ABSTRACT

THE STUDY OF FACTORS AFFECTING ORAL HEALTH
IN A SAMPLE FROM NHANES SURVEY
IN THE UNITED STATES

The purpose of this research was to study the factors affecting oral health in the residents of the US. This study examined if there were significant differences in health of teeth and gums with respect to last visit to the dentist, intake of fluoride drops or tablets, gender and educational level. The study analyzed secondary data from the National Health and Nutrition Examination Survey 2017-18. This study examined a population of 9,254 residents aged 1-150 years. The Chi-Square Test of Independence was used to test significance among the variables of last visit to the dentist, received fluoride drops or tablets, gender and educational level.

The study found no statistically significant differences in health of teeth and gums with respect to intake of fluoride drops or tablets, gender and educational level. However, the study did find a statistically significant difference in health of teeth and gums with regard to last visit to the dentist among residents of the US. The results of this study reported that individuals who have visited the dentist in 6 months or less have excellent health of teeth and gums. However, the researcher recommends that future studies should review other factors affecting oral health such as high sugar intake, diabetes, chronic diseases, and genetics.

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THE STUDY OF FACTORS AFFECTING ORAL HEALTH
IN A SAMPLE FROM NHANES SURVEY
IN THE UNITED STATES

by
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For the Department of Public Health:

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CHAPTER 1: INTRODUCTION

Oral health problems include dental caries, gum diseases, loss of natural teeth and other oral mucosal diseases (World Health Organization [WHO], 2018). Dental caries and periodontitis are the major reasons of edentulism and affects around 20-50% of the population worldwide (Nair, 2017). Tooth loss weakens mastication and causes poor diet, nutrition, and eating behavior leading to high mortality rates (Haque et al., 2019). Also, tooth loss is linked with systemic conditions such as coronary heart diseases, stroke, pneumonia, and incident disability (Tsakos et al., 2015). These oral diseases have a great impact on masticatory functions, nutritional intake, speech, swallowing, standard of living and socialization (Jin et al., 2015). The US Surgeon General called dental caries a “silent epidemic”, and it is the root cause of loss of teeth in children and can result in severe health outcomes and even mortality (Jin et al., 2015). In the United States, statistics from 2014 from the Centers for Disease Control and Prevention (CDC) stated that 17.5% of children aged 5-19 years and 27.4% of adults aged 20-44 years are suffering from untreated dental caries (National Center for Health Statistics, 2016).

The predisposing factors causing oral infections include older age, poor nutrition, tobacco and/or alcohol use, immunodeficiencies, poor dental hygiene, unfavorable social conditions, and diabetes (Petersen & Baehni, 2012). The prevalence of oral diseases is increasing in less developed countries due to modernization, low socio-economic status and change in lifestyle (Kumar et al., 2016). Studies have reported that socioeconomic status dictates oral health inequalities with poorer oral conditions seen in individuals belonging to lower socio-economic status (Kumar et al., 2016).

According to the Global Burden of Disease 2017, untreated tooth decay in permanent teeth is the most common health condition (WHO, 2017). It is found that untreated periodontal disease contributes to tooth loss among adults and is known to
compromise mastication, esthetics, self-esteem, and standard of living (Nazir et al., 2020). There are various complications associated with untreated tooth decay such as pain, poor appearance, dysfunction, irregular school attendance and low concentration on daily-life achievements (Eid et al., 2020). In the US, untreated dental caries is observed in 53 million people in the permanent dentition, and 25% of adults aged 65 years or older have lost their natural teeth due to untreated oral conditions (National Institute of Dental and Craniofacial Research [NIDCR], 2015). According to the National Health and Nutrition Examination Survey (NHANES) from 2015-2016, results show that prevalence of dental caries increases with age. The rate of untreated dental caries in deciduous and permanent dentition among children aged 2-5 years was 8.8% and children aged 2-19 years was 13% (Fleming & Afful, 2018).

Dental caries in infants and children are known by several terms such as baby bottle caries, rampant caries, and nursing caries but the most recently used term is Early Childhood Caries (ECC) (Anil & Anand, 2017). The predisposing factors causing early childhood caries are mainly feeding practices, breastfeeding, diet high in sugar, lack of fluoride exposure, and enamel defects in children (Anil & Anand, 2017). The risk factors such as family’s profession, financial and education level, social status, and access to dental care determine the cause for disparities in ECC. Additionally, factors such as a parent's attitude towards dental health, practices and psychological factors also contribute to the development of ECC (Rai & Tiwari, 2018). The ECC affects prosperity of children and is directly linked to problems ranging from local pain, decreased appetite, chewing difficulties, malnutrition, gastrointestinal disorders, sleeping difficulties, and poor school performance (Anil & Anand, 2017). The American Academy of Pediatric Dentistry (AAPD) describes early childhood caries as a public health concern that hampers the growth and development of young children (AADP, 2015).
According to WHO, fluoride toothpaste is the most popular and accepted source of fluoride use worldwide, and it is most effective to decline the prevalence of dental caries (Petersen & Ogawa, 2016). Duijster et al. (2014) showed that children from families that do not practice regular tooth brushing are more prone to experience dental caries (Duijster et al., 2014). In Norway, data from a cohort study has confirmed that brushing teeth of children with a fluoride toothpaste twice in a day reduces the chances of development of cavities from 2 to 5 years of age (Wigen & Wang, 2015). Kumar et al. (2016) suggested that the age of starting using a toothbrush is important and recommends starting age of toothbrushing in children no later than 1 year of age (Kumar et al., 2016).

For years, the recommended age of first visit to the dentist for children was around twelve months of age, but recently it has changed to a time span between 6 months of age and development of the first tooth (American Academy of Pediatrics [AAP], 2014). The reasons for this recommendation are to prevent ECC and to discover and assess the progression of any dental pathology (AAP, 2014). In addition, early visits to a dentist would educate caregivers about importance of practicing healthy oral habits, teach them about fluoride use, teething management and the co-relation between diet and oral health (AAP, 2014). However, in the US, a study conducted by Kopycka-Kedzierawski and Billings (2011) reported that about 32% of children had never had a dental check-up. Previous studies have reported that occupation and education, family size, and birth order have known to affect dental visits by children (Onyejaka et al., 2016).

Dental caries is treated in dental offices by examination and taking X-rays of both treated and untreated lesions (National Institute of Dental and Craniofacial Research [NIDCR], 2018). Amongst other etiological factors, diet is an important factor in causing tooth decay and enamel erosion (Burgess, 2015). Soft drinks are the main contributing factor causing dental caries and loss of tooth enamel as they contain acidogenic and
cariogenic properties (Haque et al., 2019). The WHO published the guideline “Sugars intake for adults and children” with an aim to decrease the incidence of dental caries (WHO, 2015). This guideline suggests daily consumption of sugar less than 10% of total energy intake in both adults and children (WHO, 2015). These guidelines can be adopted as policy in most cases. The policy could regulate food and nutrition labelling, consumer knowledge and regulation of beverages that are high in sugar (WHO, 2015).

As previously mentioned, dental caries remains the most prevalent oral disease worldwide, burdening millions of people, especially children and older adults with pain, poorer quality of general health and life. For this reason, it is important to study further the various factors that affect the oral health in adults in the United States.

**Background**

Oral health is greatly affected by various kinds of oral infections, such as dental caries, periodontal diseases, lesions in HIV/AIDS, mucosal and salivary gland diseases, orofacial pain and clefts, and occasionally oral cancer (Jin et al., 2015). Untreated dental caries can lead to constant pain, difficulty in eating, sleeping, the need for dental filling, poor quality of life, systemic health conditions, emergency hospitalizations and rarely can result in death (Holben et al., 2017).

The occurrence of oral diseases is more prevalent among marginalized population groups, such as people with less education, living in poor conditions and negligent oral habits. According to the CDC, 35-44 years aged Hispanic Whites are twice more likely to have untreated tooth decay than non-Hispanic Whites, mainly due to lower access of minorities to dental care and low socio-economic status (CDC, 2016). In addition, the prevalence of dental caries is most commonly observed in individuals with poor dietary habits, high consumption of sugar and limited access to oral healthcare (Petersen & Ogawa, 2016). In 2018, oral cavity cancers rank among the top 15 most common cancers
worldwide, with a total of 354,864 incident cases (Bray et al., 2018). Oral cavity cancers are responsible for causing 177,384 deaths in 2018 worldwide (Bray et al., 2018).

According to the literature, studies have proven that the caries rate is greater in women than in men. The biological factors like salivary composition and flow rate, hormonal changes in pregnancy and earlier tooth eruption among females have led to higher caries incidence in women than men (Mamai-Homata et al., 2016). Other factors such as presence in the kitchen and making refreshments, and social factors like women’s role in society and family contribute to higher caries incidence in women than men (Mamai-Homata et al., 2016). Contrastingly, some research has also reported that with the exception of puberty and pregnancy, women exhibit fewer periodontal problems as compared to men. This could be due to better oral hygiene practices and behavior among females (Mamai-Homata et al., 2016).

The literature has shown strong evidence for an association between low education of parents, low socio-economic status and poverty and increased risk of having dental caries (Schwendickle et al., 2015). Recent research has suggested that parental education and socioeconomic factors have a strong connection with children’s oral health practices and knowledge (Kato et al., 2017). A cross-sectional study was conducted in Japan to determine the association between parent’s professions and degree of education and the rate of tooth decay in 3 years old children (Kato et al., 2017). A total of 6,315 children and parents participated in the study. This study reported that children with employed fathers working in the professional field and engineering department, sales, or clerical were less prone to experience dental caries as compared to an unemployed father. Similarly, an employed mother who was a career woman or an office worker was linked with good oral hygiene in their children (Kato et al., 2017). This study also suggested that parental education had a significant association with development of dental caries in young children (Kato et al., 2017).
Dental caries is preventive in nature, which can be detected and possibly reversed in its primary phases. Recent studies have re-affirmed the role of fluorides in primary prevention of dental caries, through community water fluoridation and use of fluoride toothpaste twice a day (Cochrane Library, 2014). Adolescents with limited oral health care access and inadequate exposure to fluoride were hopeful to be affected by dental caries than by an individual who is exposed to certain degree of fluorosis. The latter is due to exposure to fluoride from an early age like, drinking fluoridated water and use of conventional toothpastes (Ricomini et al., 2012). Progression of caries in the deeper layers of the tooth (pulp) may be minimized by increased concentration of fluoride intake. Fluoride can be incorporated in the developing tooth if the child uses fluoride toothpaste or drinks fluoridated water (O’Mullane et al., 2016).

There is an expected increase in oral health problems in the elderly population, along with general health problems (Lee et al., 2016). Globally, poor oral health among elderly population is associated with loss of natural teeth, dental caries experience, gum disease, xerostomia, oral cancer and mucosal lesions (Delwel et al., 2018). Poor oral health is associated with reducing chewing ability, digestion and taste, weight loss, geriatric diseases, impaired communication, low self-esteem and inactive social life (Saliba et al., 2018). The current approach to prevent oral diseases in elderly adults is to recognize high-risk individuals, conduct regular screenings, and offer healing treatments. In addition, daily rinsing with fluoride mouth rinse helps to prevent root caries. Another method is to use over-the-counter toothpastes and to get a layer of silver diamine fluoride applied professionally by a dentist once a year (Hyde et al., 2017).

Oral health is an important component of overall health and affects quality of life (U.S. Department of Health and Human Services [HHS], 2000). It is essential to practice healthy oral habits and schedule regular dental visits to maintain good oral health (HHS, 2000). According to the CDC, 2017, only 29.2 % of older adults had dental coverage in
2017 (Kramarow, 2019). Dental insurance was found to be lower among 3 groups of older adults- those aged 77 years and older, those of Hispanic origin and those of lower income (Kramarow, 2019). In three states of the US, low-income population has no access to oral healthcare insurance, and those residing in twelve other states have insurance for only limited conditions such as trauma or uncontrolled bleeding (Center for Health Care Strategies, 2018).

**Problem Statement**

Studies on the factors affecting oral health among adults in the US are limited. According to the Global Burden of Disease Study 2017, oral diseases affect around 3.5 million people globally and dental caries is found to be the most common condition (WHO, 2017). According to the WHO, dental caries affects about 60-90% of schoolchildren and most adults (WHO, 2016). It also causes tooth loss in elderly population worldwide (WHO, 2016). According to NHANES 2015-2016, the prevalence of untreated dental caries was 13% among youth aged 2-19 years. The prevalence of untreated dental caries in children aged 2-5 years was 8.8%, 6-11 years was 15.3% and 12-19 years was 13.4% (Fleming & Afful, 2018).

Oral diseases threaten countries worldwide and affect people’s well-being causing toothache, irritation, disfigurement and even mortality in severe cases. Oral diseases such as periodontal diseases are known to have a significant association with non-communicable diseases such as diabetes mellitus, cardiovascular diseases, chronic renal disease, pneumonia, rheumatoid arthritis, and cancer (Dorfer et al., 2017). The main etiological factors causing dental caries in countries are consumption of diet high in sugar and inadequate exposure to fluoride (WHO, 2015).

In the US, the percentage of individuals without dental health insurance is higher than individuals without health insurance. Oral health diseases are considered as a public
health threat and often remain untreated in the US. Many citizens of the US are deprived of regular dental healthcare, which is important for oral healthcare. In Minneapolis, over 10,000 patients visited 5 hospitals for emergency dental care and were treated only for minor symptoms like pain and ignoring the underlying pathology of the disease (Donoff et al., 2014). American residents aged 65 years and older, particularly those with low-income face significant challenges to access dental coverage (Oral Health America, 2016). Moreover, dental treatment is very expensive in developed nations as well, with an average of 5% of total health expenditure and 20% of out-of-pocket expenditure (Organization for Economic Co-operation and Development [COPD], 2018). An overall decrease in the rate of oral diseases is seen in countries with planned public health programs and oral health interventions, using fluoride as the main preventive factor for dental caries, along with leading healthier lifestyles and regular oral hygiene practices (Petersen & Ogawa, 2016). Therefore, this research will study the various factors affecting oral health in a sample from NHANES survey in the US.

**Research Questions**

This study investigated the factors associated with oral health in a sample from NHANES Survey in the US and responded to the research question “What are the factors affecting oral health of residents in the United States.” This study tested the following research questions:

1. Is there an association between health of teeth and gums and the last visit to a dentist with compliance of recommended 6 months check-up?
2. Is there an association between health of teeth and gums and intake of fluoride drops or tablets?
3. Is there an association between health of teeth and gums and gender?
4. Is there an association between health of teeth and gums and educational level?

**Hypothesis**

The following null hypothesis were identified to emphasize the purpose of this study:

*Hypothesis 1:* There is no statistically significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months.

*Hypothesis 2:* There is no statistically significant difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets.

*Hypothesis 3:* There is no statistically significant difference in the rate of health of teeth and gums according to gender.

*Hypothesis 4:* There is no statistically significant difference in the rate of health of teeth and gums according to educational level.

**Theoretical Framework**

The Health Belief Model (HBM) is the model used to study this health behavior. It is the most popular and widely used theoretical model in the health-promotion behavior and emphasizes on people’s attitudes about their choices (Elvis et al., 2015; Tarkang & Zotor, 2015). The HBM consists of six main constructs: perceived susceptibility, perceived benefits, perceived severity, perceived barriers, cues to action, and self-efficacy (Xiang et al., 2020). The HBM associates psychological theories of making choices to an individual’s decision about alternate action to maintain good health (Sharma & Romas, 2017).
Recently, a cross-sectional study was conducted to predict oral health behaviors among Iranian students, aged 10-12 years old in 2016. The questionnaire for the study had eight items in relation to demographic variables, 30 items on oral hygiene beliefs (HBM constructs) to understand the oral health behaviors of the children. The findings of the study highlighted that the mother’s education and family income had a significant relationship with children’s oral health status (Goodzari et al., 2019). Another study conducted by Rahmati-Najarkolaei et al. (2016) noted that perceived barriers, cues to action, and mother’s education was significantly associated with oral health behaviors in children.

A study was conducted in Democratic Republic (DR) using the HBM model to understand oral health behavior. Dental checkups were conducted in schools in October 2013. The data collected used questionnaire-based surveys that included socio-economic and demographic information, their beliefs derived from HBM and oral health behavior of young children. The results of this study showed that children who consumed diet high in sugar or snacks daily were more likely to have caries (Phanthavong et al., 2019). Therefore, it might be possible to reduce the occurrence of caries in these young children if their parents change their self-efficacy for consuming more healthy diet low in sugar (Phanthavong et al., 2019).

**Limitations**

1. This study is an analysis of secondary data collected from NHANES.
2. The participants’ responses regarding dental caries were self-reported.
3. The participants’ responses regarding fluoride prescription were self-reported.
4. The participants’ may not have enough knowledge on the topic and inadvertently provided inaccurate responses.
5. The participants’ may be unaware of their dental status and could have led to inaccurate answers.

6. The sample size may not have accurately represented the general US population.

**Definition of Terms**

The following terms were used throughout the research study:

*Access to oral health care:* It is the percentage of the user population that underwent at least one procedure in a dental clinic within the previous year (Indian Health Services, 2009).

*Adolescents:* According to WHO, an adolescent is an individual in the 10-19 years age group (WHO, 2021).

*Adults:* According to WHO, an adult is a person older than 19 years of age (WHO, 2016).

*Child:* A human being between the developmental period of infancy and puberty (Rathus, 2013).

*Dental caries:* It is the damage to a tooth surface caused by acids from bacterial breakdown of sugars, starches and cellulose (Longbottom et al., 2009).

*Early Childhood Caries (ECC):* Presence of multiple tooth cavities, lost or restored tooth surfaces in any deciduous tooth in a child younger than 6 years of age (AAPD, 2014).

*Educational level:* It is the highest degree of education that one has obtained (US Census Bureau).

*Fluoride tablets (Fluoride supplements):* They are useful in preventing tooth decay in children older than six months in regions where there is limited supply of water
fluoridation system. It is generally prescribed as a liquid, pill or paste by mouth (WHO, 2009).

*Fluoride:* It protects the tooth surface from cavities by strengthening the outermost layer of the tooth (enamel), in pre-eruptive, post-eruptive, systemic and topical situations (CDC, 2018).

*Oral health or Dental health:* A state of relief from recurring dental pain, cancer, contamination, discomfort and other conditions that allows a person to speak, eat and perform other daily activities (WHO, 2018).

*Socio-economic status:* It is the class or rank of an individual or of a family within a society. It is estimated as a combination of profession, education, financial status, affluence and housing district (Bell, 2015).

*United States of America:* It is a country comprising 50 states and located in North America (Winther, 2020).

**Summary**

Dental caries is the most prevalent chronic oral infection across the world affecting young children and adults both. The risk factors causing dental caries include more exposure to cariogenic bacteria, excessive consumption of sugar, poor oral hygiene, inadequate exposure to fluoride, inappropriate methods of feeding infants and improper training and education on the importance of oral health. This disease affects males and females both, but some studies show evidence that women are at a higher risk of exposure to caries than men.

The aim of this study was to investigate factors like gender, educational level, last visit to the dentist and if received fluoride drops or tablets have an association with rate of oral health among residents in the US. The literature review describes previous and
recent studies of association between gender, educational level, visit to the dentist, access to oral health care, socioeconomic status and fluoride intake and oral health.
CHAPTER 2: LITERATURE REVIEW

This chapter includes a comprehensive review of literature on oral health, caries and other dental conditions. The literature was located through electronic databases such as PubMed and Google Scholar. The literature available at Henry Madden Library at California State University, Fresno was also reviewed. The search was done based upon peer-reviewed literature review. Searches were made with the terms: dental caries, oral health, sugar and dental caries, risk factors causing dental caries, nutrition and dental caries, socioeconomic status and dental caries, oral health care access, disparities in dental care.

Age of Starting Brushing Teeth and Oral Health

The starting age of toothbrushing in children is advised with the eruption of first tooth, which is around 6 months of age, and parents should take their children to the dentist no later than 1 year (AAP, 2015). The CDC suggests that children should start using fluoride toothpaste at the age of 2 years. Children younger than 2 years should use a grain size of fluoride toothpaste and children older than 3 years should not use more than 0.25 g until 6 years to prevent excessive fluoride ingestion (Thornton- Evans et al., 2019).

One study estimated the patterns of tooth brushing and toothpaste use among children and adolescents by analyzing NHANES 2013-2016 data (Thornton-Evans et al., 2019). A total of 5,157 children aged from 3-15 years participated in the analysis. The data was attained from evaluations made using interview answers and medical examinations (CDC, 2019). The children’s parents' answers to questions such as age at which child started brushing teeth, age at which child began to use toothpaste and number of times they brushed their teeth everyday were recorded (CDC, 2019). The analysis of NHANES 2013-2016 data revealed that more than 38% of children aged 3-6 years used
more toothpaste than advised by CDC. Additionally, around 80% of children aged 3-15 years began using a toothbrush later than advocated. Children who lived in low-income households or children with parents who were less educated started using toothbrushes at age greater than 3 years (Thornton-Evans et al., 2019).

A cross-sectional study was conducted in Sudan with the purpose to determine the rate of dental caries and tooth brushing habits (Elidrissi & Naidoo, 2016). A total of 553 school children aged 3-5 years participated in this research. Data were obtained through interviewing the mothers of the children and by a modified WHO examination form. The questionnaire asked questions regarding knowledge about the cause of tooth decay, tooth brushing habits of their children and age at which they started (Elidrissi & Naidoo, 2016). The results suggested that 490 children brushed their teeth daily. Only 6.8% of mothers confirmed using a toothbrush soon after the first tooth eruption and 92.6% mothers waited 3 years until they started brushing their children’s teeth. Mothers who started brushing their children’s teeth at an early age showed less development of dental caries in their teeth than those who waited until 2 years (Elidrissi & Naidoo, 2016).

Another cross-sectional study was conducted to survey toothbrushing consistency among 4-6 years old Iranian children and was associated with mother’s attitude towards oral health behavior. The results reported that 12.8% of children and 18.4% of mothers brushed their teeth twice daily. About 47.3% of children brushed their teeth once a day and nearly 38.7% of children started brushing their teeth regularly at 4 years of age (Soltani et al., 2017).

A study was conducted on 328 preschool children aged 2-5 years in Greece to promote oral health education by supervising their tooth brushing with fluoride and to assess the impact of fluoride varnishes in children used as an alternative to toothbrushing with fluoride (Agouropoulos et al., 2014). Dental professionals delivered an oral health education class to all the children. A grain size amount of 1,000 ppm fluoride toothpaste
was applied on the brush by teachers and trained children in their brushing technique (Agouropoulos et al., 2014). Additionally, fluoride varnish was applied on teeth of the test group twice a year and the control group were given placebo effects. The results found that fluoride varnishes in children were ineffective in delivering caries preventive benefits when used as an alternative to toothbrushing with fluoride in children (Agouropoulos et al., 2014).

**Socioeconomic Status and Oral Health**

A study was conducted in India comprising 1,000 school going children from ages 3-12 years from various schools in Andhra Pradesh. Amongst 1,000 children examined, 443 were boys and 557 were girls. Amongst all participants, 701 children were with both parents working and 299 were with one person working (Gokhale & Nuvula, 2016). The questionnaire consisted of questions regarding the socio-economic and the working status of the parents. A significance level of 0.05 was used and multiple logistic regression analysis, odds ratio and Chi square test was used to analyze the data. The findings suggested that children from higher socio-economic status showed less cases of tooth decay (6.4%). However, children from lower socio-economic background were at a higher risk of experiencing dental caries (46%) (Gokhale & Nuvula, 2016).

Past research has explained that low socio-economic status can be a hindrance to good dental hygiene because of the expensive dental treatment, lower access to dental insurance, less knowledge of negative impact of health compromising behaviors among adults (The Korea National Health and Nutrition Examination Survey [KNHANES], 2008-2010). Another study was conducted in Korea to identify the relationship between family’s socio-economic status and dental caries experience. This study included data from KNHANES, 2010-2012. A total of 1,829 individuals participated from ages 13-18 years in the study. The study was analyzed using multiple logistic regression (Kim et al.,
2018). The study supported that a positive relationship was found between family income and permanent dental caries in male adolescents. The odds ratio and 95% CI were 0.43, 0.41 and 0.28 for low-middle, medium-high and high-income groups respectively. This study concluded that higher household socio-economic status could protect adolescents against dental caries (Kim et al., 2018). The rate of untreated tooth decay reduced from 18.6% for adults from families living below the minimum wage to 7.0% for youth whose families lived with income above 300% of the state poverty line (Fleming & Afful, 2018).

A cross-sectional study was conducted from December 2015-May 2016 in Sichuan, China. The study consisted of 744 people aged 65-74 years, out of which 362 were men and 382 participants were women. The data were obtained through an oral screening and a survey given to the participants (Wang et al., 2017). The results reported that subjects who were well educated and had higher household income had lower incidences of dental caries (Wang et al., 2017). Schwendickle et al. (2015) found that lower socio-economic status is significantly associated with greater risk of developing dental caries (Schwendickle et al., 2015). This study suggests policy makers to design and implement better interventions for older populations of lower SES.

**Fluoride and Oral Health**

Fluoride is the main factor that has shown to lower the rate and severity of tooth decay in the US (HHS, 2015). The reason behind decrease in dental caries in industrialized nations is the use of fluoride toothpaste for brushing teeth in children and adolescents (Buzalaf & Levu, 2011). Water fluoridation is considered an important strategy in the management of untreated tooth decay (Iheozor-Ejiofor, 2015). Community water fluoridation is considered as a major accomplishment of preventive medicine in the US (Slade, 2018). Recently, a cross-sectional study was conducted in the US to examine
the supply of community water fluoridation and the occurrence of dental caries in children and adolescents. The data were collected from oral screening data from NHANES (1999 to 2004 and 2011 to 2014) (Slade et al., 2018). Dental caries prevalence was measured for 7,000 children (2-8 years) in primary dentition and for 12,604 children (6-17 years) in permanent children. The results showed that areas in the US supplied with higher water fluoridation concentration were correlated with lower levels of tooth decay. The preventive fraction of fluoridated water was 30% in deciduous teeth and 12% in permanent dentition (Slade et al., 2018).

A study was conducted on 12 years old children with an aim to compare the efficacy of water and salt community water fluoridation in preventing dental caries on school going children (Fabruccini et al., 2016). A total of 1,528 participants in South Brazil and 1,154 participants in Uruguay were examined. The data were examined using Logistic regression and Poisson regression. The findings reported that school children exposed to salt fluoridation were more prone to experience untreated tooth decay as compared to children exposed to water fluoridation (Fabruccini et al., 2016).

Another study was conducted in the US to determine the co-relation between non-consumption of tap water and dental caries among children. Tap water contains ideal fluoride concentration of 0.7mg/L, which is beneficial for US residents drinking city water (Sanders & Slade, 2018). The data were analyzed from NHANES 2005-2014. The age of the participants was categorized as 2-5, 6-11, and 12-19 years. The interview was directed to learn about the main source of drinking water. The results highlighted that 15% of children and adolescents did not consume tap water and 50% of them had dental caries experience. The findings of this study concluded that non-consumers of tap water were probably to experience tooth decay in their lifetime (Sanders & Slade, 2018).
Educational Level and Oral Health

A study was conducted in 2012 with an aim to assess whether factors like parents’ educational level and family income are linked to occurrence of dental caries in children aged 4-14 years (Cianetti et al., 2017). The study consisted of 269 participants. The oral exam was performed by a dental provider and the number of cavities were recorded. The questionnaire contained questions: Educational level of parents- primary school, middle school, high school and university (Cianetti et al., 2017). The result showed that out of 269 participants, 163 children had dental caries and 68 showed no signs of dental caries. Pertaining the education of parents, mothers of 110 children had a low educational level, the prevalence of caries was found to be 87.2% in their children. The mothers of 121 children had a high education level, their children showed a 55.4% prevalence of dental caries (Cianetti et al., 2017). Regarding the father’s education level, 122 children of fathers with a low education level showed 80.3% of dental caries while 109 children of fathers with high educational level presented 59.6% of caries (Cianetti et al., 2017). Therefore, the study concluded that parents’ education is directly linked with the development of dental caries in young children.

Another study was conducted in Turkey to understand the impact of mother’s education on children’s oral health. The study comprised 148 children aged 5-14 years and they were chosen from the dental clinic files in Turkey (Kuteri & Uzel, 2020). The files included the child’s age, gender, frequency of sugar intake, the mother’s age, her education level and her brushing habits. The authors found no link between Decayed Missing Filled Teeth (DMFT) in children and their frequency of consuming sugars (Kuteri & Uzel, 2020). They also found a positive relationship between mother’s toothbrushing and their children’s toothbrushing habits. The results also reported an association between mother’s educational level and children’s toothbrushing frequency. However, on the contrary to the above study, there was no association found between
mother’s education and the number of cavities in their children’s mouth (Kuteri & Uzel, 2020).

**Visit to a Dentist and Oral health**

The American Academy of Pediatrics has recommended first dental visit by 12 months in children (AAPD, 2015). A timely first dental visit creates awareness in parents and caregivers about healthy oral behaviors and allows the early identification of any risk factors (Subramaniam & Reghuvaran, 2019). Studies suggest that the first dental visit was found to differ in different countries. In the past, studies suggested that the recommended age of first dental visit for children was before 1 year of age. Early dental visits result in arrest of dental caries, fewer restorations and dental procedures which can decrease expenditures for parents (Subramaniam & Reghuvaran, 2019).

A study was performed in Saudi Arabia with an aim to analyze the relationship between children’s dental habits and regular visits to the dentist (Alayadi et al., 2019). This study consisted of participants aged 6-12 years and the sample size was 1,087 participants (721 females and 166 males). The study consisted of a parent's questionnaire and clinical assessment of children detecting dental caries in them. The questionnaire consisted of questions like dental visit within 12 months and the reason for dental visit. It also included questions on health behavior like frequencies of brushing their teeth, use of fluoride toothpaste and the consumption of sugars. The analysis was carried out by a logistic regression model (Alayadi et al., 2019). The results highlighted that only 6.8% of the sample reported regularly visiting their dentist. The percentage of children visiting the dentist regularly was lowest for children whose mothers had lowest education. The results also showed that females and children with high family income were more likely to visit a dentist. It was found that the caries experience was inversely associated with regular dental visits among children (Alayadi et al., 2019).
Another cross-sectional study was conducted in India with an aim to explore the age at which parents took their children to the dentist for the first time. This study randomly selected dental colleges and private dental clinics in Bengaluru, India. The interviewer asked parents about the age of their children and reasons for their first dental visit. The results highlighted that the average age of the first visit to the dentist was between 8.18 years and 3.2 years. Only 1 child reported visiting a dentist at 1 year old. 13% of children visited the dentist at the age of 6 years. The study found no significant difference between girls and boys for the first visit to the dentist. Pain and tooth decay were found to be the cause behind children’s first visit to the dentist (Subramaniam & Reghuvaran, 2019).

**Access to Oral Health Care**

In the United States, the initiative to improve the quality of oral healthcare for underserved populations such as people who belong to low-income and minority groups, rural areas or uninsured has not received much attention in the past (Northridge et al., 2020). In the US, The District of Columbia and eighteen states offer considerable dental benefits to Medicaid patients which includes restorative procedures with an annual cap of at least $1,000 (Center for Health Care Strategies, 2018). Seventeen states offer limited dental coverage which include an annual cap of $1,000 or less, excluding major restorative treatments (Center for Health Care Strategies, 2018). Mid income or poor older adults have the option of paying via cash or credit for dental procedures because of high out-of-pocket costs (Manski & Rohde, 2017).

The high expenditure of dental treatment and limited access to oral health care insurance dictates the utilization of dental care by individuals. Medicare does not include preventive screenings for oral health services for eligible individuals. Although Medicaid programs cover emergency dental services, only 28 states in the US provide oral health
benefits to Medicaid enrolled adults beyond urgent care (Adesanya et al., 2016). The Gary and Mary West Senior Dental Center (GMWSDC) are raising the need for affordable, high quality dental care to older populations, enabling them to lead more productive and fulfilling lives (West Health, 2019).

Recent studies have reported that individuals with high-income levels use oral health care more than lower-income populations as they can afford the high cost of the dental services (Mohammadbeigi et al., 2013). A cross-sectional study was conducted in Iran, which consisted of 281 children aged from 6-7 years. The study was aimed to evaluate the utilization of Oral Health Care (OHC) by children (Mohammadbeigi et al., 2013). Data was obtained by a survey which consisted of 2 main questions asked from children's parents, ‘Did you have access to OHC in the last year?’ and ‘Have you utilized OHC in the past year?’. Additionally, the education level of children was also considered in the study. The results reported that the education level of parents dictated the utilization rate of OHC among their children. The study stated that children with parents having a higher education were more aware to use OHC (Mohammadbeigi et al., 2013).

Another study was carried out in Karachi, Pakistan in 2015 with an aim to understand the hurdles that limit the access to dental care in the low socio-economic communities (Hemani et al., 2017). In this study, the age group ranged from 26-65 years. The WHO Oral Health Survey was used to acquire the relevant information. The findings of this research reported that the expense of dental treatment is associated with access to a personal dentist. The study showed that cost is the major factor in utilizing oral health care services, especially for marginalized communities, underserved patients and patients with disabilities (Hemani et al., 2017). It is therefore, unfortunate that oral treatment is one of the most expensive treatment worldwide which limits its access to middle and low-socioeconomic classes and older people.
Gender and Oral Health

The previous literature in Tokyo has shown that women have higher number of cavities and filled teeth as compared to men and women tend to be edentulous at a younger age (Dental Health Division of Health Policy Bureau, 1995). On contrary, another previous literature in Jordan found that female dental students were more aware of dental hygiene practices and reported brushing their teeth more frequently than their male peers and hence, showed fewer cases of dental caries as compared to men (Al-Omari & Hamasha, 2005).

Currently, a study was conducted on Greek students who study in a dental school (Mamai-Homata et al., 2016). The students participated in a survey in 1981, 2000 and 2010. The age range for students was 19-25 years in all 3 years. The sample size was 180 students in 1981, 109 in 2000 and 96 in 2010. The variables recorded in the study were coronal caries, periodontal status and oral hygiene status. The data were analyzed by bivariate and meta-analysis (Mamai-Hamata et al., 2016). On the oral hygiene front, the findings highlighted that females had better oral hygiene status than males in years 1981 and 2000. On the contrary, the oral hygiene status of men was better than women in 2010. On the coronal caries front, analysis on results by gender showed no significant differences (Mamai-Hamata et al., 2016). According to this study, females brushed their teeth more and have better oral hygiene than men. Both men and women are equally informed about oral hygiene instructions and disregards the previous literature that women experience more dental caries (Mamai-Homata et al., 2016).

A cross-sectional study was conducted in Riyadh to understand variation of males and females with respect to oral health behaviors and beliefs (Hamasha et al., 2018). The target audience was adult out-patients from various medical departments of the hospital. The questionnaire consisted of two parts: demographic section and beliefs and behaviors section. The sample size was 519 adults, with 251 males and 268 females.
The results of the study reported that both men and women had the same belief of regularly tooth brushing their teeth. However, good oral habits such as brushing and flossing teeth were more frequently practiced by females as compared to males. Also, both males and females had the same belief about carbohydrates causing the development of dental caries and the significance of scheduling regular dental visits. However, the results suggest that males consumed less carbohydrates as compared to females and females visited their dentist more frequently (Hamasha et al., 2018). This study concluded females practiced positive oral health practices frequently as compared to males.

**Disparities in Oral Health Care**

Oral health discrimination still exists among underserved populations, especially people living in low-income areas, individuals belonging to racial/ethnic minority groups, and those residing in areas that have limited access to oral healthcare. It is also more likely seen in people with disabilities and malformations, including older adults who are dependent on others. An analysis of NHANES data, 2009 to 2012 showed that the prevalence of dental caries and periodontitis was almost 20% greater among Hispanics and non-Hispanics Blacks than among non-Hispanic Whites (Fischer et al., 2017).

Also, data from NHANES 2011-2012 revealed that Hispanic and non-Hispanic Black children aged 2-8 years reported high rates of untreated tooth decay than non-Hispanic White children in the same age group (Fischer et al., 2017). It is found that oral health has a direct link with education and income level, and individuals with low-income and low education are more likely to have poor oral health as compared to individuals with higher levels of education or income. Also, individual’s socio-economic factors such as family income and education limit the availability to dental care (Kim et al., 2016).
Another research was analyzed to find out association of SES factors with oral health disparities in California (Telford et al., 2011). The study examined data from California Health Interview Survey (CHIS), 2017. This study used logistic regression to analyze and explain disparities related with SES. This study revealed that poverty was the only factor responsible for inequalities in self-reported dental health. By encouraging balanced nutrition and dental check-ups at regular intervals, these disparities can be slowly eliminated (Telford et al., 2011).

**Health Belief Model and Oral Health**

The Health Belief Model is based on the prevention of diseases and health behaviors and advocates a relationship between health beliefs and behavior. This model helps people perceive a health threat and their behaviors lead them to make changes toward good health (Vaezipour et al., 2018). A study was conducted in Qom, a city in Iran in 2016 to evaluate the impact of an education program based on the Health Belief Model on improving oral health practices among the participants (Vaezipour et al., 2018). There was a total of 100 participants who were 7th grade students, out of which 50 students were a part of the intervention group and 50 students comprised the control group. The questionnaire included questions about knowledge related to oral health conditions and about seven constructs of the model (Vaezipour et al., 2018). After the pretest, educational training was conducted including lectures, posters, videos and group discussions. After the training, the questionnaire was returned to the intervention and control group. The findings of the study reported a significant increase in the average scores of the constructs of knowledge, perceived susceptibility, perceived severity, perceived barriers, and perceived self-efficacy. This study highlighted that after the educational training, the knowledge of the intervention group related to healthy oral habits was significantly different and improved than the control group. Also, remarkable
improvement in the construct of perceived self-efficacy in the intervention group was observed. The results showed no significant difference in the brushing of teeth and flossing in both intervention and control groups (Vaezipour et al., 2018).

A study was conducted in Alaska, US to explore the constructs of the Health Belief Model about oral hygiene behaviors of parents and their children aged 0-6 years. The purpose of the study was to determine tooth brushing patterns in parents of children and the relationship between parents’ oral health beliefs and tooth brushing frequency (Hiratsuka et al., 2019). A survey was distributed to the parents with questions like “How often do you brush your teeth” and “How often do you brush your children’s teeth.” Pearson Chi-Square test was used to analyze the data. The results showed that the majority of parents did not brush their children’s teeth twice daily. This study concluded that the advised level of tooth brushing was 49 times higher in children when their parents brushed their teeth twice daily (Hiratsuka et al., 2019).

Another study was conducted with an aim to determine the factors that may influence children to practice good oral hygiene based on the Health Belief Model. The participants were 42 American children who were second through fifth graders. The subjects were interviewed regarding their histories of caries, perceived confidence in tooth brushing, self-perceived susceptibility and vulnerability for caries and perceived benefits and barriers to practicing good dental hygiene (Walker & Jackson, 2015). The results of the study showed that most children related good oral health as part of overall health and wellness. Some participants assumed poor oral health is only observed in older population while some believed that poor oral health can occur at any stage. The subjects stated esthetic components as important and the desire to please others by regular tooth brushing. The participants cited insufficient time and limited access to oral hygiene aids as a hindrance to practice oral hygiene routine (Walker & Jackson, 2015).
National Health and Nutrition Examination Survey (NHANES)

The National Health and Nutrition Examination Survey (NHANES) is a program of studies conducted to evaluate the health and nutritional status of children and adults in the US, which is conducted by the National Center for Health Statistics (NCHS) (CDC, 2020). The survey examines about 5,000 residents of the US annually. The NHANES interview includes many categories: demographic, socioeconomic, dietary and health related questions in their questionnaires. The diseases or medical conditions surveyed in NHANES are anemia, cardiovascular diseases, diabetes, environmental exposures, kidney diseases, infectious diseases, nutrition, obesity, oral health, reproductive history and sexually transmitted diseases.

The NHANES also includes people over 60 years and older and samples African, American, Asians and Hispanics. Health interviews are conducted in participants' homes. The staff consists of physicians, a dentist, health technicians and health interviewers (CDC, 2020). The study staff are mostly bilingual. The survey findings from NHANES data have been utilized to determine the rate and severity of chronic conditions and the etiological factors of these diseases. Results of NHANES is beneficial to the residents of the US in many ways. By identifying predisposing factors causing the diseases and needs of the population, the government will formulate new policies and health education programs that will benefit people in the communities and in the country (CDC, 2020).

Summary

The literature review analyzed various factors that are associated with causing oral health problems. The sections that were reviewed in detail were age starting brushing teeth, socioeconomic status, fluoride tablets intake, last visit to a dentist, educational level, access to dental care, gender and disparities in oral health care. There are many studies that have concluded association between socio-economic status and development
of dental infections, especially untreated tooth decay. The previous studies have shown that women tend to be more prone to developing dental caries due to less saliva production, pregnancy and hormonal fluctuations. But the new literature has discarded this theory and concluded that both men and women are equally aware about oral hygiene and have equal chances of developing dental caries.
The purpose of this study was to investigate factors affecting oral health among US residents in a sample from NHANES survey. The various factors discussed in the literature review are gender, educational level, socioeconomic status, receiving fluoride drops or tablets, visit to a dentist and access to oral health care. This chapter presents the research design and how the population, instrumentation, setting and measures were related to the data analysis.

**Study Population**

In the original NHANES survey, the data were collected from the US residents selected from 30 different survey locations aged 1 to 80 years and older in 2017-2018. This study will focus on oral health among all age groups from 1-150 years. Of those selected, 9,254 participants completed the interview and 8,704 were examined. For this study, the population was examined by using the National Health and Nutrition Examination Survey (NHANES), 2017-2018. The NHANES data comprised two questionnaires, a demographic questionnaire and an oral health questionnaire. Both the questionnaires were asked at the residence of the participants using the Computer-Assisted Personal Interview (CAPI) system. A proxy was present for participants who were 16 years or under. Data were obtained on many topics regarding the individual demographics, lifestyle and oral health status. Permission to use NHANES public data was attained from CDC (see Appendix A).

**Variables**

The dependent variable used in this study was: Rate the health of your teeth and gums. The four independent variables used in this study were: When did you last visit a dentist, whether Received fluoride Rx drops or tablets, Gender and Educational level for
Adults 20+ years. Table 1 describes the variables and their description. The responses for dependent variable, health of teeth and gums were recoded into excellent, very good, good and fair. The options fair and poor were recoded into “fair” and the option “don’t know” was deleted to simplify the result options.

**Table 1**

*Description of Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description of Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (n=9,254)</td>
<td>1= Male</td>
</tr>
<tr>
<td></td>
<td>2= Female</td>
</tr>
<tr>
<td>Educational level 20+ Adults (n=3,685)</td>
<td>1= Less than 9\textsuperscript{th} grade</td>
</tr>
<tr>
<td></td>
<td>2=9-11\textsuperscript{th} grade</td>
</tr>
<tr>
<td></td>
<td>3= High school graduate</td>
</tr>
<tr>
<td></td>
<td>4= Some college or AA graduate</td>
</tr>
<tr>
<td></td>
<td>5= College graduate or AA degree</td>
</tr>
<tr>
<td></td>
<td>7= Refused</td>
</tr>
<tr>
<td></td>
<td>9= Don’t know</td>
</tr>
<tr>
<td>Health of teeth and gums (n= 8,895)</td>
<td>1= Excellent</td>
</tr>
<tr>
<td></td>
<td>2= Very Good</td>
</tr>
<tr>
<td></td>
<td>3= Good</td>
</tr>
<tr>
<td></td>
<td>4= Fair</td>
</tr>
<tr>
<td>Last visit to a dentist (n= 8,897)</td>
<td>1= 6 months or less</td>
</tr>
<tr>
<td></td>
<td>2= More than 6 months ago, but not more than 1 year ago</td>
</tr>
<tr>
<td></td>
<td>3= More than 1 year ago, but not more than 2 years ago</td>
</tr>
<tr>
<td></td>
<td>4= More than 2 years ago, but not more than 3 years ago</td>
</tr>
<tr>
<td></td>
<td>5= More than 3 years ago, but not more than 5 years ago</td>
</tr>
<tr>
<td></td>
<td>6= More than 5 years ago</td>
</tr>
<tr>
<td></td>
<td>7= Never have been</td>
</tr>
<tr>
<td></td>
<td>77= Refused</td>
</tr>
<tr>
<td></td>
<td>99= Don’t know</td>
</tr>
<tr>
<td>Received Rx fluoride drops or tablets</td>
<td>1= Yes</td>
</tr>
<tr>
<td></td>
<td>2= No</td>
</tr>
<tr>
<td></td>
<td>7= Refused</td>
</tr>
<tr>
<td></td>
<td>9= Don’t know</td>
</tr>
</tbody>
</table>
Data Collection

This study was an analysis of secondary data collected from NHANES 2017-2018. This study examined data from individuals aged 1-150 years and total participants in this age group were 9,254. The study determined the last visit to the dentist, fluoride intake, rate of health of teeth and gums, gender and educational level. Variables were analyzed using SPSS, a statistical software package. The Human Subjects Approval Letter to proceed with secondary data was obtained from the Committee of the Protection of Human Subjects (see Appendix B).

Variable Definitions

The following questions provided information concerning oral health status among the participants:

Question 0HQ845- “Rate the health of your teeth and gums?” The responses were coded to include 1. “Excellent”; 2. “Very good”; 3. “Good”; 4. “Fair”.

Question 0HQ030- “When did you last visit a dentist?” The responses were coded to include: 1. “6 months or less”; 2. “More than 6 months ago, but not more than 1 year ago”; 3. “More than 1 year, but not more than 2 years ago”; 4. “More than 2 years ago, but not more than 3 years ago”; 5. “More than 3 years ago, but not more than 5 years ago”; 6. “More than 5 years ago”; 7. “Never have been”; 77. “Refused”; 99. “Don't know”.

Question OHQ566- “Received Rx fluoride drops or tablets?” The responses were coded to include: 1. “Yes”; 2. “No”; 7. “Refused”; 9. “Don't know”.

Demographic Variables

Question RIAGENDR- “Gender of the participant?” The responses were coded to include: 1. “Male”; 2. “Female”.

Question DMDEDUC2- “What is the highest grade or level of school completed or the highest degree?” The responses were coded to include: 1. “Less than 9th grade”; 2. “9-11th grade”; 3. “High school graduate”; 4. “Some college or AA degree”; 5. “College graduate or above”; 7. “Refused”; 9. “Don’t know”.

Research Questions

This study investigated the factors associated with oral health in a sample from NHANES Survey in the US and responded to the research question “What are the factors affecting oral health of residents in the United States”. This study tested the following research questions:

1. Is there an association between health of teeth and gums and the last visit to a dentist with compliance of recommended 6 months check-up?
2. Is there an association between health of teeth and gums and intake of fluoride drops or tablets?
3. Is there an association between health of teeth and gums and gender?
4. Is there an association between health of teeth and gums and educational level?

Data Analysis

Secondary data from NHANES 2017-2018 survey was used and inputted into SPSS to test the hypothesis using the Chi- Square Test of Independence. The Chi- Square Test of Independence was used because it provides a test to determine whether there is a significant difference between two categorical variables. The significance level of 0.05%, marginal error of 5% and C.I. (Confidence Interval) of 95% was used for data analysis. The sample size calculated for this study was 369. The dependent variable was the rate of health of your teeth and gums. The independent variables were gender, educational level,
last visit to a dentist and if received fluoride drops or tablets. The dependent and independent variables were analyzed using SPSS 25 edition statistical software.

**Summary**

This study utilized secondary data from NHANES 2017-2018. Data were analyzed using the Chi-Square Test of Independence. The aim of this research was to determine the role of factors like last visit to the dentist, intake of fluoride drops or tablets, gender and educational level in oral diseases among US residents. A total of 9,254 participants participated in the study and the significance level of 0.05%, marginal error of 5% and C.I. of 95% was used for data analysis.
CHAPTER 4: RESULTS

The purpose of this study was to examine factors affecting oral health among US residents. The data were collected from NHANES 2017-2018 survey. Chapter 4 provides detailed results of the hypothesis that were run.

Demographics

This study used the NHANES data from 2017-2018. The total number of participants were 9,254 (NHANES, 2017-2018) and out of those, a total of 8,704 participants were examined. Table 2 presents a detailed description of demographic variables. Regarding gender, a total of 9,254 participated and most respondents were females (50.8%). For educational level 20+ adults, 5,569 respondents’ answers were recorded and were categorized as less than 9th grade (5.2%), 9-11th grade (6.9%), High school graduate (14.3), Some college or AA degree (19.2%), College graduate or above (14.4%), Refused (.0%) and Don’t know (.1%).

Table 2

<table>
<thead>
<tr>
<th>NHANES Survey Demographics for Gender and Educational level for Adults 20+</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4557</td>
<td>49.2</td>
</tr>
<tr>
<td>Female</td>
<td>4697</td>
<td>50.8</td>
</tr>
<tr>
<td>Educational level 20+ adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 9th grade</td>
<td>479</td>
<td>5.2</td>
</tr>
<tr>
<td>9-11th grade</td>
<td>638</td>
<td>6.9</td>
</tr>
<tr>
<td>High school graduate</td>
<td>1325</td>
<td>14.3</td>
</tr>
<tr>
<td>Some college or AA degree</td>
<td>1778</td>
<td>19.2</td>
</tr>
<tr>
<td>College graduate or above</td>
<td>1336</td>
<td>14.4</td>
</tr>
<tr>
<td>Refused</td>
<td>2</td>
<td>.0</td>
</tr>
<tr>
<td>Don’t know</td>
<td>11</td>
<td>.1</td>
</tr>
</tbody>
</table>
Last Visit to a Dentist and Health of Teeth and Gums

The survey asked the residents about their last visit to the dentist. The responses were recorded to include: 6 months or less, More than 6 months ago, More than 1 year ago, More than 2 years ago, More than 3 years ago, More than 5 years ago, Never, Don’t know (see Table 3).

Table 3

Rate the Health of Your Teeth and Gums and When Did You Last Visit a Dentist

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>6 mo or less</th>
<th>More than 6 mo ago</th>
<th>More than 1 yr ago</th>
<th>More than 2 yrs ago</th>
<th>More than 3 yrs ago</th>
<th>More than 5 yrs ago</th>
<th>Never</th>
<th>Don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1006</td>
<td>202</td>
<td>101</td>
<td>40</td>
<td>31</td>
<td>76</td>
<td>226</td>
<td>5</td>
<td>1687</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>11.3</td>
<td>2.3</td>
<td>1.1</td>
<td>0.5</td>
<td>0.3</td>
<td>0.9</td>
<td>1.2</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Very Good</td>
<td>1191</td>
<td>350</td>
<td>204</td>
<td>88</td>
<td>72</td>
<td>124</td>
<td>103</td>
<td>2</td>
<td>2134</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>13.4</td>
<td>3.9</td>
<td>2.3</td>
<td>1.0</td>
<td>0.8</td>
<td>1.4</td>
<td>1.2</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Good</td>
<td>1258</td>
<td>451</td>
<td>360</td>
<td>192</td>
<td>149</td>
<td>269</td>
<td>133</td>
<td>8</td>
<td>2820</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>14.2</td>
<td>5.1</td>
<td>4.1</td>
<td>2.2</td>
<td>1.7</td>
<td>3.0</td>
<td>1.5</td>
<td>0.1</td>
<td>31.7</td>
</tr>
<tr>
<td>Fair</td>
<td>612</td>
<td>355</td>
<td>335</td>
<td>207</td>
<td>219</td>
<td>443</td>
<td>62</td>
<td>13</td>
<td>2246</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>6.9</td>
<td>4.0</td>
<td>3.8</td>
<td>2.3</td>
<td>2.5</td>
<td>5.0</td>
<td>0.7</td>
<td>0.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Total</td>
<td>4067</td>
<td>1358</td>
<td>1000</td>
<td>527</td>
<td>471</td>
<td>912</td>
<td>524</td>
<td>28</td>
<td>8887</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>45.8</td>
<td>15.3</td>
<td>11.3</td>
<td>5.9</td>
<td>5.3</td>
<td>10.3</td>
<td>5.9</td>
<td>0.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Chi-Square is 1121.787, df= 21 and p-value is <0.001

The first hypothesis stated that there is no statistically significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The Pearson Chi-Square value was 1121.787, df= 21, and p-value was < 0.001. Since the p-value was less than 0.05, it can be concluded that there was a significant difference between the health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The results of this test reject the null hypothesis. The findings of this study showed that individuals who have visited the dentist in 6 months or less have rated their health of teeth and gums as excellent as compared to those who did not visit the dentist in the last 6 months.
Received Rx Fluoride Drops or Tablets
and Health of Teeth and Gums

The survey asked the residents about their intake of fluoride drops or tablets. The answers were recorded as Yes, No, Refused, Don’t Know (see Table 4).

Table 4

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td></td>
<td>71</td>
<td>651</td>
<td>0</td>
<td>722</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>3.1</td>
<td>28.8</td>
<td>0.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Very Good</td>
<td></td>
<td>64</td>
<td>501</td>
<td>6</td>
<td>571</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>2.8</td>
<td>22.2</td>
<td>0.3</td>
<td>25.3</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td>79</td>
<td>622</td>
<td>4</td>
<td>705</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>3.5</td>
<td>27.5</td>
<td>0.2</td>
<td>31.2</td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td>31</td>
<td>228</td>
<td>1</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>1.4</td>
<td>10.1</td>
<td>0.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>245</td>
<td>2002</td>
<td>11</td>
<td>2258</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>10.9</td>
<td>88.7</td>
<td>0.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Chi- Square value is 8.784, df= 6 and p-value is .185

The second hypothesis stated that there is no statistically difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets. The Pearson Chi- Square value was 8.784, df= 6, and the p-value was 0.185. Since the p-value was greater than 0.05, it can be concluded that there was no significant difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets. The results of this test fail to reject the null hypothesis.

Gender and Health of Teeth and Gums

The survey asked the participants about their gender. The answers were recorded as Male and Female (see Table 5).

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Male</th>
<th>Female</th>
<th>Don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td></td>
<td>71</td>
<td>651</td>
<td>0</td>
<td>722</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>3.1</td>
<td>28.8</td>
<td>0.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Very Good</td>
<td></td>
<td>64</td>
<td>501</td>
<td>6</td>
<td>571</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>2.8</td>
<td>22.2</td>
<td>0.3</td>
<td>25.3</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td>79</td>
<td>622</td>
<td>4</td>
<td>705</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>3.5</td>
<td>27.5</td>
<td>0.2</td>
<td>31.2</td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td>31</td>
<td>228</td>
<td>1</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>1.4</td>
<td>10.1</td>
<td>0.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>245</td>
<td>2002</td>
<td>11</td>
<td>2258</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>10.9</td>
<td>88.7</td>
<td>0.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Chi- Square value is 5.391, df= 3, and p-value was .145. Since the p-value was greater than 0.05, it
can be concluded that there was no significant difference in the rate of health of teeth and
gums according to gender. The results of this test fail to reject the null hypothesis.

Table 5

Rate the Health of Your Teeth and Gums and Gender

<table>
<thead>
<tr>
<th>Category</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>818</td>
<td>869</td>
<td>1687</td>
</tr>
<tr>
<td>%</td>
<td>9.2</td>
<td>9.8</td>
<td>19.0</td>
</tr>
<tr>
<td>Very Good</td>
<td>1020</td>
<td>1114</td>
<td>2134</td>
</tr>
<tr>
<td>%</td>
<td>11.5</td>
<td>12.5</td>
<td>24.0</td>
</tr>
<tr>
<td>Good</td>
<td>1372</td>
<td>1448</td>
<td>2820</td>
</tr>
<tr>
<td>%</td>
<td>15.4</td>
<td>16.3</td>
<td>31.7</td>
</tr>
<tr>
<td>Fair</td>
<td>1147</td>
<td>1099</td>
<td>2236</td>
</tr>
<tr>
<td>%</td>
<td>12.9</td>
<td>12.4</td>
<td>25.3</td>
</tr>
<tr>
<td>Total</td>
<td>4357</td>
<td>4530</td>
<td>8887</td>
</tr>
<tr>
<td>%</td>
<td>49.0</td>
<td>51.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Chi- Square value is 5.391, df= 3 and p- value is .145

Educational Level and Health of Teeth and Gums

The survey asked the residents about their educational level for 20 years and
above adults. The answers were recorded as Less than 9th grade, 9-11th grade, High
school graduate, some College or AA graduate, College graduate or above, Refused and
Don’t know (see Table 6).

Table 6

Rate the Health of Your Teeth and Gums and Educational Level for Adults 20+

<table>
<thead>
<tr>
<th>Category</th>
<th>Less than 9th grade</th>
<th>9-11th grade</th>
<th>H.S. graduate</th>
<th>Some college or AA college</th>
<th>College graduate or above</th>
<th>Refused</th>
<th>Don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>96</td>
<td>108</td>
<td>232</td>
<td>311</td>
<td>271</td>
<td>1</td>
<td>1</td>
<td>1020</td>
</tr>
<tr>
<td>%</td>
<td>1.8</td>
<td>2.0</td>
<td>4.3</td>
<td>5.8</td>
<td>5.1</td>
<td>0.0</td>
<td>0.0</td>
<td>19.1</td>
</tr>
<tr>
<td>Very Good</td>
<td>108</td>
<td>155</td>
<td>306</td>
<td>405</td>
<td>301</td>
<td>1</td>
<td>2</td>
<td>1278</td>
</tr>
<tr>
<td>%</td>
<td>2.0</td>
<td>2.9</td>
<td>5.7</td>
<td>7.6</td>
<td>5.6</td>
<td>0.0</td>
<td>0.0</td>
<td>23.9</td>
</tr>
<tr>
<td>Good</td>
<td>145</td>
<td>209</td>
<td>401</td>
<td>514</td>
<td>414</td>
<td>0</td>
<td>3</td>
<td>1686</td>
</tr>
<tr>
<td>%</td>
<td>2.7</td>
<td>3.9</td>
<td>7.5</td>
<td>9.6</td>
<td>7.8</td>
<td>0.0</td>
<td>0.0</td>
<td>31.6</td>
</tr>
<tr>
<td>Fair</td>
<td>116</td>
<td>142</td>
<td>325</td>
<td>464</td>
<td>305</td>
<td>0</td>
<td>4</td>
<td>1356</td>
</tr>
<tr>
<td>%</td>
<td>2.2</td>
<td>2.7</td>
<td>6.1</td>
<td>8.7</td>
<td>5.7</td>
<td>0.0</td>
<td>0.1</td>
<td>25.4</td>
</tr>
<tr>
<td>Total</td>
<td>465</td>
<td>614</td>
<td>1264</td>
<td>1694</td>
<td>1291</td>
<td>2</td>
<td>10</td>
<td>5340</td>
</tr>
<tr>
<td>%</td>
<td>8.7</td>
<td>11.5</td>
<td>23.7</td>
<td>31.7</td>
<td>24.2</td>
<td>0.0</td>
<td>0.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Chi- Square value is 17.133. df= 18 and p-value is .514
The fourth hypothesis stated that there is no statistically significant difference in the rate of health of teeth and gums according to the educational level. The Pearson Chi-Square was 17.133, df= 18 and p-value was .514. Since the p-value was greater than 0.05, it can be concluded that there was no significant difference in the rate of health of teeth and gums according to the educational level. The results of this test fail to reject the null hypothesis.

Summary

Chapter 4 consisted of a detailed analysis of NHANES 2017-2018 data collected from 50 states of the US. The Chi-Square Test of Independence was used to analyze the data. Chapter 4 included tables for last visit to the dentist, received fluoride drops or tablets, gender, educational level and health of teeth and gums. The analysis determined if there was any significant difference between last visit to the dentist, received fluoride drops or tablets, gender, educational level and health of teeth and gums. The results showed that one out of the four hypotheses demonstrated significant differences. The findings of this study suggested that there was a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. There was no statistically significant difference found in the other three hypotheses. Chapter 5 will provide discussion, conclusions and recommendations for this study.
CHAPTER 5: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine whether there was an association between health of teeth and gums and last visit to dentist, whether received fluoride drops or tablets, gender and educational level. The data was derived from NHANES 2017-2018 survey. The Chi-Square Test of Independence was used to analyze the data for the relationship among the variables: last visit to the dentist, received fluoride drops or tablets, gender, education level and health of teeth and gums. The literature presented the variables as factors that influence the oral health of individuals in the US. This chapter discusses the NHANES 2017-2018 survey, along with demographic findings, research questions, and implications for public health. This chapter also presents conclusions and recommendations for future research.

Demographic Findings

Only the NHANES 2017-2018 survey was used to provide data on the two demographic variables of gender and educational level. Table 2 (p. 34) showed the demographic variables. A total of 9,254 participants were a part of this study and most respondents were females (50.8%). Regarding educational level for adults above 20 years, 5.2% of the respondents were 9th grade, 6.9% were 9-11th grade, 14.3% were high school graduates, 19.2% were had some college or AA degree, 14.4% were college graduates or above.

Discussion of Research Questions

This study found a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The findings of this study showed that 1,006 residents rated their health of teeth and gums as excellent, having last seen a dentist in 6 months or less.
According to the findings of this study, the health of teeth and gums significantly deteriorated for those who did not visit the dentist in more than 2 years. The findings of this research question were similar to studies discussed in the literature review. The literature shows that dental caries in children can be prevented if they visit a dentist before or soon after the eruption of their first tooth (AAPD, 2015). At the same time, literature also suggests that children with high family income and lower mean of caries experience were more likely to visit the dentist (Alayadi et al., 2019).

This study did not find a significant difference in the rate of health of teeth and gums between those receiving drops or tablets and those not receiving drops or tablets among children aged 3-15 years in the US. The findings of this study suggest that 71 children who received fluoride drops or tablets rated the health of their teeth and gums as excellent and 651 children who did not receive fluoride drops or tablets also rated the health of their teeth and gums as excellent. The findings of this research question were different from the literature reviewed. The literature suggests that higher fluoride concentration in drinking water in the US is associated with lower dental caries (Slade, 2018). Also, the literature highlights that children who do not consume tap water that contains fluoride were more likely to experience dental caries in their lifetime (Sanders & Slade, 2018).

This study found no significant difference in the rate of health of teeth and gums according to gender among participants aged 1-150 years. The results of this study showed that 869 females rated the health of teeth and gums as excellent and 818 males rated the health of teeth and gums as excellent. Also, 1,114 females rated the health of their teeth as very good as compared to 1,020 males. In this study, the number of participating females tended to rate the health of their teeth and gums higher than males. However, there was no significant difference found between gender and the rate of health of their teeth and gums. The literature shows mixed results, some literature suggests that
females having lower levels of protective IgA as compared to males, pregnancies and being more prone to harbor S. mutans can lead them to develop dental caries (Ferraro & Vieira, 2010). The growing literature suggests that both men and women are equally aware of oral hygiene and both have equal chances of developing dental caries (Mamai-Homata et al., 2016).

This study found no significant difference in the rate of health of teeth and gums according to educational level among participants aged 20 years and above. The findings suggest that participants who have some college or AA degree have reported better health of their teeth and gums as compared to participants who are less educated than them. But the numbers are not very significant to conclude an association between educational level and health of teeth and gums. The findings of this research question are different from the literature reviewed. The literature suggests that in a study conducted by Kuteri & Uzel in 2020, the results showed that a mother’s educational level is directly related to children’s tooth brushing but not related to number of cavities in child’s mouth (Kuteri & Uzel, 2020).

Implications for Public Health

The findings of this research propose that there are implications for public health in reference to oral health among residents in the US. According to the American Dental Association (ADA), frequent visits to the dentist should be scheduled with your dentist and the intervals of meeting should be determined by the dentist. The investigators from the University of Michigan School of Dentistry found an association between long-time edentulism and the consistency of visiting the dentist in adults. The researchers concluded that more vulnerable patients would gain from regular preventive dental visits, while less vulnerable individuals would benefit most from preventive services like
scaling of their teeth once a year. They concluded that personalized oral care is important for all individuals and this should be tailored by their dentist (ADA, 2013).

The AAP published a policy on dental home, which encourages parents to set up a source for professional dental care by the age of 12 months. The recommendations for dental home services include brushing infants’ and young children’s teeth twice and using fluoride toothpaste, which is essential for child's dental care (AAP, 2016). The AAPD also recommends childcare centers and caregivers to practice preventive practices that can reduce the chances of developing ECC in children (AAPD, 2016). The AAPD encourages pediatric dentists to hold regular oral health consultations with childcare centers. They also recommend oral health education programs for all children that will promote healthy oral habits and introduce the concept of oral hygiene (AAPD, 2016).

For community fluoridation water systems, U.S. Public Health Services (PHS) recommends a fluoride concentration of 0.7mg/L (ppm) to reduce the prevalence of dental caries in populations (Public Health Reports, 2015). Since 2014, the US Preventive Services Task Force has recommended dental providers to apply a layer of fluoride varnish to tooth surfaces of the children aged 5 years and younger to prevent tooth decay and help remineralization of tooth surface (Northridge, Kumar, & Kaur, 2020). A US national evaluation was carried out to assess the influence of policy that requires fluoride varnish application on uninsured children’s teeth reported that these children have a great possibility of having excellent teeth than children who did not receive fluoride varnish (Kranz et al., 2019).

Improving preventive dental services used by low- income children is a Healthy People 2020 objective (HHS, 2018). A study from 2001-2014 showed that preventive dental check-ups and services have been well used by underprivileged children from all backgrounds, however, rates of oral health maintenance such as application of topical fluoride and dental sealants remained low in 2014 (Wei et al., 2018). In 2016, the
National Survey of Children’s Health (NSCH) assessed various oral healthcare preventive services utilized by children (Lebrun- Harris et al., 2016).

The Affordable Care Act (ACA) has included provisions to address important services such as to increase oral health coverage and easy access to underserved populations, and to promote public education. Another important provision by ACA is to include dental insurance for children as a part of the essential health services and qualified health plans (Reusch, 2014).

Oral health promotion is an attempt to form laws for community, create favorable environments, educate people and enhance personal skills to maintain healthy oral cavity. A successful oral health promotion program includes encouraging balanced diet, which is low in sugar, practicing good oral hygiene habits, easy access to preventive dental services, and promoting the use of topical fluoride (Niranjan et al., 2017). Empowerment of community members than compelling is an essential part of achieving good oral health (WHO, 2017).

Oral health status is determined by etiological factors, such as tobacco, sugar, and microflora that have a negative effect on the quality of life. Encouraging the community members of adopting healthy behaviors such as restraining use of tobacco and alcohol, curbing diet high in sugar and promoting oral hygiene practices such as dental floss, fluoride use are important factors to ensure good oral health status in the community members (Niranjan et al., 2017).

Conclusions and Recommendations

Overall, the results of the study suggest further and advanced research regarding factors affecting oral health in the US residents. As previously stated, oral diseases are the most common chronic diseases throughout one’s lifespan. About 25% of young children, 50% of adolescents and more than 90% of adults experienced dental caries. Ten
percent of young children to 26% of adults aged 20-64 years have experienced untreated dental caries (CDC, 2019).

This study demonstrated that there were significant differences among one of four hypotheses. There was a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. This study concludes that individuals who have visited the dentist in 6 months or less have rated their health of teeth and gums as excellent as compared to those who did not visit the dentist in the last 6 months. There was no significant difference found in the rate of health of teeth and gums and received fluoride drops or tablets, gender and educational level. The results reflect that factors such as visiting a dentist early in life affect the oral health of individuals in the US.

This researcher recommends community- based prevention programs in the future that includes the implementation of supervised toothbrushing programs in preschools and day care settings. The researcher also recommends every child to register at a local dental clinic by the age of 1 year and parents should help their children to establish a dental routine. There needs to be more programs implemented on oral health for pregnant women following onto the postnatal period. In addition, fluoride programs should be promoted which would include brushing with toothpaste containing fluoride at 1000 ppm+. Introduction of brief counselling techniques such as motivational interviewing to help deliver oral health advice to young children and their parents would be beneficial (Naidu & Nunn, 2020).

The researcher recommends promoting oral health education interventions by conducting classes or sessions in every community and spreading key messages like to reduce the consumption and frequency of intake of sugary drinks and snacks. Also, to encourage children and adults to maintain oral hygiene by regularly brushing twice with fluoride toothpastes and flossing every night. Other oral hygiene practices such as
interdental toothbrushes should be encouraged to use and should be demonstrated by a dentist. Lastly, the researcher strongly recommends regular dental visits at an interval of 6 months to your local dentist regardless of age and oral conditions. These regular oral examinations will aid in assessing oral conditions like caries, periodontal diseases and oral cancers. Edentulous patients should also be motivated to get regular dental check-ups to avoid any serious dental condition (Levine & Stillman-Lowe, 2019).

This researcher recommends future research should include diverse topics like diet high in sugar, diabetes, role of chronic diseases, and genetics affecting oral health of people living in the US. Another variable to explore could be oral health care for elderly population in nursing homes in the US. The researcher also recommends studying populations according to age groups and state of location in the US. This will provide better insight into fluoride level exposure in the participants that may vary from state to state.

**Summary**

The purpose of this study was to determine if there were significant differences in the rate of health of teeth and gums with respect to factors such as last visit to the dentist, received fluoride drops or tablets, gender and educational level. NHANES 2017-2018 survey data were analyzed using the Chi-Square Test of Independence in SPSS for significance. The results of the study showed that one out of four hypothesis demonstrated significant differences. The findings of this study reported a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The results suggest that there was no significant difference between the health of teeth and gums and the intake of fluoride drops or tablets, gender and educational level. Therefore, this
researcher recommends additional studies on factors such as diet high in sugar, socio-economic status, diabetes and genetics affecting oral health among individuals in the US.
REFERENCES
REFERENCES


APPENDICES
APPENDIX A: PERMISSION TO USE NHANES PUBLIC DATA
Thank you for contacting CDC-INFO. We are sorry for the delay in responding to your inquiry. A recent high volume of inquiries has delayed our response.

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APPENDIX B: HUMAN SUBJECTS APPROVAL LETTER
November 2, 2020

Helda Pinzon-Perez Ph.D.
Professor,
Department of Public Health

Dear Dr. Pinzon-Perez,

The Department of Public Health, Committee for the Protection of Human Subjects, has deemed your protocol entitled ‘THE STUDY OF FACTORS AFFECTING ORAL HEALTH IN ADULTS AGED 20 YEARS AND ABOVE IN THE UNITED STATES’ is analysis of secondary data and therefore is exempted from the full review from the Committee of the Protection of Human Subjects. You may begin your research.

Should any further research protocol or administrative changes take place, please be advised you will need to resubmit your application for further review.

I hope the research project goes well.

Sincerely,

Rohan Jadhav, MPH, PhD
Chair, Committee for the Protection of Human Subjects
Department of Public Health
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Parneet Sihota

Type full name as it appears on submission

4/4/2021

Date