Title Page

**The Relationship between Affordability and Utilization of Dental Services: A Secondary Data Analysis of 2015-2016 NHANES Data**

by

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Abstract

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**The Relationship between Affordability and Utilization of Dental Services: A Secondary Data Analysis of 2015-2016 NHANES Data**

Dillon A. Mody, MPH

University of Pittsburgh, 2019

**Abstract**

*Background*: In the United States, oral health disparities are a public health concern as minority populations face barriers affording and utilizing dental services. Previous literature examines the relationship between racial/ethnic and socioeconomic inequalities and the utilization of dental services. However, there is a gap in literature pertaining to the ability to afford care.

*Methods*: A cross-sectional analysis using the 2015-2015 National Health and Nutrition Examination Survey (NHANES) examined the ability to afford and utilize dental care in the past 12 months when care was needed. The analysis stratified the study population by race/ethnicity, socioeconomic status, and by both race/ethnicity and socioeconomic status. Respective racial/ethnic groups included White, Black, and Hispanic populations. Socioeconomic status was binary coded to include participants living under an annual household income of $34,999 and individuals living above an annual household income of $75,000. These respective cohorts were labeled “Under $34,999” and “Over $75,000”. The stratification of racial/ethnic groups by socioeconomic status included cohorts titled “White Under $34,999”, “White Over $75,000”, “Black Under $34,999”, “Black Over $75,000”, “Hispanic Under $34,999”, and “Hispanic Over $75,000”. The study also analyzed the descriptive statistics for the entire sample, stratifying by race/ethnicity and by socioeconomic status.

*Results*: Racial/ethnic minorities and those with lower income (Black populations, Hispanic populations, and individuals under $34,999) were found to have higher rates of being unable to afford and utilize dental services in the past 12 months, especially when care was needed, in comparison to White populations and individuals living above $75,000. Lower socioeconomic groups representing all racial classes (“White Under $34,999”, “Black Under $34,999”, and “Hispanic Under $34,999”) and were found to have higher rates of being unable to afford and utilize dental services in the past 12 months, especially when care was needed, in comparison to their counterparts living at a higher socioeconomic level.

*Conclusion*: Racial/ethnic groups and those with lower socioeconomic status were more likely to face challenges or barriers affording and utilizing dental services on an annual basis.

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Preface

I would like to thank Dr. Tiffany Gary-Webb, Dr. Thistle Elias, and Dr. Deborah Polk for their patience, help, and continued support throughout my education at the Graduate School of Public Health. I would also like to thank my parents and my sister for their unconditional love and encouragement in pursuing my dreams. I am blessed to have these people involved in my life.

# Background

## Research Question:

What is the influence of racial and socioeconomic inequalities on the relationship between the ability to afford dental care and the actual utilization of dental services?

## Purpose

For decades, researchers have studied the association between the ability to afford dental care and the utilization of dental services. However, researchers have recently begun to narrow their scope of study to analyze how ethnicity, gender, socioeconomic status, educational attainment, and health literacy affect this relationship. This analysis aims to investigate the influence of racial and socioeconomic inequalities on the relationship between the ability to afford dental care and the utilization of dental services. Specifically, the researcher conducted secondary data analysis of the 2015-2016 National Health and Nutrition Examination Survey (NHANES) dataset to test the proposed hypothesis. The research findings will inform public health efforts focused on reducing oral health disparities for all individuals residing in the United States.

## Self-Efficacy and David R. Williams Racism and Health Framework

The use of behavioral theory and conceptual framework provide a logical explanation of the intrinsic factors that influence an individual’s oral health behavior. In the United States, racism throughout society influences the health behavior of minority populations.1 Racism creates an environment where racial/ethnic minorities and individuals living among lower socioeconomic levels are severely disadvantaged. These factors create the foundation for the proximal pathways that predict health behavior and overall health outcomes. Dr. David Williams states that the various mechanisms rooted in the proximal pathway of racism accumulate and act together to affect health.1 These factors include knowledge, societal capital, economic resources, the influence of psychosocial stressors, and cultural perceptions.1 Specifically, Dr. Williams states that racism creates different opportunities to obtain resources for individuals living at various socioeconomic levels.1 Additionally, racism creates an environment where minority populations lack proper oral health literacy to seek appropriate care. Therefore, minority populations must overcome numerous obstacles to allocate the appropriate resources, build health literacy awareness, and overcome cultural beliefs to obtain the confidence to create positive changes in behavior.

In regards to oral health behavior, Dr. David William’s Racism and Health Framework provides the necessary foundation to understand how cultural and structural barriers limit racial/ethnic minorities and individuals living among lower socioeconomic levels from seeking health care. Racial minorities and individuals living among lower socioeconomic levels must first develop a sense of oral health literacy to prioritize the utilization of dental services. A combination of life experiences, educational attainment, and cultural beliefs contribute to each individual’s level of oral health literacy. The ability to afford dental services is a complex issue rooted in Dr. David Williams Racism and Health Framework’s concept of proximal pathways. Specifically, an individual’s economic standing and perceived ability to afford dental services is dependent on a variety of societal resources, economic opportunities, and the absence of environmental stressors within the community. Additionally, the concept of self-efficacy plays a large role in the utilization of dental services as individuals must believe that they have the proper resources to perform the respective behavior and they must believe that the behavior creates positive benefits.2 Self-efficacy is similar to oral literacy as it develops through life experiences and exposure to personal testimonies explaining the benefits of engaging in the respective behavior. Therefore, the utilization of dental services among minority populations is dependent on a strong sense of self-efficacy, adequate oral health literacy, and the ability to overcome structural and social barriers to obtain the necessary economic resources.

## Income Disparities by Race

Existing data suggest that income disparities exist by various racial or ethnic groups. Since 2013, there has been an increase in income disparity for both Black and Hispanic populations compared to White populations.3 Interestingly, Asian populations showed the greatest increase in median household income compared to White and Black populations from 1970 to 2016.4 In 2016, the median household income by race for Asian populations was $51,288, followed by White populations at $47,958, Black populations at $31,082, and Hispanic populations at $30,400.4 Currently, it is difficult to pinpoint the specific causes that contribute to the widening gap in income by race/ethnicity. However, factors including education, occupational status, racial discrimination, social capital, and residential segregation play a role in the income inequality currently present in the United States.5-7 Furthermore, researchers have identified that inherently historical factors such as residential segregation by race/ethnicity contributes to disparities in income as it “produces inequality in social and economic opportunities and outcomes”.8 Additional research in the oral health field found that current residential segregation by race/ethnicity creates an environment where underprivileged individuals are unable to afford healthcare.9 A recent analysis of income disparity in relation to dental outcomes found that variables associated with economic inequality correlate to adverse oral health outcomes.10 This research study also suggests that the lack of available oral health resources in certain geographic locations perpetuate adverse oral health outcomes regardless of an individual’s economic standing. Furthermore, factors associated with segregation and structural barriers limit available resources that could be used to improve the overall oral health outlook for minority populations.11 These research articles show that the racial/ethnicity disparity in income throughout the oral health field is a complex issue due to various related factors.

## Dental Utilization Rates by Race and Income

Compiled data from the CDC shows that the use of dental services differs by race/ethnicity and income. According to Bambas & Casas, “Many of the discussions about health equity make reasonable claims that there are inequalities in health status and access to care for different categories of people, whether identified by social class (as measured by income, wealth, and/or formal education), spatial distribution, gender, or ethnicity.”12. Specifically, White adults aged 18-64 were the highest percentage racial/ethnic group to visit the dentist at least once a year at 68.3%.13 Asians were the next highest percentage racial/ethnic group at 66.2% followed by Black and Hispanic populations at 59.3% and 55.3% respectively.13 In fact, data show that the percentage of individuals that have never received dental services is disproportionately higher among minority groups, especially Hispanic populations.14 Thus, the race/ethnicity disparity in the annual utilization of dental services mirrors the current race/ethnicity pattern seen among income disparity in the United States. Similarly, the annual utilization of dental services also varies by economic status. CDC data also show that adults aged 18-64 living above 400% of the Federal Poverty Level were most likely to seek dental services at 79.1%.13 Individuals living 200%-399% above the Federal Poverty Level utilized dental services at 60.9%, while those living 100%-199% and below 100% of the poverty level utilized services at 46.4% and 49.0% respectively.13 The American Dental Association’s Health Policy Institute determined that the gap in utilization of dental services among low-income and high-income adults residing in the United States is slowly improving.15 These studies imply that various complex issues dictate the utilization of dental services for every economic and racial/ethnic group.

## Individual Utilization of Dental Services

The American Dental Association recommends that all individuals should seek dental services on an annual basis.16 Additionally, the American Dental Association mandates that dentists should create an individual plan of treatment for each patient based on their health history and current oral health status.16 This research implies that the recommended utilization of dental services varies for each individual. Adequate use of available dental services creates positive social, physical, and mental benefits.17 Specifically, utilization of dental services prevents adverse medical outcomes, pain, a decrease in quality of life, future costs associated with care, and lost time in employment or other activities.18 Additional benefits of care include an increase in self-confidence, self-esteem, and a decrease in social discrimination.17 This research reaffirms the notion that dental healthcare creates positive health benefits beyond the treatment of adverse oral health outcomes. Therefore, it is imperative that all individuals regardless of socioeconomic status or racial identity should have access to oral healthcare.

 In addition to depending on structural-level characteristics, a person’s utilization of dental services also depends on many intrinsic factors unique to each individual. Beyond these factors, it is important to understand that the cumulation of life experiences across the lifespan also influences behavior as an adult. Possible predictors for the lower utilization rates of dental services amongst minority populations include differences in clinical condition, knowledge of disease and treatment options, underuse of available healthcare, misconceptions about treatment, and the overall quality of healthcare.19 Furthermore, the decision to seek and utilize oral health services is partially rooted in the various cultural beliefs of different racial/ethnic groups. The presence of fear and anxiety may also deter individuals in need of oral health services from seeking care.20 Specifically, these feelings of fear and anxiety may be rooted in previous painful or traumatic experiences and exposure with unpleasant dental professionals.20 Additionally, a history of medical abuse among previous generations of African American, Hispanic, and Native American populations has been passed down to family members throughout time creating fear and anxiety of utilizing medical services. Therefore, research shows that individuals must overcome their cultural beliefs and intrinsic views to take advantage of oral health services.

Cultural beliefs and values are embedded within each individual. These traits are unique to each cultural unit, and they are passed down through generations. Understanding how cultural beliefs influence oral health behavior provides an explanation of the inherent factors that promote or impede the utilization of dental services. An examination of cultural beliefs by race and ethnicity may provide an explanation of the existing disparities in oral health. It is important to note that available literature on oral health-related cultural beliefs focuses on individuals at lower socioeconomic levels.21 Interestingly research shows that both African American and Hispanic populations rely on cultural beliefs that dissuade or impede the use of preventive dental services.21 The influence of cultural beliefs by race, ethnicity, and economic status demonstrates that each individual’s personal upbringing plays a large role in their perceived perception surrounding the importance of maintaining good oral health.

## Affordability of Dental Services

The ability to afford dental care is a complex issue for all adults regardless of their race/ethnicity or socioeconomic status. A literature review reveals that there is limited available research that examines the ability to afford dental services in the context of race/ethnicity and income. However, research shows that the costs associated with dental care are a financial burden for many households.22 Existing literature states that there is a positive correlation between the ability to afford care and the utilization of dental services in the past year.23 According to the 2008 National Health Interview Survey, the inability to afford dental care and the lack of insurance were the most significant reasons that an adult aged 18-64 decided to forgo dental services.24 Specifically, the ability to afford available dental services is dependent on various individual and structural-level characteristics. These variables include dental insurance coverage, employment status, education, and the structure of oral health care systems.25 Dental insurance coverage in the United States is a multifaceted issue as policies regarding oral health coverage have evolved over the years. Dental insurance coverage is usually limited to those people that possess the necessary employment status or economic standing to obtain private insurance.25 Adults that qualify for programs such as Medicaid are often unable to afford oral health services as the program has very limited coverage.26 According to McGinn-Shapiro, approximately 45 states provide a form of dental coverage for Medicaid-enrolled adults.27 However, it is important to note that coverage varies state-by-state from comprehensive benefits to only emergency care.27 For individuals that possess dental coverage, the ability to afford care may be a serious issue as miscellaneous costs pertaining to care are a barrier for receiving oral healthcare.28 Adults without adequate dental coverage are in a unique position where they must decide to absorb the costs associated with care or to risk susceptibility of developing adverse oral health outcomes. The ability to absorb costs associated with care contributes to oral health disparities among people living at lower socioeconomic levels as data suggest that wealthy individuals without dental coverage utilize oral health services more frequently than less wealthy individuals regardless of the presence of dental coverage.29 The recent change in Medicaid policy further complicates dental coverage throughout the United States. The new policy expands dental coverage for Medicaid recipients residing in states that chose to adapt the policy change.30 However, Medicaid varies on a state-to-state basis providing variations of dental coverage for its recipients. Therefore, Medicaid recipients living in states that did not adapt the policy change nor provide dental coverage are at a significant disadvantage. This puts adults in a unique position where they are unable to afford care until significant oral health problems exist as Medicaid now only funds emergency dental care.31 Consequently, this recent change in policy has significantly increased the rate of emergency visits on a national scale.32

## Sample Characteristics

There are numerous factors that may influence the utilization of dental services. Understanding these factors will help in determining the true relationship between the ability to afford dental care and the actual utilization of dental services. These factors include gender, educational attainment, marital status, and United States citizenship status.

### Gender

Gender is directly correlated with dental utilization as research states that females are significantly more likely to utilize dental services.20

### United States Citizenship

United States citizenship is a variant that affects the overall health outlook of all minority populations. Current research suggest that individuals that possess United States citizenship are over 3 times as likely to seek healthcare services in comparison to individuals that do not possess citizenship.33 In regards to dental utilization, research shows that noncitizens are almost 30% less likely to seek care in comparison to citizens.34 Examining the influence of United States citizenship is extremely complex as there are numerous factors in play that hinder individuals from seeking dental services. It is also important to note that the current political climate and the fluid residency status of individuals that do not have citizenship make it difficult to understand the true factors that complicate the use of oral health services. Understanding these variables is vital to producing a comprehensive study on the current state of oral health in the United States.

### Marital Status

Marital status is a complicated variable that is positively associated with the use of dental services. Multiple studies suggest that individuals that are married have higher utilization rates of oral healthcare services in comparison to individuals that are not married.35,36

### Educational Attainment

Educational attainment is another predictor correlated to the utilization of dental services. According to Listl, “higher educational attainment resulted in increased probabilities of regular dental attendance”37. Additionally, research states that educational attainment strongly influences income level.38 Therefore, it is possible to infer that individuals occupying lower socioeconomic levels are more likely to have less educational attainment in comparison to individuals occupying higher socioeconomic levels.

## Implications

This study aims to address a gap in literature pertaining to oral health habits in relation to socioeconomic status and race/ethnicity for all adults residing in the United States. Specifically, the study will address and investigate the contributing factors that perpetuate oral health disparities as literature suggests that the use of dental services relates to physical, mental, and social wellbeing.17,18 These findings are vital in improving the overall oral health outlook of all residents in the United States as public health and dental professionals examine methods to make dental care more affordable for all individuals regardless of their respective socioeconomic status.

# Introduction

In the United States, the presence of oral health disparities has become a public health concern as the utilization of dental services is slowly decreasing. 39 According to the American Dental Association, individuals should seek dental services on an annual basis with additional care based on their dentist’s discretion.40 The regular and preventive use of dental services prevents adverse outcomes associated with poor oral health including pain, a decrease in quality of life, future costs associated with emergency care, and lost time in employment or other activities.18 Additionally, the use of dental services provides mental and social benefits that create an increase in self-confidence and self-esteem along with a decrease in social discrimination.17 Despite the positive health benefits, the utilization of dental services on an annual basis remain disproportionately low among racial/ethnic minorities and individuals living among lower socioeconomic levels compared to White populations and individuals living at higher socioeconomic levels.41,42

## Income Disparities by Race

The issue of socioeconomic disparity has perpetuated throughout time in the United States. Current socioeconomic disparities by racial/ethnic groups exist as the median household income for White populations stands at $51,288 along with African American populations at $31,082 and Hispanic populations at $30,400.4 Factors such as educational attainment, occupational status, social capital, racial discrimination, and residential segregation play a role in maintaining current levels of racial and socioeconomic inequality.5-7 It is important to note that there are a variety of additional factors that contribute to these socioeconomic inequalities.

## Dental Utilization by Race and Income

There are racial/ethnic disparities in the utilization of dental services. The utilization rate of dental services varies disproportionately by racial groups as 68.3% White populations utilize services compared to 59.3% of Black and 55.3% of Hispanic populations.13 Additionally, utilization rates by people at various socioeconomic levels follow similar trends as individuals living above 400% of the Federal Poverty Level are significantly more likely to utilize services compared to individuals living below 100% of the Federal Poverty Level at a rate of 79.1% and 49.0%, respectively.13 Potential factors contributing to the disproportionate utilization rate of dental services among minority populations include differences in knowledge of disease and treatment options, underuse of healthcare services, and misconceptions about treatment.19 Structural barriers hindering the use of dental services include overall quality of care, adequate dental coverage, proximity to oral health care facilities, and the ability to devote the necessary time to receive oral health services.19 Additional factors may include fear, anxiety, prior bad experiences with oral health professionals, and a lack of oral health literacy.20

## Affordability of Dental Services

The ability to afford dental services is a multifaceted issue for individuals of all racial and socioeconomic levels as many households view costs associated with care as a financial burden.22 Variables associated with the ability to afford care include but are not limited to employment status, educational attainment, dental insurance coverage, and the overall structure of the oral healthcare network.25 These factors are cyclical as the ability to obtain dental coverage is dependent on employment status and economic standing.25 Individuals without adequate dental coverage are in a difficult position where they must either absorb the costs associated with care or risk the development of adverse oral health outcomes. These findings are supported by the fact that wealthy individuals without dental coverage utilize services at a higher rate than non-wealthy individuals.29 Individuals possessing adequate forms of dental coverage face challenges affording care as they are limited to the providers linked to their dental networks and reimbursement programs.25 According to research, Black populations have a significantly lower rate of dental coverage in comparison to White populations.19,43 However, these particular studies fail to mention coverage rates for Hispanic populations. Individuals living among lower socioeconomic levels are in a position where they lack adequate dental coverage.44 Additionally, individuals that qualify for programs such as Medicaid are also at a disadvantage as these complex programs provide limited coverage forcing individuals to absorb costs associated with care.31

## Research Question and Hypothesis

Currently, the relationship between the ability to afford care and the actual utilization of dental services as a function of race/ethnicity is unknown. However, previous research suggests that there is a positive relationship between the ability to afford dental care and the utilization of dental services.23,36,45

Therefore, this study aims to examine the influence of racial/ethnic and socioeconomic disparities on the ability to afford dental care and the utilization of dental services in the past 12 months. Based on previous literature, socioeconomic and racial minorities are less likely to be able to afford dental care in the past 12 months in comparison to White populations and individuals living above an annual household income of $75,000.41,42 This study provides the foundation to assist public health and dental professionals in improving the utilization rate of dental services among minority populations.

# Methods

## Data Source

This study is a secondary data analysis of the 2015-2016 National Health and Nutrition Examination Survey (NHANES) data funded in part by the National Center for Health Statistics (NCHS), the Division of Health and Nutrition Examination Surveys (DHANES), and the Centers for Disease Control and Prevention (CDC). The NHANES is a nationally representative study that utilizes interviews and examinations to provide vital and health statistics for the United States.46 The 2015-2016 NHANES sample targeted 15,327 participants with 9,971 participants completing the interview and 9,544 participants completing the medical examination at 30 survey locations throughout the country.47 The total 2015-2016 response rate is 61.3%. NHANES utilizes a complex probability design to sample noninstitutionalized individuals across the 50 states and the District of Columbia. The survey developed primary sampling units (PSU’s) which consist of counties or small groups of adjacent counties.47 The PSU’s are then divided into a block or a group of blocks containing a cluster of households.47 Within the cluster of households, the survey identifies specific households to target participants.47 Participants under the age of 18 must have legal consent from a parent or guardian.

NHANES conducts face-to-face interviews consisting of socioeconomic, demographic, dietary, and health-related questions.48 The demographic section includes a set of questions pertaining to gender, age, race, military service, country of birth, citizenship status, educational attainment, annual household income, and marital status. The core interview component also includes a section on oral health. The oral health interview questionnaire includes 25 questions that discuss the use of dental services, conversations with oral health professionals about current oral health status, perceptions of the importance of oral health, last oral cancer exam, oral hygiene behavior, and self-perception regarding periodontal disease.49 NHANES also conducts medical examinations from licensed medical professionals consisting of dental, medical, physiological, and laboratory screenings. NHANES does not measure dental insurance or coverage.

## Descriptive Statistics

We used various descriptive statistics to provide a brief overview of the total sample. The results were broken down with respect to racial identity (Table 1) and socioeconomic status (Table 2). The measure of gender identified participants as either male or female. The measure of United States citizenship identified participants as either a citizen or not a citizen. The measure of marital status identified participants as either married or unmarried. We condensed all participants that originally identified as widowed, divorced, separated, never married, and living with a partner into the unmarried category. The measure of educational attainment measured participants based on their highest grade or level of school that was completed. Categories include less than 9th grade, 9th-11th grade, high school/GED, some college or AA (Associate’s) Degree, and college graduate or above. Additionally, we used the NHANES oral health questionnaire to measure the last use of dental services in the past 12 months. Categories include last use of dental services in the past 6 months or less and 6-12 months. Additional categories for participants that have not used dental services in the past year include more than 1 year, but not more than 2 years ago; more than 2 years, but not more than 3 years ago; more than 3 years, but not more than 5 years ago; more than 5 years ago; and never been.

## Categorical Variables

We analyzed the ability to afford dental care and the utilization of dental services in the past 12 months, stratifying by income and race/ethnicity, that were surveyed during the 2015-2016 NHANES study. NHANES does not directly categorize individuals based on their socioeconomic status. Therefore, we created a binary socioeconomic variable using data from the annual household income question. Participants representative of the desired socioeconomic levels were grouped into two groups based on their annual household income. Individuals that reported that their annual household income was less than $34,999 were placed in a category labeled “Under $34,999”. Individuals that reported that their annual household income was above $75,000 were placed in a category labeled “Over $75,000”.

NHANES collects basic demographic information including racial/ethnic identity. Categories include White, Black, Mexican American, and other Hispanic. We combined Mexican American and other Hispanic categories to form one group titled “Hispanic”. Therefore, we used three categories (White, Black, and Hispanic) to identify the racial/ethnic background of the participants.

Additional variables were created to represent racial/ethnic identity with respect to socioeconomic status. Each racial/ethnic group (White, Black, and Hispanic) was characterized by their annual household income. Individuals living below $34,999 were grouped into a separate cohort labeled as “Under $34,999” individuals living above $75,000 were grouped into another cohort labeled as “Over $75,000”. The variables include White Under $34,999, White Over $75,000, Black Under $34,999, Black Over $75,000, Hispanic Under $34,999, and Hispanic Over $75,000.

The analysis excluded participants whose annual household income fell between $35,000 and $75,000 (n=4,013), who refused to answer the respective question, or who did not know the answer to the respective question. The analysis also excluded participants that did not identify as White, Black, or Hispanic (n=1,547). The remaining participants were included in the total sample. Additional information is available through the CDC.50

##  Main Variable Creation

Our exposure variable is defined as whether an individual could afford costs associated with dental care. The outcome variable is defined as whether an individual utilized dental services in the past 12 months. To create the exposure variable, a new variable was created using two separate but associated questions from the oral health questionnaire. The first question asks whether an individual needed dental care during the past 12 months but was unable to receive the said care. The second question is a subset of the original query for individuals that responded “yes” that they needed care in the past 12 months but they were unable to receive it. The new question asks whether individuals that needed dental services in the past 12 months but were unable to receive care due to the ability to afford costs associated with care.

## Statistical Analysis

We use chi-square analysis to examine the relationship between the two stratified factors and the ability to afford and utilize dental care in the past 12 months, stratified by race/ethnicity and socioeconomic status. All estimates come from the intricate survey weighting system highlighted in the NHANES analytic guidelines.51 We used STATA v.15.1 to conduct all analysis with an alpha level of 0.05.

# Results

## Sample Characteristics

The total demographic and dental visit characteristics by race (Table 1) and socioeconomic status (Table 2) are listed in the respective tables. White populations were 49.04% male and 50.96% female. Black populations were 46.19% male and 53.81% female. Hispanic populations were 50.01% male and 49.99% female. Study participants living below $34,999 were 43.92% male and 56.08% female. Participants living above $75,000 were 51.23% male and 48.77% female. United States citizenship status varied by race and socioeconomic status as Hispanic populations and individuals living below $34,999 were less likely to be United States citizens at 72.89% and 87.38%, respectively. Marital Status also varied by race and socioeconomic status as Black populations and individuals living below $34,999 were less likely to be married. Only 33.88% of Black individuals and 34.11% of individuals living below $34,999 were married. Education level also varied by race and socioeconomic status as White populations and individuals living above $75,000 had greater educational attainment. In fact, 36.79% of White participants and 52.13% of individuals living above $75,000 reported that they were at least college graduates. The study did not measure sample characteristics for the study population that was stratified by both race/ethnicity and socioeconomic status.

## Dental Visit Characteristics

The descriptive statistics showed that dental visit characteristics varied by race and socioeconomic status. Specifically, the use of dental services in the past 6 months was greatest among White populations compared to Black and Hispanic populations with a percentage of 52.17%, 39.11%, and 38.53%, respectively. Rates for utilization of dental services in the past 6-12 months differed slightly with White populations at 13.63%, Black populations at 19.42%, and Hispanic populations at 16.92%. In regards to socioeconomic status, the use of dental services in the past 6 months was greater among individuals living above $75,000 compared to those living below $34,999 with a respective rate of 61.36% and 34.67%. Dental utilization rates in the past 6-12 months are fairly similar among individuals living above $75,000 and those living below $34,999 with a respective rate of 15.59% and 14.80%.

Dental visit characteristics were analyzed further by racial identity and socioeconomic status (Table 3). Statistics for the utilization of dental services in the past 12 months show that White Under $34,999, Black Under $34,999, and Hispanic Under $34,999 populations had the lowest utilization rates at 34.39%, 32.85%, and 34.27%, respectively. Utilization rates of dental services in the past 12 months among White Over $75,000, Black $75,000, and Hispanic $75,000 cohorts were significantly greater than their counterparts living at lower socioeconomic levels. Black and Hispanic populations had a much lower rate than White populations at 49.62%, 47.41%, and 63.65%, respectively.

Table 1 Sample Characteristics by Race/Ethnicity n=8,424

Table 2 Sample Characteristics by Income n=5,958



Table 3 Oral Health Habits by Race/Ethnicity and Income n=5,019



*Note:* All data denoted with an asterisk (\*) were found to be statistically significant (p<.01)

## Summary of Results

Chi-square analysis found that race/ethnicity (Table 1) and socioeconomic status (Table 2) are associated with the inability to utilize dental services in the past 12 months when one needed oral health care due to costs associated with care. Additionally, an analysis of stratified racial/ethnic groups by socioeconomic status (Table 3) revealed that minority populations are associated with the inability to utilize dental services in the past 12 months when one needed oral health care due to costs associated with care.

The analysis revealed that Hispanic populations are more likely than White or Black populations to be unable to utilize dental services in the past 12 months when one needed oral health care due to costs associated with care with a rate of 14.58%, 13.62%, and 9.69%, respectively. It is important to note that the relationship among racial/ethnic groups was statistically significant (p<.01). Socioeconomic status was also associated with the inability to utilize dental services in the past 12 months when you needed oral health care due to costs associated with care. Specifically, individuals living below $34,999 were significantly more likely than individuals living above $75,000 to be unable to afford dental care when they needed oral health care services in the past 12 months with a respective rate of 20.85% and 4.15%. The relationship between socioeconomic groups was statistically significant (p<.01).

 An analysis of stratified racial/ethnic and socioeconomic cohorts found that White Under $34,999, Black Under $34,999, and Hispanic Under $34,999 were significantly more likely than White Over $75,000, Black Over $75,000, and Hispanic Over $75,000 to be unable to afford dental when they needed oral health care services in the past 12 months. White, Black, and Hispanic populations living at or below $34,999 had a respective rate of 23.52%, 19.44%, and 19.23%. White, Black, and Hispanic populations living at or above $75,000 had a respective rate of 3.76%, 5.20%, 9.38%.

# Discussion

This study utilized a nationally representative sample from NHANES to demonstrate that racial/ethnic minority groups and socioeconomic status (Black populations, Hispanic populations, and individuals under $34,999) are associated with the ability to afford and utilize dental services. Furthermore, the analysis of the relationship between the respective racial/ethnic and socioeconomic cohorts (White Under $34,999, White Over $75,000, Black Under $34,999, Black Over $75,000, Hispanic Under $34,999, and Hispanic Over $75,000) revealed that all racial/ethnic populations living at a lower socioeconomic status face greater challenges affording and utilizing dental compared to their racial/ethnic counterparts living at higher socioeconomic status.

These findings reinforce and build upon previous related studies 41,42. However, it is important to note that this is the first study to examine this relationship with respect to racial/ethnic and socioeconomic disparities. Prior studies concluded that Black (OR=1.296, 95% CI:1.187-1.416), Hispanic (OR=1.051, 95% CI:.929-1.188), and populations living below an annual household income of $50,000 (OR=1.992, 95% CI:1.871-2.120) are less likely to utilize dental services in the past 12 months due to costs associated with care.42 Both studies also demonstrate that racial/ethnic minorities and lower socioeconomic status are also associated with the inability to utilize dental services in the past 12 months. These results are similar to our findings; however, this study used a different methodology and data source. Another study that utilized the 2011-2014 NHANES dataset for adults aged 30 and older found similar findings that suggest that race/ethnicity influences the lack of utilization of dental services in the past 12 months for individuals that needed immediate care.41 These results confirm our findings that racial/ethnic minority groups, Black and Hispanic populations, may lack the proper resources to utilize dental services in the past 12 months when care is needed. It is important to note that this study did not assess the impact of socioeconomic status or the ability to afford dental services. Additionally, it is important to note that the study used different methodological principles to perform their analysis. Therefore, the similarities between the literature and our data suggest that our findings are robust.

The findings from our study and the use of previous related research support the notion that racial/ethnic minorities and socioeconomic groups face challenges affording and utilizing dental services on an annual basis. Interestingly, our study was able to determine that these challenges do not exist for just racial minorities but also lower socioeconomic groups. The analysis of racial/ethnic groups stratified by socioeconomic status demonstrated that a greater percentage of all racial/ethnic categories living at lower socioeconomic levels were found to be unable to afford or utilize dental services in the past 12 months. Interestingly, in this relationship, the greatest rate of those unable to afford care was found among White populations living under $34,999. Additionally, among higher socioeconomic status populations differences exist in the ability to afford and utilize dental services. This suggests that there are racial/ethnic factors among Black and Hispanic populations living above $75,000 that make them more prone than White populations to being unable to afford and utilize dental services in the past 12 months. These findings suggest that factors unique to race/ethnicity vary with respect to socioeconomic status.

Since we did not directly analyze the relationship between race/ethnicity and socioeconomic status, we cannot determine if race/ethnicity or socioeconomic status plays a larger role in the utilization and affordability of dental services. Additionally, we were unable to determine how coverage influences the ability to afford and utilize dental services.

## Conceptual Framework

The David R. Williams Racism and Health framework and the concept of self-efficacy provide a logical explanation of the influences of race/ethnicity and socioeconomic status on the inability to afford and use dental services in the past 12 months. Specifically, racial/ethnic minorities and individuals living among lower socioeconomic levels face barriers that limit the utilization of dental services. Based on the findings from the analysis, individuals living among lower socioeconomic levels face unique challenges that hinder the ability to build the proper oral health literacy, allocate the appropriate resources, and overcome cultural beliefs to build up the necessary self-efficacy needed to utilize dental services. However, it is impossible to determine based on the available data if these factors accumulate throughout an individual’s course of life. Additionally, structural barriers that are unique to each community may play a role in impeding the utilization of dental services. Specifically, a prior history of poor quality of care, discriminatory practices and beliefs within the healthcare facility, and a lack of healthcare facilities or dental professionals within the community due to segregation may dissuade individuals from seeking oral health care. Individuals with lower socioeconomic status may experience numerous proximal pathways that may limit the ability to allocate the appropriate resources to seek care. These pathways include economic opportunities and societal resources.1 Economic opportunities are largely attributable to educational attainment, current employment status, and familial wealth. Although these factors are not related, they act on one another to create stress and unequal opportunities for certain populations. Individuals living in lower socioeconomic classes may be in a position where their place of employment does not provide dental coverage, they do not qualify for government assistance programs offering dental coverage, they have a limited disposable income making it difficult to allocate resources for care, or they cannot allocate the necessary time needed to receive dental care. Societal resources are unique to each community and geographic location. Rurality also plays a role in the utilization of dental services as the location and distance from dental services increase costs associated with care.

 Since all racial/ethnic classes have a positive association with the inability to afford dental care and utilize dental services in the past 12 months, it is possible to infer that social and structural barriers embedded in the Williams Racism and Health framework are relevant to all individuals in some capacity. Specifically, cultural stigma, prejudice, stereotypes, and stressors regarding oral health care may impede individuals from seeking dental services or allocating resources to afford services. In order to overcome societal and cultural barriers, individuals must build the proper oral health literacy, and overcome cultural beliefs to build up the necessary self-efficacy needed to utilize dental services.

## Demographic Factors

 Differences in gender, United States citizenship, marital status, and educational attainment among racial/ethnic and socioeconomic classes may provide an explanation for the relationship between the ability to afford and utilize dental services on an annual basis. A review of literature found that these variables play a role in influencing the utilization of dental care. However, there is limited literature suggesting that these factors also impact the ability to afford care. It is impossible to determine how these variables influence the stratified racial/ethnic and socioeconomic classes (White Under $34,999, White Over $75,000, Black Under $34,999, Black Over $75,000, Hispanic Under $34,999, and Hispanic Over $75,000) since the study did not account for these demographic factors. It is important to note that these factors may play a role in influencing the ability to afford and utilize dental services, but they are not the sole predictor of the relationship. Additionally, it is currently unknown how these variables interact to affect the relationship between the ability to afford and utilize dental services.

### Gender

 Since gender is correlated with the utilization of dental services, it is important to examine the gender breakdown of all racial/ethnic and socioeconomic classes.20,52 Specifically, literature states that females are more likely to utilize dental services.20,52 The differences in the gender breakdown among racial/ethnic classes are negligible suggesting that this variable does not directly affect the ability to afford or utilize dental services between these groups. For people of different socioeconomic status, gender seems to have an inverse relationship with the ability to afford and utilize dental services. Individuals living below $34,999 have a gender breakdown of 43.92% male and 56.08% female. Individuals living above $75,000 have a gender breakdown of 51.23% male and 48.77% female. Therefore, in terms of socioeconomic status, it is possible that there are additional factors that influence the relationship between gender and the utilization of dental services.

### United States Citizenship

 According to research, individuals that are United States citizens are three times more likely to utilize dental services than individuals that are not United States citizens.33 A breakdown of citizenship status reveals the disproportionate rate among Hispanic populations as only 72.89% of this population possesses United States citizenship compared to 98.72% of White populations and 95.54% of Black populations. This variable may be a predictor of the relationship between the ability to afford and utilize dental services among Hispanic populations. Research suggests that Hispanic immigrant populations have poor oral health in comparison to other racial/ethnic immigrant populations 34. However, this research does not account for the ability to afford and utilize dental services. Specific factors that may influence this relationship include a lack of oral health literacy, fear or anxiety of using oral health care services, inadequate dental coverage or insurance, a lack of health care providers within the community due to isolation or segregation, and the inability to communicate effectively with dental professionals. It is not currently known how these factors interact to impede Hispanic populations from affording and utilizing dental services.

### Marital Status

 According to research, marital status is correlated with the utilization of dental services as individuals that are married are more likely to seek services in comparison to individuals that are not married.35,36 However, it is difficult to assess the relationship between marital status and the ability to afford care due to limited available literature. An examination of marital status among racial/ethnic and socioeconomic classes reveals a disproportionately high rate of unmarried participants representing Black populations and individuals living below $34,999. Therefore, it is possible to infer that marital status is a contributing factor in the high rate of participants reporting that they are unable to afford and utilize dental care in the past 12 months among Black populations and individuals living below $34,999. Additional research is needed to understand if cultural beliefs or structural barriers contribute to the high rate of unmarried participants among these respective cohorts. It is also unknown how marital status affects dental coverage, oral health literacy, and other factors that enable the ability to afford and utilize dental services on an annual basis.

### Educational Attainment

 According to research, greater levels of educational attainment are directly correlated with the utilization of dental services.37 Additionally, research states that greater levels of educational attainment are correlated with greater levels of household income.38 However, due to the complex factors that contribute to the ability to afford dental services among all populations, it is impossible to conclude that educational attainment directly affects the ability to afford care. An examination of educational attainment among our sample reveals that White populations and individuals living above $75,000 have a significantly greater level of education attainment. It is possible to infer that an increase in educational attainment increases oral health literacy, the ability to obtain dental coverage or insurance, and the ability to additional resources necessary to seek care. Therefore, it is possible to conclude that educational attainment is a contributing factor in the ability to afford and utilize dental care on an annual basis.

## Limitations

The NHANES 2015-2016 Oral Health dataset aids in providing data used to calculate vital health statistics for the United States. Therefore, the study does not measure or assess the specific factors that influence the utilization and affordability of dental services within the country. This lack of data limits the ability to provide a comprehensive explanation of the contributing factors that inhibit the use of dental services for racial/ethnic minorities and populations living at lower socioeconomic levels. Since the oral health dataset was obtained on a self-report basis, it is possible that response bias may skew the results. Specifically, this means that participants may be motivated to inflate their annual household income, overstate their utilization of dental services, and falsely report their ability to afford dental services. Since some questions require the study participants to provide an answer based on their life experiences, there may be a lack of uniformity in the interpretation of various questions. The lack of data regarding dental coverage and insurance limits the capacity to analyze factors associated with dental utilization and the ability to afford dental services.

## Strengths

The secondary data analysis of the 2015-2016 NHANES study provides a nationally representative sample that is applicable to the entire United States through the use of sample weighting. Therefore, the results of the study apply to all United States residents. This study demonstrates that various variables within the NHANES dataset can be manipulated to create new measures to examine the overall oral health outlook of the United States.

## Future Research

Since this is one of the first studies to examine the ability to afford and utilize dental care, in the past 12 months, additional research is needed to bolster the results and to further investigate the influence of racial/ethnic identity and income. A logistic regression analysis of racial classes by income will provide valuable data informing dental and public health professionals of at-risk populations that need additional resources to obtain oral health care services. Additionally, the secondary data analysis of various nationally representative datasets (Medical Expenditure Panel Survey, Behavioral Risk Factor Surveillance System, etc.) will augment the findings providing a comprehensive overview of the relationship between being able to afford dental services and the actual utilization of care. Further research investigating of this relationship with respect to specific geographic regions of the United States will aid in developing interventions targeting at-risk populations in the region. These studies will also be able to incorporate the concept of rurality into the analysis. All future studies should account for previously unmeasured covariates that play a role in influencing the interaction.

 This study can inform interventions emphasizing the importance of maintaining good oral health, educating individuals to improve their health literacy, and providing knowledge regarding the existence of programs or facilities subsidizing the cost of dental services. Improving the oral health literacy of minority populations is essential as it will create positive changes in health behavior for current and future generations. Dental and public health professionals need to work in unison to identify at-risk populations and communities that would benefit from these interventions. Direct efforts to improve the affordability and utilization of oral health services require patience, vision, and collaboration. Strategically lobbying United States legislators to improve policy regarding dental insurance reform will increase the reach of dental coverage throughout the country. The use of a student loan subsidy programs to incentivize dental professionals practicing in at-risk communities will improve access to care for marginalized or isolated populations. Examining available data to develop oral health education seminars in at-risk communities will improve oral health literacy among minority populations. The use of available technology to provide medical translation services will reduce fear or anxiety associated with the use of dental services and improve oral health literacy. Lastly, contracting with existing medical transportation services to provide accessibility to oral health care for rural or geographically isolated communities will increase the utilization of dental services and decrease costs associated with care. This study holds the potential to generate the knowledge and awareness required to create a positive impact on the overall oral health outlook of all Americans.

# Conclusion

This study built upon previous literature to find that racial and socioeconomic inequalities among minority populations create challenges in affording and utilizing dental services on an annual basis. Our analysis found that Black and Hispanic populations had significantly higher rates of being unable to afford and utilize dental services on an annual basis in comparison to White populations. A stratified analysis by race/ethnicity and socioeconomic status found that White, Black, and Hispanic individuals living below $34,999 were significantly more likely to be unable to afford and utilize dental services on an annual basis in comparison to White, Black, and Hispanic individuals living above $75,000. These findings should be used to inform public health and dental professionals to develop meaningful interventions geared towards providing additional attention and resources for at-risk and marginalized populations living in poverty so they can afford and utilize dental services on an annual basis.

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