression and ANOVA tests and set it to be statistically significant at $p < 0.05$.

Data Availability

The data obtained and used to support the findings of this study are available from the corresponding author upon request. The corresponding author possesses data and may make data available upon request.

3. ANALYSIS RESULTS

Distribution Analysis Results

The study consisted of 39% males and 61% females (Figure 5). The sample population was composed of 8% diabetic patients and 92% non-diabetic patients (Figure 6). The median age of the data was 61 years old, with the lower quartile (Q1) ranging from 47 to 61 years old and the upper quartile (Q3) ranging from 61 to 75 years old (Figure 7). A total of 25% of the patients had high blood pressures and 22% had high cholesterol levels (Figure 8).

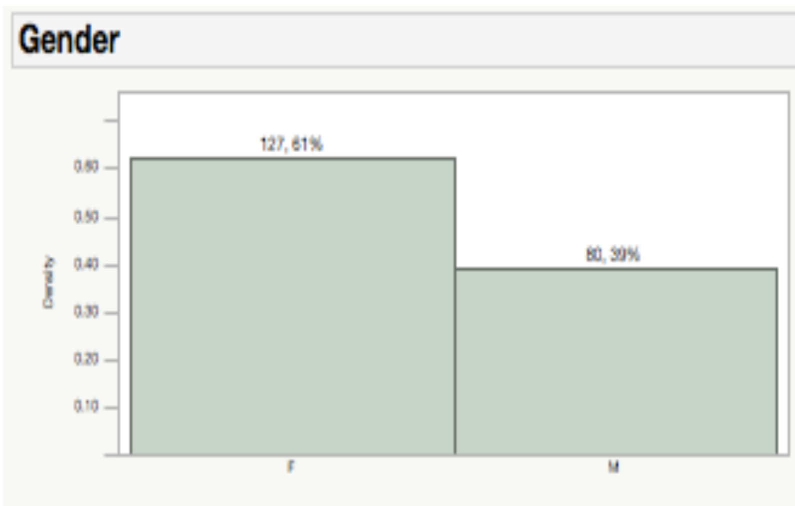


Figure 5: Gender Distribution.

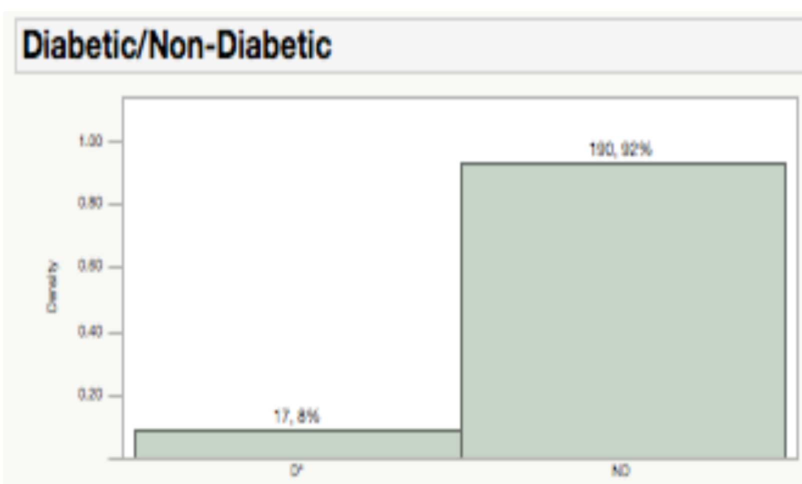


Figure 6: Diabetic and Non-Diabetic Distribution.

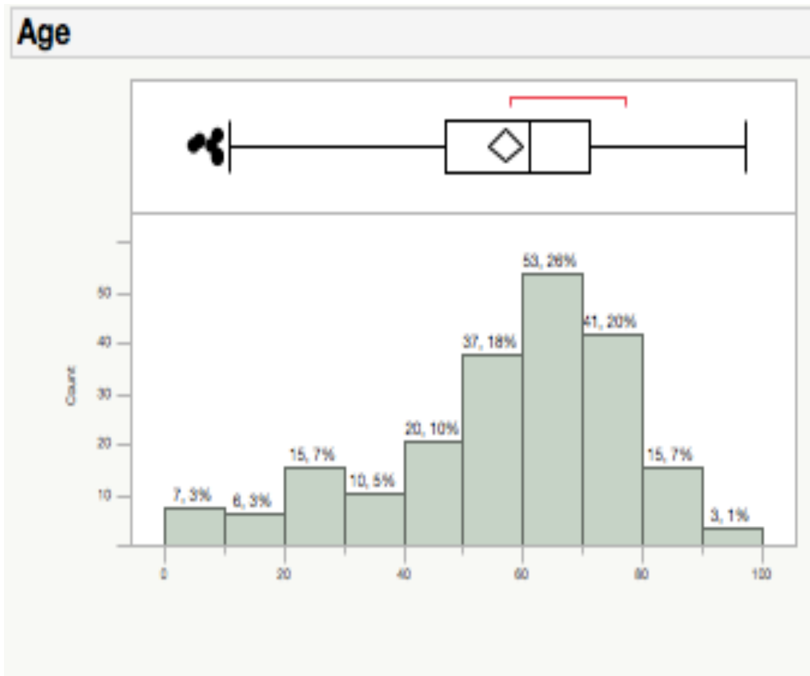


Figure 7: Age Distribution.

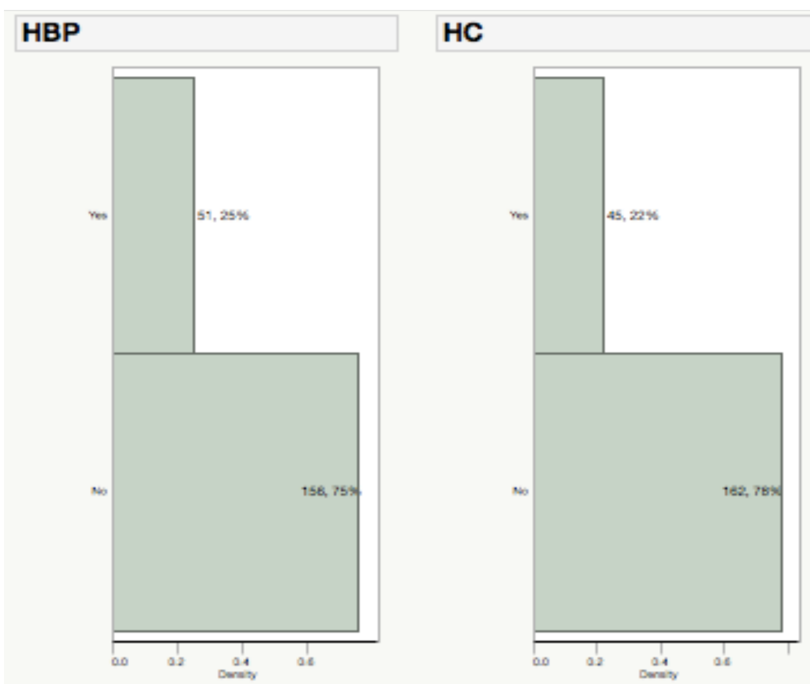


Figure 8: Underlying Health Issues Distribution.

Analysis between Dental Caries and Age

The study found that dental caries was positively correlated to age. (Figure 9. Regression; $R^2 = 0.31426$, $p < 0.0001$).

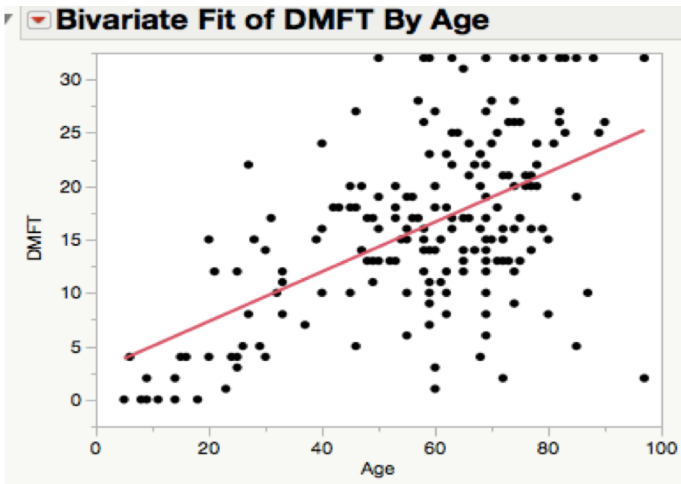


Figure 9. DMFT Index by Age. (Regression; $R^2 = 0.31426$, $p < 0.0001$)

Analysis between Dental Caries and Gender

The study found that there is a significant difference among the dental caries status of males and females. (Figure 10. ANOVA: $F = 6.6031$, $p > 0.0109$).

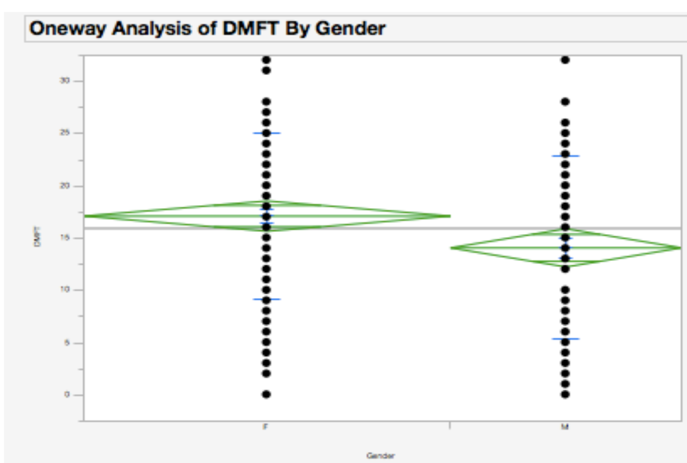


Figure 10. DMFT Index by Gender. (ANOVA: $F = 6.6031$, $p > 0.0109$)

Analysis between Dental Caries and Diabetes Mellitus

The study did not observe a significant difference among the dental caries status of diabetic and non-diabetic patients. (Figure 11. ANOVA: F = 0.6529, p > 0.4200).

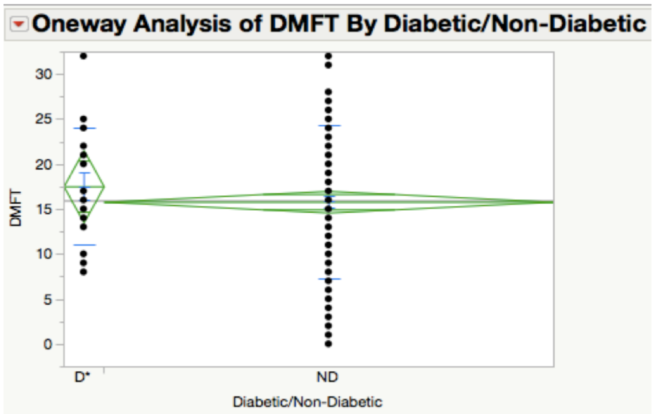


Figure 11. DMFT by Diabetic/Non-Diabetic patients. (ANOVA: F = 0.6529, p > 0.4200)

Analysis between Dental Caries and Adverse Health Conditions

The study found that dental caries was significantly associated with adverse health conditions such as high blood pressure and high cholesterol. (Figure 12a and 12b. ANOVA: F = 8.0782, p > 0.0049 and ANOVA: F = 7.4797, p > 0.0068).

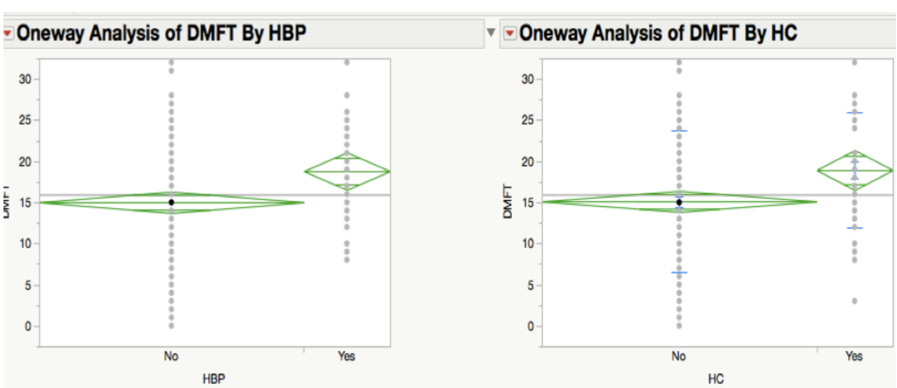


Figure 12a (left) and 12b (right). DMFT Index by High Blood Pressure and High Cholesterol. (ANOVA: F = 8.0782, p > 0.0049 and ANOVA: F = 7.4797, p > 0.0068)

4. DISCUSSIONS

Relationship between Dental Caries and Age

Regression analysis showed a positive correlation between dental caries and age. Specifically, there was an increased likelihood of dental caries found among older patients in the study. According to the National Institute of Dental Health and Craniofacial Research (2018), 42% of children ages 2 to 11, 20% of adolescents ages 12 to 19, 92% of adults ages 20 to 64, and 93% of seniors 65 and older were diagnosed with dental caries. The increasing age of an individual was positively correlated with the increasing prevalence of dental caries in permanent teeth, supporting the results of the study. An article from Harvard Health Publishing (2010) has shown to support this statement when they discovered that the rate of tooth decay with people over 65 years old outpaces that of school children. This could be particularly due to a lifetime of crunching, gnawing, and grinding of food, which naturally wears away the enamel layer of the tooth and becomes more feasible for bacteria to attack. However, the actual effect that age has on the prevalence of dental caries is still warranted due to an uneven distribution of the sample and a bias of having the median age of the study at 61 years old.

Relationship between Dental Caries and Gender

The ANOVA analysis suggested a significant relationship between dental caries and gender. The female patients in this study exhibited a higher likelihood of dental caries than males. Researchers Lukacs and Largaespada (2006) examined this association among the people in Guanches and discovered that this instance could be due to either earlier eruption of teeth in girls causing longer exposure of teeth to the cariogenic oral environment, easier access to food supplies by women and frequent snacking, or pregnancy. The results exhibited a higher caries incidence rate in females were attributed to the physiological changes associated with fluctuations in hormone levels and saliva composition and flow rate of women during puberty, menstruation, and pregnancy.

Another reason could be due to women naturally having less saliva than men (Lund, 2009). A reduction in saliva production means that the saliva's antimicrobial capacity is also reduced. Less food residue is being removed from the surfaces of the teeth and thus allowing more bacteria to react with acid and initiate caries development.

The sex disparities in dental caries hold valid support for this association but it is hard to confirm the effect of gender on dental caries true for this study alone due to bias with an uneven distribution in females to male ratio (1.6:1).

Relationship between Dental Caries and Diabetes

The ANOVA analysis did not establish a significant relationship between diabetes and dental caries. This was expected since only 17 out of 207 (8%) of the population sample were diabetic and to find such a relationship could be just due to bias. Aside from this, a literature review between diabetes and dental caries has been unsuccessful to establish a significant relationship despite larger sample sizes (Taylor et al., 2004). The review mentioned cases of increased, decreased, and similar caries experiences between diabetic and non-diabetic patients. There is still an increasing need for repetitive studies and more effective techniques with regards to the effect that diabetes has on dental caries prevalence to arrive at a final conclusion.

Relationship between Dental Caries and Adverse Health Conditions

The ANOVA analysis revealed that dental caries was significantly associated with adverse health conditions such as high blood pressure (hypertension) and high cholesterol. High blood pressure occurs alongside high blood glucose levels. Similar to diabetes, one of the clinical manifestations of high blood pressure is hyposalivation, a possible cause of dry mouth (Kumar, et al., 2012). In regard to this association, a study has associated higher dental caries with hypertensive patients than healthy individuals (Johnston & Vieira, 2014). The link between the two may be heavily influenced by medication intake such as antihistamine and antihypertensive drugs especially with diuretics (Scully, 2003). With antihypertensive drugs, the main concern is the overgrowth of the gums supporting the tooth. If this issue is not addressed properly, the accumulation of plaque builds up and makes the tooth harder to clean. Over time, the tooth becomes susceptible to dental caries or tooth loss.

Elevated cholesterol levels can cause inflammation in the body's bloodstream, which could damage the structures supporting the tooth and cause tooth infection or tooth loss (Hagh et al., 2014). There has not been a direct link to dental caries yet but an increasing number of tooth loss with patients with higher cholesterol levels also increases the number of missing teeth (M) when measuring the DMFT index of patients. This could have potentially skewed the results of the data since the loss of a tooth was not caused by decay itself but rather an inflammation of the gums.

5. STUDY LIMITATIONS

The study encountered several limitations during data collection process. The factors investigated (age, gender, and underlying conditions) were not direct causes of dental caries but rather extrinsic determinants. To form a solid conclusion means repetitive studies for each factor studied must be accumulated for a longer period (possibly years).

Although x-rays and images were utilized along with data collection, the data was collected independently. There may be errors in the study that were unaccounted for in the examination of the patient's dental caries status using the DMFT index. For instance, it could have been that the tooth marked as a filled tooth (F) may have been due to cosmetic issues rather than a decay issue. The guidance that would have been helpful to receive face-to-face from a dental professional and committee members were also limited in this study.

Another limitation of the study was not being able to extrapolate the type of diabetes and the date of diagnosis for each diabetic patient since their charts simply lack this information. For future studies, this should be identified because the treatment strategies for a patient who has type 1, type 2, or another type of diabetes differ. If such a relationship between diabetes and prevalence of dental caries is proven to be directly associated in the future, then a proper diagnosis of the type of diabetes is crucial to better manage the disease and decrease dental caries.

The main link between diabetes and dental caries prevalence for this study was dry mouth. However, the examiner did not have the proper resources to ascertain the function of the salivary glands and measure the salivary flow rate per minute of each patient. This is a research that the author aims to conduct in the future.

Unfortunately, the timing reserved for data collection was halted short due to an ongoing pandemic, COVID-19, which resulted in a small sample size, an uneven and less diverse distribution. Due to this reason and the data only coming from one center in Florida, this study cannot be generalized to all U.S. dental centers.

6. CONCLUSIONS

According to this study, older patients, females, and especially those with underlying health issues such as high blood pressure and high cholesterol levels should closely monitor their oral health since an increased susceptibility to dental caries was associated with these respective groups of patients.

Although this study did not find any significant association between dental caries in patients with diabetes, the need for repetitive studies, more effective testing techniques, and a larger and more proportionate sample distribution are still warranted to conclude a final association between the two.

In future studies, the rates of salivary flow, oral bacterial count, acid production, and caries incidence in the mouth would have been more desirable measures since these factors directly influence dental caries formation.

Other environmental variables that could also influence the prevalence of dental caries should also be considered. Factors such as poor oral hygiene, compliance with continuous dental treatment, diet, exercise, and control of medication intake could be improved to help decrease the prevalence of dental decay and allow individuals to live healthier lives overall.

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