

PREVENTIVE DENTAL BEHAVIORS AMONG U.S. COLLEGE STUDENTS
BASED ON THE HEALTH BELIEF MODEL

By

MARYAM BAGHIZADEH FINI

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Tehran University of Medical Sciences

Tehran, Iran

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Thesis Approved:

Dr. Ho Han, Ph.D.

Thesis Adviser

Dr. Kelley E. Rhoads, Ph.D., CHES

Dr. Carlos C. Mahaffey, PharmD, MPH

Name: MARYAM BAGHIZADEH FINI

Date of Degree: MAY, 2022

Title of Study: PREVENTIVE DENTAL BEHAVIORS AMONG U.S. COLLEGE STUDENTS
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Abstract: **Introduction.** Individuals' beliefs about oral diseases can influence their preventive dental behaviors such as tooth brushing, tooth flossing, and regular dental checkups. The Health Belief Model (HBM) has been frequently utilized in behavioral studies to better understand health behaviors, and it can be used as an indicator of preventive dental behaviors. Studying the impact of COVID-19 on preventive dental behaviors would be also necessary to develop the foundation for future intervention research. **Purpose.** To evaluate college students' preventive dental behaviors based on HBM, identify key constructs of HBM to promote preventive dental behaviors, and determine the impact of the COVID-19 pandemic on college students' preventive dental behaviors. **Method.** 550 college students (ages 18 to 25; 69.8% female) participated in the study. An online survey was used for data collection. Descriptive statistics were calculated for demographic, COVID-19 variables, and the prevalence of preventive dental behaviors. After adjusting demographic characteristics, a multivariate analysis of variance was used to examine the relationship between the HBM constructs and preventive dental behaviors. In addition, chi-square was used to determine the prevalence of preventive dental behaviors associated with dental knowledge. **Result.** Perceived barriers and self-efficacy were significant predictors of preventive dental behaviors among college students ($p < 0.001$). Also, a significantly higher proportion of students with sufficient dental knowledge met the recommendations for tooth brushing and regular dental checkups compared to those with deficient and moderate dental knowledge ($p < 0.05$). Although most of the participants (about 80~89%) claimed that the COVID-19 pandemic had no influence on their preventive dental behaviors, a considerable number of the students still reported positive and negative influences of COVID-19 on their behaviors. **Conclusion.** The Health Belief Model could be an effective framework to promote preventive dental behaviors for college students, particularly, using perceived barriers and self-efficacy. In addition, increasing dental knowledge could be another effective strategy to promote preventive dental behaviors. Lastly, an intervention program for promoting preventive dental behaviors would be beneficial when the behaviors are treated as daily habits rather than common health-related behaviors

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CHAPTER I

INTRODUCTION

Oral Health is historically described as a disease-free oral condition that enhances the appearance and supports normal mouth function (Kumar et al., 2017). The Federal Dental International (FDI) World Dental Federation recently revised the definition of oral health in a broad sense so that it encompasses the capability to smile, smell, speak, touch, taste, chew, swallow, and express a wide range of emotions via facial gestures confidently without any pain, unpleasantness, or craniofacial sicknesses (Glick et al., 2017).

Oral health is significantly important because untreated oral illnesses and disorders and poor oral hygiene can immensely influence the quality of life (Dagneu et al., 2019). As the U.S. Surgeon General highlighted the link between oral health and general health in 2001, the healthcare sector has paid remarkable attention to oral health. Since then, studies have shown a relationship between oral health and a variety of other health problems, such as heart disease, osteoporosis, digestive illness, stroke, metabolic syndrome, poor pregnancy results, obesity, diabetes, and the human papillomavirus (Basch et al., 2019; Glick, 2005). Furthermore, ignoring oral health may result in severe pains that can influence the quality of life and productivity (Petersen et al., 2005).

Despite notable advances in oral health indicators across populations, the World Health Organization (WHO) reported that oral health issues are still not effectively controlled worldwide.

For instance, periodontitis and dental caries are two significant oral diseases that impact 60 and 36 percent of the world's population, respectively (Kumar et al., 2017; Yao et al., 2019). Oral illnesses are among the most prevalent chronic illnesses and are recognized as a global health challenge due to their high incidence, adverse effect on people and society, and high treatment costs (Sheiham, 2005; Peres et al., 2019). Across most industrial nations, treatments of oral illnesses are the fourth most costly treatments. As a result, oral health is considered a paramount concern for individuals and communities (Kumar et al., 2017).

Oral health is linked to people's dental knowledge and preventive dental behaviors (Farsi et al., 2020). The cornerstone for good oral health is excellent preventive dental behaviors, which can prevent up to 80% of dental issues (Dagnew et al., 2019). As an oral health recommendation, teenagers and adults should perform preventive dental behaviors, including tooth brushing twice a day for two minutes each time, tooth flossing once a day to eliminate dental plaque collected between adjacent teeth (Centers for Disease Control and Prevention [CDC], 2021; Creeth et al., 2009), and visiting a dental professional for regular dental checkups at least once per year (including those who have missing natural teeth or are using dentures) (CDC, 2021).

The importance of meeting the oral health recommendation was more emphasized during the COVID-19 pandemic. The virus and various government actions have significantly influenced the whole population's business, home, and social life, and as a result, many people's preventive dental behaviors were limited. For example, dental offices postponed elective dental operations and only offered emergency dental services during the pandemic, and people also raised serious concerns about getting COVID-19 by visiting a dentist. Therefore, a large proportion of the population skipped regular dental checkups. In addition, social distancing due to the COVID-19

pandemic can negatively influence mental health (Esteves et al., 2021). Individuals with mental health problems do not usually follow the oral health recommendation and proper diet and are at higher risk of oral health issues (Kisely, 2016).

College students are considered a high-risk population for oral health problems. Students' lifestyles are usually full of new adventures, joy, anxiety, unhealthy behaviors, and social and academic expectations throughout college. Therefore, college students' preventive dental behaviors may soon become less crucial due to the distractions. Also, college students no longer have the companion of parents who could remind them to take care of their teeth. Some college students may forget to brush or floss their teeth for several days (Crabtree et al., 2016; Small et al., 2013; VanWormer et al., 2013; Dewald, 2016). On the other hand, college years can be the ideal time to establish lifelong healthy habits, particularly in the area of oral health, since various healthy behaviors adopted in college years are likely to remain for the rest of students' lives (Crabtree et al., 2016; Small et al., 2013).

Theoretical Basis

Oral health can be impacted by the beliefs and values of individuals and communities. Oral health displays sociopsychological characteristics that are important to determine the quality of life. Oral health is also affected by evolving experiences, attitudes, expectations, and the capacity to adjust to new situations. According to the data, psychological behavior theories may promote oral health and related behaviors. The most popular theories in oral health include the Health Belief Model (HBM), Locus of Control, Self-Efficacy, Stages of Change, and the Theory of Reasoned Action. HBM will be applied in this study since previous studies have shown that HBM is useful

in assessing preventive dental behaviors, but the results were controversial (Nasab et al., 2019; Renz et al., 2007; Ghaffari et al., 2018; Jeihooni et al., 2018; Buglar, 2010, Hou, 2018).

Statement of the Problem

As mentioned earlier, oral health has a broad impact on general health and well-being. People who neglect the oral health recommendation will face various sufferings, such as incurring excruciating pain, various health problems, expense, time, etc. College can be a neglectful period in students' lives that may lead to irrecoverable problems for their oral health. We can enumerate several reasons for this fact:

1. Students have a hectic time at college, and they experience high-stress levels and anxiety.
2. College students tend to be risk-takers.
3. They are usually surrounded by their peers, not parents who remind them to take care of their oral health.

Thus, we need to focus on this high-risk group because college time is perfect for establishing lifelong healthy behaviors such as good preventive dental behaviors. Therefore, it is essential to study the behaviors of college students when it comes to oral health, especially during the COVID-19 pandemic, which might have influenced their preventive dental behaviors. Also, this study plans to understand college students' beliefs, especially frequent misunderstandings and erroneous beliefs about preventive dental behaviors.

Purpose of Study

The primary purpose of this study is to evaluate college students' preventive dental behaviors and their attitudes toward the behaviors based on the Health Belief Model. The secondary purpose is to identify the prevalence of preventive dental behaviors among college students based on their level of dental knowledge. The tertiary purpose of the study is to determine the impact of the COVID-19 pandemic on college students' preventive dental behaviors

Research Questions

RQ1: Which construct of the Health Belief Model (HBM) is the best indicator of preventive dental behaviors, including tooth brushing, tooth flossing, and regular dental checkups?

RQ2: What is the prevalence of preventive dental behaviors among college students based on their level of dental knowledge?

RQ3: How does the COVID-19 pandemic impact college students' preventive dental behaviors in the U.S.?

CHAPTER II

LITERATURE REVIEW

Preventive Dental Behaviors, Oral Health, and General Health

As numerous medical publications have demonstrated, good health begins in the mouth. Nowadays, excellent oral health is about not only keeping teeth healthy but also about overall health and well-being (Fiorillo, 2019). Many studies have shown a correlation between oral health and general health and identified a relationship between oral health and several other health issues (Basch et al., 2019; Glick, 2005). For example, periodontal disorders have been related to cardiovascular illnesses, high blood pressure, stroke, diabetes, dementia, and respiratory problems, all linked to an inflammatory process (Sabbah et al., 2019). In addition, several studies have found a link between dental caries and atherosclerosis and cardiometabolic risk factors (Kim et al., 2019). Oral health is influenced by dental knowledge and preventive dental behaviors (Farsi et al., 2020). Excellent preventive dental behaviors are the foundation of good oral health. They can prevent up to 80% of dental problems because preventive dental behaviors significantly influence the composition of the oral microbiome (Dagnew et al., 2019; Kane, 2017).

Preventive Dental Behaviors among College Students in the United States

University students are well known for being overworked, stressed out, exhausted, and preoccupied with social approval. Therefore, individual health practices may soon become less crucial to students due to distractions. Also, they do not have their parents around to remind them to clean their teeth anymore. As a result, some college students may forget to brush or floss their teeth for several days (Small et al., 2013; VanWormer et al., 2013; Dewald, 2016). It is shown that 75% of students brushed their teeth twice a day, with women brushing their teeth more frequently than men, and only one-third of the students flossed their teeth every day (Luebke & Driskell, 2010). Crabtree et al. (2016) also identified that although students followed the recommendations for tooth brushing and regular dental checkups, they did not meet the tooth flossing recommendation. In addition, Vang et al. (2016) at the University of California, Merced, explored that a large proportion of UC Merced students have incorrect oral health information, which may lead them to poor preventive dental behaviors. Thus, according to different studies, college students' preventive dental behaviors need to be improved.

Health Behavior Theories and Oral Health

Numerous articles employed several theories to investigate oral health problems, including the Theory of Planned Behavior (TPB), the Theory of Reasoned Action (TRA), and the Health Belief Model (HBM) (Dumitrescu et al., 2011; Lavin & Groarke, 2005; Syrjälä et al., 2002). For instance, Dumitrescu et al. (2011) utilized TPB to design a questionnaire that assessed attitudes, subjective norms, perceived behavior control, preventive dental behaviors intentions, and

preventive dental behaviors. They discovered that attitude, perceived behavioral control, and dental knowledge were all predictors of intention to improve preventive dental behaviors.

Lavin and Groarke (2005) also employed TPB to predict tooth flossing behavior and intentions. The researchers identified that the Theory of Planned Behavior constructs explained 46% of the variance in intention and 29% of the variance in behavior. Implementing intentions was not shown to be a helpful strategy for boosting dental floss use. In order to enhance tooth flossing intentions and behavior, they proposed that programs should address the attitude and perceptions of control.

Furthermore, researchers adopted TRA to investigate the link between the tooth brushing attitude, subjective norm, intention, behavior, and diabetes (Syrjälä et al., 2002). Their findings revealed that a stronger intention to tooth brushing was linked to a more significant claimed number of tooth brushing. The attitude and subjective norm of tooth brushing were associated with the intention of tooth brushing. As a result, it can be inferred that both subjective norm and attitude are essential in improving oral health among diabetic patients, and enhancing dental attitude may impact diabetes adherence.

Only a few studies on preventive dental behaviors, dental knowledge, and beliefs have been conducted in the U.S. When Langha (2004) examined the oral health of college students at a Midwestern university, he mainly focused on students' knowledge, behaviors, and beliefs. The findings revealed that their students were well-informed about their oral health. The survey found that respondents had positive attitudes toward oral health. Despite their knowledge and positive attitude toward oral health, students continued to engage in harmful practices such as smoking. There was no noticeable difference between men and women in the target population regarding knowledge, attitude, or behavior (Langha, 2004).

Some research has evaluated preventive dental behaviors by using HBM in international settings outside of the U.S. For instance, in Iran, Jeihooni et al. (2018) developed clinical trial research based on HBM for pregnant women. They used a random sampling approach to choose 110 pregnant women, and the findings confirmed that the intervention successfully promoted dental decay prevention practices. Also, Ghaffari et al. (2018) did almost the same research on 135 pregnant women to see the effectiveness of an educational intervention program based on HBM. The participants were separated into an experimental and a control group using a randomized multistratified sampling method. The experimental group received an educational package to increase pregnant women's knowledge about oral/dental health problems during pregnancy time. On the other hand, the control group did not get any educational intervention. In terms of immediate posttest findings, such as perceived susceptibility, severity, benefits, barriers, and self-efficacy, as well as awareness and performance dimensions, researchers found a statistically significant difference between the experimental and control groups. Furthermore, except for perceived susceptibility, the two groups differed considerably in terms of other variables, including perceived severity, benefits, barriers, and self-efficacy, as well as awareness and performance, two months following the intervention.

Buglar (2010) also used HBM in Australia to investigate the links between HBM beliefs and tooth brushing and tooth flossing. Self-efficacy in tooth brushing and tooth flossing, as well as perceived barriers, were found to be more predictive of preventive dental behaviors than perceived severity and benefits. In addition, Hou (2018) investigated the capability of the constructs of HBM to explain tooth brushing, tooth flossing, and regular dental checkups in Chinese college students. According to the study, self-efficacy was the strongest predictor of tooth

brushing and regular dental checkups, whereas perceived barriers and dental knowledge were the best predictors of tooth flossing.

In the U.S., Walker and Jackson (2015) used HBM to assess self-efficacy in tooth brushing, perceived susceptibility to dental decays and poor oral health, and perceived benefits and barriers to good preventive dental behaviors in eight focus groups of 42 American children (second through fifth graders). Most kids felt that excellent oral health was essential to their overall health. Some children believed that bad oral health exclusively affects the elderly, whereas other children thought it might start at any age. Children reported the desire to impress others by cleaning their teeth without being reminded of excellent preventive dental behaviors. They discovered that the biggest obstacles to good preventive dental behaviors were insufficient time and restricted availability of toothbrushes and toothpaste.

Health Belief Model

The Health Belief Model (HBM) is a psychological and social theory-based model. It has been frequently utilized in behavioral studies to better understand health behaviors. HBM was created in the 1950s by social psychologists at the U.S. Public Health Service (Costa, 2020; Janz & Becker, 1984). HBM considers two aspects of people's perceptions of health behavior in reaction to any diseases: (1) perceptions of the threat of illness (such as oral diseases) and (2) assessment of the efficacy of behaviors (such as good preventive dental behaviors) to combat this threat. A person's perception of threat is made up of their perceived susceptibility and severity to a particular sickness or hazard, such as dental caries, gum diseases, and other health issues associated with poor preventive dental behaviors (Sesagiri. et al., 2020; Rakhshanderou et al., 2020; James et al., 2012). The term "perceived susceptibility" relates to a subjective assessment

of the risk of developing a disease. In contrast, “perceived severity” refers to concerns about the seriousness of developing a disease or failing to cure it. This definition of perceived severity covers assessments of both clinical outcomes (such as death, disability, and suffering) and potential social outcomes (such as influence on employment, family life, and social interactions) (Janz & Becker, 1984).

The behavioral assessment is based on perceptions about the health behavior’s benefits (good preventive dental behaviors), such as healthy teeth and gums and fresh breath, as well as perceived barriers or costs to adopt the behavior, such as a lack of time or insufficient knowledge. Therefore, threatened people are not likely to adopt the recommended behavior unless they feel that performing that behavior is possible and beneficial (Janz & Becker, 1984). Furthermore, cues to action are reminders or situations that initiate the desired health behavior. There are two types of cues to action to motivate people to take action: (i) internal (e.g., physiological symptoms like acute pain); (ii) external (e.g., social media, reminders, and advice). Also, self-efficacy refers to a patient’s belief in their ability to adopt a behavior or take action, such as excellent preventive dental behaviors (Sesagiri. et al., 2020; Rakhshanderou et al., 2020; James et al., 2012; Coe et al., 2012). In addition to the aforementioned constructs of HBM, it was also hypothesized that a variety of demographic, sociopsychological, and structural factors might impact perception and, therefore, indirectly affect behaviors in any specific situation. (Janz & Becker, 1984).

Understanding people’s beliefs and attitudes about certain health concerns are critical in order to make positive changes in behaviors. According to studies on health-related behaviors, people will not attempt to perform any diagnostic tests, get treatment, or develop any preventive behaviors for a health problem unless they have a minimum degree of relevant health motivation

and information. Moreover, these people must feel susceptible, knowledgeable about the severity of their condition, and confident in the effectiveness of health behaviors. Researchers have identified that people who acquire confidence in their ability to modify their habits are more willing to adopt healthy behaviors. Previous studies have shown that HBM is useful in assessing oral health behaviors, but the results were controversial. Also, to the best of our knowledge, there is currently no study evaluating the preventive dental behaviors based on HBM for this specific target population. These reasons explain why the researchers chose HBM to conduct this study among U.S. college students.

Impact of COVID-19 on Preventive Dental Behaviors

The worldwide coronavirus disease 2019 (COVID-19) outbreak was proclaimed a pandemic by the World Health Organization (WHO) on March 11, 2020. SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) is a novel virus that is mainly spread indirectly or directly through personal contact with infected people via airborne respiratory particles (Baghizadeh Fini, 2020; Bahl et al., 2020). The virus and numerous government actions because of this pandemic have significantly influenced the entire population's job, housing, and social life and probably impacted many people's oral health. These oral health consequences can be ascribed to both direct and indirect effects induced by the virus and the societal reaction. Xerostomia (the most frequent symptom with 43% prevalence), taste dysfunction (an established indicator of COVID-19), vesiculobullous lesions, and necrotizing periodontitis are direct consequences of COVID-19 on oral health. These direct impacts of COVID-19 on oral health are expected to be insignificant and mild. On the other hand, the indirect consequences are vaster and more complicated due to the lack of accessibility to oral healthcare (46.7% postponed dentist

appointments) (Daly & Black, 2020; Amorim Dos Santos et al., 2021; Kranz et al., 2021). The American Dental Association (ADA), the most prominent dental organization, on March 16, 2020, suggested that dental clinics suspend elective dental operations and only offer emergency dental services to keep patients out of hospital emergency rooms. As a result, dental care became much more difficult to obtain (Brian & Weintraub, 2020).

Anxiety about catching the virus or simply re-engaging with people after a period of social distancing may also make access to dental care difficult. Many people sought to postpone regular dental checkups due to COVID-19 infection fears. Furthermore, the economic consequences of long-term income reductions may negatively impact the population's oral health. Reduced buying power may affect food and preventive dental behaviors, and other behavioral and cultural predispositions, like health-harming habits, including smoking and decreased dental visits (Daly & Black, 2020).

Because excellent preventive dental behaviors are vital in minimizing dental issues and preserving good oral health, it is critical to implement the oral health recommendation throughout and after the pandemic (Zhang et al., 2021). Zhang et al. (2021) discovered that the number of tooth brushing did not vary substantially by age among Chinese participants during this pandemic. According to our knowledge, no research has been conducted in the United States to study the influence of the COVID 19 pandemic on preventive dental behaviors among college students. Since good preventive dental behaviors are significant during the pandemic, this study aims to evaluate students' preventive dental behaviors by adding some questions to the survey.

CHAPTER III

METHOD

Research Design

A quantitative, cross-sectional study was conducted to identify the study's purposes. An online survey, Qualtrics, was utilized to complete the data collection in this study. Qualtrics is survey software that the researchers used as a survey tool and combined with SPSS to analyze data from the completed survey. The study was approved by the Oklahoma State University Institutional Review Board. Data was collected in October and November of 2021.

Participants and Recruitment

A total of 600 college students representing various academic disciplines on campus were recruited to participate in the online survey. Inclusion criteria included undergraduate students (1) who are 18-25 years old, (2) who have access to the Internet, and (3) who are studying in the United States. Using a snowball sampling design, a recruitment email linking to the online survey was sent to two random samples of 5,000 students to generate a sample of convenience. In addition, students were recruited using a flyer (Appendix A), email advertisements, and word of mouth within the university. Recruitment information and a prepared flyer introducing the study were emailed to students to invite them to complete the survey. Participants received a link to the online

questionnaire from their personal computers or personal smartphones. Also, the flyer was posted in all departments and buildings on the OSU campus. Participants were sent a follow-up email to remind them to complete the form if they had not already done it.

The online survey lasted approximately 15-20 minutes to complete. With the participation agreement, all participants completed an online informed consent form (Appendix B) prior to beginning the survey. The online survey consisted of a series of questions related to general information and preventive dental behaviors, including tooth brushing, tooth flossing, regular dental checkups, and their beliefs about preventive dental behaviors. Also, there were some questions asking about the impacts of COVID-19 on students' preventive dental behaviors. Finally, respondents were thanked for their assistance in the research. The participants were also asked to provide their email addresses if they would like to be entered into the gift card drawing. They could win one of twenty \$15 Amazon gift cards, one of two \$50 Amazon gift cards, and one \$100 Amazon gift card. All the collected information was kept confidential to the extent allowed by law and university policy.

Survey Instrument

The developed questionnaire for this study is composed of three parts: (1) demographic information, COVID-19 Statistics, and level of dental knowledge, (2) preventive dental behaviors and the impact of COVID-19 on preventive behaviors, and (3) the constructs of HBM for preventive dental behaviors. The questionnaire can be found in Appendix C.

Demographic Information

The first section of the survey with ten questions was used to collect general demographic information. This section gathered data on age, gender, race, year in school, dental insurance, last

dental checkup, dental knowledge, and COVID-19 vaccination. These questions were obtained from the American College Health Association-National College Health Assessment (ACHA-NCHA) surveys and Hou's (2018) study. Also, some questions were added by the researchers.

Preventive Dental Behaviors

The following section consists of seven questions designed to determine the students' preventive dental behaviors. This section questioned students on how often they brush and floss their teeth and visit a dentist for regular dental checkups. We provided six options for tooth brushing and tooth flossing: not at all, once a week, every second day, once a day, twice a day, and more than twice a day. These questions were adapted from Hou's (2018) study. For regular dental checkups, there were four choices: not at all, once a year, twice a year, and more than twice a year. Also, four new questions were added to this part to evaluate the impacts of COVID-19 on students' preventive dental behaviors. They were asked whether the COVID-19 pandemic impacted habits of tooth brushing, tooth flossing, and regular dental checkups and whether this impact was positive or negative. It was also asked how the students did their regular dental checkups during the COVID-19 pandemic, online or in-person.

Constructs of HBM for Preventive Dental Behaviors

Finally, the last section includes all six constructs of HBM, including perceived susceptibility to dental caries and gum diseases with five questions, perceived severity of dental caries and gum diseases with ten questions, perceived benefits of following the oral health recommendation with nine questions, perceived barriers to following the oral health recommendation with ten questions, cues to action with ten questions, and self-efficacy with six questions. For the current study, the researchers modified the original HBM questionnaire according to the target behavior (i.e., preventive dental behaviors) and population (i.e., college

students). The modification included wording changes in some questions and eliminating some items that were not directly linked to the target participants. The reliability and validity of the original HBM questionnaire were tested elsewhere (Champion, 1984; Dean-Baar, 1991). All questions are scored on a five-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree).

Data Collection Procedures

Prior to collecting data, the study protocol was approved by the OSU Institutional Review Board (IRB-21-360) (Appendix D). Data was collected between October and November of 2021. All participants completed an online informed consent form before beginning the survey. It was emphasized that they were not under any pressure to fill out the survey, and participation was entirely optional. There was no time limit to answer the survey questions. Qualtrics software was used to collect and save all of the survey data. Therefore, the collected data was kept confidential to the extent allowed by law and university policy.

Data Analysis

Data was entered, cleaned, and analyzed using SPSS statistical program version 22 (IBM Inc., Chicago, IL, USA). Simple descriptive statistics as frequency distributions, means, and percentages were calculated for the study variables. After adjusting demographic characteristics (gender, race, and year in school), multivariate analysis of variance (MANOVA) was used to examine the relationship between HBM components and preventive dental behaviors, including tooth brushing and tooth flossing, and regular dental checkups. In addition, chi-square was used to find any relationships between dental knowledge level and preventive dental behaviors.

CHAPTER IV

FINDINGS

Descriptive Statistics

After excluding 50 participants with missing data, speed response, and straight-line response, a total of 550 college students were included for the data analyses in this study. Table 1 illustrates the descriptive variables of the participants. Participants were predominantly female (69.8%) and White (77.1%), with an average age of 19.9 ± 1.7 years. The highest percentage of participants was in the first year (33.4%), while the lowest percentage was in the fifth year (4.0%). It is shown that 71.5% of the participants had received at least one dose of a COVID-19 vaccine, while 97.7% of them were fully vaccinated. It is also demonstrated that during the pandemic, 71.5% of the participants had never been tested positive for COVID-19, and 28.5% had become infected with COVID-19 or reinfected.

The prevalence of college students meeting the oral health recommendation was 10.9%. Specifically, the majority of students followed the recommendations for tooth brushing (61.4%) and regular dental checkups (59.4%), whereas only 19.4% of the participants met the recommendation for tooth flossing. During the pandemic, the majority of the participants (74.9%) continued to have in-person regular dental checkups, whereas others selected either a virtual visit (0.5%) or non-visit (24.6%) for their regular dental checkups.

Table 1 also shows the level of dental knowledge and the resources for acquiring dental information. Greater than half of the participants (52.2%) reported a sufficient level of dental knowledge (40.9% sufficient and 11.3% very sufficient), while others reported their dental knowledge as moderate (37.6%) or deficient (8.9% deficient and 1.3% of very deficient, respectively). The dentist was selected as the primary resource for acquiring dental information, followed by the Internet (43.1%) and social network (e.g., people around me) (35.6%).

Table 1: Descriptive statistics of the sample

Demographic characteristics	n (%) or means
Age (years)	19.86 ± 1.73
Gender	
Female	384 (69.82)
Male	152 (27.64)
Other	14 (2.54)
Race	
White	424 (77.09)
Black	15 (2.73)
Hispanic	26 (4.73)
Asian or Pacific Islander	29 (5.27)
Other	56 (10.18)
Year in School	
1 st year	184 (33.45)
2 nd year	115 (20.91)
3 rd year	131 (23.82)
4 th year	98 (17.82)
5 th year	22 (4.00)
COVID-19 Statistics	
Receiving COVID-19 vaccine	
Yes	393 (71.5)
No	157 (28.5)
Fully vaccinated	
Yes	384 (97.7)
No	9 (2.3)
Frequency of positive COVID-19 test	
0	393 (71.5)
1	140 (25.4)
Multiple times	17 (3.1)
Preventive dental behaviors	
Tooth brushing	
Meeting	338 (61.45)
Non-meeting	212 (38.55)
Tooth flossing	
Meeting	107 (19.45)
Non-meeting	443 (80.55)
Regular dental checkups	
Meeting	327 (59.45)
Non-meeting	223 (40.55)
Oral health recommendation	
Meeting	60 (10.91)
Non-meeting	490 (89.09)
Regular dental checkups during COVID-19	
In-person	412 (74.9)
Online	3 (0.5)
Neither	135 (24.6)
Level of dental knowledge	
Very deficient	7 (1.3)
Deficient	49 (8.9)
Moderate	207 (37.6)
Sufficient	225 (40.9)
Very sufficient	62 (11.3)
Resource of dental knowledge	
Your dentist	494 (89.8)
Your doctor	74 (13.4)
Internet	237 (43.1)
Books and journals	43 (7.8)
People around me	196 (35.6)
Other resources	49 (8.9)
<i>Note.</i> Respondents could select more than one option for resource of dental knowledge. Percentages will not sum to 100%.	

HBM and Preventive Dental Behaviors

Multivariate analysis of variance (MANOVA) was used to determine the first research question of this study: which construct of the Health Belief Model (HBM) is the best indicator of preventive dental behaviors, including tooth brushing, tooth flossing, and regular dental checkups. As shown in Table 2, no significant mean differences between the two groups of meeting and non-meeting preventive dental behaviors were found in the constructs of perceived susceptibility and perceived severity except for tooth flossing in perceived severity ($F[1, 548] = 4.03, p = .045$). The mean scores of the two constructs were also not significantly different when all preventive dental behaviors were combined as an oral health recommendation ($F[1, 548] = .46, p = .497$ and $F[1, 548] = .03, p = .863$, respectively). However, it was identified that the mean scores of perceived barriers and self-efficacy were significantly different between the two groups in all preventive dental behaviors ($p < .001$). Lastly, the mean score of the cues to action construct was significantly higher in the group of meeting tooth brushing ($F[1, 548] = 7.75, p = .006$) compared to the non-meeting group.

Table 2: Mean scores of the Health Belief Model constructs in relation to preventive dental behaviors.

Preventive Dental Behaviors		SUS	p	SEV	p	BEN	p	BAR	p	CA	p	SE	p
Tooth brushing	Non-meeting	3.55 ± 0.51	.054	3.91 ± 0.51	.197	4.32 ± 0.43	.063	3.67 ± 0.73	<.001*	3.54 ± 0.54	.006*	3.44 ± 0.88	<.001*
	Meeting	3.48 ± 0.58		3.96 ± 0.49		4.40 ± 0.46		4.10 ± 0.69		3.66 ± 0.52		4.00 ± 0.72	
Tooth flossing	Non-meeting	3.52 ± 0.55	.800	3.92 ± 0.50	.045*	4.36 ± 0.44	.576	3.87 ± 0.74	<.001*	3.61 ± 0.54	.615	3.70 ± 0.82	<.001*
	Meeting	3.54 ± 0.60		4.03 ± 0.48		4.39 ± 0.47		4.19 ± 0.67		3.64 ± 0.49		4.14 ± 0.78	
Regular dental checkups	Non-meeting	3.58 ± 0.59	.079	3.94 ± 0.52	.784	4.33 ± 0.46	.063	3.70 ± 0.77	<.001*	3.58 ± 0.56	.236	3.63 ± 0.83	<.001*
	Meeting	3.49 ± 0.53		3.95 ± 0.48		4.40 ± 0.43		4.10 ± 0.66		3.64 ± 0.51		3.89 ± 0.81	
Oral health recommendation	Non-meeting	3.53 ± 0.55	.497	3.94 ± 0.49	.863	4.36 ± 0.45	.499	3.89 ± 0.74	<.001*	3.61 ± 0.54	.573	3.73 ± 0.82	<.001*
	Meeting	3.48 ± 0.60		3.95 ± 0.52		4.41 ± 0.46		4.29 ± 0.61		3.65 ± 0.48		4.21 ± 0.81	

Note. SUS: Perceived Susceptibility. SEV: Perceived Severity. BEN: Perceived Benefits. BAR: Perceived Barriers. CA: Cues to Action. SE: Self Efficacy. *p: p-value < 0.05.

Dental Knowledge and Preventive Dental Behaviors

According to Table 1, about half of the participants reported that they had sufficient dental knowledge, whereas only 10% claimed they had deficient dental knowledge. Dentist (89.8%) was a primary source of their dental knowledge, followed by the Internet (43.1%) and people around them (35.6%). The chi-square test was done to identify any relationships between dental knowledge and preventive dental behaviors. Table 3 shows the prevalence of meeting the preventive dental behaviors associated with the levels of dental knowledge, which were categorized as deficient, moderate, and sufficient. A significantly higher proportion of college students was found in performing tooth brushing and regular dental checkups in the sufficient group compared to the deficient and moderate groups ($\chi^2 [2] = 11.30, p = .004$ and $\chi^2 [2] = 36.96, p < .001$, respectively), whereas no significant proportion difference was found for tooth flossing across the three groups ($\chi^2 [2] = 5.04, p = .081$). Despite the nonsignificant finding for tooth flossing, a similar pattern (e.g., a higher proportion of meeting the recommendation in the sufficient group compared to other groups) was observed.

COVID-19 Pandemic and Preventive Dental Behaviors

Simple descriptive statistics as numbers and percentages were calculated for the prevalence of preventive dental behaviors during the COVID-19 pandemic. Table 1 shows that 71.5% of the participants had received the COVID-19 vaccine, with 97.7% of them being fully vaccinated. Table 1 also indicates that only 10.9% of participants followed the oral health recommendation, with the majority of participants following the recommendations for tooth brushing (61.4%) and regular dental checkups (59.4%), but only 19.4% following the recommendation for tooth flossing.

Although the majority of the participants answered that the COVID-19 pandemic had no influence on the preventive dental behaviors such as tooth brushing (79.1%), tooth flossing (89.4%), and regular dental checkups (81.2%), a considerable number of participants still claimed the influence of COVID-19 on the behaviors (Table 4). For example, the participants flossed their teeth more often during COVID-19 compared to before the pandemic, whereas fewer frequencies of tooth brushing and regular dental checkups occurred due to the pandemic.

Table 3: Relationship between meeting preventive dental behaviors and dental knowledge.

Preventive Dental Behaviors		Dental knowledge			p
		Deficient	Moderate	Sufficient	
Tooth brushing	Non-meeting	23 (41.07)	97 (46.86)	92 (32.06)	.004*
	Meeting	33 (58.93)	110 (53.14)	195 (67.94)	
Tooth flossing	Non-meeting	46 (82.14)	176 (85.02)	221 (77.00)	.081
	Meeting	10 (17.86)	31 (14.98)	66 (23.00)	
Regular dental checkups	Non-meeting	39 (69.64)	98 (47.34)	86 (29.97)	<.001*
	Meeting	17 (30.36)	109 (52.66)	201 (70.03)	
Oral health recommendation	Non-meeting	53 (94.64)	193 (93.24)	244 (85.02)	.006*
	Meeting	3 (5.36)	14 (6.76)	43 (14.98)	

Note. *p-value < 0.05.

Table 4: Influence of COVID-19 on preventive dental behaviors.

Preventive Dental Behaviors		N	%	p
Tooth brushing	No	435	79.09	<.001*
	Yes, more	52	9.45	
	Yes, less	63	11.45	
Tooth flossing	No	491	89.44	<.001*
	Yes, more	44	8.01	
	Yes, less	14	2.55	
Regular dental checkups	No	446	81.24	<.001*
	Yes, more	4	0.73	
	Yes, less	99	18.03	

Note. *p-value < 0.05.

CHAPTER V

DISCUSSION

Oral health is important for people's general health and well-being, especially for college students who are experiencing a challenging transition to an independent lifestyle. Its importance is further emphasized in a drastic environmental change such as COVID-19 (Kamel et al., 2021). Oral health can be impacted by individuals' dental knowledge and preventive dental behaviors, including tooth brushing, tooth flossing, and regular dental checkups. Since the Health Belief Model (HBM) has been widely utilized to describe and promote various health behaviors in behavioral research, the current study determined the prevalence of college students' preventive dental behaviors associated with their attitudes toward the behaviors using HBM. In addition, this study identified the impact of college students' dental knowledge level and the COVID-19 pandemic (i.e., an environmental change) on their preventive dental behaviors. Overall, this study found that perceived barriers and self-efficacy among the constructs of HBM were the strongest predictors of preventive dental behaviors in college students. The results also showed that a higher prevalence of preventive dental behaviors was found when the participants had sufficient dental knowledge compared to those with a deficient or moderate level of dental knowledge. Lastly, the majority of the participants reported no impact of the COVID-19 pandemic on their preventive dental behaviors, while a considerable number of the participants claimed the positive and negative influence of COVID-19 on their behaviors.

HBM and Preventive Dental Behaviors

HBM has proven to be an effective framework to predict preventive dental behaviors in various populations (Mehtari Taheri et al.; Ashoori et al., 2020; Hou, 2018). Perceived susceptibility and perceived severity are two key constructs of HBM to explain and predict health behavior changes. Given the concept of the constructs, an individual should develop a belief in a personal threat (i.e., a combination of perceived susceptibility and perceived severity) from a certain health condition before adapting a health behavior (Rosenstock, 1974). However, the current study found that the scores of both constructs were not significantly different between the groups of meeting and non-meeting the oral health recommendation. This means that perceived susceptibility and perceived severity may not be strong predictors of preventive dental behaviors among college students, which is in agreement with previous studies (Hou, 2018; Mehtari Taheri et al., 2021; Ashoori et al., 2020). This finding could be attributable to a characteristic of preventive dental behaviors. The behaviors are considered more like lifestyles such as repetitive daily habits than health-oriented behaviors. According to the previous studies, the predictive scores of perceived susceptibility and perceived severity are higher in non-repetitive, disease preventive behaviors (e.g., breast cancer screening behavior) compared to habitual behaviors (e.g., physical activity) (Tarı Selçuk et al., 2022; Hosseini et al., 2017). In addition, as the risk of oral diseases is often seen as less dangerous than other chronic health problems like cancer and cardiovascular disease, the threat-based constructs may have a lack of ability to motivate people to take action against oral diseases (Tan et al., 2001).

A key finding of the current study suggests that perceived barriers and self-efficacy in the HBM constructs could be the strongest constructs to predict and promote preventive dental

behaviors among college students. These results support previous findings that perceived barriers and self-efficacy are two important constructs of HBM to accomplish ideal behavior changes in various populations (Jones et al., 2015). Perceived barriers refers to a person's evaluation of the obstacles, such as fatigue, laziness, time restriction, cost, and anxiety, to change a behavior (Janz & Becker, 1984). In the current study, perceived barriers is a significant predictor of preventive dental behaviors among college students. Previous studies have also found a high score of perceived barriers as a significant determinant of not following the oral health recommendation (Mehtari Taheri et al., 2021; Buglar et al., 2010; Ashoori et al., 2020). This result can be explained by another characteristic of preventive dental behaviors. Unlike other preventive health behaviors resulting in a quick consequence of behavior change (e.g., wearing a mask to protect against COVID-19), there is a delay in developing oral diseases associated with the poor performance of preventive dental behaviors. Given this consideration, people are more likely to focus on current challenges (e.g., the presence of barriers) in performing preventive dental behaviors than on the possible future consequences, and thus, perceived barriers may play an important role in performing the behaviors. In addition to the perceived barriers, individuals are more likely to adopt a healthy behavior when they are capable of overcoming the barriers of behavior change. This capability is recognized as the self-efficacy construct in HBM (Janz & Becker, 1984). This study revealed a significant relationship between self-efficacy and preventive dental behaviors. The result suggests that college students are more likely to perform preventive dental behaviors when they feel confident in overcoming current barriers to perform the behaviors. Consistent findings were observed in previous studies that a higher level of self-efficacy was correlated to a better performance of preventive dental behaviors (Mehtari Taheri et al., 2021; Buglar et al., 2010; Ashoori et al., 2020).

Dental Knowledge and Preventive Dental Behaviors

In this study, a self-determined level of dental knowledge in college students was found to be associated with their preventive dental behaviors. In general, about 60% of the participants met the recommendations for tooth brushing (61.5%) and regular dental checkups (59.5%), while 23% was in compliance with the tooth flossing recommendation. These proportions found varied significantly with the different levels of dental knowledge. For example, a significantly higher proportion of students met the recommendations for tooth brushing and regular dental checkups when they had a sufficient level of dental knowledge compared to the other groups with insufficient and moderate levels of dental knowledge. Although a nonsignificant finding was observed in tooth flossing, a similar pattern was observed in the proportion. This positive relationship is consistent with previous notions that individuals who had enough dental knowledge were more likely to follow the oral health recommendation (Al-Ansari et al., 2003). In contrast, it was found that a lack of necessary dental knowledge led to poor performance of preventive dental behaviors among college students, in turn putting them at a higher risk of oral health (Koubaytari, 2017). Lastly, an intervention study had also come up with the same result that improving dental knowledge was a critical strategy to promote preventive dental behaviors (Dagnew et al., 2019). Therefore, the results of this study support a mediating role of dental knowledge to promote preventive dental behaviors in prospective studies.

COVID-19 and Preventive Dental Behaviors

This study found that the COVID-19 pandemic did not influence the majority of the participants' preventive dental behaviors. As aforementioned, preventive dental behaviors seem to be fundamentally distinct from other preventive health behaviors. Preventive dental behaviors are

similar to repetitive daily habits that are often described as a settled tendency of behavior performed in frequent repetition. In other words, such behavior is not easily affected by a sudden environmental change such as the COVID-19 pandemic (Haefner, 1974). Nonetheless, investigating the influence of COVID-19 on preventive dental behaviors was necessary to develop the foundation for future research focusing on promoting preventive dental behaviors in a sudden environmental change. In the current study, a considerable number of the participants reported positive and negative influences of COVID-19 on their tooth brushing (20.9%), regular dental checkups (18.8%), and tooth flossing (10.6%). The participants reported both positive and negative influences (9.5% vs. 11.5%, respectively) of COVID-19 on their tooth brushing. According to the responses to an open-ended question in the current study (Table 5), some college students brushed their teeth less frequently compared to before the pandemic mainly because of their increased levels of anxiety and depression and fewer chances of contacting others (e.g., staying home most of the time), whereas more frequent tooth brushing occurred in others because of their increased free time and intention to have a better self-care to protect themselves from COVID-19. In addition, the COVID-19 pandemic primarily and negatively influenced college students' regular dental checkups. Based on the findings in the current study, the main reason for the reduced usage of dental services was the decreased availability of dental care during the pandemic in the United States. COVID-19 has resulted in the shutdown of dental offices and a reduction in their hours of operation, with the exceptions of emergency and urgent treatments, restricting regular care and preventive treatments (Brian & Weintraub, 2020). Several students in this study also answered that "during the quarantine, I had appointments that I was unable to attend due to everything being shut down" (Table 5). Furthermore, during the pandemic, the required social distancing has decreased the demand for dental treatments and increased people's anxiety. As anxious people were less

inclined to leave their homes to see a dentist unless there was an emergency (Brondani et al., 2021), the students also tried to avoid non-urgent dental visits during the pandemic. Lastly, COVID-19 has resulted in a long-term income reduction and lowered purchasing power, which, in turn, can negatively impact the population's dental care (Daly & Black, 2020). A consistent finding was reported in the current study that "I can't afford to be seen by a dentist as often because of financial issues due to the COVID-19 pandemic". (Table 5).

Limitations

Several study limitations must be acknowledged. The study results were derived from a cross-sectional analysis of college students attending a large-size, modern land-grant university in the U.S. Also, the majority of participants were White and female students (77.1% and 69.9%, respectively). These conditions may limit the generalizability of the study findings to U.S. college students and other diverse populations. In addition, the COVID-19 status, such as incidence and death rates and governmental responses to the pandemic, were different across the states in the U.S. at the period of data collection. Thus, COVID-19 could have varying impacts on students' preventative dental behaviors depending on the state where the students were located during the pandemic. Future research focusing on large and diverse populations across the states is suggested.

Conclusion

The Health Belief Model has the potential to be an efficient framework to predict preventive dental behaviors for college students, particularly using perceived barriers and self-efficacy. It is recommended to consider the common characteristics of preventive dental behaviors when developing an intervention program to promote the behaviors. An intervention program

focusing on overcoming perceived barriers and increasing self-efficacy to perform preventive dental behaviors would be beneficial. In addition, increasing dental knowledge could be another potential strategy to promote preventive dental behaviors, especially among college students. Although college students' preventive dental behaviors are not largely influenced by a sudden environmental change such as the COVID-19 pandemic, there still exists a gap to be improved.

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APPENDICES

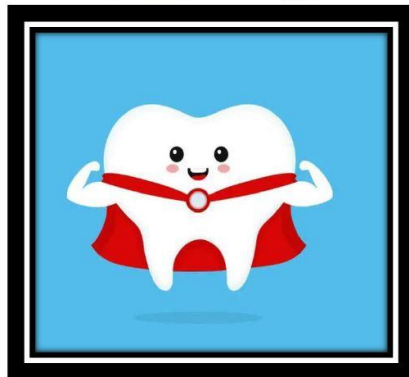
Appendix A

Flyer

RESEARCH STUDY – AMAZON GIFT CARD DRAWING



Oral Health survey



You are eligible to participate if you:

- are an undergraduate student aged 18-25
- are studying in the U.S.
- have access to the internet



The QR code for the survey:

The link for the survey:

https://okstateches.az1.qualtrics.com/jfe/form/SV_6tIEgEw1CWJJB1I

Email: mbaghiz@okstate.edu Call: 405-612-1737

Complete the questionnaire to:

help us learn more about your oral health, your beliefs about it, and the influence of the COVID-19 pandemic on your oral health.



It may take only 15- 20 minutes but you can win:

- One of twenty \$15 Amazon Gift Cards
- One of two \$50 Amazon Gift Cards
- One \$100 Amazon Gift Card



SCHOOL OF
COMMUNITY HEALTH SCIENCES,
COUNSELING AND
COUNSELING PSYCHOLOGY

Appendix B

Informed Consent Form

❖ **Investigator:**

I am a graduate student and this is my thesis research and I am working under Dr. Han's supervision.

Dr. Ho Han, Assistant Professor

Maryam Baghizadeh Fini, DDS, MS

School of Community Health Sciences, Counseling & Counseling Psychology

College of Education and Human Sciences

Oklahoma State University

The School of Community Health Sciences, Counseling & Counseling Psychology at Oklahoma State University supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that participation is completely voluntary and that even if you agree to participate, you are free to withdraw at any time without penalty. Your relationship with the investigator(s) will not be affected in any way if you refuse to participate.

❖ **Purpose:**

This research project is being conducted to discover more about your oral health and your beliefs about it, as well as the influence of the COVID-19 pandemic on your oral health. You must be 18-25 years old to participate.

❖ **What to Expect:**

This research study is administered completely online. This study will entail your completion of a confidential online survey. The survey is expected to take approximately 15 – 20 minutes to complete and only needs to be completed once. The survey includes questions about your oral health, including tooth brushing, tooth flossing, and regular dental checkups, your beliefs about oral health, and the impact of COVID-19 on your oral health. If at any time you do not wish to continue with this survey, you can exit the survey.

At the end of the survey, you will be asked to enter your email address **ONLY** if you are interested in participating in a drawing for one of twenty \$15 Amazon gift cards, one of two \$50 Amazon gift cards, and one of \$100 Amazon gift cards. Your email address will be kept separate from your individual survey response and will **ONLY** be used for the purposes of the gift card drawing. Your email address will be deleted within two weeks after this survey closes.

❖ **Risks:**

There are no risks associated with this project which are not expected to be greater than those ordinarily encountered in daily life.

❖ **Benefits:**

We believe that the information obtained from this study will help us gain a better understanding of undergraduate students' oral health, which may help public health professionals to better design educational programs and research projects in these areas in order to improve students' oral health and decrease the costs of poor oral health.

❖ **Compensation:**

There is no compensation for completing this online survey. However, if you provide your email address to be entered into the gift card drawing, you could win one of twenty \$15 Amazon gift cards, one of two \$50 Amazon gift cards, and one of \$100 Amazon gift cards.

❖ **Participant Rights:**

Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this study at any time.

❖ **Confidentiality:**

The research team works to ensure confidentiality to the degree permitted by technology. It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. However, your participation in this online survey involves risks similar to a person's everyday use of the Internet. If you have any questions, you could consult the survey provider privacy policy at <https://www.qualtrics.com/privacy-statement/> .

All information will be kept confidential to the extent allowed by law and university policy. Research records will be stored on a password protected computer in a locked office and only researchers and individuals responsible for research oversight will have access to the records. Survey responses will be kept for an indefinite period of time; however, all personal identifiers (e.g., your email address) will be deleted within two weeks of the online survey closing. Your email address, if provided, will **ONLY** be used for the purposes the gift card drawing. All published work will be reported using group data, no personal identifiers will be included, to ensure you cannot be connected to your responses and your privacy will be protected.

❖ **Contacts:**

You may contact the researcher at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study:

Dr. Ho Han, Assistant Professor

School of Community Health Sciences, Counseling & Counseling Psychology

College of Education and Human Sciences

Oklahoma State University

Phone: 405-744-4837

Email: hohan@okstate.edu

Maryam Baghizadeh Fini, DDS, MS

School of Community Health Sciences, Counseling & Counseling Psychology

Oklahoma State University

Phone: 405-612-1737

Email: mbaghiz@okstate.edu

If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

❖ **If you choose to participate:**

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

- I affirm that I am 18-25 years old:
 - o Yes
 - o No
- I affirm that I am an undergraduate student:
 - o Yes
 - o No
- I affirm that I am currently residing in the United States:
 - o Yes
 - o No
- I have read and fully understand this consent form. I hereby give permission for my participation in this study.
 - o Yes
 - o No

IRB Office:

Approved: 09/08/2021

IRB#: IRB-21-360

Appendix C

Health Belief Model Questionnaire for Dental and Oral Health

“**Dental and oral health**” means the capability to smile, smell, speak, touch, taste, chew, swallow, and express a wide range of emotions via facial gestures confidently without any pain, unpleasantness, or craniofacial sicknesses. Poor dental and oral health can cause oral diseases as well as several medical problems such as heart disease, cancer, and diabetes. So, the earlier you acquire appropriate oral hygiene practices like brushing and flossing and decide to see your dentist regularly, the simpler it will be to avoid costly dental operations and long-term health consequences.

Target Behavior: Improve U.S. college students' dental and oral health

The following questions ask about your general information. Please select the option that best describes you. All your responses will be kept entirely confidential and anonymous.

General Information

1. How old are you?
2. Which term do you use to describe your gender identity?
 - (a) Woman
 - (b) Man
 - (c) Trans woman
 - (d) Trans man
 - (e) Genderqueer
 - (f) Trans women
 - (g) Another identity (please specify):
3. How do you usually describe yourself? (Mark all that apply)
 - (a) White
 - (b) Black or African American
 - (c) Hispanic or Latino/a
 - (d) Asian or Pacific islander
 - (e) American Indian, Alaskan Native, or Native Hawaiian
 - (f) Biracial or Multiracial
 - (g) Other
4. What is your year in school?
 - (a) 1st year undergraduate
 - (b) 2nd year undergraduate
 - (c) 3rd year undergraduate
 - (d) 4th year undergraduate
 - (e) 5th year undergraduate
5. Do you have any dental health insurance?
 - (a) Yes
 - (b) No
6. when was the last time you went to a dentist?
7. How would you grade your knowledge of dental and oral health?
 - (a) Very deficient
 - (b) Deficient
 - (c) Moderate
 - (d) Sufficient
 - (e) Very sufficient

8. How do you obtain your dental and oral health-related knowledge?

- (a) Your dentist (b) Your doctor (c) Internet (d) Books and journals
(e) People around me (f) Other resources

9. Have you received a COVID-19 vaccine?

- (a) Yes (b) No

- If yes, are you fully vaccinated (i.e., two doses of Pfizer or Moderna, or one dose of Johnson & Johnson)?

- (a) Yes (b) No

10. How many times have you tested positive for COVID-19?

- (a) 0 (b) 1 (c) Multiple times

The following questions ask about your oral hygiene practices. Please select the option that best describes your oral hygiene protective behavior.

Dental and Oral Hygiene Practices

1. How often do you brush your teeth every week?

- (a) not at all (b) once a week (c) every second day (d) once a day (e) twice a day (f) more than twice a day

2. Does the COVID-19 pandemic impact your habit of brushing teeth?

- (a) No (b) Yes, I brush more than before (c) Yes, I brush less than before

If yes, Please specify why COVID-19 impacts your tooth brushing.....

3. How often do you floss your teeth every week?

- (a) not at all (b) once a week (c) every second day (d) once a day (e) twice a day (f) more than twice a day

4. Does the COVID-19 pandemic impact your habit of flossing teeth?

- (a) No (b) Yes, I floss more than before (c) Yes, I floss less than before

If yes, Please specify why COVID-19 impacts your tooth brushing.....

5. How often do you visit a dentist for a dental checkups?

- (a) Not at all (b) Once a year (c) Twice a year (d) More than twice a year

6. Does the COVID-19 pandemic impact your habit of visiting a dentist for a checkups?

- (a) No (b) Yes, I do dental checkups more than before (c) Yes, I do dental checkups less than before

If yes, Please specify why COVID-19 impacts your tooth brushing.....

7. How did you do your dental checkups during the COVID-19 pandemic?

- (a) In-person visit (b) Online visit (c) None of them

Dental and Oral Health Beliefs

Dental caries is an infectious condition that damages the structure of teeth. This can result in a cavity, which can be a tiny or big hole in a tooth. **Gum disease** originates from bacterial in your mouth and can lead to loss of teeth due to infection and inflammation of the tissue surrounding your teeth if not treated appropriately. Some of the indicators of gum disease are (1) bleeding before and after tooth brushing, (2) red, swollen gums, (3) bad breath or bad taste, (4) painful chewing, (5) sensitive teeth, and (6) loose teeth.

In this part, we are asking questions about your beliefs regarding oral health and oral hygiene habits, and you will use rating scales with five options. You will select an option that best describes your opinion. For example, if you think your answer is **neither disagree nor agree**, then you would select ““neither””.

Completely Disagree	Disagree	Neither	Agree	Completely Agree
1	2	3	4	5

Perceived susceptibility

- It is possible that I will develop dental caries and gum disease.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- My chance of developing dental caries and gum disease is high.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I don't brush my teeth regularly, it is more likely that I will develop dental caries and gum disease.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I don't floss my teeth regularly, it is more likely that I will develop dental caries and gum disease.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I don't do a dental checkups regularly, it is more likely that I will miss existing dental caries and gum disease.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

(1) Perceived severity

- If I develop dental caries and gum disease, it will be really serious.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries, I will experience severe toothaches.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop gum disease, I will experience severe bleeding when I brush or floss my teeth.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries, it will affect my eating ability.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries, it will affect my speaking ability.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries and gum disease, it will make me seem unattractive because of my appearance and bad breath.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries and gum disease, it will have a negative impact on my daily life.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries and gum disease, it will lead to other health problems such as heart disease, cancer, etc.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Dental caries and gum disease can finally lead to loss of teeth.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- If I develop dental caries and gum disease, it will be pretty costly for me.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

(2) Perceived benefits

- Brushing and flossing my teeth on a daily basis will keep my teeth and gum in a healthy status.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Dental caries and gum disease will be avoided by brushing and flossing my teeth on a daily basis.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Brushing and flossing my teeth on a regular basis will keep them clean.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Brushing and flossing my teeth on a regular basis will give me fresh breath.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Brushing and flossing my teeth on a daily basis will boost my self-esteem.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- With routine dental checkups, the dentist will be able to detect tooth and gum issues before they become more serious and untreatable.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- With routine dental checkups, the dentist can examine your teeth and gum for the effects of your bad habits such as chewing ice, biting your nails, clenching your jaw, grinding your teeth, eating sticky or hard sweets, brushing your teeth too hard, drinking coffee and red wine, and smoking and recommend you based on the severity of the effect on your teeth.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Routine dental checkups will inform me how to take care of my dental and oral health correctly.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Routine dental checkups, brushing, and flossing your teeth will prevent you from extra costs.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

(3) Perceived barriers

- I will not take care of my dental and oral health because I don't think dental and oral health is essential.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because I don't have enough oral health-related information.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because of work and study-related fatigue.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because I am too lazy.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because of my busy schedule and lack of time.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because I forget to brush and floss my teeth or visit my dentist regularly.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because most people around me don't take care of their oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot take care of my dental and oral health because it costs me money.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot do my dental checkups because of dental anxiety or fear.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I cannot do my dental checkups because I feel ashamed of my oral health not being in good shape.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

(4) Cues to action

- My loved ones remind me to take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Informational materials (e.g., posters, flyers, newspapers, advertisements, etc.) remind me to take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- Observing the negative impacts of not taking care of dental and oral health reminds me to take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- My daily schedule reminds me to take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- My bad oral health and experiencing severe pain make me take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- My intimate contact, such as a kiss, makes me take care of my dental and oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I will brush my teeth if I have a favorite toothpaste or toothbrush.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I will do my dental checkups if I have a favorite dentist.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I will take care of my dental and oral health if other people compliment my teeth.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I will do a dental checkups if it is free of charge.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

(5) Self-efficacy

- I am confident that I can brush my teeth daily even when I encounter situations that make me difficult to do that.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I am confident that I can floss my teeth daily even when I encounter situations that make me difficult to do that.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I am confident that I can do my routine dental checkups even when I encounter situations that make me difficult to do that.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I am confident that I can take a good care of my dental and oral health even when I feel tired.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I am confident that I can take a good care of my dental and oral health even when I am so busy.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

- I am confident that I can take a good care of my dental and oral health even when most people around me don't take care of their oral health.

Completely Disagree		Neither		Completely Agree
1	2	3	4	5

Appendix D

IRB Approval



Oklahoma State University Institutional Review Board

Date: 09/08/2021
Application Number: IRB-21-360
Proposal Title: Predictors of Oral and Dental Health Among US College Students Based on the Health Belief Model

Principal Investigator: Maryam Baghizadeh Fini
Co-Investigator(s):
Faculty Adviser: Ho Han
Project Coordinator:
Research Assistant(s):

Processed as: Exempt
Exempt Category:

Status Recommended by Reviewer(s): Approved

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in 45CFR46.

This study meets criteria in the Revised Common Rule, as well as, one or more of the circumstances for which continuing review is not required. As Principal Investigator of this research, you will be required to submit a status report to the IRB triennially.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 405-744-3377 or irb@okstate.edu.

Sincerely,
Oklahoma State University IRB

Supplementary Files

Table 5. Illustrative quotations for COVID-19 influences on preventive dental behaviors

Preventive dental behaviors	Categories	Illustrative Quote	N (%)
Positive influences on preventive dental behaviors			
	Bad breath	<p><i>Increase brushing to prevent bad breath when wearing a mask.</i></p> <hr/> <p><i>Wearing a mask all the time has affected my breath.</i></p> <hr/> <p><i>Wearing a mask makes me smell my own breath.</i></p>	5 (9%)
Tooth brushing	Better self-care because of COVID-19	<p><i>The idea of getting COVID is scary. So, showering, washing my hands, and brushing my teeth are ways to help cleanse my body more to be able to prevent myself from getting it.</i></p> <hr/> <p><i>I am more conscious about my health.</i></p> <hr/> <p><i>Because I feel like I am surrounded by germs now.</i></p>	23 (43%)
	Having more free time	<p><i>It gives me more free time sometimes and when I have free time, I sometimes just brush my teeth to burn time.</i></p> <hr/> <p><i>Since I am home more often then I tend to take care of myself.</i></p> <hr/> <p><i>Just in the home for more hours and get more chances.</i></p>	26 (48%)

		<i>I have a lot more time on my hands so when I get bored I floss sometimes.</i>	
	Having more free time	<i>I had more time at home and I wasn't just rushing around at night to get to bed. I actually took the time to floss often enough to form a habit.</i>	29 (72.5%)
		<i>I had more time to focus on my health so more time to remember to floss.</i>	
Tooth flossing	Better self-care because of COVID-19	<i>Thought of good health is more prominent.</i> <i>I was more focused on my health during that time.</i>	7 (17.5%)
		<i>I use my oral hygiene as proof to myself that I can still take care of myself during the depressive swings the pandemic brings.</i>	
	Increased knowledge	<i>Dentist informed me of the benefits of flossing for overall health.</i> <i>Like with brushing, I am more aware and trying to floss more often.</i>	4 (10%)
		<i>Increased awareness of healthy habits.</i>	
Negative influences on preventive dental behaviors			
	Wearing a mask	<i>I wear a mask so why do I have to worry about brushing my teeth nobody can see or smell anyway.</i> <i>Because I wear a mask I am more lenient in brushing my teeth in the morning when I am in a rush.</i>	4 (6%)
		<i>Wear mask less self-conscious.</i>	
Tooth brushing	Mental disorders	<i>Depression from pandemic made it hard to do more than once a day.</i> <i>When my mental health suffers, which happened during the pandemic, I don't take as good care of my health, including brushing my teeth.</i>	27 (43%)
	laziness	<i>Been a little more depressed, so I feel like I don't have the energy sometimes to do it.</i> <i>I became lazier about my oral health during the pandemic.</i>	6 (10%)

		<i>I'm just lazier now and don't want to get out of bed and I don't have a consistent schedule.</i>	
		<i>It creates a sort of laziness and change in my day to day schedule. for a while, I would wake up at 3-4 pm and wouldn't brush my teeth because I was ready for lunch.</i>	
		<i>Forget to because I'm staying at home.</i>	
	Stay at home and less contact	<i>Less need to go out of the house. Easier to forget to brush.</i>	26 (41%)
		<i>I interacted with less people over the course of the pandemic, and my routines were broken down, so I felt less pressure to brush teeth.</i>	
	Wearing a mask	<i>Don't think about it because I wear a mask.</i>	1 (6%)
	Mental disorders	<i>As days became more repetitive, it became hard for me to continue doing basic daily things. Taking care of my body became harder mentally.</i>	2 (12.5%)
		<i>Same as before: my hygiene has decreased as my mental health has gotten worse.</i>	
Tooth flossing	Laziness	<i>With the pandemic, it was easy to lose a daily routine and get lazy with personal care.</i>	
		<i>Tend to lay in bed more and forget to floss.</i>	6 (37.5%)
		<i>Just didn't feel like I needed it since I was bored and lazy all day and inside and not eating out.</i>	
	Stay at home and less contact	<i>Floss less often because I didn't leave home and it lost my habit.</i>	3 (19%)
		<i>Don't leave the house as much.</i>	
	Having difficulties getting back to normal routine	<i>Classroom and time management has become more difficult to control.</i>	4 (25%)
		<i>I just have struggled to keep up with routines that I had before the pandemic.</i>	
Regular dental checkups	Limited access to dental care	<i>My dentist office closed.</i>	
		<i>COVID has made scheduling dentists appointments more difficult.</i>	57 (59.5%)

	<i>During quarantine I had appointments that I was unable to attend do to everything being shut down.</i>	
Avoiding close contact	<i>During the height of the pandemic I did not want to go to the dentist's office.</i>	
	<i>It requires an in person visit which is a risk with COVID-19.</i>	28 (29%)
	<i>I didn't go during the pandemic as a safety measure.</i>	
Financial issues	<i>Can't afford to be seen as often</i>	
	<i>I no longer have insurance to visit the dentist.</i>	8 (8.5%)
	<i>Distance, money for gas.</i>	
Lack of motivation	<i>Lack of motivation to do things.</i>	
	<i>Being home all time changed my willingness to attend things.</i>	3 (3%)

VITA

Maryam Baghizadeh Fini

Candidate for the Degree of

Master of Science

Thesis: PREVENTIVE DENTAL BEHAVIORS AMONG U.S. COLLEGE STUDENTS
BASED ON THE HEALTH BELIEF MODEL

Major Field: Health Promotion

Biographical:

Education: Master of Science, Doctor of Dentistry

Completed the requirements for the Master of Science in Health and Human
Performance, Health Promotion Option

Oklahoma State University, Stillwater, Oklahoma in May, 2022.

Completed the requirements for the Dentistry at Tehran University of Medical Sciences,
Tehran, Iran in 2018.