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Oral health knowledge and dental utilization among Hispanic adults in Iowa

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ORAL HEALTH KNOWLEDGE AND DENTAL UTILIZATION
AMONG HISPANIC ADULTS IN IOWA

by

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CERTIFICATE OF APPROVAL

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MASTER'S THESIS

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Para mi familia

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ABSTRACT

Objectives: To determine oral health literacy levels among Hispanic adults living in Iowa, and assess the relationship between oral health literacy and dental utilization.

Methods: This cross-sectional study included a convenience sample of self-identifying Hispanic/Latino adults. Participants were recruited via mass email, word of mouth, and from faith-based organizations that provided church services in Spanish. Participants were recruited from urban and rural communities in Central and Eastern Iowa. Participants were asked to complete a questionnaire, in either English or Spanish, that contained questions pertaining to: oral health literacy, dental utilization, acculturation, language proficiency, demographic information, country of origin, number of years living in the United States, and preferences pertaining to the characteristics of their dental providers (e.g. importance of dentist to be able to speak Spanish). Oral health literacy was assessed using the *Comprehensive Measure of Oral Health Knowledge (Macek and colleagues).* Oral health knowledge levels were categorized as low (0-14) or high (15-23). Dental utilization was defined as visiting a dental provider within the past 12 months or more than 12 months ago. Bivariate analyses were conducted using the Chi-square test with oral health knowledge and dental utilization being the two main outcome variables. Multiple logistic regression models were created to identify the variables related to low oral health knowledge irregular dental utilization. Statistical significance was set as $p<0.05$. IRB approval was obtained prior to conducting the study.

Results: Three hundred thirty-eight participants completed the questionnaire. Sixty-seven percent of participants (n=228) completed the questionnaire in Spanish. The mean oral health knowledge score was 14 (low knowledge =51% vs. high knowledge = 49%). Thirty-five percent reported visiting the dentist >12 months ago. Bivariate analyses revealed that the following respondents were more likely to have low oral health knowledge (p<0.05): being older (i.e. 55-71 years of age), male, self-reporting low health literacy, having less than a high-school education, earning ≤$25,000, not having dental insurance, having low acculturation, being born

outside of the United States, preferring a dental provider who speaks Spanish, perceiving one's oral health to be fair/poor/or not knowing the status of one's oral health, seeking dental care someplace other than a private dental office, and being more likely to seek care for a problem related visit rather than routine care. Having low oral health knowledge was statistically significantly associated visiting a dentist >12 months ago. Many other variables were also associated (p<0.05) with infrequent dental utilization: low health literacy, being male, having <12th grade degree or a high school diploma, earning ≤$25,000, not having dental insurance, having low acculturation, reporting fewer years living in the United States, preferring a dental provider who speaks Spanish, perceiving one's oral health to be fair/poor/or not knowing the status of one's oral health, and seeking dental care someplace other than a private dental office. Final logistic regression analyses indicated that having less than a 12th grade education, lack of dental insurance, and a preference for receiving care from a Spanish speaking dental provider were associated with low oral health literacy. Furthermore, final logistic regression results predicting irregular dental utilization demonstrated that the following variables were statistically significant: being male, earning ≤$25,000 per year, not having dental insurance and having a history of tooth decay.

Conclusion: Dental utilization and oral health knowledge appear to be associated. Patients with low oral health literacy may be less likely to utilize dental care, thus decreasing the opportunity to increase dental knowledge. Dental teams should recognize which patients are more likely to have low oral health literacy and provide dental education in patients' preferred language.

PUBLIC ABSTRACT

The objectives of this study were to determine the oral health knowledge levels of Hispanic adults living in Iowa and whether oral health knowledge is associated with the use of dental care. A survey was conducted with 338 participants who were recruited via mass email, word of mouth, and from faith-based organizations that provided church services in Spanish. Oral health knowledge was assessed using the *Comprehensive Measure of Oral Health Knowledge (Macek and colleagues)* and was categorized as low (0-14) or high (15-23). Dental care was defined as visiting a dental provider ≤12 months or >12 months ago. Fifty-one percent of participants had low oral health knowledge. Thirty-five percent of participants reported visiting the dentist >12 months ago. Participants with low oral health literacy were more likely to have less than a 12th grade education, lack dental insurance, and prefer to receive care from a Spanish speaking dental provider. Participants who visited the dentist >12 months ago were more likely to be male, earn ≤$25,000 per year, lack dental insurance, and have a history of tooth decay. Additionally, participants with low oral health knowledge were more likely to visit the dentist > 12 months ago. Patients with low oral health literacy may be less likely to utilize dental care, thus decreasing the opportunity to increase dental knowledge. Dental teams should recognize which patients are more likely to have low oral health literacy and provide dental education in patients' preferred language.

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CHAPTER I-INTRODUCTION

The National Literacy Act of 1991 defines literacy as "an individual's ability to read, write, and speak in English, compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's main goals, and develop one's knowledge and potential."[1] While many would consider such skills a necessity, between 1/3-1/2 of Americans have below basic or basic literacy skills.[2] More importantly, when it comes to one's own health, having such skills is necessary to not only understand what a doctor is recommending, but also necessary for survival. Health literacy is defined as "one's ability to understand basic health information in order to make appropriate health decisions."[3] When compared to individuals with intermediate or proficient health literacy, individuals with below basic or basic health literacy skills have a greater chance of misusing medications, not adhering to their doctor's instructions, or even visiting an emergency room for reasons that could have been prevented by having appropriate knowledge.[3]

While health literacy generally describes overall systemic health comprehension, few studies have focused on oral health literacy levels. Oral health literacy has been defined by the Institute of Medicine as "the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions."[4] Focusing on oral health literacy levels is important because it can help dental professionals understand how non-professionals understand oral health.

Healthy People 2020's overarching goals are to eliminate disparities and improve the health of all people.[5] While dental disease has decreased over the years, due to many prevention based products and treatments available, dental disease has not decreased as much among minority groups in the United States.[6] Improving the health literacy of the population is one solution that can help achieve the Healthy People 2020 goal to improve the health outcomes of the United States' population. However, different levels of health literacy exist among the

diverse populations living in the United States, with minorities generally having lower health

literacy levels than whites.[7, 8]

Hispanics are currently the largest minority group in the United States.[9] This group

currently represents approximately 16.7% of the United States population, and by the year 2050,

it is expected that Hispanics will represent 30% of the population in the United States.[10]

According to the 2000 U.S Surgeon General's report, Mexican-American children, adolescents

and adults are more likely than whites to experience oral health disparities such as increased

caries rates and untreated dental caries.[11] It was also found that periodontal diseases, such as

gingivitis and periodontitis, were the most common oral health disparity among this group.[11]

Because few studies have examined the oral health literacy of Hispanic populations, it is

unknown whether low oral health literacy is contributing to these disparities.

In 2004, the Hispanic Dental Association and the University of Puerto Rico School of

Dentistry, San Juan, assembled a workshop to develop an agenda on much-needed research

relating to the oral health of Hispanics in the United States.[12] The workshop suggested that

researchers should conduct the following studies with Hispanic populations: population based

studies, social and behavioral sciences studies, and health promotion and communications

studies.[12]

Because oral health literacy studies have the potential to address all of the

aforementioned areas of research, determining the oral health literacy status of Hispanics would

add to the much-needed body of literature that is missing within this group. Additionally,

understanding the oral health literacy status of Hispanic populations might help lead to

interventions that will improve the dental health outcomes within this population.

Therefore the purpose of the present study was to assess the oral health literacy levels

among a convenience sample of Hispanic adults residing in Eastern and Central Iowa.

Specifically, the study examined whether there was a difference in the oral health knowledge

between participants who prefer to read or speak in Spanish compared to participants who are

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comfortable using English. Additionally, the study assessed whether oral health knowledge was associated with dental utilization.

CHAPTER II-LITERATURE REVIEW

The Hispanic Population

According to the U.S. Census Bureau, the population in the United States is expected to become more racially and ethnically diverse by the year 2060.[9] While the non-Hispanic white population is currently the largest ethnic group in the United States, this population is expected to slowly decrease by approximately 20.6 million people to 199.6 million people during the period 2024-2060.[9] Concurrently, the population composed of ethnic minority groups in the United States is expected to increase.[9] During 2000-2010, more than half of the growth in the United States population was due to an increase in the Hispanic population.[13] Currently, the Hispanic population represents 17% of the total population, making it the largest minority group in the United States.[14] The Hispanic population is projected to more than double by the year 2060, from 53.3 million to 128.8 million.[9] Thus, this group will continue to be the largest ethnic minority group in the United States.

While the majority of Hispanics live in the Western or Southern regions of the United States, the Midwest has also experienced a growth in the Hispanic population.[13] Between 2000-2010, this population increased by 49%, which was more than twelve times the growth of the overall Midwest population (4%).[13] In the state of Iowa, Hispanics account for 5.6% of the overall population.[15] Since 2000, there has been a 110.5% population increase among the Hispanic population in Iowa.[15] It is projected that by the year 2040, the Hispanic population in Iowa will comprise of 13% of the population.[15]

Health disparities exist within the Hispanic population.[6] The Hispanic Health and Nutritional Survey (HHANES) was an early survey (1982-84) aimed at determining the health status of Hispanics in the United States.[16] Specifically, it aimed to estimate the health of Puerto Ricans, Mexican Americans, and Cubans.[16] It was determined that higher prevalence rates of diabetes mellitus existed among Hispanics than non-Hispanic whites.[16] For example, 3.8% of Hispanics of Mexican origin in the age group 20-44 years and 23.9% of Hispanics of Mexican

origin in the age group 45 to 74 had type II diabetes, while 2.4% and 15.8% of Hispanics of Cuban descent had type II diabetes, and 4.1% and 26.1% of Puerto Ricans had type II diabetes in these age groups, respectively.[17] For non-Hispanic whites, the prevalence for the age group of 20-44 years was 1.6% and for the age group 45 to 74 years, it was 12%.[17] Today, common chronic health conditions among Hispanics include diabetes mellitus, hypertension, cardiovascular disease, and obesity.[18]

Oral health disparities are also of concern within Hispanics. The Centers for Disease Control and Prevention reports that overall, Hispanics, non-Hispanic blacks, and American Indians or Native Americans have the poorest oral health of any racial and ethnic groups in the United States.[19] Tooth decay is of concern for both children and adults. For example, racial and ethnic disparities are greater for Mexican and black, non-Hispanic children aged 2-4 years and 6-8 years compared to non-Hispanic white children.[19] Mexican American and non-Hispanic black adults aged 35-44 years have twice as much untreated tooth decay as non-Hispanic whites.[19]

Eliminating health and oral health disparities among racial and ethnic groups requires constant effort. Healthy People 2020 is an example of one such effort. Its goal is to improve the health of all Americans, increase quality of life and eliminate health disparities.[19] The Surgeon General's Report on Oral Health in 2000 is also an indicator of the constant effort to decrease oral health disparities among Americans in the United States. The report emphasized that oral health is essential to the overall well-being of an individual, and it is not just "healthy teeth."[11] The document also emphasized that although all Americans can achieve oral health, not all are reaching the same level of oral health.[11] Specifically, the document identified poor children, the elderly, and those belonging to racial and ethnic groups as the "most vulnerable citizens."[11]

In order to understand why Hispanics have health and oral health disparities, it is imperative to recognize that within this racially and ethnic group there are specific cultural and sociodemographic barriers that affect access to healthcare. The present chapter will discuss these barriers and how they impact healthcare access among Hispanics living in the United States.

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Additionally, the chapter will focus on general literacy, health literacy, and oral health literacy trends in the United States and explore the associations between literacy and health outcomes.

The terms Latino and Hispanic are commonly used interchangeably. Even though it is imprecise to reduce such a diverse group to just one name, for the purpose of this study, the term Hispanic will be used. Latino is defined as an individual from Latin American descent.[20] Hispanic, in the United States, is defined as an individual from a Spanish speaking country in the Caribbean, North America (México), Central America, South America, and Spain.[20] As such, Brazil is excluded from this definition.[20]

<div align="center">Barriers to Healthcare and Oral Healthcare</div>

Betancourt et al. determined that there are barriers to health promotion and disease prevention in the Hispanic population due to structural, organizational, provider based-based, and/or sociodemographic barriers.[21] Examining these barriers gives a better understanding of the reasons why both treatable and preventable diseases disproportionately affect this population.[21]

<div align="center">Structural Barriers</div>

Structural barriers are those that pose a challenge to accessing health care due to the complexity of our health care system.[21] There are two types of structural barriers: extramural, the type of barriers experienced by an individual "from their home to the health care facility," and intramural, the type of barriers an individual faces while in the health center or the health care provider's office.[21]

Extramural Barriers

Obtaining health can be a challenge for all racial and ethnic groups, including, but not limited to, Whites, American Indian, and African-Americans. However, among the Hispanic population, many extramural barriers are especially difficult to overcome in obtaining health care.

Limited Clinic Operating Hours

Limited operating hours of a clinic or provider's office impedes patients from seeking care when they are unable to obtain care during usual clinic hours.[21] This, in turn, causes patients

to obtain health care at a facility, such as the emergency room of a hospital, where hours are unlimited.[21] In 2011, the Centers for Disease Control reported that 50.6% of Hispanic adult's age 18-64 had visited the emergency room in the past twelve months due to having no other place to go compared to 44.9% of non-Hispanic whites.[22] Considering that a hospital emergency room is based on immediate need, continuity of care is an issue. Without continuity of care, it is difficult to manage chronic health diseases, thus leading to disparities of health.

Transportation

Geographically, Hispanics are likely to reside in urban or rural areas of the United States that have been designated as health professional shortage or medically underserved areas.[23] As such, they may have to travel long distances to seek healthcare.[21] A study by Flores et al., which identified access barriers to health care among a Hispanic population residing in Boston, Massachusetts, found that the most cited barrier (21%) that had ever caused them not to bring their children in for health care treatment was transportation.[24] Similarly, the results of a systematic review conducted by Perez-Escamilla et al. found that transportation was the third most reported barrier for oral health care among Hispanic immigrants in the United States.[25]

Literacy

Literacy plays a great role in knowing how to appropriately seek care. Literacy is defined as having the ability to "use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential."[2] Health literacy, a component of literacy is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."[3] As of 2012, only 65% of Hispanic individuals age 25 and older had completed a high school or higher education compared to 85.7% of African-Americans and 92.5% of Whites.[26] Furthermore, the 2003 National Assessment of Adult Literacy (NAAL) reported that Hispanic adults had the highest percentage of below basic literacy levels (prose, document, and quantitative) compared to Blacks, Whites, Asians/ Pacific Islanders, American Indians/Alaska Natives, and Multiracial

ethnic and racial groups.[2] Similarly, the 2003 NAAL found that Hispanics had the worst scores pertaining to health literacy.[27] Forty-four percent of Hispanics had below basic health literacy levels compared to 24% of Blacks and 9% of Whites.[27] These findings are problematic given that literacy is associated with understanding the etiology of diseases, the importance of treating disease,[28, 29] and knowing how to seek dental and general healthcare.[30, 31]

Intramural Barriers

Intramural barriers are the type of barriers an individual faces while seeking health care or within the health care provider's office.[21]

Long Waiting Times

Waiting times include both long waiting times for an appointment to be scheduled and/or waiting a long time to see the provider while at the office. For example, 15% of Hispanic parents whose children were patients at the Pediatric Hispanic Clinic in Boston, Massachusetts, reported that the single greatest barrier to health care was long waiting times in the physician's office.[28] A study by Cortés et al. also reported that long wait times to schedule an appointment and while at the provider's office conflicted with work schedules, which resulted in loss of wages.[32] Similarly, a migrant Hispanic farmworkers study reported a loss of wages due to dental appointments that consumed a great deal of time.[33]

Organizational Barriers

Organizational barriers are "factors that can affect both the availability and acceptability of health care for Hispanic Americans." [21]

Health Care Workforce Issues

The percentage of Hispanic health care providers is limited in the United States.[21] Increasing the proportion of Hispanic health care workers provides opportunities to reduce certain barriers to care,[24] such as language and cultural beliefs. Providers that understand the social and cultural beliefs of the communities they serve may be more likely to organize health care delivery

systems to meet the needs of minority populations,[21] which in turn, may lead to better health outcomes.

Provider-Based Barriers

Provider-based barriers are those that "emerge during the medical encounter, when sociocultural differences between patient and provider are not fully appreciated, accepted, explored, and/or understood." [21]

Acculturation

Acculturation, which is how much an individual has integrated into the Anglo/American language and mainstream culture,[21] is associated with health care access. Hispanics who have lived in the United States for longer periods of time, as indicated by years or generations, are likely to have different cultural beliefs and values than recently immigrated Hispanics. This is due to exposure to varying experiences within the United States.[21]

Language is commonly used to measure acculturation in studies determining barriers to health care access. Language differences between providers and patients pose a barrier to accessible health care, which can lead to issues with medical instruction compliance and/or unfortunate health outcomes.[34] This is especially important among the Hispanic population since 74.3% of Hispanics in the United States speak Spanish at home.[35] Cristancho et al. examined health information preferences among Hispanic immigrants in rural Midwest and found that 55% preferred to receive information in Spanish.[36] A study by Solis et al. found that speaking Spanish language predicted less preventive health screening service use among Mexican-Americans.[37] Flores et al. found that 11% of Hispanic parents reported lack of cultural understanding by staff as a barrier for them not bringing their children in for care.[24] Additionally, parents who spoke little or no English reported that multiple adverse medical events occurred as a result of the medical staff not speaking Spanish. This included poor medical care, misdiagnosis, and prescription of inappropriate medications for their children.[24]

Similarly, acculturation is associated with oral healthcare. Riley et al. studied the association between acculturation and orofacial pain among South Floridian Hispanics.[38] It was determined that speaking more Spanish than English was associated with less access to oral healthcare for orofacial pain, greater pain intensity, and increased problems with physical and emotional functioning.[38] In another study by Jaramillo et al., Hispanic adults were surveyed using the Behavioral Risk Factor Surveillance System to determine if language acculturation was associated with use of oral health services.[39] Participants who completed the survey in Spanish were less likely to have had a dental visit within the past 12 months compared to participants who completed the survey in English.[39] Likewise, another study conducted in Florida among four Hispanic groups found that participants who primarily spoke a language other than English (i.e. Spanish or other) were significantly less likely to have a dental home.[40]

Health Beliefs and Alternative Medicine

Health beliefs, including the use of folk healers or traditional medicine, contribute as a barrier to Hispanics accessing Western health care.[34] Within this population, it is common for people to seek care from a yerbero(a)-an herbalist, a sobador(a)-a massage therapist, or a curandero(a)- a person who uses a combination of healing techniques involving prayer, herbs, and healing rituals.[34, 41] Flores et al. found that: 1) the use of home remedies, 2) whom people seek for advice, and 3) a belief in folk medicine influenced how and when Hispanic parents accessed health care for their children.[28] In addition to seeking health care from the aforementioned folk healers, Hispanic populations have an abundance of respect for older individuals, such as grandmothers, within their families.[29, 34] This can be a barrier to care if the advice from these older individuals contrasts with Western medicine practices.[34]

Sociodemographic Barriers

Sociodemographic barriers are individual characteristics that affect Hispanics in seeking health care in the United States. [42]

Low Income

Hispanics in the United States are likely to report low socioeconomic status. In 2013, 24% of Hispanic families lived in poverty compared to only 10% of non-Hispanic white families.[43] Low socioeconomic status has been reported among Hispanics as a barrier to health care. Flores et al. reported that difficulty paying for medical bills was the fourth most common barrier that prevented Hispanic parents from accessing health care for their children.[24] Riley et al. found that lower financial status was associated with not having a dental home.[38] In addition to low income being associated with lack of access to care, it is also associated with poor health outcomes. Guarnizo-Herreño et al. found that low socioeconomic Hispanic children have a 30% higher prevalence of dental disease than non-Hispanic white children.[44]

Lack of Insurance

A recent finding in the 2012 Census Bureau reported that Hispanics have the highest uninsured rates of any other racial and ethnic group in the United States.[45] When insurance is limited or not available, it becomes a barrier for Hispanics to seek healthcare,[24] and they often do not have a routine place to obtain health care.[37] Additionally, a lack of dental insurance is associated with fewer visits to the dentist and decreased utilize of preventive dental services, such as cleanings.[46]

Citizenship Status

Citizenship status has been reported to be associated with health care usage among Hispanics compared to non-Hispanic blacks and whites.[47] Undocumented individuals are ineligible to receive public insurance due to their immigration status. They are also unable to obtain employment, thus they do not have access to private insurance. This lack of insurance, as well as income barriers associated with unemployment, impacts undocumented individuals' ability to access the health care system.[47]

Barriers to Healthcare and Oral Healthcare Summary

Hispanics in the United States experience numerous barriers that prevent them from seeking health care. Structural barriers include limited clinic operating hours, transportation, health literacy, and long waiting times for an appointment and/or while at the office to see a provider. The limited proportion of Hispanic health care providers in the United States is an example of an organizational barrier faced by the Hispanic population. Additionally, provider-based barriers experienced by this population include low acculturation to the Anglo/American language and mainstream culture, and cultural health beliefs that result in using alternative medicine. Lastly, low income, lack of insurance, and citizenship status are example of sociodemographic barriers faced by Hispanics in the United States.

<u>Literacy</u>

The following section will focus on the various literacy levels of the United States population. Specifically, literacy levels of Whites, Hispanics, and Blacks will be compared and discussed based on the 1992 National Adult Literacy Survey (NALS) and the 2003 National Assessment of Adult Literacy (NAAL). Additionally, literacy levels based on age, sex, language, income level, and education will also be discussed.

On a daily basis and throughout life, adults constantly interact with reading and writing whether it is at work, at home with their children, or at their physician's office, such as filling out their health history. Literacy is defined as being able to "use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential."[2] In other words, having literacy consists of being able to do more than just read and write. Understanding what one is reading and writing is essential because it usually involves a purpose; no matter what objective it is that one is trying to reach.

The United States Department of Education has assessed the literacy of the nation twice. The first assessment was conducted in 1992 with the National Adult Literacy Survey.[48] In 2003, the National Assessment of Adult Literacy (NAAL) again assessed the English literacy of the

adult population in the United States.[2] The National Center for Education Statistics collected, analyzed and reported the national data with the hope that the information would improve the literacy of adult Americans in the United States. The assessment included 18,000 adults, aged 16 or older, who lived in households. Additionally, 1,200 prison inmates were included in the assessment. The final report included not only the literacy levels of adult Americans in the United States, but also the changes in literacy levels from the 1992 National Adult Literacy Survey. Additionally, the 2003 NAAL described how Americans use written information at work, with their family, and within community settings.[2]

<center>Measuring Literacy</center>

In the 2003 NAAL report, literacy was directly measured by tasks that adults usually encounter in everyday life.[2] Adults were interviewed in English or Spanish to gather demographic information; however, all of the materials that were used to assess literacy levels were only printed in English.[2]

Similar to the 1992 National Adult Literacy Survey, the 2003 NAAL used three literacy scales: prose, document, and quantitative.[2] Prose literacy assessed the knowledge and skills used to perform tasks related to searching, understanding, and using information from continuous texts. This section included information from brochures, editorials, and instructional resources. Document literacy assessed the knowledge and skills needed to perform the aforementioned tasks utilizing information from non-continuous texts. This section included documents such as work applications, maps, food labels, and bus/train schedules. Quantitative literacy assessed the knowledge and skills necessary to identify and perform computational tasks utilizing numbers within printed resources. This section included tasks such as figuring out how to calculate a tip or balancing a checkbook.[2]

<center>Levels of Literacy</center>

Four levels of literacy, based on scores from each scale (prose, document, and quantitative) were utilized in the 1992 and 2003 National Adult Literacy Survey: below basic,

<center>13</center>

basic, intermediate, and proficient.[2] These levels of literacy were used to define the participants'

knowledge, skills, and capabilities related to the three types of literacy-prose, document, and

quantitative literacy.[2]

A below basic level of literacy indicated that individuals were able to demonstrate "no

more than the most simple and concrete literacy skills."[2] This included easily locating

information in common prose texts, following instructions for written information in simple

documents, and being able to quantitatively perform simple mathematical tasks (primarily

addition). Below basic scores ranged as followed: prose: 0-209; document: 0-204; and

quantitative: 0-234.[2]

A basic literacy level indicated that individuals were able to perform "simple every day

activities."[2] This included being able to read and understand information in common prose texts

and documents. Additionally, participants were easily able to locate and use quantitative

information to solve one-step mathematical problems when the tasks were specified. Basic

literacy scores ranged as followed: prose: 210-264; document: 205-249; and quantitative: 235-

289.[2]

An intermediate level of literacy indicated that individuals were able to show the skills

essentially required to perform "moderately challenging activities."[2] Within the prose assessment,

individuals were able to moderately read and understand condensed, uncommon text.

Additionally, they were able to summarize the text, make simple conclusions, determine cause

and effect within the text, and understand the purpose of the author. Within the document

assessment, individuals were able to locate information within complex documents. Similarly,

individuals who scored at the intermediate level within quantitative literacy were able to locate

and solve unusual problems when the mathematical task was not specifically explained.

Intermediate literacy scores ranged as followed: prose: 265-339; document: 250-334; and

quantitative: 290-349.[2]

A proficient level of literacy indicated that individuals were able to show the necessary skills to complete more challenging activities.[2] This included reading lengthier, more challenging prose material and also being able to form and make more complex logical conclusions. The document measure included being able to combine, synthesize, and analyze a variety of complex documents. Finally, the quantitative measure assessed how well the individual was able to solve complex multi-step problems when they were not described. Proficient literacy scores ranged as followed: prose: 340-500; document: 335-500; and quantitative: 350-500.[2]

General Literacy Trends Found in the 2003 NAAL

Overall, no statistically significant changes were seen in average prose and document literacy levels when comparing 1992 to 2003.[2] In 2003, 14% of the population was found to have below basic prose scores, 29% had basic prose scores, 44% had intermediate prose scores, and 13% had proficient prose scores. In respect to document literacy in 2003, 12% had below basic scores, 22% had basic scores, 53% had intermediate scores, and 13% had proficient scores. The 2003 quantitative scores determined that 22% had below basic literacy, 33% had basic literacy, 33% had intermediate literacy, and 13% had proficient literacy. Similarly, findings from the 1992 assessment found that 14% had below basic prose literacy, 28% had basic literacy, 43% had intermediate literacy, and 15% had proficient literacy. In respect to document literacy, 14% had below basic literacy, 22% had basic literacy, 49% had intermediate literacy, and 15% had proficient literacy. Finally, 26% had below basic quantitative literacy, 32% had basic literacy, 30% had intermediate literacy, and 13% had proficient literacy. Compared to 1992, average quantitative literary scores improved in 2003 (275 vs. 283, respectively). Nonetheless, the 2003 assessment found that 3% of the United States population (representing approximately 7 million adults) was classified as being non-literate in English or having below basic literacy level due to difficulty answering the easiest questions.[2]

Demographic Characteristics and Literacy

Gender

The 2003 NAAL found that women had higher average prose and document literacy than men (277 vs. 272 and 272 vs. 269, respectively).[2] However, men had higher average quantitative scores than women (286 vs. 279).[2] The 1992 National Assessment of Literacy Survey (NALS) found that women had higher average prose scores compared to men (277 vs. 276). [48] However, men had higher average document and quantitative literacy scores than women (274 vs. 268 and 283 vs. 269, respectively).[48]

Race and Ethnicity

The 2003 NAAL scores showed that Whites and Asian/Pacific Islander adults had higher average prose, document, and quantitative literacy levels than Black and Hispanic adults (see Table 1).[2] However, Blacks had higher average prose and document literacy scores than Hispanic adults. While the average prose, document, and quantitative literacy scores for Whites did not statistically change from 1992 to 2003, Blacks' prose, document, and quantitative literacy scores increased in 2003. Additionally, the prose literacy levels of Asian/Pacific Islander adults also increased. While the other racial and ethnic groups increased their literacy levels or stayed the same in the aforementioned domains between 1992 to 2003, the Hispanic populations prose and document literacy levels decreased. In contrast, their quantitative domain average remained the same. Due to the decrease in literacy levels of the Hispanic population, the percentage of Hispanic adults who had Below Basic prose and document literacy levels increased (1992 = 35% vs. 2003 = 44 %).[2]

The Hispanic population in the 2003 NAAL included adults from Puerto Rico, Cuba, Mexico, Central or South America, and Other descent.[2] Within this population, the 2003 NAAL results showed that Puerto Rican adults and those who reported "Other" had higher prose and document literacy than Mexican and Central and South American adults (242 vs. 204, respectively). Puerto Ricans also had higher average quantitative literacy scores than Mexicans

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(249 vs. 207). As mentioned previously, the prose and document literacy scores declined for the overall Hispanic population from 1992-2003 (Table 1). Specifically, this decline was for Mexican and Central or South American adults, while the average document and quantitative literacy increased for Puerto Rican adults. The 2003 NAAL also reported that about 50% of Mexicans, Cubans, and Central or South Americans had Below Basic prose literacy, which was an increase from 1992 (40%, 37%, and 38%, respectively), while no difference was seen in the 28% of Puerto Rican adults that had below basic prose literacy.[2]

Table 1. Average prose, document, and quantitative scores by race and ethnicity from the 1992 and 2003 National Assessments of Adults Literacy

Population	Average Prose Score	Average Document Score	Average Quantitative Score
1992			
White	287	281	288
Black	237	230	222
Hispanic	234	228	233
Asian/Pacific Islander	255	259	268
American Indian/Alaska Native	254	247	245
2003			
White	288	282	297
Black	243	238	238
Hispanic	216	224	233
Asian/Pacific Islander	271	272	285
American Indian/Alaska Native	264	258	265
Multiracial	273	269	270

Language Background

The 2003 NAAL examined if participants' language background was associated with literacy levels. Specifically, the survey assessed participants' primary spoken language prior to starting school and the age at which participants learned to speak English.[2] Overall, adults who spoke only English before starting school had the higher average prose, document, and quantitative scores (Table 2). However, all three scores increased from 1992-2003. In contrast,

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average prose, document, and quantitative scores decreased for adults who spoke only Spanish before starting school. These individuals were classified as having below basic prose (61%), document (49%), and quantitative literacy (62%).[2] A decrease in literacy was only seen among this group.

Table 2. Average prose, document, and quantitative scores by language spoken before starting school from the 1993 and 2003 National Assessments of Adult Literacy

Language Spoken Before Starting School	Average Prose Score	Average Document Score	Average Quantitative Score
1992			
English Only	282	275	280
English and Spanish	255	253	247
English and Other	273	260	271
Spanish	205	216	212
Other Language	239	241	246
2003			
English Only	283	276	289
English and Spanish	262	259	289
English and Other	278	268	289
Spanish	188	199	211
Other Language	249	257	270

It was also reported that older age at which adults learned to speak English decreased average prose and document literacy.[2] Adults who learned English between the ages of 16-20 and 21 or older had overall lower average literacy scores than adults who learned English at age 10 or younger and 11-15 years (Table 3).[2]

Table 3. Average prose, document, and quantitative scores by age learned English from the 1992 and 2003 National Assessments of Adult Literacy

Age Learned English	Average Prose Score	Average Document Score	Average Quantitative Score
1992			
10 or younger	263	257	260
11-15	235	248	251
16-20	205	211	218
21 or older	187	203	196
2003			
10 or younger	274	267	278
11-15	242	251	265

Table 3-Continued

16-20	208	229	238
21 or older	191	206	223

Age

The trends related to age and literacy varied by age group (Table 4). In spite of the increased overall literacy scores when comparing 1992 to 2003, elderly participants (i.e. 65 years of age and older) had the lowest overall average literacy score among all participants.[2] The elderly participants were also the most likely to have below basic scores in prose, document, and quantitative literacy compared to the other participants. Adults between the ages of 50-64 showed an increase in overall average literacy scores between 1992-2003. Similarly, the average quantitative literacy score increased for adults between ages 25 and 39. In contrast, prose literacy levels declined for adults between the ages of 25-39 and 40-49 during this same time period. Additionally, the average document literacy score declined for adults between the ages of 40-49.[2]

Table 4. Average prose, document, and quantitative scores by age from the 1992 and 2003 National Assessments of Adult Literacy

Age Group	Average Prose Score	Average Document Score	Average Quantitative Score
1992			
16-18	270	270	264
19-24	280	282	277
25-39	288	286	286
40-49	293	284	292
50-64	269	258	272
65+	235	221	235
2003			
16-18	267	268	267
19-24	276	277	279
25-39	283	282	292
40-49	282	277	289
50-64	278	270	289
65+	248	235	257

Household Income

The 2003 NAAL reported that as the level of income increased in the household so did the overall average literacy level.[2] For example, 26% of adults who reported a household income of less than $10,000 were categorized as having a below basic prose literacy level. In contrast, only 2% of adults who had a household income of $100,000 or more were categorized as having a below basic prose literacy level.[2] Similarly, the 1993 NAAL results determined that 43% of adults who reported being in poverty had below basic prose literacy, while only 4% who reported being in poverty had proficient prose literacy.[48]

Education

In both 1992 and 2003, the overall trend demonstrated that as the level of education increased, so did the average prose, document and quantitative literacy scores (Table 5).[2] Among all participants, the average scores for prose and document literacy among adults with some college or higher levels of education decreased between 1992-2003.

Table 5. Average prose, document, and quantitative scores by education from the 1992 and 2003 National Assessments of Adult Literacy

Education	Average Prose Score		Average Document Score		Average Quantitative Score	
	1992	2003	1992	2003	1992	2003
Still in high school	268	262	270	265	263	261
Less than/some high school	216	207	211	208	209	211
GED/high school equivalency	265	260	259	257	265	265
High school graduate	268	262	261	258	267	269
Vocational/trade/business school	278	268	273	267	280	279
Some college	292	287	288	280	295	294
Associate's/2-year degree	306	298	301	291	305	305
Bachelor's degree	325	314	317	303	324	323
Graduate studies/degree	340	327	328	311	336	332

Summary of the 2003 National Assessment of Adult Literacy (NAAL)

The National Center for Education Statistics found that the average prose and document literacy scores remained the same from the 1992 National Adult Literacy Survey (NALS) to the 2003 National Assessment of Adult Literacy (NAAL). In contrast, the average quantitative literacy scores increased during that time. Nonetheless, it was concluded that approximately 7 million adults in the United States (i.e. 3% of the adult population) were considered to be non-literate in English or have a below basic literacy level due to incorrectly answering the easiest questions. In general, women were found to have higher average prose and document literacy scores than men. Whites and Asian/Pacific Islander adults had higher average prose, document and quantitative scores than Black and Hispanic adults. Between 1992-2003, all of the racial and ethnic groups, with the exception of the Hispanic population, maintained or improved their average literacy scores. In contrast, the Hispanic population's prose and document literacy levels decreased, but stayed the same in the quantitative domain. Adults who spoke English only or English including another language had higher quantitative literacy scores than those who reported speaking Spanish, but no English. Adults 65 years of age and older had the lowest overall average literacy levels compared to other age groups. As income increased, so did overall average literacy levels. Similarly, overall average literacy levels increased with additional educational attainment.

Health Literacy

Adults in the United States must frequently complete health literacy tasks such as filling out health history forms, making appropriate health decisions, and choosing a medication at the pharmacy and then using it appropriately. Decisions like these are crucial for optimal health, especially among vulnerable populations. The Institute of Medicine describes health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."[3] It is important to determine health literacy levels within the United States because low health literacy has been

found to be related to poor health outcomes.[49-51] As a society, low health literacy is of concern

because many of these poor health outcomes are preventable. It is hoped that by improving

society's health literacy, more diseases can be appropriately managed or prevented. The

following section describes some of the most common ways that health literacy can be assessed.

Next, the section presents demographic trends associated with health literacy levels. Lastly, the

relationship between health literacy and various health outcomes are presented.

Measuring Health Literacy

Researchers have developed multiple methods for measuring health literacy. The

following section describes some of the common types of tools that have been developed and

how they are used to measure health literacy.

Word Recognition Tools

Word recognition instruments are used to determine reading ability by requiring

individuals to read words aloud from a list.[52] The advantage of using a word recognition tool is

that they are usually quick and easy to administer, and they are easy to score. Because word

recognition tools merely measure an individual's ability to recognize or read medical words and

pronounce them correctly, it is unknown if an individual truly understands the meaning of the

terms. Thus, the disadvantage of these tools is that they do not measure comprehension.

Nonetheless, it is assumed that if an individual is not able to correctly pronounce multiple

medical terms, then they may also have difficulty comprehending medical information.[52-55]

Rapid Estimate of Adult Literacy in Medicine (REALM)

The REALM is a validated 66-item medical word recognition instrument with a focus on

words representing body parts and diseases.[52] Individuals are given a sheet with three lists, each

containing 22 medical terms. The words are arranged based on their number of syllables and their

difficulty in pronunciation. One point is awarded per word for correct pronunciation. In contrast,

if an individual incorrectly pronounces a word or states they don't know how to pronounce it,

they receive zero points for that word. Levels of health literacy are classified as limited health

literacy (0-44 points), marginal health literacy (45-60), and adequate health literacy (61-66).

Administration of the REALM takes approximately 2-3 minutes. Other versions of the REALM

have been developed, such as the Rapid Estimate of Adult Literacy in Medicine-Short Form

(REALM-SF),[56] which uses only seven medical terms of the original 66 from the REALM, and

the Rapid Estimate of Adult Literacy in Adults-Teen (REALM-Teen).[57] The latter consists of 66

medical terms, but specifically uses medical terms targeted toward adolescents.

Medical Achievement Reading Test (MART)

The MART is a validated 42-item word recognition instrument with a focus on medical

terms usually found on pharmaceutical bottles or health education pamphlets.[55] It is printed in

small letters on a glossy sheet of paper in order to determine how difficult it is for individuals to

read medical instructions, such as those found on pharmaceutical bottles. Words are arranged in a

consistent level of difficulty based on the number of syllables each word contains. If the

individual incorrectly pronounces 10 words, the test is terminated. The MART takes

approximately five minutes to complete.[55]

Reading Comprehension Tools

Reading comprehension instruments have been developed to determine comprehension of

written information.[58] These types of tests usually ask that individuals read written passages and

answer questions pertaining to the passages. Often, individuals are asked to complete "fill in the

blank" questions where the individual inserts a medical word into a sentence.[58]

The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult

Literacy (NAAL)

The National Center for Education Statistics (NCES) collected, analyzed, and reported

the data for the 2003 National Assessment of Adult Literacy.[27] Health literacy was a new

component that was added to the 2003 National Assessment of Adult Literacy. The purpose of

adding this component to the survey was to assess the associations between health literacy and

sociodemographic information, preventive health practices, and where adults seek health information.[27]

A total of 28 prose, document and quantitative items were used to measure health literacy (note: definitions of prose, document, and quantitative literacy can be found in the previous literacy section).[27] These tasks were based on three health and health care information service domains: clinical, prevention, and navigation of the health care system. There were 12 prose items, 12 document items, and 4 quantitative items (28 total) within the health literacy section of the survey instrument. All of the questions were intended to assess how participants locate and understand health information and services.[27]

The clinical domain (3 health literacy tasks) consisted of health activities, such as patient-provider interaction, clinical visits, diagnosis and treatment of a disease, and medications.[27] Tasks included filling out a health history form, understanding medication prescription, including dosage, and following diagnostic test recommendations from health care providers. The prevention domain (14 health literacy tasks) consisted of concepts related to maintaining and improving health, disease prevention, interfering before health problems worsened, and being involved in caring for and managing disease. Tasks included being able to follow age-appropriate guidelines for preventive health services, identifying signs and symptoms of health conditions that a health provider should address, and knowledge about how dietary and exercise habits influence development of serious health conditions. Finally, the navigation of the health care system (11 health literacy tasks) domain consisted of health activities such as navigating the health care system and knowing what the rights and responsibilities of individuals were. Such tasks included knowing what a health insurance plan will pay or not pay for, giving informed consent for health care services, and determining if one is eligible for public insurance (Medicaid and/or Medicare) or other assistance programs.[27]

Levels of health literacy were categorized similarly to general literacy levels from the 2003 NAAL: below basic, basic, intermediate, and proficient.[2] A below basic level (0-184 points)

required that adults be able to locate straightforward pieces of information from simple documents.[27] A basic level (185-225) required location of information in longer, more complex documents. An intermediate level (226-309) required that adults interpret health information from more involved documents. Finally, a proficient level (310-500) required that adults be able to compare various pieces of information or apply further complicated health documents.[27]

Test of Functional Health Literacy in Adults (TOFHLA)

The TOFHLA is a validated 67-item comprehension test that contains two components: reading comprehension (50 items) and numerical ability (17 items).[58] The two components focus on what is necessary to adequately follow medical instructions, such as discharge instructions and prescribed medicaments. The test takes approximately 30 minutes to complete and is rated on a scale of 0-100. Levels of health literacy are categorized as the following: inadequate (<60), marginally adequate (60-74), and adequate (>75). The TOFHLA is available in both English (TOFHLA-E) and Spanish (S-TOFHLA).[7] Due to the time that is necessary to administer the test, a shortened version of Test of Functional Health Literacy Adults was developed (TOFHLA-Short).[59] The TOFHLA-S contains only one reading comprehension passage instead of two and four multiple choice questions in the numeracy component instead of 17.[59]

Short Assessment of Health Literacy for Spanish-speaking Adults-50 (SAHLSA-50)

The SAHLSA is a validated 50-item word recognition test, based on the REALM.[60] However, unlike other word recognition tests, the SAHLSA-50 has a comprehension component. The instrument takes approximately 2-3 minutes to administer. The SAHLSA was specifically developed to target the Spanish-speaking population's health literacy levels including an individual's ability to read and comprehend common medical terms in Spanish. To develop the SAHLSA, fifty medical terms from the REALM were chosen and translated into Spanish. For the comprehension component, two common words were chosen to match the REALM term. One of the words was meaningfully associated with the REALM term, and the other word was a distractor. In order to assess comprehension, individuals are shown a medical term on an index

card and asked to read it aloud. Then, the examiner reads aloud the key and distractor terms and asks the individual to choose which word is related to the original medical term. A third option, "I don't know," is also available to choose from. Individuals are given one point for correctly pronouncing and choosing the key term and zero points for correctly pronouncing the term, but choosing the distracter term or indicating they do not know which word is the key term. Inadequate health literacy is defined as scoring between 0-37 points, while adequate health literacy is defined as 38 or more points.[60]

Newest Vital Sign (NVS)

The NVS is a validated six-question reading comprehension tool with a numeracy component that takes approximately three minutes to complete.[61] Individuals are given a nutrition label and asked about the contents of the label, which requires reading and understanding to answer the six questions. One point is given for each correct question answered, and zero points are given for each incorrect answer. Health literacy is classified as "likely" low (0-1 points), "possibly" low (2-3 points), and adequate (4-6 points).[61]

Set of Brief Screening Questions (SBSQ)

The SBSQ are three validated questions with a focus on reading comprehension.[62] The three questions asked are: "How often do you have someone (like a family member, friend, hospital/clinic worker or caregiver) help you read hospital materials?" (always, often, sometimes, occasionally, or never), "How often do you have problems learning about your medical condition because of difficulty understanding written information?" (always, often, sometimes, occasionally, or never), and " How confident are you filling out forms by yourself?" (extremely, quite a bit, somewhat, a little bit, not at all). Individuals who respond "always," "often," or "sometimes," and "somewhat," "a little bit," or "not at all," are considered to have limited health literacy.[62]

Another version of the SBSQ has been developed that consists of only one question, "How confident are you filling out medical forms by yourself?" (extremely, quite a bit,

somewhat, a little bit, not at all). [57] Individuals are considered to have limited health literacy if

they answer "somewhat," "a little bit," or "not at all." [63]

Single Item Literacy Screener (SILS**)**

The SILS is similar to the SBSQ,[64] however, the question asked is "How often do you

need to have someone help you when you read instructions, pamphlets, or other written material

from your doctor or pharmacy?" (Always, often, sometimes, occasionally, or never). Individuals

are considered to have limited health literacy if they respond "always", "often", or "sometimes".[64]

Measuring Health Literacy Summary

Several tools have been developed to measure health literacy. The variety of tools

available measure health literacy differently. For example, the REALM[52] and MART[55] measure

health literacy by medical word recognition. In contrast, the 2003 National Assessment of Adult

Literacy (NAAL),[27] the TOFHLA,[58] which is available in Spanish and English, and the

TOFHLA-S[59] measure reading comprehension. The SAHLSA-50[60] and the NVS[61] are additional

reading comprehension health literacy tools, however, they also contain word recognition and

qualitative components, respectively. Other methods, such as the SBSQ[62] and the SILS[64] are brief

question assessments that can be used to screen for limited health literacy levels in adults. While

having multiple tools available is beneficial from both research and clinical application

standpoints, having one instrument that can measure word recognition, prose, document, and

quantitative literacy associated with health literacy in a short time would be the ideal tool. At this

point, such an instrument does not exist. Nevertheless, the currently available instruments are of

value in assessing the health literacy of specific populations so that educational interventions can

be developed to help prevent and manage disease.

Health Literacy Trends

It is important to understand which sociodemographic characteristics are associated with

health literacy. As such, numerous studies have assessed the health literacy of adult populations

within the United States using a variety of the aforementioned health literacy tools. Since the

purpose of this thesis is to assess the oral health literacy of Iowa's Hispanic population, the following section will focus on the demographic characteristics that have been found to be associated with health literacy, regardless of race/ethnicity, at a national level and the demographic characteristics that have been found to be associated with health literacy within exclusively Hispanic populations. Specifically, this section will present the findings from five studies: 1) "The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adults Literacy (NAAL),[27] 2) "Health Literacy Among Spanish-speaking Patients in the Emergency Department (North Carolina),"[7] 3) "Correlates of Health Literacy Among Hispanics in Arkansas,"[8] 4) "The Association Between Language Proficiency and Outcomes of Elderly Patients with Asthma,"[65] and 5) "Impact of Health Literacy on Longitudinal Asthma Outcomes."[49]

"The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy (NAAL)"

The 2003 NAAL measured general literacy levels (i.e. prose, document, and quantitative) of the adult population in the United States. Additionally, for the first time, it also assessed health literacy.[27] Further details about this study and how health literacy levels were measured are available in the previous sections entitled "Literacy" and "Health Literacy."

"Health Literacy Among Spanish-speaking Patients in the Emergency Department"

Brice et al. conducted this study to determine the health literacy levels among Spanish-speaking patients admitted to the University of North Carolina Hospitals.[7] The authors gathered demographic information and surveyed English and Spanish-speaking participants to determine their health literacy status. Potential participants were asked to participate if they were either admitted to the emergency department or if they were accompanying an individual at the emergency department. Exclusion from the study included being: bilingual, a non-native English or Spanish speaker, less than 18 years old, in police custody, or in unstable health. Additionally, potential participants were excluded if they had mental or visual impairments or self-reported

complete illiteracy. Health literacy was measured using the Test of Functional Health Literacy in Adults (TOFHLA) or the Spanish version (S-TOFHLA). This study used a matched-cohort design and enrolled Spanish-speakers matched to English-speakers based on age ($\pm$ 5 years), gender, and area of treatment. Recruits consented to participation in writing; interviewers read the consent document to participants, as needed. The following demographic information was collected: primary language (English or Spanish), gender, country of origin, status as a patient or parent accompanying a patient, occupation, and form of housing. Participants were also asked about the level of education they completed and to self-assess their reading ability as "poor", "fair", "good" or "excellent." The above-mentioned demographic information and self-assessed reading ability were then analyzed to determine if there were any correlations with either the TOFHLA or S-TOFHLA scores, as applicable.[7]

"Correlates of Health Literacy among Hispanics in Arkansas"

The purpose of this study conducted by Boyas was to determine what effects health literacy had among Hispanics in the United States due to the "mixed and inconsistent" results of language acculturation and the lack of research assessing health literacy among this population.[8] This study focused on determining if variables such as gender, language acculturation, age, educational level, income, and citizenship status, were associated with health literacy scores among self-identified Hispanics. This cross-sectional study used data from the 2008 Quality of Life in Arkansas survey, which "examines self-perceptions of satisfaction with various life domains." Participants in this study lived in either urban or semirural communities in Arkansas. Inclusion criteria included being: either Hispanic or Latino, at least 18 years of age, and without cognitive limitations. Additionally, participants could not be institutionalized. A self-reported questionnaire was given to each participant in either English or Spanish, based on the participant's preference. The health literacy component included Chew's three health literacy questions (SBSQ), a validated health literacy tool to identify inadequate health literacy levels. Literacy levels were categorized as: inadequate (0-16), marginal (17-22), and adequate (23-36).

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To measure acculturation, the Short Acculturation Scale for Hispanics was used. Higher scores from this Likert-type scale meant higher levels of language acculturation.[8]

 "The Association Between Language Proficiency and Outcomes of Elderly Patients with Asthma"

Very little is known about whether language barriers play a role in the outcomes among Hispanics with asthma. Therefore, the purpose of the Wisnivesky et al. study was to determine if there was an association between English proficiency with the morbidity and self-management behaviors of elderly inner-city asthmatics.[65] The authors hypothesized that elderly asthmatic adults with limited English proficiency would be less likely to adhere to medication, have worse asthma control, and self-assess their quality of life as poor.[65]

This prospective cohort study included participants from Mount Sinai Medical Center in East Harlem, New York and Northwestern University Hospital and Mercy Health Clinics in Chicago, Illinois.[65] Inclusion criteria for this study required that participants be diagnosed with uncontrolled asthma, be 60 years of age or older, and speak English or Spanish. Subjects were excluded if they had a history of smoking 10 or more pack-years or if they had been diagnosed with chronic obstructive lung disease or other chronic respiratory illness. Additionally, non-Hispanic participants were excluded if they self-identified as having limited English proficiency.[65]

Subjects who reported that English was not their primary language were asked to rate how well they were able to speak and understand English as either very poor, fair, good, very good or excellent.[65] Hispanic subjects who responded as very poor, poor, or fair were immediately categorized as having limited English proficiency. Subjects were then placed into three groups: non-Hispanic (all native English speakers), Hispanics proficient in English, and Hispanics with limited English ability. This was done to determine if there was an association between language proficiency and asthma outcomes.[65]

Asthma control was evaluated using the Asthma Control Questionnaire (ACQ), a validated English and Spanish instrument tool that contains questions about symptoms of asthma, activity limitation, and use of a bronchodilator.[65] These questions were scored on a 7-point Likert scale, with higher scores representing poor asthma control. [64]Subjects were also asked about the resources they used for acute asthma conditions and the number of exacerbations that required outpatient or inpatient care.[65]

Asthma-related quality of life was assessed using the Mini-Asthma Quality of Life Questionnaire (AQLQ), a validated English and Spanish instrument tool that contains 4 areas: activity limitations, symptoms, emotional function, and environmental stimuli. Increasing scores of the AQLQ is associated with a better quality of life.[65]

Medication adherence was assessed using the validated Medication Adherence Reporting Scale (MARS), a 10-item tool that measures how well an individual adheres to their asthma medication regimen.[65] Questions are scored on a 5-point Likert scale, with higher scores meaning better adherence ($\geq$4.5). The MARS score was calculated in order to determine if English proficiency was associated with poorer asthma outcomes. Other variables measured in the study were sociodemographic characteristics, history of asthma, comorbid conditions, and symptoms of depression, which was measured using the Patient Health Questionnaire.[65]

Lastly, to assess health literacy, the validated Short Test of Functional Health Literacy in Adults (S-TOFHLA) was used in both English and Spanish. Adequate health literacy was scored as 23 or greater, and limited health literacy was scored as 22 or lower.[65]

"Impact of Health Literacy on Longitudinal Asthma Outcomes"

Similarly, Mancuso et al. measured associations between health literacy and other variables that were independently correlated with asthma outcomes.[49] The study assessed 224 participants who were involved in a cohort study (1995-1999) at Cornell Internal Medicine Associates in New York; a primary care practice that serves patients from different socioeconomic groups.[49]

The authors assessed the following outcomes: asthma quality of life, functional status, and the type of asthma resource utilization during an asthma attack.[49] The Asthma Quality of Life Questionnaire (AQLQ) was given to participants at enrollment and subsequently every six months for a duration of two years. The Medical Outcomes Study SF-36, which consisted of Physical and Mental Components, was used to assess functional status at enrollment and every six months. Lastly, participants self-reported resource utilization every three months via telephone or in person when they presented for an office visit.[49]

Variables that could be associated with the various asthma outcomes were assessed upon enrollment.[49] For example, demographic information was collected during enrollment. Additionally, participants were asked to rate how difficult it is for them to access asthma care. Participants also had to indicate how frequently they use asthma medication. Those who reported daily use were classified as having severe asthma. Participants were asked to complete the "Check Your Asthma" 12-question IQ test in order to measure awareness of asthma characteristics, asthma's mechanism of action, and the self-management of asthma. Lastly, the Geriatric Depression Scale (GDS) was used to assess depression symptoms. Subjects who returned to the clinic after the initial appointment were asked to complete the Test of Functional Health Literacy in Adults (TOFHLA) in order to assess their health literacy. The TOFHLA was available to subjects in both English and Spanish, depending on the subject's preference. Health literacy scores were defined as adequate (≥75), marginal (60-74), or inadequate (≤60).[49]

Health Literacy Scores

With the health literacy component in the 2003 National Assessment of Adult Literary, it was determined that 14% of the population had below basic health literacy, 22% had basic health literacy, 53% had intermediate health literacy and 12% had proficient health literacy.[27] The mean TOFHLA score in Brice et al. was 75.25, indicating adequate functional health literacy.[7] However, Spanish speakers had a lower mean score than English speakers (59.72 vs. 90.78) indicating inadequate functional health literacy among the Spanish speaking participants.[7] Boyas

was able to determine that among Hispanic adult participants within the study, the average health literacy score was 24.06 out of 36 indicating adequate health literacy levels for this population.[8] In the Wisnivesky et al. study, 27% of the sample had inadequate health literacy.[65] Mancuso et al. reported that 82% of the participant's had adequate health literacy, 8% had marginal health literacy, and 10% had inadequate health literacy.[49] The authors later dichotomized the scores that found that 82% had adequate literacy vs. 18% had inadequate health literacy.

Predictors of Health Literacy

The following section discusses the variables measured in the 2003 NAAL, Brice et al., Boyas, Wisnivesky et al., and Mancuso et al. studies and their association with health literacy levels. If the findings from an article are not discussed within a section, then the authors did not examine the relationship between health literacy and that particular variable.

Gender

The 2003 National Assessment of Adult Literacy (NAAL) found that overall, women had higher average health literacy scores than men (248 vs. 242, respectively).[27] Specifically, men were more likely to have below basic levels of health literacy than women (16% vs. 12%, respectively), while women were more likely to have intermediate levels of health literacy than men (55% vs. 51%, respectively).[27] In contrast, there were not any statistically significant differences between men and women with regard to basic and proficient health literacy levels.[27] Within the solely Hispanic population studies, gender was not found to be associated with differences in health literacy. In the Brice et al. study, it is unclear if gender was analyzed to determine its associations with health literacy.[7] Therefore, it is unknown if it was a predictor of health literacy in their study. Similarly, Boyas found that there was no correlation with gender and health literacy (r=-0.04, p=0.05).[8] In the Mancuso et al. study, only women participated, and it was determined that 82% of the participant's had adequate health literacy, 8% had marginal health literacy, and 10% had inadequate health literacy.[49]

Race and Ethnicity

Since the Brice et al. study and the Boyas study solely focused on Hispanic adults, the association of race and ethnicity with health literacy was not studied and therefore is not discussed here. However, the 2003 NAAL study found that race and ethnicity was significantly associated with health literacy. Specifically, participants who identified as White or Asian/Pacific Islander had higher average and proficient health literacy levels compared to Black, Hispanic, American Indian/Alaskan Natives, and Multiracial participants.[27] Compared to all surveyed racial and ethnic groups, Hispanic adults had the lowest average health literacy levels. For example, 58% of Whites, 52% of Asian/Pacific Islanders, 59% of Multiracial adults, and 41% of Blacks had Intermediate health literacy levels compared to 31% of Hispanic adults. Likewise, the percent of adults with Below Basic health literacy levels were higher among Hispanics (41%) and Blacks (24%) than the other populations (White=9%, Multiracial=9%, Asian/Pacific Islander= 13%, American Indian/Alaska Native=25%.[27] Similar to the 2003 NAAL study, Wisnivesky et al. and Mancuso et al. reported that health literacy was associated with race and ethnicity. Specifically, Wisnivesky et al. reported that 18% of non-Hispanic participants had inadequate health literacy, 29% of participants who reported being Hispanic, English proficient speakers had inadequate health literacy, and 68% of participants who reported being Hispanic with limited English proficiency had inadequate health literacy. As such, Hispanic participants significantly had inadequate health literacy compared to non-Hispanic participants (p<0.0001).[65] Mancuso et al. reported that 56% of the Hispanic participants and 38% of the African American participants scored in the marginal/inadequate health literacy levels compared to 0% of Whites who scored the same (p=0.001).[49]

Language Background

Four studies found that language was associated with health literacy. The 2003 NAAL study found that adults who solely spoke a language other than English had overall lower average health literacy score than adults who spoke English only or English and another language

(Spanish=174, Other language=229, English or Spanish=232, English and other language= 244 and English only=251, respectively).[27] Individuals who spoke English, English and Spanish or English and another language had an average Intermediate health literacy score whereas participants who spoke Spanish only had an average Below Basic health literacy score.[27] Brice et al. reported that English-speaking participants had an average health literacy score of 90.78/100, indicating adequate health literacy levels.[7] However, Spanish-speaking participants had an average score of 59.72, indicating inadequate health literacy levels. Furthermore, Brice et al. found that 7% of English-speakers had less-than-adequate health literacy, while 74% of Spanish-speakers had less-than-adequate health literacy.[7] Similarly, Boyas found that there was a strong correlation with participant's language acculturation and health literacy.[8] Therefore, those who indicated being less linguistically acculturated to the English language were more likely to have low health literacy compared to participants who were more acculturated (r=0.57, p=0.001).[8] The Wisnivesky et al. study found that English language proficiency was associated with health literacy. Specifically, 68% of the Hispanic participants with limited English proficiency had inadequate health literacy compared to the 29% of the Hispanic participants who were proficient in English that scored the same.[65] Furthermore, only 18% of the non-Hispanic had inadequate health literacy levels (p<0.0001).[65]

Age

Results from the 2003 NAAL study showed that adults age 65 and older had the lowest average health literacy score compared to the other age groups (age 16-65+, Table 6). Furthermore, they were the group most likely to have below basic health literacy levels.[27] In contrast, individuals in the 25 to 39 year age group had the highest overall score and were the most likely to be in the proficient health literacy level compared to the other age groups.[27] Similar to the 2003 NAAL study, Boyas determined that older age was correlated with lower health literacy levels (r=-.27, p=0.01).[8] However, it is unclear in the Brice et al. study if age was analyzed to determine its association with health literacy.[7] In the Mancuso et al. study, it was

found that those younger in age (41 mean years) were more likely to have adequate health literacy while those who were older in age (50 mean years) were more likely to have marginal/inadequate health literacy (p<0.0001).[49]

Table 6. Average health literacy score by age group from the 2003 National Assessment of Health Literacy in Adults

Age Group	Average Health Literacy Score
16-18	244
19-24	249
25-39	256
40-49	249
50-64	246
65+	214

Education Level

Four studies found that an increase in educational attainment was associated with increased health literacy scores. According to the 2003 NAAL study, adults with a high school degree or GED or higher were more likely to have proficient health literacy levels compared to participants with less than a high school degree.[27] Conversely, those who did not attend high school or were currently attending school had lower average health literacy scores and were the most likely to have below basic health literacy levels (Table 7). Brice et al. found that, on average, participants who spoke English had completed more school than their Spanish-speaking counterparts (10.59 years vs. 7.95 years, respectively).[7] Within the study, 55% of English-speakers self-assessed their reading ability as excellent, while only 13% of Spanish-speakers reported the same. The authors found that completing fewer years of school (p= 0.0007) and poor self-assessed reading ability (p= 0.0004) were predictors of inadequate health literacy levels.[7] Similarly, Boyas found that having less years of education (less than high school) was significantly associated with lower levels of health literacy (β=.46, p=0.001).[8] Mancuso et al. determined that a lower percentage (16%) of participants who were college graduates had

marginal/inadequate health literacy while a higher percentage (63%) of participants we who had

less than high school education had marginal/inadequate health literacy (p<0.0001).[49]

Table 7. Average health literacy score by highest education attained from the 2003 National

Assessment of Health Literacy in Adults

Highest Level of Education Attained	Average Health Literacy Score
Still in high school	241
Less than high school/some high school	184
GED/high school equivalency	232
High school graduate	232
Vocational trade/business school	241
Some college	253
Associate's/2-year degree	264
Bachelor's degree	280
Graduate studies/degree	287

Income Level

The studies found mixed results pertaining to income level and health literacy status. The

2003 NAAL study found that as the poverty threshold increased, so did average health literacy

scores (Table 8). Adults who were at or below the federal poverty level, on average, were likely

to have basic health literacy levels while those who were at 175% of the federal poverty level

were more likely to have intermediate health literacy levels.[27] In contrast, neither Brice et al. nor

Boyas found income to be associated with health literacy scores (p>0.05).[7, 8]

Table 8. Average health literacy score by poverty threshold from the 2003 National Assessment

of Health Literacy in Adults

Poverty Threshold	Average Health Literacy Score
Below poverty	205
100-125%	222
126-150%	224
151-175%	231
Above 175%	261

Citizenship Status

The relationship between citizenship status and health literacy was only addressed with the Boyas study.[8] Within that study, 66% of the participants were not United States citizens. Participants who were not citizens were more likely to have low health literacy (r=.37, p=0.001).[8]

Insurance Status

Mancuso et al. found that among the participants who reported having Medicaid as their health insurance, 39% had adequate health literacy, and 77% had had marginal/inadequate health literacy (p=0.0001).[49]

Predictors of Health Literacy Summary

Findings from the five studies suggest that health literacy is associated with a variety of sociodemographic characteristics, although the strength of their association varied by study. The 2003 National Assessment of Adult Literacy (NAAL) found that men, Hispanics, participants whose first language was something other than English, older adults (i.e. adults age 65 and older), and adults who did not attend high school or were currently attending school were more likely to have below basic health literacy compared to their counterparts. Additionally, adults who were considered to be at or below the federal poverty level were more likely to have basic health literacy levels compared to adults with higher incomes.[27] Wisnivesky et al. and Mancuso et al. also found that race and ethnicity were associated with health literacy levels. The Wisnivesky et al. study found that English language proficiency was associated with health literacy.[65] Similarly, Brice et al. and Boyas found that adults who reported Spanish as their primary language,[7] low levels of language acculturation,[8] poor self-assessed reading ability,[7] and not being a United States citizen[8] were associated with low health literacy. Brice et al., Boyas, and Mancuso et al. found that fewer years of education was associated with low health literacy levels.[7, 8, 49] Additionally, two studies found that older individuals were more likely to have low health literacy.[8, 27] Lastly, Mancuso et al. reported that that insurance status was also associated with low health literacy levels.[49]

<u>Health Literacy and Health Outcomes</u>

Health literacy is vital when making healthcare decisions, and the ability to make informed decisions influences all facets of healthcare.[3] Studies have shown that patients with low health literacy have worse health outcomes.[66] This literature review is going to focus specifically on the association between low health literacy and asthma. The association between low health literacy and asthma management is problematic since patients with low health literacy may have less asthma knowledge and self-efficacy, which can lead to less effective asthma self-management.[49, 65] As indicated by the 2003 NAAL study, minority groups, such as Hispanics, are more likely to have lower health literacy than their White counterparts.[27] This is especially problematic if a person is not proficient in English since they then have an additional barrier to overcome in order to achieve optimal health outcomes.[7, 8, 65] Thus, lack of proper understanding about asthma and how to treat it is especially challenging among this group.[65] The following section will further discuss the associations between health literacy and asthma outcomes, with an emphasis on language and ethnicity. Specifically, the first study assesses how health literacy levels and health outcomes vary based on whether the participants speak English or Spanish.[65] The second study assessed how race and ethnicity were associated with health literacy and asthma management.[49]

"The Association Between Language Proficiency and Outcomes of Elderly Patients with Asthma"

See "Health Literacy Trends" (above) for details about this study. Outcomes associated with health literacy from this study are described below in "Levels of Health Literacy by Poor Health Outcomes".

 "Impact of Health Literacy on Longitudinal Asthma Outcomes"

See "Health Literacy Trends" (above) for details about this study. Outcomes associated with health literacy from this study are described below in "Levels of Health Literacy by Poor Health Outcomes".

Poor Health Outcomes by Levels of Health Literacy

The following section reports on the associations between health literacy and various asthma outcomes as described in the Wisnivesky et al. and Mancuso et al. studies.[49, 65]

Asthma Quality of Life

In both studies, Asthma Quality of Life Questionnaire (AQLQ) scores were associated with both language and health literacy. Wisnivesky et al. found that AQLQ scores were lowest when controlled for health literacy among Hispanics with limited English proficiency when compared to non-Hispanic subjects (mean difference 0.60; 95% CI: -1.11 to -0.13; p=0.02). As such, Hispanics with limited English proficiency reported poorer quality of life related to asthma.[65] Likewise, Mancuso et al. found that individuals with marginal/inadequate (<75 points) health literacy scores had a worse quality of life than those with adequate (≥75 points) health literacy scores (p=0.009).[49]

Medication Adherence

Wisnivesky et al. found that Hispanics with limited English proficiency were less likely to adhere to medications when compared to non-Hispanic subjects (OR: 0.33; 95% CI: 0.36-1.46); however, this finding was only significant when adjusted for health literacy scores (p=0.05).[65]

Resource Utilization

Both language proficiency and health literacy were associated with the use of hospital care for the management of asthma. Wisnivesky et al. reported that Hispanic subjects who were proficient in English had higher odds of experiencing asthma exacerbations requiring inpatient care compared to non-Hispanic subjects (OR 2.1; 95% CI: 0.93-4.95).[65] Additionally, Hispanic subjects with limited English proficiency also had higher odds of requiring inpatient care due to asthma exacerbations than non-Hispanic subjects (OR: 2.20; 95% CI 0.78-6.1).[65] When inpatient care was compared between the two groups and controlled for health literacy, the association with inpatient visits for the management of asthmas was not statistically significant (p=0.13).[65] When

looking at emergency department use for the treatment of asthma, Mancuso et al. reported that participants with lower health literacy scores were more likely to use a hospital emergency department during the study period (p=0.03).[49]

Functional Status

Mancuso et al. measured functional status using the Medical Outcomes Study SF-36, which consisted of Physical and Mental Components.[49] The authors found that participants who had lower health literacy scores had worse physical functional status (P=0.0007).[49]

Asthma Control

In the Wisnivesky et al. study, Asthma Control Questionnaire (ACQ) scores were compared between Hispanics with English proficiency and Hispanics with limited English proficiency.[65] When asthma control was controlled for health literacy, the authors found that asthma control was not significantly different between groups (p=0.56).[65]

Asthma Awareness

Mancuso et al. reported that health literacy was not statistically associated with asthma severity, self-efficacy, and knowledge.[49] However, based on the Check Your Asthma IQ survey, participants who scored marginal/inadequate health literacy were "less likely to consider asthma episodes potentially harmful, to know about warning signs, and to know about monitoring lung function" compared to those with adequate health literacy.[49]

<div align="center">Poor Health Outcomes by Levels of Health Literacy Summary</div>

The Wisnivesky et al. and Mancuso et al. studies measured different variables associated with language proficiency, health literacy, and asthma outcomes. Asthma quality of life was associated with language proficiency and health literacy levels. Additionally, Wisnivesky et al. found that elderly Hispanic patients with limited English proficiency had poorer asthma control, and had the lowest overall medication adherence than Hispanics who were proficient in English.[65] Both language proficiency and health literacy were associated with the use of hospital care for the management of asthma.[65]

Mancuso et al. concluded that having low health literacy has an effect on poor asthma knowledge.[49] This is especially of concern due to the inability to detect asthma attack warning signs, which can lead to harmful asthma outcomes or even death. Lastly, low health literacy levels were associated with poorer physical functional status.[49]

<p align="center">Health Literacy Summary</p>

Various tools are available to measure the health literacy levels of the United States population,[27, 55, 58, 61, 62, 64] some of which have been translated and/or developed to measure the health literacy levels of the Spanish-speaking population.[60] The health literacy levels of the adult population were first assessed on a national basis in 2003 with the National Assessment of Adult Literacy (NAAL),[27] while other studies have specifically assessed the health literacy of Hispanic populations.[7, 8] In general, adults who are female,[27] White or Asian/Pacific Islander,[27] native English speakers,[7, 8, 27] younger, [27, 8] highly educated, [27, 7, 8] above the poverty level, [27] and United States citizens[8] have higher health literacy levels than their counterparts. Low health literacy levels have been shown to be associated with poor health outcomes.[49, 65] When looking at health literacy and asthma as an example, Wisnivesky et al. and Mancuso et al. found that asthmatic adults with low health literacy levels had poorer quality of life and were more likely to use an inpatient/hospital emergency room for asthma exacerbations.[49, 65] Low medication adherence [65]and poor asthma knowledge[49] were also found to be associated with low health literacy levels.

<p align="center">Oral Health Literacy</p>

Compared to general health literacy, very little research has been conducted related to oral health literacy.[4] Because health literacy impacts an individual's ability to properly understand health information, it can also affect how well dental health is understood.[4] The Institute of Medicine defines oral health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions."[4] In other words, recognizing that dental disease is preventable and knowing what measures to take can lead to better oral health outcomes.

<p align="center">42</p>

The following section describes the various methods that are available to measure oral health literacy. Additionally, general trends pertaining to the levels of oral health literacy and the sociodemographic characteristics associated with oral health literacy are presented. Lastly, associations between oral health literacy and dental behaviors and outcomes are discussed.

Measuring Oral Health Literacy

Various oral health literacy tools have been developed, many of which are based on existing health literacy tools. Similar to health literacy instruments, oral health literacy measurements have been developed which assess word recognition and reading comprehension. Additional instruments have been developed to assess oral health knowledge, a component of oral health literacy.[67] The following section will describe some of the tools that are available to assess oral health literacy and how they are administered.

Word Recognition Tools

Similar to health literacy word recognition instruments, oral health literacy word recognition tools are used to determine reading ability and require individuals to read words aloud from a list.[52, 68] They can usually be completed within a few minutes, and are easy to administer and score. However, as previously mentioned, word recognition tools do not measure comprehension, which is a disadvantage in determining if the individual truly understands the meaning of the term. Instead, they only measure the ability to recognize or read and pronounce the words from a list. It is assumed that if an individual is not able to recognize or read and pronounce the term, then they must also have difficulty comprehending related information.[52, 68]

Rapid Estimate of Adult Literacy in Dentistry (REALD-30)

The REALD-30 was developed at the time when only a few methods were available to determine dental health literacy.[68] It is based on the Rapid Estimate of Adult Literacy in Medicine (REALM), which is a 66-item medical word recognition instrument.[52] The REALM evaluates medical word recognition as well as "lay terms for body parts and illnesses".[52] The REALD-30 was developed with the idea that the dental and medical systems contrasts on a variety of

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characteristics due to the different ways individuals utilize each system.[68] A total of 30 dental terms are included in the REALD-30. Emphasis is placed on disease-specific terms including etiology, anatomy, prevention, and treatment. Similar to the REALM, the REALD-30 is a word recognition instrument. Individuals read the terms aloud and get scored one point for each term they pronounce correctly and zero points for mispronouncing a term. Specific cutoffs for low and high oral health literacy was not established when this instrument was developed. A score of zero indicates lowest oral health literacy, while a score of 30 indicates a score of highest oral health literacy. Although the REALD-30 is easy to score and administer, it is only a word recognition instrument, which does not assess comprehension. A longer version of the REALD-30, the REALD-99 was developed prior to the REALD-30, but its use has been limited due to the length of time it takes to administer the test.[69] The REALD-30 uses a subset of the words from the REALD-99 that were deemed to be the most predictive of assessing oral health literacy.[68]

Rapid Estimate of Adult Literacy in Medicine-Dentistry (REALM-D)

The REALM-D is an oral health literacy measurement tool that is also based on the Rapid Estimate of Adult Literacy in Medicine (REALM).[70] The purpose of the REALM-D is to measure "universal" health literacy using a combination of dental and medical terms in one instrument. The REALM-D has a total of 84 terms including medical/dental, behavioral/psychosocial, and payment terms. The instrument contains three lists. Each list has six dental terms and 22 medical terms. Individuals are given a copy of the instrument and are asked to read each word aloud. If individuals are unable to read a term, they can say "blank" or "don't know" and move on to the next term. Scoring for the REALM-D is as follows: a correctly pronounced word is given a score of one and mispronounced or "blank/don't know" words are scored as zero.[70]

This instrument includes both dental and medical terms, which is a unique aspect from other health and oral health literacy instruments that only include terms pertaining to that specialty.[70] This combination gives health care providers the ability to measure "universal" health

literacy as compared to measuring with various instruments at once, thus saving time and resources.[70] Additionally, the inclusion of behavioral/psychosocial and payment terms demonstrates the various areas of which health care is comprised.

The REALM-D is also user friendly and has an easy scoring method.[70] This instrument is scored as a continuous variable, with higher scores and more answers correct on the second and third lists showing higher oral health literacy, whereas lower scores and more items missed on the second and third lists showing lower oral health literacy. Comparisons in scores can be made among groups of people (e.g sex, age, education) to assess whether differences exist. Recently, a shorted version of the REALM-D, the REALMD-20, has been developed, which is quicker in detecting limited oral health literacy in less than three minutes.[71] One disadvantage of both instruments is that they are exclusively a word recognition tool, thus it is unknown whether an individual understands the terms based on their ability to read the word.[70]

Oral Health Literacy Assessment in Spanish (OHLA-S)

The OHLA-S is a word recognition oral health literacy assessment tool with a comprehension component.[72] It is targeted specifically to Spanish-speaking populations due to the constant exclusion of this population in previous oral health literacy assessments. The OHLA-S contains 24 of the 30 dental terms that are in the REALD-30, however, they have been translated, and a comprehension component is included. Additional words, a key term and a distracter term, have been added in a multiple-choice format where one word is associated with the stem dental term and the other is not (e.g. stem word: sugar, key word associated: sweet, distracter word: bitter). Scoring is similar to the REALD-30 where one point is awarded for correct pronunciation and zero points are awarded for mispronunciation or if the individual chooses "don't know". However, since the OHLA-S has the comprehension component, in order to receive a full point, the individual must pronounce the dental term and correctly associate it with the key word associated with it. The OHLA-S gives researchers the opportunity to assess oral health literacy levels among Spanish-speaking populations, which had not been assessed prior to the

development of this tool. The comprehension component gives this instrument a unique feature

that is lacking in the other oral health literacy word recognition instruments.[72]

Reading Comprehension and Knowledge Tools

Reading comprehension instruments have been developed to determine comprehension of

written information.[58] Similar to health literacy reading comprehension tools, oral health literary

reading comprehension tools usually ask that the individual read written passages and answer

questions such as filling in the blank with a medical word missing in a sentence.[73, 74] In addition

to the reading comprehension instruments, some instruments assess individual's knowledge about

oral health.[67, 75] Rather than asking participants to read a passage and then answer questions

pertaining to that passage, the knowledge questionnaires simply ask participants questions

pertaining to oral health to assess their baseline knowledge, without the aid of reading passages

prior to answering the questions.

Test of Functional Health Literacy in Dentistry (TOFHLiD)

The TOFHLiD is a reading comprehension and numerical ability test based on the Test of

Functional Health Literacy in Adults (TOFHLA).[73] The reading comprehension section of the

TOFHLiD consists of three passages regarding instructions for a caregiver following a child's

fluoride varnish treatment, consent for dental treatment, and a description of Medicaid rights and

responsibilities. The fifth, sixth, or seventh word in a sentence is omitted in a sentence in order

for the passages to be converted to a reading comprehension test. Participants are asked to

identify the correctly omitted word from among three other distracter words. The numeracy

section of the TOFHLiD includes 12 questions relating to fluoride toothpaste instructions, bottle

prescriptions for fluoride drops/fluoride tablets, and a pediatric dental appointment. Each section

(i.e. the reading comprehension section and the numeracy section) has 50 questions, thus there are

100 questions within the instrument. The scoring of the TOFHLiD is as follows: <60 inadequate

functional health literacy, 60-74 marginally adequate functional health literacy, and >74

functional health literacy. The TOFHLiD demonstrates a portion of the oral health literacy's

framework, which is reading comprehension. This helps in discriminating incorrect distracter words that would otherwise be chosen by those who truly do not understand the meaning of the term. The inclusion of numeracy comprehension is also an advantage because it is an important aspect of oral health literacy. Knowing not only how to read prescription labels, but also understanding what the instructions mean, determines accurate handling of medications. Although reading comprehension is a strong asset of the TOFHLiD, the total number of questions is a disadvantage, especially in public health dentistry where saving time and resources are essential.[73]

Oral Health Literacy Instrument (OHLI)

The OHLI is a 74-item oral health literacy tool modeled after the Test of Functional Health Literacy in Adults (TOFHLA).[74] It contains three components: a 38-item reading comprehension component, a 19-item numeracy component, and a 17-item oral health knowledge component. The reading comprehension section is comprised of a passage with missing terms relating to dental caries and another passage relating to periodontal disease. Individuals are asked to choose the correct missing term from four options that are similar in sound or grammatically incorrect. The numeracy component of the OHLI tests individuals' comprehension of directions in taking prescribed medication for dental treatment, post extraction instructions, and clinical appointments. Individuals are shown medication bottles that are labeled, an appointment card, and an instruction pamphlet. Then, they are asked questions about it, such as when is it appropriate to eat or drink after taking the medication at a specific hour. The oral health knowledge component contains seven pictures showing 17 dental related items such as oral diseases and conditions, dental fillings, perioral and intra-oral structures, and different oral hygiene aids. Each picture contains a list of numbered words and individuals are asked to choose the word that matches the picture. To score the OHLI, one point is awarded if the question is answered correctly, and zero points are awarded if the participant answers the question incorrectly or if the participant is unable to answer a question. Total points for the OHLI range

from 0 to 100, and oral health literacy levels are placed into three categories: inadequate (0-59), marginal (60-74), and adequate (75-100). Each point is weighted in order to create an oral health literacy score range of 0-100.[74]

Conceptual Measure of Oral Health Knowledge (CMOHK)

Health literacy comprises reading comprehension, word recognition, communication skills, and conceptual knowledge. However, few limited oral health knowledge tools have been developed in oral health literacy research.[67, 75] As such, the CMOHK was developed to assess oral health knowledge.[67] The CMOHK is a validated 23-item questionnaire related to oral health knowledge, decision-making and outcomes. The main topic areas that are included in the questionnaire are: basic knowledge about oral health, dental caries prevention and management, periodontal disease prevention and management, and oral cancer prevention and management. In order to limit bias related to reading ability, interviewers administer the survey to the participant by reading the questions aloud from a bi-fold folder or electronic device (e.g. laptop).[67] Participants are able to simultaneously hear the question/answers and read the questions and answers themselves. Participants are given the option to respond, "I don't know" if they do not know an answer to a question. Originally, scores for the CMOHK ranged from 0-23 and were categorized as the following: poor (0-11), fair (12-14), good (15-23).[67] However, when the instrument was used with an elderly population, the scores were modified to reflect the literacy of the population.[76]

Oral Heal Literacy Adults Questionnaire (OHL-AQ)

The OHL-AQ is a 17-item oral health literacy questionnaire that contains four topic areas: reading comprehension, numeracy, listening, and decision-making. It was developed after assessing several existing oral health literacy questionnaires including: REALD-30, REALD-99, REALM-D, OHLI, TOFHLiD, and the CMOHK.[75] The reading comprehension component is self-administered and contains three incomplete sentences regarding oral health knowledge. Participants are asked to select the most appropriate word to complete each sentence. Out of the

five options, one word is correct, three words are incorrect, and one is "do not know." The numeracy component is also self-administered and contains four questions relating to a prescribed medication and instruction for use. The listening component consists of two questions regarding post extraction instruction. The questionnaire administrator reads aloud three sentences related to post-extraction instructions two times. After hearing the sentences, individuals are asked to write down the instructions. Lastly, the decision-making component contains five questions relating to oral health problems and items on a dental history form. Scores for the OHL-AQ range from 1 to 17. Each correct answer is awarded one point, and zero points are awarded if the question is answered incorrectly or if the question is left unanswered. Oral health literacy levels are categorized as follows: inadequate (0-9), marginal (10-11), and adequate (12-17).[75]

Measuring Oral Health Literacy Summary

Oral health literacy is a fairly new component of health literacy and thus, fewer oral health literacy tools are available compared to health literacy. Similar to health literacy tools, some oral health literacy tools have been based on word recognition, such as the REALD-30,[68] REALM-D,[70] REALMD-20,[71] and OHLA-S.[72] Other tools available to measure oral health literacy are based on reading comprehension, knowledge, numeracy, or a mixture of all of the aforementioned items. Examples of these instruments include the TOFHLiD,[73] OHLI,[74] CMOHK,[67] and OHL-AQ.[75] Having a tool that assesses oral health knowledge is important as it helps researchers understand what individuals know about oral health and the prevention and management of oral diseases. Nonetheless, all of the aforementioned instruments have essential roles in oral health literacy research. As oral health literacy continues to evolve, other instruments will undoubtedly be developed. Ideally, these instruments will consider the needs of minority populations, especially those who are not native English speakers.

Oral Health Literacy Trends

Assessing oral health literacy levels within minority populations, such as Hispanics, is crucial due to the prevalence of oral diseases within these populations. However, the majority of

studies assessing oral health literacy either focus predominately on White participants, or have limited numbers of minority participants within their studies. Furthermore, none of the studies focus solely on one minority population. While one study does describe the OHLA-S, which is an oral health literacy instrument developed for Spanish speaking participants, the authors merely focus on reporting the development of a Spanish oral health literacy tool rather than describing the outcomes of the study.[75] Consequently, knowledge about the oral health literacy of specific minority populations is limited.[70, 77] As such, the following sections will describe the oral health literacy of a variety of populations, rather than limiting the information to Hispanic populations. However, information pertaining to Hispanic populations and other minority groups will be presented, when available. Specifically, the following section will describe studies that have used the aforementioned oral health literacy assessment tools and present their results.

Rapid Estimate of Adult Literacy in Dentistry-30 (REALD-30)

"Oral Health Literacy Levels Among a Low-Income WIC Population"

The purpose of this study was to assess the oral health literacy levels of a low-income (WIC) population within seven counties in North Carolina.[77] Additionally, the study aimed to determine if racial differences existed among the oral health literacy levels of participants. The study used cross-sectional data from 1,405 participants associated with the Carolina Oral Health Literacy (COHL) study. WIC clinics were selected based on their geographic location, population demographics, the rural/urban makeup, if it was an active clinic, and if a relationship had been established with the investigators. Inclusion criteria included: being enrolled in the North Carolina WIC program, having a healthy infant or child less than 5 years or age, and the child attending with the primary caregiver to the clinic. In addition, children had to be eligible for or enrolled in Medicaid so that a follow-up assessment pertaining to future investigations could be made using Medicaid claims data. Caregivers had to be at least 18 years old and speak English to participate in the study. Informed consent information was provided to the caretakers in writing, and it was also read aloud. Participants were selected from the eligible designated WIC clinics

and asked to answer eight questions from the COHL eligibility screening form. If eligible, the caregiver was then given a survey with five areas: sociodemographic information, dental health and behavior, oral health impact profile, self-efficacy, and oral health literacy. Caregiver demographic information included gender, age, race (White, African-American, American Indian or Alaskan Native), ethnicity (Hispanic/Hispanic, non-Hispanic/non-Hispanic, and unknown), education level completed, marital status, and number of children. Oral health literacy was measured using the Rapid Estimate of Adult Literacy in Dentistry (REALD-30). Thirty dental related words were read aloud by the participants to the interviewers, in order of increasing difficulty. Scores ranged from 0 (lowest literacy) to 30 (highest literacy). Since a specific cutoff for low and high oral health literacy was not established when the REALD-30 was developed, a range of low and high oral health literacy is not presented in this study. Overall, the mean REALD-30 score in this study was 15.8. The authors reported that this score is the lowest of other studies that have assessed oral health literacy with the REALD-30.[77]

"Oral Health Literacy Among Female Caregivers: Impact on Oral Health Outcomes in Early Childhood"

The purpose of this study was to determine if associations exist between caregivers' oral health literacy with oral health knowledge, oral health behaviors, and self-reported oral health status.[78] Cross-sectional data were used from the Carolina Oral Health Literacy (COHL) study (see: Oral Health Literacy Levels Among a Low-Income WIC Population). Oral health literacy was measured using the Rapid Estimate of Adult Literacy in Dentistry (REALD-30). Oral health knowledge was measured using a 6-item knowledge survey that included knowledge on topics on dental disease prevention. Scores ranged from 0 to 6, with a lower score indicating lower oral health knowledge. Oral health behaviors were assessed with a questionnaire developed by Douglass et al., which focused on oral hygiene and high-caries-risk dietary behavior questions. Lastly, caregivers were asked to assess their children's oral health status by answering questions from the National Health and Nutrition Examination Survey. The mean oral health literacy score

in this study was 15.8 out of 30 among all groups, which denoted a mid-range oral health literacy score. Additionally, the oral health knowledge mean score among all groups was 4.8 out of 6. Overall, there was a statistically significant positive correlation between oral health literacy scores and oral health knowledge (Spearman's p=0.19; 95% CI= 0.13, 0.24).[78]

Rapid Estimate of Adult Literacy in Medicine-Dentistry (REALM-D)

"Screening for Oral Health Literacy in an Urban Dental Clinic"

The purpose of this study was to develop an oral health literacy tool, the REALM-D, in order to determine if an association existed between oral health literacy and individual characteristics within a culturally diverse adult population attending a large urban dental clinic in Los Angeles, California.[70] Two hundred participants were recruited from the UCLA School of Dentistry Oral Diagnosis Clinic between January 2005 and June 2006. Inclusion criteria consisted of being: at least 18 years old, not having cognitive, vision, or hearing impairments, and being able to understand questions provided by the interviewer in English. Once eligible, subjects signed a consent form, and it was also read aloud to maximize comprehension. Subjects then were given a copy of the newly designed REALM-D and asked to pronounce each word. If pronounced correctly, one point was scored vs. zero points incorrectly. Additionally, the Patient Health Beliefs and Attitudes Questionnaire was given to the subjects. The interviewers read each question aloud, pointed to the question, and asked the participant to follow along. The categories of questions on the latter questionnaire were: health education assessment, health values, health beliefs, health attitudes, and health locus of control. Because this instrument is scored as a continuous variable, with higher scores and more answers correct on the second and third lists showing higher oral health literacy, levels of oral health literacy are not given.[70]

Oral Health Literacy Assessment in Spanish (OLHA-S)

"Oral Health Literacy Assessment: development of an oral health literacy instrument for Spanish speakers"

The purpose of this study was to develop a word recognition oral health literacy assessment tool with a comprehension component, targeted specifically to Spanish-speaking populations due to the constant exclusion of this population in previous oral health literacy assessments.[72] Information about the development of the tool is available in the above section entitled "Assessment of Oral Health Literacy". The OHLA-S contains 24 dental terms and additional words have been added in a multiple-choice format where one word is associated with the stem dental term and the other, distracters, are not (e.g. stem word: sugar, key word associated: sweet, distracter word: bitter). This stem word is considered the comprehension component, thus, individuals are not given a point if they unable to pronounce the term and match the corresponding key word associated with that term. Additionally, the Lee et al. study measured gender, age, years of education, self- reported health status, oral health knowledge (measured by five questions pertaining to prevention of periodontal disease and tooth decay), oral health-related quality of life (measured by using the Oral Health Impact Profile (OHIP-14), and health literacy (measured by three basic screening questions). Participants from this study were recruited from Woman Infant Clinic's (WIC) from several regions in the North Carolina, an Early Head Start center, a pediatric continuity care clinic at the University of North Carolina at Chapel Hill, and private homes. Participants were included in the study if they were fluent in English or Spanish, were 18 years of age or older, but less than 80 years of age, had no obvious signs of cognitive impairment, had no vision or hearing problems, and showed no signs of drug and alcohol intoxication. Since the purpose of this study was to develop an oral health literacy instrument, specific sample scoring is not provided. However, the authors tested potential scoring systems using linear regression models to determine the best scoring method.[72]

Test of Functional Health Literacy in Dentistry (TOFHLiD)

"Development and Testing of the Test of Functional Health Literacy in Dentistry (TOFHLiD)"

The purpose of this study was to develop a reading comprehension and numerical ability test based on the Test of Functional Health Literacy in Adults (TOFHLA).[73] Caregivers whose children were attending a pediatric dental clinic at the University of North at Chapel Hill and the Orange County Health Department dental clinics were recruited to participate in the study to validate this tool. Inclusion criteria consisted of having a child who was 15 years or younger and the caregiver had to speak English. A total of 102 caregivers participated in the study. A questionnaire with information regarding oral health quality of life, caregiver's perceived oral health status, and caregiver's perception of their child's oral health status was also provided to caregivers. The authors reported that the mean health literacy score among the sample was 93.7, indicating functional health literacy. Information about the development of this tool is available in the section entitled "Assessment of Oral Health Literacy".[73]

Oral Health Literacy Instrument (OHLI)

"Development and evaluation of an oral health literacy instrument for adults"

The purpose of this study was to develop and validate a reading comprehension and knowledge test for the measurement of oral health literacy in adults.[74] A convenience sample of 100 participated in the study. Participants were recruited from the Faculty of Dentistry Clinics at the University of Toronto, Toronto, Canada. Inclusion criteria consisted of being 18 years of age or older, ability to read English well, without psychiatric disorders and illnesses, and without any psychiatric or mental disabilities. A questionnaire containing the oral health literacy test and demographic information was provided to participants. The authors reported that the mean oral health literacy score of 87.2 indicated adequate oral health literacy. However, the mean oral health knowledge score was 57.5, which indicated inadequate oral health knowledge.[73]

Comprehensive Measure of Oral Health Knowledge (CMOHK)

"Measuring Conceptual Health Knowledge in the Context of Oral Health Literacy: Preliminary Results"

The purpose of the study was to create a conceptual oral health knowledge questionnaire for use among a sample of low-income Maryland adults.[67] Due to funding, only 100 subjects were able to participate in the study. Inclusion criteria were: at least 18 years of age, live in the Baltimore area, have participated in the US Bureau of the Census in order to determine their education level. Phone numbers were randomly chosen and were drawn from the Baltimore areas where the US Bureau of the Census registered lower levels of education compared to the general population of Baltimore. Once the 100 subjects were chosen, face-to-face interviews were conducted. Participants were provided a bi-fold binder so they were able to see the question being asked aloud by the interviewer. If a subject did not know the answer to a question, they were allowed to answer, "I don't know." The REALM and S-TOFHLA were given to the subjects after completion of the conceptual oral health knowledge survey. In addition, a survey regarding demographics, education level, household income, and history of decay, periodontal disease, and oral cancer and their last dental visit was conducted. Oral health knowledge scores were categorized into three categories: poor (0-11), fair (12-14), and good (15-23). Overall, 29% of participants were determined to have poor oral health literacy, 28% were determined to have fair oral health literacy, while 42% of participants were found to have high oral health literacy.[67]

"Oral Health Knowledge Among Elderly Patients"

The purpose of this study was to assess the oral health knowledge among an elderly population (65+).[76] Participants were recruited from two university-based clinics at the University of Iowa College of Dentistry in Iowa City, Iowa. Potential participants were recruited by the research team in the clinics and mailed flyers to patients that had upcoming dental appointments. Potential participants who did not return the flier were called to account for literacy issues that the potential participant could have had. Similar to the above-mentioned study (Macek et al.), the tool

used to measure oral health literacy was the Comprehensive Measure of Oral Health Knowledge. Instead of using a bi-fold binder to read the questions aloud to the participants, the CMOHK questions were displayed on slides from a laptop computer. Therefore, participants were able to read the question along with the team member who read each questions aloud. A point was given for each question answered correctly and zero points if a question was answered incorrectly or if the participant answered "I don't know." In addition, health literacy was assessed by asking participants "How often do you have someone help you read instructions, pamphlets, or other written material for the doctor or pharmacy?" Participants who answered "sometimes", "often", or "always" had low health literacy and those who answered "never" or "rarely" had high health literacy. Participants were also given a questionnaire consisting of demographic and dental information. Because this population was different than the one studied in Macek et al., the scoring system was modified to accommodate this elderly population. Overall, 39% had poor oral health knowledge, 27% had fair oral health knowledge, and 39% had good oral health knowledge. In respect to health literacy, only 18.4% reported having low health literacy compared to 81.6% who reported having high health literacy.[76]

Oral Health Literacy Adult Questionnaire (OHL-AQ)

"New Oral Health Literacy Instrument for Public Health: Development and Pilot Testing"

The purpose of this study was to develop and test an oral health literacy questionnaire containing the following components: reading comprehension, numeracy, listening, and decision-making.[75] Contrary to the above-mentioned studies, participants were recruited via stratified multistage random area sampling from five different districts from Tehran, Iran. A convenience sample of 97 participated in the study. Inclusion criteria consisted of being between the ages of 18-65 and able to read or write in Persian. Participants completed the oral health literacy questionnaire on their own along with demographic and dental brushing behavior questions. Oral health literacy scores were categorized based on the number of correct questions answered. The categorization is as follows: inadequate (0-9 points), marginal (10-11), and adequate (12-17). In

this study, the mean oral health literacy score was 10.5, indicating marginal oral health literacy. In addition, 39.2% of participants had inadequate oral health literacy, 16.5% had marginal oral health literacy, and 44.3% had adequate oral health literacy. [75]

<div align="center">Predictors of Oral Health Literacy</div>

Several demographic characteristics have been found to be associated oral health literacy. The following section discusses the various sociodemographic characteristics that have been found to be associated with oral health literacy based on the nine articles presented above. If the findings from an article are not discussed within a section, then the authors did not examine the relationship between oral health literacy and that particular characteristic.

Levels of Oral Health Literacy by Gender

Oral health literacy levels varied in each study. Lee et al. excluded males from their study. Therefore, differences in oral health literacy by gender are not reported.[77] However, they reported that the mean oral health literacy score in their sample was 15.8.[77] Gender was not associated with oral health literacy levels in Atchison et al. study.[70] The mean score for males was 78.8, and it was78.6 for females (p=0.903).[70] Lee et al. did not find an association with gender and oral health literacy scores (p=.42).[72] Sabbahi et al. found no significant association with gender and oral health literacy scores.[74] Descriptive analysis in the Macek et al. study showed that a higher percentage of males were in the poor, fair, and good oral health literacy categories compared to females (Table 9). In contrast, McQuistan et al. did not find an association with oral health knowledge and gender (p>0.05).[76] Naghibi Sistani et al. compared mean gender oral health literacy scores and found no statistical difference (p=0.11).[75]

Table 9. Percentage of male and female participants by oral health knowledge category (Macek et al. 2010)

Gender	Poor (0-11)	Fair (12-14)	Good (15-23)
Male	37.8	31.1	31.1
Female	23.6	25.5	50.9

Levels of Oral Health Literacy by Income

Descriptive analyses of household income based on oral health knowledge scores were reported in the Macek et al. study.[67] Overall, a higher percentage of participants with unknown household income or a household income of $0-$25,000 were in the poor and fair oral health knowledge groups compared to participants who reported a household income of ≥$25,000 (Table 10).[67] McQuistan et al. did not find an association with income and oral health knowledge (p>0.05).[76]

Table 10. Percentage of participants' household income by oral health knowledge category (Macek et al. 2010)

Household Income	Poor (0-11)	Fair (12-14)	Good (15-23)
Unknown	40.0	13.3	46.7
$0-$25,000	33.3	29.4	37.3
≥$25,000	20.6	32.3	47.1

Levels of Oral Health Literacy by Dental Payment Type

Atchison et al. analyzed the association between dental payment type (insurance vs. self-pay).[70] Participants who reported having dental insurance had a mean oral health literacy score of 78.5, while participants who reported self-paying for dental services had a mean oral health literacy score of 79.3. As such, these mean scores were not statistically significant (p=0.484).[70] Similarly, McQuistan et al. did not find an association with insurance status and oral health knowledge (p>0.05).[76]

Levels of Oral Health Literacy by Race and Ethnicity

In general, race, and sometimes ethnicity, was found to be associated with oral health literacy. Lee et al. found that the mean oral health literacy score was 17.4 for whites, 15.3 for African-American, and 13.7 for American Indians.[77] Due to the low number of subjects in the non-white racial groups, Hispanic ethnicity was reported for whites only. Hispanic whites scored an average of 17.8, and non-Hispanic whites scored an average of 17.4, thus Hispanic ethnicity

was not significantly associated with oral health literacy. When adjusting for education, county of residence, age, and Hispanic ethnicity, it was found that the higher adjusted oral health literacy scores were from whites (22.5), with a mean difference of 2.0 from the other groups, whereas American Indians and African-American's scores were almost identical (20.5 and 20.3, respectively).[77] Vann et al. reported that mean oral health knowledge and oral health literacy scores were lower among American Indians and African-Americans compared to Whites (oral health knowledge: 4.7, 4.7 vs. 4.9, and oral health literacy: 13.7, 15.3 vs. 17.4, respectively).[78] Atchison et al. also found that race was significantly associated with oral health literacy.[70] When comparing White participants to non-White participants (i.e. Hispanic, African-American, Asian/Pacific Islander, American Indian, and "other" groups), non-white subjects had significantly lower mean REALM-D scores (76.2) compared to white participants (80.5; $p \leq 0.002$).[70]

Levels of Oral Health Literacy by Age

The results assessing the relationship between age and oral health literacy varied. In the Lee et al. study, it was found that age was not statistically associated with oral health literacy ($p=0.52$).[77] Participants in the lowest age group (17.2-20.9 years of age) had an average oral health literacy score of 14.2, while participants in the higher age groups (20.9-23.4, 23.4-26.5, 26.5-30.9 years), had scores the ranged from 16.3 and 16.6.[70] Vann et al. reported that as age increased in the participants, so did oral health knowledge and oral health literacy score.[78] For example, participants in the 17.2-21.3 age group had mean oral health knowledge scores of 4.5 and mean oral health literacy scores of 14.0 compared to participants in the 21.3-23.8 age group who scored 4.7 in oral health knowledge and 15.5 in oral health literacy.[78] Lee et al. and Sabbahi et al. did not find an association with age and oral health literacy scores ($p>0.05$).[72, 74] Similarly, McQuistan et al. found that although there was a trend toward the oldest participants having lower oral health knowledge, the scores between the oldest and younger participants were not statistically different ($p>0.05$).[76] In contrast, Macek et al. reported that age was significantly

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associated with oral health knowledge scores (p<0.05).[67] For example, 15 participants in the 18-44 age group were in the poor category of oral health knowledge, compared to nine participants in the 45-64 age group, and five in the 65 and over age group.[67] Interestingly, the Macek et al. study showed that participants in the oldest age group had the highest knowledge, which is opposite of usual health literacy findings. Lastly, Naghibi Sistani et al. did not find a significant difference in age groups and oral health literacy mean scores (p=0.87).[75]

Levels of Oral Health Literacy by Education

Education was found to be associated with oral health literacy scores in eight studies.[67, 70, 72, 74-77] In the Lee et al. study, those who had a college degree or higher had higher mean scores (20.1) than those who had education levels below high school (13.0).[77] Vann et al. reported that having a higher education indicated higher oral health knowledge and literacy scores.[78] Participants who did not finish high school had a mean knowledge of 4.6 and a mean oral health literacy score of 12.9 compared to participants who had a college degree or higher who scored a mean knowledge score of 5.2 and a mean oral health literacy score of 21.[78] Similarly, Atchison et al. reported that participants who had more than a college education had a higher mean score (81.2) than those with less than high school education 75.6 (p=0.005).[70] Lee et al. reported that years of schooling was associated with oral health literacy scores (p<0.01).[72] Sabbahi et al. reported that levels of education were only significant without adding oral health knowledge scores to the multiple linear regression model (p<0.05).[74] Macek et al. also reported that education was significantly associated with oral health knowledge (p<0.05).[67] For example, twelve participants who had less than 12 years of education obtained a poor score. Likewise, 11 participants who had completed 12 years of education also received a poor score. In contrast, only six participants who completed more than twelve years of education received a poor score.[67] McQuistan et al. reported that 52.8% of the participants who had an education level of high school or less had poor oral health knowledge compared to 25.6% who completed more than high school education.[76] Naghibi Sistani et al. reported that as age increased, so did mean oral health

literacy scores (p<0.001).[75] For example, participants with 1-5 years of education had a mean oral

health literacy score of 6.6, while participants with 6-12 years of education had a mean oral health

score of 10. Participants with more than 12 years of education had a mean oral health literacy

score of 12.2.[75]

Levels of Oral Health Literacy by Marital Status

Descriptive analysis in the Lee at al. study showed a trend in higher mean oral health

literacy scores.[77] Participants who self-reported being married had a mean REALD-30 score of

17.3 compared to a score of 16.8 for those who reported being separated/divorced, and 15.2 for

those who reported being single parents. This variable was not analyzed at the bivariate or

included in the multiple linear regression models.[77]

Levels of Oral Health Literacy by Language

Language was associated with oral health literacy in the Atchison et al. study.[70] The

overall mean score for non-English speakers was 73.4, whereas the overall mean score for

English speakers was 80.1 (p=0.002).[70]

Levels of Oral Health Literacy by Health Literacy

Health literacy was associated with oral health literacy scores in the Lee et al. study

(β=0.22, p=0.03).[72] In contrast, health literacy was not statistically significantly associated with

oral health knowledge in the McQuistan et al. study.[76]

Predictors of Oral Health Literacy Summary

Although far fewer oral health literacy studies have been conducted compared to the

number of general health literacy studies, several trends can be observed, many of which are

similar to those found within general health literacy studies. Gender was not associated with oral

health literacy levels in the Atchison et al. and Lee et al. studies.[70, 72] However, Macek et al.

reported that males tended to have lower oral health literacy scores than women.[67] In addition,

Macek et al. reported that participants with an unknown income or an income of $0-$25,000

tended score in the poor or fair oral health knowledge category.[67] Lee et al. and Vann et al. found

that race was associated with oral health literacy.[67, 78] Specifically, minority groups were more

likely to have lower mean oral health literacy scores than Whites.[77] Similarly, non-white

participants in the Atchison et al. study also had lower mean oral health literacy scores than

whites.[70] Age was not found to be a predictor of oral health literacy within both the Lee et al.

studies,[72, 77] but it was associated with health literacy and knowledge in Vann et al. and Macek et

al. studies.[67, 78] Contrary to general health literacy studies, Vann et al. and Macek et al. found that

that older age individuals had higher oral health knowledge than their younger counterparts.[67 78]

Education was found to be associated with oral health literacy in eight of the studies; higher

education levels were associated with higher oral health literacy scores.[67, 70, 72, 74-78] Participants

who were married were more likely to have higher oral health literacy scores than participants

who were single or separated/divorced.[77] Atchison et al. found that being a native English-speaker

resulted in higher oral health literacy scores than non-native English speakers. [70]

<u>Oral Health Outcomes</u>

Dental caries among children is the number one chronic disease among children in the

United States, especially among minority and low-income populations.[19] When it comes to oral

health, caregivers' influence on their children is of importance since behaviors are learned at an

early age.[78] In 2000, the Surgeon General's report, "Oral Health in America," stated that parents

without appropriate oral health knowledge may be more likely to avoid oral health modalities for

the prevention of disease.[11] This gives reason to believe that caregivers play an important role in

their children's oral health knowledge and behaviors, as well as parents' ability to appropriately

take care of their children's teeth.[11] Furthermore, oral health literacy may also be associated with

oral health outcomes within adult populations. The following section describes associations

between oral health literacy and oral health knowledge, behaviors, and oral health status.

"Oral Health Literacy Among Female Caregivers: Impact on Oral Health Outcomes in Early

Childhood"

See "Oral Health Literacy Trends" (above) for details about this study.[78] Outcomes associated with oral health knowledge and oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes."

"Impact of Caregiver Literacy on Children's Oral Health Outcomes"

This study's purpose was to determine if there was an association between primary caregivers' oral health literacy and their children's oral health outcomes.[79] This cross-sectional study was comprised of English speaking caregivers of children who were six years of age or younger. A convenience sample of 106 caregiver-child dyads was recruited from the University of North Carolina School of Dentistry teaching clinic. Potential participants were invited to participate in the study if it was their initial visit at the School of Dentistry. The study assessed caregivers' oral health literacy and oral health knowledge, their perceptions of their children's oral health status, the caregivers' demographics, oral health behaviors pertaining to their children, and the child's clinic dental health status. Oral health literacy was measured using the REALD-30. Oral health knowledge was measured using a questionnaire developed by Shick et al. The focus of this oral health knowledge questionnaire was dental disease prevention. Children's oral health behavior was measured using a questionnaire developed by Douglass et al. Oral health perception was measured using questions from the NIDCR National Oral Health Surveys. Questionnaires were used to assess the previously mentioned variables. Clinical dental health was also measured using the Poulson and Horowitz index. The three severity zones in this index were: 1) caries free and no treatment necessary, 2) low to moderate treatment needs, 3) and advanced treatment needs.

The mean REAL-D score was 20.7. In this study, low oral health literacy was defined as scoring ≤22, and the authors reported that 55.7% of the participants had low oral health literacy.[79] Although individual knowledge items were associated with REAL-D 30 scores, the overall oral health knowledge item score was not statistically associated with oral health literacy.[79]

"Oral Health Literacy Assessment: Development of an Oral Health Literacy Instrument for Spanish Speakers"

See "Oral Health Literacy Trends" (above) for details about this study.[72] Outcomes associated with oral health knowledge and oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes."

"Development and Testing of the Test of Functional Health Literacy in Dentistry (TOFHLiD).

See "Oral Health Literacy Trends" (above) for details about this study.[73] Outcomes associated with oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes".

"Oral Health Literacy Levels Among a Low-Income WIC Population"

See "Oral Health Literacy Trends" (above) for details about this study.[77] Outcomes associated with oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes".

"New Oral Health Literacy Instrument for Public Health: Development and Pilot Testing"

See "Oral Health Literacy Trends" (above) for details about this study.[75] Outcomes associated with oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes".

"Development and Evaluation of an Oral Health Literacy Instrument for Adults"

See "Oral Health Literacy Trends" (above) for details about this study.[74] Outcomes associated with oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes".

"Oral Health Knowledge Among Elderly Patients"

See "Oral Health Literacy Trends" (above) for details about this study.[76] Outcomes associated with oral health literacy from this study are described below in "Associations Between Oral Health Literacy and Oral Health Outcomes".

Poor Oral Health Outcomes by Levels of Oral Health Literacy

Several associations were noted in the aforementioned studies assessing oral health literacy and oral health outcomes. The results are presented by outcome. Studies that are not mentioned within a particular outcome did not measure that outcome's association with oral health literacy, and therefore are not discussed.

High Caries Risk Behaviors

High caries risk behaviors were found to be associated with oral health literacy in three studies.[75, 78, 79] Vann et al. asked caregivers the frequency of brushing their child's teeth, the frequency of juice consumption by the child, the frequency of sweet snack consumption by the child, and history of ever putting the child to sleep with a bottle.[78] Similarly, Miller et al. asked the frequency of brushing their child's teeth and history of ever putting the child the bed with a bottle.[79] Additionally, Miller et al. asked caregivers if they used toothpaste when brushing their child's teeth, and history of their child and other children visiting a dentist.[79] In the Vann et al. study, participants who reported not brushing or not cleaning their children's teeth daily were more likely to have lower oral health literacy scores than participants who cleaned their children's teeth daily (14.8 vs.16.0, respectively).[78] Additionally, participants who put their child to sleep with a bottle (14.9) were more likely to have lower oral health literacy scores than participants who did not put their child to sleep with a bottle (14.9 vs.16.2, respectively).[78] Caregivers of children who consumed fruit juice more than once a day had lower mean oral health literacy scores than children who never consumed fruit juice (15.4 vs. 16.0, respectively).[78] Similarly, caregivers of children who consumed sweet snacks more than once a day had lower mean oral health literacy scores than children who never consumed sweet snacks (15.7 vs. 15.8).[78] Miller et al. found that caregivers of children who had not previously visited a dentist had higher mean oral health literacy scores than those who reported taking their child to a dentist (22.9 vs. 19.6, p=0.03).[79] Further, Naghibi Sistani et al. reported that participant's brushing behaviors were associated with mean oral health literacy scores (p=0.03).[75] Participant's who reported brushing

their teeth 1-2 times per day had a mean score of 10.8, while participants who reported brushing their teeth 1-2 or 3 times per week who had a mean score of 9.3, respectively.[75]

Perceptions of Children's Oral Health Status

Caregiver's perception of their children's oral health status was found to be associated with oral health literacy in three studies.[73, 78, 79]After adjusting for demographic information, Vann et al. found that low oral health literacy was associated with caregivers reporting poor oral health status among their children (OR=1.44; 95% CI=1.02, 2.05).[78] Additionally, African-Americans and American-Indians, who tended to score lower than Whites on the oral health knowledge test, were the most likely to report poor oral health status among their children (African American: OR=1.04, 95% CI=0.75, 1.44; American-Indians: OR=1.56; 95% CI=1.06, 2.29).[78] Similarly, Miller et al. found that oral health literacy was associated with caregivers' reported children's oral health status.[78] Caregivers who reported their children to have poor or fair oral health status were more likely to have a lower mean oral health literacy score than caregivers who reported their children's oral health status as excellent, very good, or good (19 vs. 22, respectively; p=0.003).[79] Gong et al. reported that the association between oral health literacy and caregivers' self-reported child's oral health status was not significant in their study (p>0.05).[73]

Self-Reported Health Status and Self-Reported Oral Health Status

Self-reported health status was correlated with oral health literacy scores in the Lee et al. study (r=0.18, p≤0.05).[72] However, Gong et al. did not find an association with oral health literacy and self-reported oral health status.[73]

Clinical Dental Health Examination

Clinically confirmed oral health status was associated with oral health literacy. Miller et al. found that children who had severe dental disease were more likely to have caregivers with lower oral health literacy scores than children who were identified as having no or minimal dental needs (mean oral health literacy scores: 18 vs. 22, respectively; p=0.001).[79] Additionally, when controlling for race and income, children who were diagnosed with mild to moderate treatment

needs were more likely to have caregivers who scored higher on the oral health literacy survey than the caregivers of children with severe dental treatment needs (OR: 1.14; 95% CI= 1.05-1.25, p=0.003).[79]

Oral-Health Related Quality of Life

Two studies reported the association of oral health literacy and oral-health related quality of life. Lee et al. determined that oral-health quality of life was correlated with oral health literacy scores (r=0.29, p≤0.05).[72] Similarly, Gong et al. reported this association (p<0.05).[73]

Last Dental Visit

Dental utilization was associated with oral health literacy scores. Lee et al. reported descriptive data for participants' last dental visit with the corresponding mean oral health literacy scores.[77] Participants who reported going to the dentist <12 months ago or 2-5 years ago had the same mean oral health literacy score of 15.8. Participants who reported going 12-23 months ago had a mean oral health literacy score of 16.1. The lowest mean oral health literacy score, 15.4, was among participants who reported going to the dentist 5+ years ago.[77] Similarly, Sabbahi et al. found an association with frequency of dental visits and oral health literacy scores (p<0.05).[74] However, McQuistan et al. did not find an association with last dental visit and oral health knowledge (p>0.05).[76]

Poor Oral Health Outcomes by Levels of Oral Health Literacy Summary

Several variables were associated with oral health literacy and poor oral health outcomes. Vann et al. and Millet et al. reported that caregivers who exposed their children to high caries risk behaviors were more likely to have lower oral health literacy scores.[78, 79] Similarly, Naghibi Sistani et al. reported that adults in their study who exposed themselves to high caries behaviors were also more likely to have lower oral health literacy scores.[75] Vann et al and Miller et al. determined that caregivers reporting poor oral health status among their children were more likely to have lower oral health literacy scores. Specifically, Vann et al. reported that minority groups, African-American and American-Indians, were more likely to have lower oral health knowledge

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scores than Whites and were the most likely to report poor oral health status among their children.[78] Miller et al. found that caregivers who reported their children to have poor or fair oral health status were more likely to have a lower mean oral health literacy score than caregivers who reported their children's oral health status as excellent, very good, or good.[79] Lee et al. found an association with self-perceived health status and oral health literacy scores.[72] Miller et al. confirmed from clinical dental examinations that caregivers' children who had severe dental disease were more likely to have low oral health literacy scores than caregivers of children who were identified as having mild to moderate dental disease.[79] Lee et al and Gong et al. found an association with oral health literacy and oral health quality of life.[72, 73] In respect to participants' last dental visit, Lee et al. reported that those who reported going to the dentist 5+ years ago had a lower mean oral health literacy score than participants who had gone to the dentist less than 5 years ago.[77] Sabbahi et al. also reported a significant association with oral health literacy and frequency of dental visits. [74]

<div align="center">Oral Health Literacy Summary</div>

Because oral health literacy is a fairly new component of health literacy, the tools used to assess oral health literacy are fewer in comparison to health literacy tools. The existing tools encompass word recognition, reading comprehension, knowledge, numeracy or a combination of the aforementioned components. When compared to health literacy studies, fewer studies have assessed the oral health literacy levels of minority populations. Similar to health literacy studies, sociodemographic characteristics have been found to be associated with oral health literacy; however, the results have varied by study. For example, gender was significantly associated with oral health literacy in the Macek et al. study,[67] but not the other studies.[72, 74-78] Similarly, Macek et al. found an association between income and oral health knowledge,[67] whereas McQuistan et al. did not.[76] Other variables that were sometimes found to be associated with oral health literacy include age, education, marital status, English proficiency, and minority status. Specifically, younger individuals tended to have lower oral health literacy levels than older individuals.[67, 78]

Less education was found to be associated with lower oral health literacy levels.[67, 77 72, 74-76, 78] Lee et al. reported that individuals who were not married had lower mean oral health literacy scores than married individuals.[77] Further, Atchison et al. reported that oral health literacy scores tended to be lower in non-native English speakers.[70] In respect to levels of oral health literacy among minority populations, these groups tended to have lower mean oral health literacy scores than Whites.[70, 77, 78]

Oral health literacy was also associated with oral health outcomes and behaviors. Low oral health literacy was more common among minority caregivers reporting poor oral health status among their children.[78, 79] Low oral health literacy among adults and adults caregivers was also associated with exposure to high caries risk behaviors such as not brushing children's or ones teeth daily, putting a child to bed with a bottle, and frequent consumption of fruit juice and sweet snacks.[75, 78, 79] Additionally, oral health literacy has was associated with self-reported health and oral health status,[72, 78, 79] clinically confirmed oral health status,[79] oral health related quality of life,[72, 73] and dental utilization.[74, 77]

Literature Review Summary

Currently, the Hispanic population represents 17% of the total population, making it the largest minority group in the United States.[9] By 2060, it is projected that this population will more than double, from 53.3 million to 128.8 million.[9] Thus, this group will continue to be the largest ethnic minority group in the United States. The Midwest has also seen a steady Hispanic population increase, specifically in the state of Iowa where the majority minority racial and ethnic group is represented by Hispanics.[15] Similarly, it is expected that this population will more than double by 2040.[15]

Health disparities exist in the United States. However, with respect to racial and ethnic groups, minorities tend to experience more health disparities than Whites. Specifically, the Hispanic population suffers from preventable chronic health and oral health conditions. Although constant efforts are being done to improve health and oral health disparities, it is important to

understand that the Hispanic population has cultural and sociodemographic barriers that affect access to healthcare and therefore affect health outcomes. These barriers, as described by Betancourt et al., include limited clinic hours, transportations, long waiting times, healthcare workforce issues, and acculturation.[21] Sociodemographic barriers that affect access to healthcare include health beliefs and use of alternative medicine, low income, lack of insurance, citizenship status, and literacy/health literacy/oral health literacy.

The health literacy levels of the population have been assessed. When comparing the results among each racial and ethnic groups, Hispanics, on average, have the lowest levels. Studies that have assessed health literacy have determined that people with the following characteristics are more likely to have low health literacy: men,[27] those whose first language is not English,[7, 8, 27, 65] older in age,[8, 49] low levels of education,[7, 8, 49] low income,[27] and/or have Medicaid insurance.[49]

Similarly, oral health literacy of specific populations have been assessed. Because oral health literacy impacts one's ability to properly understand oral health information, having low oral heath literacy can lead to poor oral health outcomes. Studies that have assessed oral health literacy have determined that, in general, low oral health literacy levels are associated with gender, income, dental insurance, race and ethnicity, age, education, marital status, and language spoken.[67, 70, 72-78] Further, studies have also determined that levels of oral health literacy are associated with oral health outcomes. For example, studies have found that high-risk caries behavior, such as less frequent tooth brushing and putting a child to sleep with a bottle are associated with low health literacy.[78, 79] Similarly, lower levels of self-reported health status,[72] poorer oral-health related quality of life,[72, 73] and less frequent dental utilization are also associated with lower oral health literacy.[74, 77]

Due to oral health literacy being a relatively new concept, studies have not solely assessed the oral health literacy levels of the Hispanic population. Although many tools have been developed, the development of Spanish tools is limited. It is important that the oral health

literacy tools be translated into Spanish in order to account for potential language barriers that may artificially decrease oral health literacy scores due to language barriers rather than an actual lack of dental knowledge. The need for these tools are essential for determining the oral health literacy levels of the Hispanic population since it can help to assess if oral health literacy is related to Hispanics' oral health disparities. Since studies have not solely assessed the oral health levels of the Hispanic population, it should be determined if the aforementioned variables that are associated with oral health literacy in White and African American populations are also associated with low oral health literacy among Hispanics so that appropriate intervention programs can be developed to increase oral health literacy with the Hispanic population, as needed. Additionally, determining oral health literacy levels among the Hispanic population may help prevent or decrease poor oral health outcomes. Lastly, since few studies have assessed the association between oral health literacy and utilization of dental services, it is important to assess this relationship within a Hispanic population to determine if oral health literacy and dental utilization are associated.

CHAPTER III-MATERIALS AND METHODS

Overview

Hispanics are currently the largest minority group in the United States.[14] They are projected to more than double by the year 2060.[9] Although the oral health of the Hispanic population in the United States has improved, the improvement has been minimal. Consequently, disparities still exist.[5] Assessing the oral health literacy of the Hispanic population may help to explain why some of these disparities are present. Oral health literacy has been defined as "the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions."[4] By understanding where a lack of knowledge exists, interventions can be developed to help improve the oral health status among the Hispanic population.

The purpose of this cross sectional study was to determine the oral health knowledge and dental care utilization among a convenience sample of Hispanic adults (18+ years of age) in Iowa. Hispanics were defined as individuals living in the United States whose ancestors, or themselves, were from a Latin American country including the Caribbean, North America (México), Central America, and South America.[80] The first aim of the study was to examine if a difference in oral health knowledge exists among Hispanic's who prefer to read or speak predominately in Spanish *vs.* those who speak and/or read in English and Spanish (bilingual) or English only. The second aim was to assess whether a difference in dental care utilization existed among participants based on their level of oral health knowledge.

Research Questions

The research questions addressed in the present study were:

1. Is there a difference in oral health knowledge among Hispanic adults based on English language proficiency?

2. Is oral health literacy associated with dental utilization?

<u>Hypotheses</u>

The following hypotheses pertain to predictions associated with which predictor variables were the most likely to be associated with low oral health literacy and irregular dental care utilization.

A. Oral Health Literacy

1. Older participants will have lower oral health knowledge than those in the younger age groups.

2. Male participants will have lower oral health knowledge than female participants.

3. Participants reporting education level as less than 12th grade will have lower oral health knowledge than those with a high school diploma/GED or college degree.

4. Participants reporting a yearly household income of ≤$25,000 will have lower oral health knowledge than participants reporting yearly household income as >$25,000.

5. Participants who report being uninsured will have lower oral health knowledge than those who are insured.

6. Participants with low health literacy will have lower oral health knowledge than those who have high health literacy.

7. Participants who needed help completing the questionnaire will have lower oral health knowledge than those who completed it on their own.

8. Participants born outside of the United States will have lower oral health knowledge than those who were born in the United States.

9. Participants living in the United States fewer years will have lower oral health knowledge than those with greater years of residence.

10. Participants with low behavior and culture acculturation scores will have lower oral health knowledge than those who have high behavior and culture acculturation scores. (See Predictor Variables: Operational Definitions for a description of low acculturation score)

11. Participants who have low language acculturation scores will have lower oral health knowledge than those who have high language acculturation scores.

12. Participants who perceive it is very important that their dental provider speaks Spanish will have lower oral health knowledge than those who perceive it is somewhat or not important.

13. Participants who perceive it is very important that their dental provider is of Hispanic/Latino descent will have lower oral health knowledge than those who perceive it is somewhat or not important.

14. Participants who needed, wanted, or had to bring a translator at their last dental appointment will have lower oral health knowledge than those who did not need a translator.

15. Participants who complete the questionnaire in Spanish will have lower oral health knowledge than those who completed it in English.

16. Participants who report seeking care more than 12 months ago will have lower oral health knowledge than those who report seeking care one year ago or less.

17. Participants who rate their teeth and gums as "fair", "poor", or "I don't know" will have lower oral health knowledge than those who rate their teeth and gums as "excellent", "very good", or "good".

18. Participants who report going someplace other than a private dental office, community health center, or University of Iowa College of Dentistry to seek dental care will have lower oral health knowledge than participants who seek care in a dental clinic.

B. Dental Care Utilization

1. Male participants are more likely to be irregular attendees of dental care compared to female participants.

2. Participants reporting education level as less than 12th grade are more likely to be irregular attendees of dental care than those with a high school diploma/GED or college degree.

3. Participants reporting a yearly household income of ≤$25,000 are more likely to be irregular attendees of dental care compared to individuals reporting a yearly household income of >$25,000.

4. Participants who report being uninsured are more likely to be irregular attendees of dental care compared to individuals who are insured.

5. Participants with low health literacy are more likely to be irregular attendees of dental care compared to individuals with high health literacy.

6. Participants with low oral health knowledge are more likely to be irregular attendees of dental care compared to individuals with high oral health knowledge.

7. Participants living in the United States fewer years are more likely to be irregular attendees of dental care compared to those living in the United States greater years.

8. Participants who perceive it is very important that their dental provider speaks Spanish are more likely to be irregular attendees of dental care than those who perceive it is somewhat or not important.

9. Participants who perceive it is very important that their dental provider is of Hispanic/Latino descent are more likely to be irregular attendees of dental care than those who perceive it is somewhat or not important.

10. Participants who needed, wanted, or had to bring a translator at their last dental appointment are more likely to be irregular attendees of dental care than those who did not need a translator.

11. Participants who completed the questionnaire in Spanish are more likely to be irregular attendees of dental care compared to individuals who completed it in English.

12. Participants who have experienced tooth decay are more likely to irregular attendees of dental care than those who have never experienced tooth decay.

13. Participants who rate their teeth and gums as "fair", "poor", or "I don't know" are more likely to be irregular attendees of dental care compared to individuals who rate their teeth and gums as "excellent", "very good", or "good".

14. Participants who report going someplace other than a private dental office, a community health center, or the University of Iowa College of Dentistry to seek dental care are more likely to be irregular attendees of dental care than participants who seek care at a dental clinic.

15. Participants who are "never", "occasionally", "sometimes" or "often" compliant with attending their dental appointments are more likely to be irregular attendees of dental care than those who are always compliant.

<div align="center">Dependent Variables</div>

The primary dependent variable for this study was oral health knowledge, which was measured by the questionnaire "Comprehensive Measure of Oral Health Knowledge."[67] For more details about this questionnaire, see the corresponding section below. Participants were categorized into two categories based on their knowledge score: poor knowledge (0-14 questions correct) or good knowledge (15-23 questions correct).

The secondary dependent variable was utilization of dental services. Participants were categorized into regular attendees (at least one dental visit within the past 12 months) versus irregular attendees (last dental visit more than 12 months ago).

Predictor Variables: Operational (Recategorized) Definitions

1. Age (categorical, ordinal): Self-reported in years then re-categorized into 3 categories: 18-35, 36-55, and 56-71. This re-categorization was based on similar age categorization by the United States Census Bureau and one other study.[81, 82]

2. Sex (binary): Self-reported as either male or female in response to question on questionnaire.

3. Residence (binary): Self-reported as town in which participants resided in then re-categorized into two categories: metropolitan and non-metropolitan. (Information about categorization is located in "Participant Recruitment and Participation" section below.)

4. Education (categorical, ordinal): Self-reported then re-categorized into three categories: less than high school degree (<12th grade), high school degree or GED, and some college or college degree.

5. Income (binary): Self-reported as annual household of ≤$25,000 and >$25,000 income in dollars in response to question in questionnaire.

6. Dental Insurance (categorical, nominal): Self-reported then re-categorized into three categories: None, Other (Medicaid or Dental Wellness Plan), and Commercial or Private.

7. Health Literacy (binary): Self-reported as limited (low) if the participant answered "Sometimes", "Often", or "Always" and adequate (high) if the participant answered "Occasionally" or "Never" to health literacy question on questionnaire.[62]

8. Oral Health Knowledge (categorical, ordinal): Reported as low if participant answered 0-14 questions correctly or high if participant answered 15-23 questions correctly using the *Comprehensive Measure of Oral Health Knowledge Questionnaire* (CMOHK).[67]

9. Questionnaire Completed (binary): Reported based on who completed the questionnaire then re-categorized into two categories: Team member or participant.

10. Birth Country (binary): Self-reported as countries then re-categorized into two categories: United States and Other.

11. Time in the United States (ordinal): Self-reported in years then re-categorized into two categories: 0-19 years and 20+ years.

12. Acculturation Level-Behavior and Culture (binary): Reported as less (low) acculturated to the Anglo/American culture if the participant's average score was between 1 and 2.99 and more (high) acculturated to the Anglo/American culture if the average score was 3.0 or greater based on the *Short Acculturation Scale for Hispanics* (SASH).[83]

13. Acculturation-Language (binary): Reported as less (low) acculturated to the English language if the participant's average score was between 1 and 2.99 and more (high) acculturated to the English language if the average score was 3.0 or greater based on the *Brief Acculturation Scale for Hispanics (BASH)*.[84]

14. Spanish speaking dental provider (binary): Self-reported as participant's perceived importance that their dental provider speaks Spanish then re-categorized into two categories: "Very important" vs. "Somewhat important/Not important."

15. Ethnic background of dental provider (binary): Self-reported as participant's perceived importance that their dental provider is of Hispanic/Latino ethnic background then re-categorized into two categories: "Very important" vs. "Somewhat important/Not important".

16. Translator needed at last dental visit (binary): Self-reported then re-categorized into two categories: "Didn't need one" vs. "None present, but I wanted one/None present, I had to bring my own/Yes, the entire appointment/Yes part of the appointment."

17. Language of questionnaire (binary): Reported based on in which language the participant chose to complete survey and then re-categorized into two categories: "Spanish" and "English."

18. Tooth decay experience (binary): Self-reported as yes or no based on question on questionnaire.

19. Dental Utilization/Last visit to dental provider (binary): Self-reported and re-categorized into two categories: Regular dental care (≤12 months) and irregular dental care (>12 months).

20. Perception of teeth and gum health (binary): Self-reported and re-categorized into two categories: Excellent/Very good/Good and Fair/Poor/I don't know.

21. Dental home (categorical, nominal): Self-reported and re-categorized into three categories: Private dental office/Community Health Center/University of Iowa College of Dentistry vs. Emergency Room/Private doctor/Folk healer/Home remedies/Other/I have no place to go.

22. Dental Appointment Compliance (binary): Self-reported and re-categorized into two categories: "never/occasionally/sometimes/often" vs. "always."

Human Subjects

An application to conduct this study was submitted to and approved by the University of Iowa Human Subject's Office (IRB#201409832).

Population Studied

Participants were included in the study if they met the following criteria: self-identified as Latino or Hispanic; spoke English, Spanish, or both; were 18 years of age or older, with an emphasis on individuals between the ages of 18-64; were able to provide their own informed consent; and resided in the state of Iowa at the time of the study. Participants were excluded from the study if they were: 17 years of age old or younger and unable to provide their own informed consent to participate in the study. Additionally, because the majority of the Hispanic population living in the United States represents Spanish speaking Latin American countries,[35] participants were excluded if they self-reported being Spanish or Brazilian.

Participant Recruitment and Participation

Recruitment of a convenience sample of participants was limited to towns and cities of

Eastern and Central Iowa (Cedar Rapids, Columbus Junction, Des Moines, Hampton, Iowa City,

Muscatine, Ottumwa, and West Liberty). The locations were selected based on the high

percentage of Latinos/Hispanics residing in these towns and cities. These locations were also

included because they had a range of populations that were considered to be metropolitan and

non-metropolitan areas. Towns and cities were identified as metropolitan or non-metropolitan by

first determining in which county each town or city was located. This was determined using the

"Iowa State Data Center". [85] Each county in Iowa has a "Federal Information Processing

Standards" code. Once the county code was determined, the United States Department of

Agriculture's "2013 Rural-Urban Continuum Codes (RUCC)" was used to classify counties as

metropolitan and non-metropolitan.[86] Metropolitan counties are based on the population size, and

non-metropolitan counties are based on the degree of urbanization (concentration of population

change from rural to urban areas) and neighboring metropolitan areas. [87]

In order to recruit participants, fliers (available in English and Spanish) approved by the

IRB were distributed around the towns and cities (See Appendix A). Additionally, word of mouth

from participants, mass email communication, and personal contact to churches and services

serving Hispanic/Latino populations was done to further recruit participants for this study. The

majority of the convenience sample was recruited from seven churches that provided services in

Spanish and parent programs that served the Hispanic/Latino population in Central and Eastern

Iowa. In order to determine if churches provided service in Spanish, web searches of churches

were made in certain towns and cities to find a contact telephone number. Each church was

contacted and asked if services were provided in Spanish. If they responded yes, they were told

about the study and asked to speak to the appropriate person in order to determine if participants

could be recruited at their church after mass. Additionally, five churches were contacted and did

not participate in the study due to lack of follow-up or they decided it was not in the best interest

of their members to participate. The research team traveled on a Sunday to each church that

agreed to participate. The principal investigator, who is a native Spanish speaker, announced at

the end of each service information about the study in order to recruit participants. If individuals

were interested in participating, the questionnaire was administered that day immediately after the

service. Recruitment that took place at parent programs that served the Hispanic/Latino

population was accomplished through word of mouth from participants that had already

participated in the study. The principal investigator was told by participants that these parent

programs involved Hispanic/Latino parents. The parent groups were contacted by the principal

investigator and were told about the study. If they agreed to participate, a date and time was set to

present information about the study to the parent group. If a parent was interested in participating,

the questionnaire was administered that day.

Prior to the administration of the questionnaire, a member of the research team explained

the consent document to the potential participant and then had the potential participant sign the

document. Participants could skip any question or stop at any time while the questionnaire was

being administered. Upon completion, participants received a $15 gift card of their choice from

either Walmart or Target at the time of participation. Additionally, participants were given a gift

card even if they were unable to complete the entire questionnaire.

<center>Questionnaire Development</center>

The questions on this questionnaire were selected from multiple validated questionnaires

and also developed specifically for this study. The questionnaire included questions pertaining to:

oral health knowledge, dental utilization, demographic information, acculturation, and health

literacy. Questions were selected and utilized verbatim or modified from the 2013-2014 National

Health and Nutrition Examination Questionnaire (NHANES),[88] University of Maryland,

Maryland Questionnaire of Adults-Prevention of Tooth Decay Questionnaire,[89] the

Comprehensive Measure of Oral Health Knowledge (see Appendix B for copy of

questionnaire),[67] the Short Acculturation Scale for Hispanics (SASH),[83] the Brief Acculturation

<center>81</center>

Scale for Hispanics (BASH),[84] and the Set of Brief Screening Questions.[63] See Appendix B and C for a copy of the questionnaire used in this study.

<div align="center">Translation of Questionnaire</div>

Questionnaires were available in English or Spanish. The principal investigator, who is a native Spanish speaker, translated the questionnaire in entirety into Spanish. Once translated, the questionnaire was sent to five faculty members at the University of Iowa College of Dentistry and Dental Clinics. The faculty members reviewed the translated questionnaire and suggested revisions to improve the translation. Next, a focus group session was conducted. Three people from the community, representing various countries, ages, education and income levels, participated to provide feedback about the revised translated questionnaire. The three participants in the focus group represented countries from Mexico, Honduras, and Ecuador. The purpose of the focus group was to ensure that the translated questions were understandable. Additionally, the participants' opinions were obtained about word choices in order to look for consensus based on global understanding of various dialects. When the participants disagreed about wording, discussions ensued until all of the participants agreed upon a revision. The principal investigator also participated in the discussions, and the thesis chair was there to ensure that meaning of the questions stayed the same.

<div align="center">Conducting the Questionnaire</div>

Participants could choose whether to complete the questionnaire in English, Spanish, or a mix of English and Spanish. Participants completed the questionnaire in one of two ways. First, all participants had the oral health knowledge questions (i.e. the Comprehensive Measure of Oral Health Knowledge[67] questions) read aloud to them by a member of the research team. A flip chart containing all of the Comprehensive Measure of Oral Health Knowledge questions was used to read aloud one question at a time. The flip chart contained one question per page. One side faced the participant and the other side faced the research team member. The participant was free to read the question, however the research team member read each question aloud to account for

reading issues from the participant. The team member manually recorded each participant's answer on a paper copy of the questionnaire. Then, participants were asked how confident they were completing medical forms by themselves. Participants who answered "never", "occasionally", or "sometimes" were automatically read the remainder of the questionnaire by the team member. Those who answered "often" or "always" had the option of reading and completing the remaining questions of the questionnaire themselves or having a member of the research team read it to them.

<div align="center">Comprehensive Measure of Oral Health Knowledge (CMOHK)</div>

The Comprehensive Measure of Oral Health Knowledge (CMOHK) is a validated 23-item questionnaire developed at the University of Maryland.[67] This questionnaire assesses basic oral health knowledge. In contrast, other oral health literacy instruments, such as the REALD-30[68] and the TOFHLAiD,[73] only focus on word recognition and reading comprehension, thus oral health knowledge can only be assumed, not assessed. For that reason, they were not utilized for this study.

When utilizing the CMOHK, each question is scored individually as correct or incorrect. Then the total number of correct answers is calculated. When the questionnaire was originally developed and utilized, knowledge scores were categorized as the following: poor (0-11 points), fair (12-14 points), and good (15-23 points).[7] However, the creator of the questionnaire,[67] and others, have modified this scoring system based on the study population.[76, 90] For the purpose of this study, knowledge scores were dichotomized into poor (0-14) or good (15-23). This scoring system was determined based on the following two reasons. First, it follows the original scoring system, but combines the two lowest scoring categories. In that way, it reduces the "grey zone" of what a "fair" score truly means. Second, the new scoring system was determined based on the mean score (14) of the participants.

Acculturation

Behavioral and Cultural Values

Multiple scales have been developed to measure acculturation levels of Hispanics.[91] Some scales

measure only specific aspects of acculturation separately (e.g. language, behaviors, or values)

while others focus on measuring specific Hispanic subgroups.[91] For the purpose of this study,

acculturation was assessed using the validated Short Acculturation Scale for Hispanics (SASH).[83]

The SASH was chosen because it measures multiple aspects of acculturation including behavior,

cultural values, and language. Additionally, the scale was designed to represent a more

generalizable Hispanic population, which represents the study sample in this study. The SASH

contains 12 questions and is ranked on a 5-point Likert scale. The SASH consists of three factors:

language use, media, and ethnic social relations. The language use component contains five

questions (1-5), while the media component contains three questions (6-8). The aforementioned

eight questions are scored based on the following responses: only Spanish (1 point), Spanish

better than English (2 points), both equally (3 points), English better than Spanish (4 points), or

only English (5 points). The ethnic social relations component contains four questions (9-12) and

is scored based on the following: All Latinos/Hispanics (1 point), more Latinos than Americans

(2 points), about half and half (3 points), more Americans than Latinos (4 points), or all

Americans (5 points). All questions are summed and divided by the total number of questions

(12) to obtain an average score ranging from 1-5. Participants are considered less acculturated to

the Anglo/American culture if their average score is between 1 and 2.99, while those with scores

between 3.0-5.0 are considered more acculturated to the Anglo/American culture. Because the

Short Acculturation Scale for Hispanics was originally developed in both Spanish and English,[83]

translation of those questions was not necessary.

Language Proficiency

Language proficiency in this study was determined using the Brief Acculturation Scale for

Hispanics (BASH).[84] The BASH is a validated acculturation scale that specifically measures

language preference for Spanish or English. The BASH is the language subscale from the Short Acculturation Scale for Hispanics previously mentioned.[83] However, only four of the five questions from the SASH are used to determine language acculturation (questions 1, 3, 4, and 5) and are ranked on a 5-point Likert scale as previously mentioned (i.e., Only Spanish (1 point)… or only English (5 points)). The four sub-questions are summed and divided by the total number of language questions (i.e. 4) to obtain and average score ranging from 1-5. Participants are considered less acculturated to the English language if their average score is less than 3 and more acculturated to the Anglo/American culture if their average score is 3 or greater.

<div align="center">Sample Size Calculation and Statistical Analysis</div>

A sample size calculation was conducted in order to find a 10% or 15% difference in oral health knowledge between those who speak and/or read in Spanish only versus those who speak and/or read in Spanish and English or English only. Based on the results of the calculation, it was estimated that a minimum sample size of 346 should be obtained.

Descriptive statistics were calculated for all of the dependent and independent variables (i.e. using means and frequencies) to depict the characteristics of the study sample. After descriptive analyses were conducted, some of the variables were re-categorized in order to facilitate additional bivariate and regression analyses. These variables were re-categorized based on the literature or for conceptual reasons in order to make the groups more even to achieve greater statistical power. Independent variables were then categorized into three domains: 1) demographic, 2) cultural, and 3) dental. See Chapter IV Tables 24-25 or 34-36 to view how the variables were re-categorized.

Next, bivariate analyses were conducted to determine the factors associated with oral health knowledge and dental utilization within each domain using the Chi-square test and the Wilcoxon rank-sum test. Statistical significance was set at $p<0.05$ for the bivariate analyses. See Tables 24-26 and 34-36 in Chapter IV.

Variables showing a significant association with oral health knowledge or dental utilization (p≤0.05) in the bivariate analysis were considered as candidates for logistic regression models for each domain separately. Multiple logistic regression models were created to identify the variables related to low oral health knowledge or irregular dental utilization, and multicollinearity was examined. Variables showing significant associations (p≤0.05) in the domain-specific logistic regression models were used to develop a final model using forward stepwise logistic regression analysis, and verified using backward elimination. All possible two-way interactions were explored for all variables in the final models. See Tables 30 and 40 in Chapter IV. All tests utilized a significance level of 0.05. SAS for Windows (v9.4, SAS Institute Inc., Cary, NC, USA) was used for the data analysis.

CHAPTER IV-RESULTS

Overview

The results in this chapter are presented in three sections: 1) descriptive characteristics of participants, 2) oral health knowledge results, and 3) dental utilization results. The descriptive characteristics of participants are presented by the three domains: 1) demographic, 2) cultural, and 3) dental. The oral health knowledge and dental utilization sections are presented in three subsections including: descriptive analysis, bivariate analysis, and logistic regression analysis. Other descriptive results pertaining to miscellaneous information related to oral health knowledge that was not associated with the comprehensive measure of oral health knowledge questionnaire were also reported. Numbered tables accompany the aforementioned sections in order to present specific results.

Descriptive Characteristics of Participants

Frequency data pertaining to the descriptive characteristics of the study participants are presented in three domains: demographic, cultural, and dental. Additionally, the participants' sources for obtaining oral health information are presented.

Demographic

Three-hundred-thirty-eight participants completed the survey. Table 11 presents participants' demographic characteristics. The mean±SD age of the study participants was 36±12.54 years. Nearly 50% of respondents were 18-35 years of age, while only 8% were in the oldest age group (56-71 years of age). The majority of the participants were female (67%), lived in a metropolitan area (63%), and were married (52%). Forty-one percent of respondents had commercial or private dental insurance, while 38% of respondents did not have any dental insurance. The basic screening health literacy question revealed that approximately 67% of the participants had high literacy (i.e. often or always feel confident filling out medical forms) while 33% of the participants had low health literacy (i.e. never, occasionally, sometimes feel confident

feeling out medical forms). The majority of the participants (73%) completed the survey by

themselves; however, 27% of participants needed assistance with completing the questionnaire.

Table 11. Demographic information of participants (n=338)*

Variable	Frequency	Valid Percent (%)
Age		
18-35	166	49.70
36-55	143	42.80
56-71	25	7.50
Gender		
Male	110	32.90
Female	224	67.10
In which town or city do you live?		
Non-metropolitan	110	36.40
Metropolitan	192	63.60
What is your marital status?		
Single	111	33.23
Partnered	21	6.29
Married	175	52.40
Widowed	4	1.20
Separated	8	2.40
Divorced	13	3.89
Other	2	0.60
What is your highest level of education?		
8th grade or less	59	17.66
Some high school, but didn't graduate	45	13.47
High school diploma or GED	120	35.93
Two year college degree	38	11.38
Four year college degree	39	11.68
Graduate degree	33	9.88
Are you currently enrolled as a student in a college or university?		
	67	21.82
Yes	240	78.18
No		

Table 11-Continued

Variable	Frequency	Valid Percent (%)
About how much is your yearly household income?		
$0-$5,000	37	11.71
$5,001-$10,000	21	6.65
$10,001-$15,000	30	9.49
$15,001-$20,000	27	8.54
$20,001-$25,000	52	16.46
$25,001-$35,000	51	16.14
$35,001-$45,000	37	11.71
$45,001-$55,000	25	7.91
$55,001-$65,000	12	3.80
$65,001-$75,000	4	1.27
$75,001 or more	20	6.33
What type of dental insurance do you have?		
Medicaid or Title 19	31	9.39
Commercial or Private (ex. Delta Dental or Blue Cross Blue	135	40.91
Shield)	9	2.73
Dental Wellness Plan	126	38.18
None	4	1.21
Other	25	7.58
Not sure/don't know		
How confident are you filling out medical forms by yourself? (Self-perceived health literacy: Limited=Never, Occasionally, Sometimes vs. Adequate=Often, Always)		
Never	13	4.23
Occasionally	11	3.58
Sometimes	79	25.73
Often	70	22.80
Always	134	43.65
Survey completed by:		
Team member	38	11.48
Participant	242	73.11
Team member and participant	51	15.41
*Not all totals equal 338 due to missing data.		

Cultural

Table 12 presents cultural characteristics of participants. Among all participants, 73%

were born outside of the United States, and 56% have lived in the United States fewer than 20

years. Furthermore, 72% received a low total acculturation score (behavioral and cultural). When

examining language acculturation specifically, 78% of participants had a low language

acculturation score. Fifty-one percent of the participants responded that it was very important that

their dental provider speaks Spanish. Forty-five percent responded that they wanted, needed, or

had to bring a translator to their last dental appointment. Approximately 65% of the participants

chose to complete the questionnaire in Spanish.

Table 12. Cultural influences of participants (n=338)*

Variable	Frequency	Valid Percent (%)
In what country were you born?		
United States	90	26.63
Other**	248	73.37
How many years have you lived in the United States?		
0-19	185	56.40
20+	143	43.60
Acculturation (Behavioral and Cultural)		
Low (1-2.99)	240	72.07
High (3-5)	93	27.93
Language Acculturation		
Low (1-2.99)	264	78.11
High (3-5)	74	21.89
How important is it for you that your dental provider speaks Spanish?		
Very important	162	51.27
Somewhat important	59	18.67
Not important	95	30.06
How important is it for you that your dental provider is of Hispanic/Latino descent?		
Very important	76	24.20
Somewhat important	56	17.83
Not important	182	57.96
If your dentist only speaks English, was a translator provider to you during your last dental visit?		
I didn't need a translator	173	55.10
None present, but I wanted a translator	40	12.74
No, I had to bring my own	24	7.64
Yes, the entire appointment	50	15.92
Yes, part of the appointment	27	8.60

Table 12-Continued

Variable	Frequency	Valid Percent (%)
Survey read to participant in:		
Spanish	218	64.69
English	109	32.34
Spanish and English	10	2.97
*Not all totals equal 338 due to missing data. ** "Other" countries included: Argentina=0.40%, Belize=0.40%, Chile=0.40%, Colombia=1.61%, Ecuador=4.44%, El Salvador=1.21%, Guatemala=6.05%, Honduras=0.81%, Mexico=77.02%, Panama=0.40%, Peru=0.81%, Puerto Rico=1.21%, Dominican Republic=0.40%, Venezuela=3.63%, Veracruz=0.40%. Total does not equal 100% due to missing data.		

Dental

Table 13 presents participants' dental characteristics. Approximately 65% of participants had visited a dentist, dental hygienist, or other dental provider within the past 12 months. Moreover, approximately 30% reported that they go to the dentist only when they have pain or discomfort or when they need something fixed. Sixty-two percent of the individuals responded that a doctor or dentist had told them they had tooth decay, while 13% responded that they had been told they had periodontal disease. Nearly all of the participants (93%) had at least one tooth present in their mouths. Approximately forty-six percent of participants reported that the condition of their teeth and gums are fair or poor. Participants were most likely to state that they seek dental care at private dental offices (45%) compared to other options for treatment. Most participants received dental care solely in the United States (70%) rather than in other countries. Forty-eight percent of respondents reported that they are always compliant with respect to attending dental appointments. The majority of respondents (73%) reported that they would be very likely to ask questions to their dental provider when they did not understand information presented to them.

Table 13. Dental characteristics of participants (n=338)*

Variable	Frequency	Valid Percent (%)
How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?		
Never	12	3.58
6 months or less	153	45.67
More than 6 months, but not more than 1 year ago	64	19.10
More than 1 year ago, but not more than 2 years ago	40	11.94
More than 2 years ago, but not more than 5 years ago	43	12.84
More than 5 years ago	20	5.97
I don't know	3	0.90
Which statement below best describes when you go to the dentist?		
I go to the dentist regularly (at least every 12 months)	200	60.42
I go only when I have pain or discomfort	56	16.92
I go only when I need something fixed	42	12.69
Other	18	5.44
I have never been to the dentist	15	4.53
Has a doctor or dentist ever told you that you had tooth decay?		
Yes	206	62.42
No	116	35.15
I don't know	8	2.43
Has a doctor or dentist ever told you that you had periodontal disease?		
Yes	43	13.03
No	276	83.64
I don't know	11	3.33
Has a doctor or dentist ever told you that you had mouth cancer?		
Yes	0	0.00
No	327	99.09
I don't know	3	0.91
Have you lost all of your upper and lower natural permanent teeth?		
Yes	21	6.36
No	307	93.03
I don't know	2	0.61
Overall, how would you rate the health of your teeth and gums?		
Excellent	19	5.64
Very good	68	20.18
Good	89	26.41
Fair	119	35.31
Poor	35	10.39
Don't know	7	2.08

Table 13-Continued

Variable	Frequency	Valid Percent (%)
When did you last brush your teeth?		
This morning	309	92.24
Last night	13	3.88
I don't brush my teeth	1	0.30
I can't remember	12	3.58
Other	0	0.00
When you brush your teeth, what do you put on your toothbrush?		
Toothpaste	336	100.0
Baking soda	0.00	0.00
Nothing	0.00	0.00
I don't brush my teeth	0.00	0.00
Other	0.00	0.00
If you had a toothache, where would you go for treatment?		
Emergency Room	10	2.99
Private doctor's office	17	5.07
Private dental office	152	45.37
Community Health Center	56	16.72
University of Iowa Dental School	62	18.51
Folk healer	1	0.30
I would use home remedies	19	5.67
Other	1	0.30
I don't have a place to go	17	5.07
In which country do you normally seek dental care?		
Only in the U.S.	235	70.15
Only in my native country	17	5.07
Both equally	36	10.75
More in the U.S. than outside the U.S.	24	7.16
More outside the U.S. than in the U.S.	11	3.28
I don't seek dental care	12	3.58
How often are you compliant with attending your dental appointments?		
Never	16	5.11
Occasionally	31	9.90
Sometimes	32	10.22
Often	83	26.52
Always	151	48.24
When you do not understand information presented to you by your dentist, how likely are you to ask questions?		
Very likely	228	73.08
Somewhat likely	64	20.51
Not very likely	20	6.41
*Not all totals equal 338 due to missing data.		

Use of Resources to Obtain Dental Information

Table 14 identifies where participants were most likely to get information about oral and dental health. Participants were the most likely to seek information from their dentist/dental hygienist (85%), health newsletters/pamphlets (64%), physician/nurses (50%), the radio/television (50%), and the internet (47%). They were the least likely to obtain information from Headstart programs (15%), WIC centers (24%), and newspapers/magazines (30%). Additionally, only 35% of participants indicated they received information from friends, relatives, and neighbors.

Table 14. Use of informational dental resources by participants (n=338)*

Variable		Frequency	Valid Percent (%)
Radio/Television			
	Yes	160	49.54
	No	163	50.46
Internet			
	Yes	152	47.06
	No	171	52.94
Newspaper/Magazine			
	Yes	97	30.12
	No	225	69.88
Health newsletters/pamphlets			
	Yes	205	64.26
	No	114	35.74
Dentist/dental hygienist			
	Yes	277	84.97
	No	49	15.03
Physician/nurse			
	Yes	158	49.53
	No	161	50.47
Friends, relatives, neighbors			
	Yes	112	35.22
	No	206	64.78
WIC centers			
	Yes	75	23.66
	No	242	76.34
Headstart			
	Yes	47	15.02
	No	266	84.98
Health department			
	Yes	119	38.64
	No	189	61.36
*Not all totals equal 338 due to missing data.			

Results Summary-Descriptive

Three hundred thirty-eight participants completed the questionnaire. The mean age of the study sample was 36 years old. The majority of participants were female, married, and lived in a metropolitan area. Approximately 52% of the participants reported having an annual income of ≤ $25,000. Forty-one percent of respondents had commercial or private dental insurance, while 38% did not have any insurance. Thirty-three percent of the participants had low health literacy, and 27% of respondents needed assistance completing the survey. Results from the cultural domain indicate that more than 70% of the participants were born in a country outside of the United States and had low acculturation levels. Furthermore, 68% of participants completed the questionnaire in Spanish. Results from the dental domain show that 65% of participants had visited a dentist, dental hygienist, or other dental provider within the past 12 months while approximately 30% reporting only going when they had pain or discomfort or when they needed something fixed. Additionally, nearly 10% had either never gone to the dentist or gone to the dentist more than 5 years ago. The majority of participants had been told by a doctor or dentist that they have had tooth decay, but many less reported having periodontal disease, oral cancer, or being edentulous. Forty-six percent of respondents indicated that they perceive the health of their teeth and gums as fair or poor. The majority of respondents indicated they would seek dental care at a private dental office, community health center, or dental school if they had a toothache. Participants were the most likely to indicate they obtain dental information from resources such as a dentist/dental hygienist, health newsletter/pamphlet, physician/nurse, and radio/television.

Oral Health Knowledge

This section contains information pertaining to participants' *Comprehensive Measure of Oral Health Knowledge* (CMOHK) score and presents the percentage of people who answered each individual question correctly. The individual questions are organized by six domains (i.e. general dental knowledge, knowledge pertaining to children's oral health, disease prevention, dental treatment, periodontal disease, and oral cancer), with the correct answer to each question

95

bolded on the table.   The results of the bivariate and logistic regression analyses for exploring the

variables influencing participants with low oral health knowledge scores were reported.

Additional information pertaining to oral health knowledge, which was not assessed as part of the

CMOHK instrument, is presented at the end of this section.

<center>Descriptive Data</center>

Comprehensive Measure of Oral Health Knowledge Score

Bothe the mean score and the median scores on the CMOHK instrument among

participants were 14 (Table 15). Scores ranged from 0-22 points (possible total=23 points), which

indicates that none of the participants correctly answered all of the questions. Categorizing

participants' scores into low or high oral health knowledge scores resulted in 51% of the

participants having a low oral health knowledge score (0-14) (Table 16).

Table 15. Comprehensive Measure of Oral Health Knowledge mean score

Variable	Mean/Median	Standard Deviation	Minimum	Maximum
Oral Health Knowledge Score	14/14	4.17	0	22

Table 16. Low and high score of Comprehensive Measure of Oral Health Knowledge (n=338)*

Variable	Frequency	Valid Percent (%)
Oral Health Knowledge Score		
Low (0-14)	168	50.91
High (15-23)	162	49.09
*Total does not equal 338 due to missing data.		

 Frequency of Participants' Responses to the Comprehensive Measure of Oral Health Knowledge:

<center>By Topic</center>

General Dental Knowledge

Table 17 presents participants' responses pertaining to general knowledge. At least 50%

of participants answered each individual question correctly.

Table 17. General dental knowledge among participants (n=338)*

Variable	Frequency	Valid Percent (%)
What is another name for the roof of your mouth?		
Gingiva	35	10.61
Canine	0	0.00
Palate	**234**	**70.91**
Gland	7	2.12
I don't know	54	16.36
This picture shows the inside of a person's mouth. The arrow points to something hanging from the back of the throat. What is this structure called?		
Incisor	4	1.21
Tonsil	40	12.12
Sinus	4	1.21
Uvula (YEWV-you-la)	**230**	**69.70**
I don't know	52	15.76
This picture shows different parts of a tooth. To what part of the tooth is the arrow pointing?		
Incisor	9	2.74
Dentin	16	4.86
Premolar	20	6.08
Enamel	**194**	**58.97**
I don't know	90	27.36
How many permanent teeth does an adult usually get?		
10	6	1.82
20	26	7.88
32	**165**	**50.00**
45	24	7.27
I don't know	109	33.03
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Children's Oral Health, Disease, and Prevention

Table 18 presents the results from the four questions asked about children's oral health. The majority of respondents knew that children get their first adult tooth at about age six and that infants should not be put to bed with a bottle that contains fruit juice because the child might get tooth decay. Furthermore, nearly 50% of respondents were able to correctly identify tooth decay in an image showing the inside of a child's mouth. However, 10% of respondents indicated they "did not know" why children should not go to bed with a bottle, and 21% "did not know" that the image showed tooth decay (and 31% incorrectly identified the decay as other oral problems).

Lastly, only 23% of the participants correctly answered the question "How many baby teeth does

a child usually get?"

Table 18. Knowledge pertaining to children's oral health, disease, and prevention (n=338)*

Variable	Frequency	Valid Percent (%)
How many baby teeth does a child usually get?		
10	37	11.21
20	**76**	**23.03**
32	68	20.61
45	3	0.91
I don't know	146	44.24
How old are children when they get their first adult tooth?		
About 1 year old	83	25.15
About 3 years old	20	6.06
About 6 years old	**188**	**56.97**
About 13 years old	23	6.97
I don't know	16	4.85
What is the main reason infants should not be put to bed with a bottle that contains fruit juice?		
The child's teeth might not come in at the right time	10	3.03
The child might get gum disease	34	10.30
The child might get tooth decay	**207**	**62.73**
The child might get crooked teeth	47	14.24
I don't know	32	9.70
This picture shows the inside of a child's mouth. What do you think is wrong?		
Gum disease	61	18.48
Tooth decay	**163**	**49.39**
Cold sores	7	2.12
Mouth cancer	31	9.39
I don't know	68	20.61
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Oral Disease Prevention

This domain contained four questions related to the prevention of oral disease (Table 19).

In general, participants had very high knowledge regarding how to prevent caries. However,

nearly 40% did not know the reason why fluoride is added to public drinking water.

Table 19. Knowledge pertaining to oral disease prevention (n=338)*

Variable	Frequency	Valid Percent (%)
As you understand it, what is the main purpose of adding fluoride to the public drinking water?		
It kills germs in the water	54	16.36
It makes the water taste better	7	2.12
It protects teeth from tooth decay	**200**	**60.61**
It protects teeth from gum disease	35	10.61
I don't know	34	10.30
According to the American Dental Association, how often should adults who have their own teeth visit the dentist?		
Every month	9	2.73
Two times per year	**248**	**75.15**
One time per year	55	16.67
When they have toothache	7	2.12
I don't know	11	3.33
In order to prevent tooth decay, people should avoid food with a lot of which of the following?		
Salt	12	3.65
Spices	6	1.82
Fat	5	1.52
Sugar	**292**	**88.75**
I don't know	14	4.26
What is the best way a person can prevent tooth decay at home?		
Using a toothpick after every meal	3	0.91
Drinking sugar-free soda	8	2.44
Rinsing with a mouthwash like Listerine	4	1.22
Brushing and flossing every day	**311**	**94.82**
I don't know	2	0.61
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Knowledge Pertaining to Dental Treatment

In general, most participants understood the purpose of braces and implants (Table 20). They also understood how dentists treat a small cavity. However, only 66% of participants knew that getting a dental cleaning was necessary to remove tartar, and only 44% of the participants were able to explain what is involved during root canal treatment.

Table 20. Knowledge pertaining to dental treatment (n=338)*

Variable	Frequency	Valid Percent (%)
As you understand it, what is the main purpose of braces?		
Replacing missing teeth	3	0.91
Preventing tooth decay	4	1.21
Making teeth whiter	1	0.30
Straightening crooked teeth	**317**	**96.06**
I don't know	5	1.52
As you understand it, what is the main purpose of dental implants?		
Replacing missing teeth	**276**	**83.89**
Preventing tooth decay	21	6.38
Making teeth whiter	5	1.52
Straightening crooked teeth	7	2.13
I don't know	20	6.08
When a person has a small cavity, how does the dentist usually treat it?		
Prescribing antibiotics	6	1.82
Placing a filling in the tooth	**290**	**87.88**
Pulling the tooth	4	1.21
Adding a dental implant	10	3.03
I don't know	20	6.06
When a person has a large cavity, sometimes he or she needs a root canal. Which of the following describes what a root canal is?		
Removing the tooth enamel	18	5.45
Removing the tooth dentin	15	4.55
Removing the tooth nerve	**146**	**44.24**
Removing the tooth cusp	45	13.64
I don't know	106	32.12
Which of the following is the best way to remove tartar from a person's teeth?		
Eating hard food like apples	4	1.21
Rinsing with a mouthwash like Listerine	5	1.52
Brushing and flossing	94	28.48
Getting a dental cleaning	**219**	**66.36**
I don't know	8	2.42
*Not all totals equal 338 due to missing data.		
Bold response indicates the correct answer.		

Periodontal Disease

Participants had mixed knowledge pertaining to periodontal disease (Table 21). For

example, 68% of the participants were able to correctly identify a picture showing gums that were

puffy and red as gingivitis. Additionally, 59% of the participants correctly answered that smoking

cigarettes is a behavior that may cause periodontal disease. However, 60% of the participants

were unable to correctly identify a picture of receding gingiva as periodontal disease.

Furthermore, 55% of participants did not know that periodontal disease is more likely to occur in

people with diabetes.

Table 21. Knowledge pertaining to periodontal disease (n=338)*

Variable	Frequency	Valid Percent (%)
This picture shows some gums that are puffy and red. What do you think this condition is called?		
Gingivitis	**226**	**68.48**
Periodontitis	28	8.48
Canker (KAYN-ker) sores	12	3.64
Leukoplakia (Lou-ko-PLAY-kia)	6	1.82
I don't know	58	17.58
Which of the following behaviors may cause periodontal disease?		
Biting your fingernails	12	3.64
Eating spicy foods	6	1.82
Drinking too much coffee	21	6.36
Smoking cigarettes	**194**	**58.79**
I don't know	97	29.39
This picture shows some teeth with receding gums. What do you think this condition is called?		
Fluorosis	14	4.24
Periodontal disease	**131**	**39.79**
Halitosis (hal-i-TOE-sis)	41	12.42
I don't know	144	43.64
Periodontal disease is more likely to occur in people with which of the following conditions?		
High cholesterol	20	6.08
Hepatitis	12	3.65
High blood pressure	8	2.43
Diabetes	**150**	**45.59**
I don't know	139	42.25
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Oral Cancer

Participants had very little knowledge pertaining to oral cancer (Table 22). Seventy-six

percent of participants did not know that that the most common sign of cancer inside the mouth is

a sore that lasts more than two weeks. Additionally, 70% of participants did not know that men

older than 40 years of age are the most likely people to get cancer inside their mouths.

Table 22. Knowledge pertaining to oral cancer (n=338)*

Variable	Frequency	Valid Percent (%)
What is the most common sign of cancer inside the mouth?		
A sore that lasts more than two weeks	**81**	**24.70**
Pain when you open your mouth	14	4.27
Gums that bleed when you brush	27	8.23
Teeth that have black spots on them	59	17.99
I don't know	147	44.82
Which of the following groups is most likely to get cancer inside their mouth?		
Men younger than 40 years of age	15	4.56
Women younger than 40 years of age	11	3.34
Men older than 40 years of age	**100**	**30.40**
Women older than 40 years of age	26	7.90
I don't know	177	53.80
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Top 10 Most Frequently Missed Oral Health Knowledge Questions Among Participants

Table 23 displays a summary of the ten most frequently missed Oral Health Knowledge

questions. It is organized with the most frequently missed question listed first. As indicated on the

table, all of the domains, except oral disease prevention are represented on the table.

Table 23. Summary table of top ten most frequently missed oral health knowledge questions

among participants (n=338)*

Variable	Frequency	Valid Percent (%)
How many baby teeth does a child usually get?		
10	37	11.21
20	**76**	**23.03**
32	68	20.61
45	3	0.91
I don't know	146	44.24
What is the most common sign of cancer inside the mouth?		
A sore that lasts more than two weeks	**81**	**24.70**
Pain when you open your mouth	14	4.27
Gums that bleed when you brush	27	8.23
Teeth that have black spots on them	59	17.99
I don't know	147	44.82
Which of the following groups is most likely to get cancer inside their mouth?		
Men younger than 40 years of age	15	4.56
Women younger than 40 years of age	11	3.34
Men older that 40 years of age	**100**	**30.40**
Women older than 40 years of age	26	7.90
I don't know	177	53.80
This picture shows some teeth with receding gums. What do you think this condition is called?		
Fluorosis	14	4.24
Periodontal disease	**131**	**39.79**
Halitosis (hal-i-TOE-sis)	41	12.42
I don't know	144	43.64
When a person has a large cavity, sometimes he or she needs a root canal. Which of the following describes what a root canal is?		
Removing the tooth enamel	18	5.45
Removing the tooth dentin	15	4.55
Removing the tooth nerve	**146**	**44.24**
Removing the tooth cusp	45	13.64
I don't know	106	32.12
Periodontal disease is more likely to occur in people with which of the following conditions?		
High cholesterol	20	6.08
Hepatitis	12	3.65
High blood pressure	8	2.43
Diabetes	**150**	**45.59**
I don't know	139	42.25

Table 23-Continued

Variable	Frequency	Valid Percent (%)
This picture shows the inside of a child's mouth. What do you think is wrong?		
Gum disease	61	18.48
Tooth decay	**163**	**49.39**
Cold sores	7	2.12
Mouth cancer	31	9.39
I don't know	68	20.61
This picture shows the inside of a child's mouth. What do you think is wrong?		
Gum disease	61	18.48
Tooth decay	**163**	**49.39**
Cold sores	7	2.12
Mouth cancer	31	9.39
I don't know	68	20.61
How many permanent teeth does an adult usually get?		
10	6	1.82
20	26	7.88
32	**165**	**50.00**
45	24	7.27
I don't know	109	33.03
How old are children when they get their first adult tooth?		
About 1 year old	83	25.15
About 3 years old	20	6.06
About 6 years old	**188**	**56.97**
About 13 years old	23	6.97
I don't know	16	4.85
Which of the following behaviors may cause periodontal disease?		
Biting your fingernails	12	3.64
Eating spicy foods	6	1.82
Drinking too much coffee	21	6.36
Smoking cigarettes	**194**	**58.79**
I don't know	97	29.39
*Not all totals equal 338 due to missing data. **Bold response indicates the correct answer.**		

Results Summary-Oral Health Knowledge

The mean oral health knowledge score was 14. This shows that over 50% of participants

missed 9 or more of the 23 questions on the CMOHK survey, thus indicating low oral health

knowledge. In general, the majority of participants correctly answered questions pertaining to

general knowledge (Table 17), caries prevention (Table 19), and dental treatment (exception: root

canal therapy; Table 20). However, respondents were less likely to correctly answer questions pertaining to children's oral health (Table 18), periodontal disease (Table 21), and oral cancer (Table 22).

<p style="text-align:center">Bivariate Analyses</p>

The results of the bivariate analyses are presented below and are organized by the three domains (i.e. demographic, cultural, and dental characteristics). Statistically significant variables (p≤0.05) associated with oral health knowledge (low vs. high) are indicated by asterisks in the tables. Narrative text describing the statistically significant associations is written in a manner to indicate which variables are associated with low oral health knowledge.

<p style="text-align:center">Demographic Variables Associated with Low Oral Health Knowledge</p>

Table 24 displays the results of bivariate analysis on demographic variables and oral health knowledge scores. Older participants were more likely to have low oral health knowledge than those who were younger (60% for 56-71 years of age vs. 49% for 18-35 and 51% for 36-55 years of age; p=0.038). Participants who were male were more likely to have low oral health knowledge than female participants (60% vs. 47%; p=0.03). Participants with limited education, were not in college, earned ≤$25,000 annually, and did not have dental insurance were more likely to have low oral health knowledge compared to participants who had a college degree or were currently in college, earned >$25,000 per year, and had dental insurance (p<0.05 in each instance). Participants who self-reported having limited health literacy were more likely to have low oral health knowledge compared to those who reported adequate health literacy (68% vs. 41%; p<0.0001). Similarly, those who needed a team member to assist them with completing the survey were more likely to have low oral health knowledge compared to participants who completed the survey without assistance (66% vs. 46%; p=0.001). However, marital status and residence (i.e. metropolitan vs. non-metropolitan) were not statistically significantly associated with oral health knowledge.

Table 24. Bivariate associations between demographic variables and oral health knowledge

| Demographic Variables | N | Oral Health Knowledge Score | | p-value |
		Low (0-14) n(%) N=168	High (15-23) n(%) N=162	
Age				0.038**
18-35	164	81(49.39)	83(50.61)	
36-55	138	71(51.45)	67(48.55)	
56-71	25	15(60.00)	10(40.00)	
Gender				0.03**
Male	107	64(59.81)	43(40.19)	
Female	219	103(47.03)	116(52.97)	
In which town or city do you live?				0.0749
Non-metropolitan	110	65(59.09)	45(40.91)	
Metropolitan	184	89(48.37)	95(51.63)	
What is your marital status?				0.265
Single	109	50(45.87)	59(54.13)	
Married/Partnered	190	98(51.58)	92(48.42)	
Widowed/Separated/Divorced/Other	27	17(62.96)	10(37.04)	
What is your highest level of education?				<0.0001**
<12th grade	100	74(74.00)	26(26.00)	
High School Diploma/GED	118	56(47.46)	62(52.54)	
College Degree	108	36(33.33)	72(66.67)	
Are you currently enrolled as a student in a college or university?				0.003**
Yes	67	24(35.82)	43(64.18)	
No	232	130(56.03)	102(43.97)	
About how much is your yearly household income?				0.007**
≤$25,000	161	93(57.76)	68(42.24)	
>$25,000	148	63(42.57)	85(57.43)	
What type of dental insurance do you have?				<0.0001**
None	121	77(63.64)	44(36.36)	
Other (Medicaid/DWP)	44	20(45.45)	24(54.55)	
Private	133	48(36.09)	85(63.91)	
How confident are you filling out medical forms by yourself?				<0.0001**
Limited	99	67(67.68)	32(32.32)	
Adequate	200	81(40.50)	119(59.50)	
Survey completed by:				0.001**
Team Member	88	58 (65.91)	30(34.09)	
Participant	235	108(45.96)	127(54.04)	

**Statistically significant (p<0.05) using chi-square test
Note: Statistical analyses were conducted based on all non-missing values

Cultural Variables Associated with Low Oral Health Knowledge

        Table 25 shows associations between cultural variables and oral health knowledge scores.

All of the cultural variables were statistically significantly associated (p<0.05) with low oral

health knowledge. Participants who were born outside of the United States were more likely to

have low oral health knowledge than those born in the United States (56% vs. 36%). Participants

who lived in the United States fewer years were more likely to have low oral health knowledge

than their counterparts (17.5 years vs. 20 years). Similarly, participants with low acculturation

levels (i.e. behavioral and cultural, and language only) were more likely to have low oral health

knowledge compared to participants with high acculturation levels (e.g. 58% vs. 32%).

Participants who believed that it was very important to have a dental provider that speaks Spanish

or was from Hispanic/Latino descent were more likely to have low oral health knowledge than

those who reported that the aforementioned characteristics were somewhat or not important.

Participants who reported that they wanted, needed, or brought a translator to their last dental

visit were more likely to have low oral health knowledge compared to those who reported a

translator wasn't needed. Lastly, participants who chose to complete the survey in Spanish were

more likely to have low oral health knowledge than participants who completed it in English

(61% vs. 31%).

Table 25. Bivariate associations between cultural variables and oral health knowledge

Cultural Variables	N	Oral Health Knowledge Score		p-value
		Low (0-14) n(%) N=168	High (15-23) n(%) N=162	
In what country were you born?				0.0010**
United States	89	32(35.96)	57(64.04)	
Other	241	136(56.43)	105(43.57)	
How many years have you lived in the United States?				0.0469**
Mean(years)		17.48 years	20.11 years	

Table 25-Continued

Cultural Variables	Oral Health Knowledge Score			
	N	Low(0-14) n(%) N=168	High(15-23) n(%) N=162	*p*-value
Acculturation (Behavioral and Cultural)				<0.0001**
Low(1-2.99)	235	136(57.87)	99(42.13)	
High(3-5)	90	29 (32.22)	61 (67.78)	
Language Acculturation				<0.0001**
Low(1-2.99)	258	148(57.36)	110(42.64)	
High(3-5)	72	20(27.78)	52(72.22)	
How important is it for you that your dental provider speaks Spanish?				<0.0001**
Very important	158	104(65.82)	54(34.18)	
Somewhat/Not important	151	49(32.45)	102(67.55)	
How important is it for you that your dental provider is of Hispanic/Latino descent?				<0.0001**
Very important	75	54(72.00)	21(28.00)	
Somewhat/Not important	232	97(41.81)	135(58.19)	
If your dentist only speaks English, was a translator provider to you during your last dental visit?				<0.0001**
Didn't need one	171	66(38.60)	105(61.40)	
Wanted/Needed/Brought	136	85(62.50)	51(37.50)	
Survey read to participant in:				<0.0001**
Spanish	221	134(60.63)	87(39.37)	
English	108	34(31.48)	74(68.52)	
**Statistically significant (p<0.05) using chi-square test Note: Statistical analyses were conducted based on all non-missing values				

Dental Variables Associated with Low Oral Health Knowledge

Table 26 presents the associations between dental variables and oral health knowledge scores. Only three of the eleven questions asked within this domain were statistically significantly associated (p<0.05) with oral health knowledge. Participants who visited a dental provider more than 12 months ago were more likely to have low oral health knowledge than participants who

visited a dental provider within the past 12 months (64% vs. 44%). Participants who rated the

health of teeth and gums as fair or poor or didn't know their oral health status were more likely to

have low oral health knowledge than those who perceived their oral health to be excellent, very

good, or good (62% vs. 40%). Participants without a regular dental home were more likely to

have low oral health knowledge than those who sought care at a private dental office or

community health center, or dental college (66% and 43% vs. 52%). Whether the participant has

had tooth decay, periodontal disease, or was edentulous was not associated with oral health

knowledge. Whether the participant seeks dental care in the United States or outside of the

country, and compliance with attending scheduled dental appointments were not associated with

oral health knowledge. Lastly, how likely it is that the participants asks questions at dental

appointments was also not associated with oral health knowledge.

Table 26. Bivariate associations between dental related variables and oral health knowledge

Dental Variables		Oral Health Knowledge Score		
	N	Low(0-14) n(%) N=168	High(15-23) n(%) N=162	p-value
Has a doctor or dentist ever told you that you had tooth decay?				0.0792
Yes	206	98 (47.57)	108 (52.43)	
No	116	67(57.76)	49(42.24)	
Has a doctor or dentist ever told you that you had periodontal disease?				0.9574
Yes	43	22 (51.16)	21(48.84)	
No	276	140(50.72)	136(49.28)	
Have you lost all of your upper and lower natural permanent teeth?				0.8895
Yes	21	11(52.38)	10(47.62)	
No	307	156(50.81)	151(49.19)	
How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?				0.0004**
≤12 months	213	93(43.66)	120(56.34)	
>12 months	114	73(64.04)	41(35.96)	
Overall, how would you rate the health of your teeth and gums?				<0.0001**
Excellent/Very good/Good	171	69(40.35)	102(59.65)	
Fair/Poor/I don't know	158	98(62.03)	60(37.97)	

Table 26-Continued

Dental Variables	N	Oral Health Knowledge Score		*p*-value
		Low(0-14) n(%) N=168	High(15-23) n(%) N=162	
If you had a toothache, where would you go for treatment?				0.0109**
Private dental office	150	65(43.33)	85(56.67)	
CHC/COD	113	59(52.21)	54(47.79)	
ER/Private doctor/Folk healer/Home remedies/Other/No place to go	64	42(65.63)	22(34.38)	
In which country do you normally seek dental care?				0.3047
Only in the U.S.	229	112(48.91)	117(51.09)	
Only in native country/Both equally/More in the U.S. than outside U.S./More outside the U.S. than the U.S./I don't seek dental care	98	54(55.10)	44(44.90)	
How often are you compliant with attending your dental appointments?				0.1369
Never	16	8(50.00)	8(50.00)	
Occasionally/Sometimes/Often	142	77(54.23)	65(45.77)	
Always	148	65(43.92)	83(56.08)	
When you do not understand information presented to you by your dentist, how likely are you to ask questions?				0.07
Very Likely	222	103(46.40)	119(53.60)	
Somewhat/Not Very Likely	83	48(57.63)	35(42.17)	
** Statistically significant (p<0.05) using chi-square test				
Note: Statistical analyses were conducted based on all non-missing values				

Logistic Regression Analyses

Three domain-specific logistic regression models were developed in order to assess the relationship between low oral health knowledge and the predictor variables that were shown to be statistically significant (p<0.05) at the bivariate level in each domain (i.e. demographic, cultural, and dental). Variables showing significant association (p<0.05) in the domain-specific logistic regression models were used to develop a final model. The results from these analyses are presented by each domain and the final logistic model.

Logistic Regression Model for Demographic Variables Associated with Low Oral Health

Knowledge

Table 27 presents the demographic variables that were statistically significantly

associated with low oral health knowledge in the logistic regression models. After controlling for

age, gender, education, annual income, type of dental insurance, health literacy, and whether the

survey was completed by a research team member or by the participant, three variables were

found to be statistically significantly associated with low oral health knowledge. Holding all

other variables constant, participants with <12th grade education were 4.48 times as likely to have

low oral health knowledge than participants with a college a degree (95% CI: 2.07-9.66;

p<0.0001). Additionally, participants without dental insurance were 2.78 times as likely to have

low oral health knowledge compared to participants who had private dental insurance (95% CI:

1.50-5.16; p=0.0015). Lastly, participants with low health literacy were 1.94 times as likely to

have low oral health knowledge than participants with high health literacy (95% CI=1.04-3.62;

p=0.0385). These three variables were then included in the final logistic regression model to

predict low oral health knowledge (see section entitled "Final Logistic Regression Model For

Demographic, Cultural, and Dental Related Variables Associated with Low Oral Health

Knowledge").

Table 27. Logistic regression model for demographic variables associated with low oral health

knowledge (n=246)*

| Demographic Variables | Low Oral Health Knowledge | |
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
What is your highest level of education?		<0.0001***
College Degree	1.00**	
<12th grade	4.48(2.07, 9.66)	<0.0001***
High School Diploma/GED	1.25(0.64, 2.46)	0.0756
What type of dental insurance do you have?		0.0023***
Private	1.00**	
None	2.78(1.50, 5.16)	0.0015***
Other(Medicaid/Dental Wellness Plan)	1.06(0.45, 2.48)	0.2635

Table 27-Continued

Demographic Variables	Low Oral Health Knowledge	
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
Health Literacy		
High(3-5)	1.00**	
Low(1-2.99)	1.94(1.04, 3.62)	0.0385***
*Missing data		
**Reference level of each variable		
***Significant at p<0.05		
Hosmer-Lemeshow Goodness of fit test (p=0.7547)		

Logistic Regression Model for Cultural Variables Associated with Low Oral Health Knowledge

Table 28 presents the cultural variables that were statistically significantly associated

with low oral health knowledge in the logistic regression models. Controlling for birth country,

number of years living in the United States, acculturation level (i.e. behavioral, cultural, and

language), participants' perceived importance of receiving care from a dental provider who

speaks Spanish and who is of Hispanic/Latino ethnicity, if a translator was provided or needed

during their last dental appointment, and the language in which the questionnaire was completed,

three variables were statistically significantly associated with low oral health knowledge. In this

model, participants with low language acculturation levels were 1.92 times as likely to have low

oral health knowledge than participants with high language acculturation (95% CI=1.00-3.70;

p=0.0499). In addition, participants who indicated that it is very important that their dental

provider speaks Spanish were 2.14 times as likely to have low oral health knowledge compared to

participants who reported that it was somewhat or not important to receive care from a Spanish

speaking dental provider (95% CI=1.21-3.79; p=0.0087). Similarly, participants who reported

that it is very important to receive care from a dental provider who is from Hispanic/Latino

descent were 2.06 times as likely to have low oral health knowledge compared to participants

who indicated that it is somewhat or not important to receive care from a Hispanic/Latino dental

provider (95% CI=1.08-3.93; p=0.0289). These three variables were then included in the final

logistic regression model to predict low oral health knowledge (see section entitled "Final

Logistic Regression Model For Demographic, Cultural, and Dental Related Variables Associated

with Low Oral Health Knowledge").

Table 28. Logistic regression model for cultural variables associated with low oral health

knowledge (n=291)*

| Cultural Variables | Low Oral Health Knowledge | |
	Odds Ratio Estimate (95% Confidence Interval)	p-value
Language Acculturation		
High (3-5)	1.00**	
Low (1-2.99)	1.92(1.00, 3.70)	0.0499***
How important is it for you that your dental provider speaks Spanish?		
Somewhat/Not important	1.00**	
Very important	2.14(1.21, 3.79)	0.0087***
How important is it for you that your dental provider is of Hispanic/Latino descent?		
Somewhat/Not important	1.00**	
Very important	2.06(1.08, 3.93)	0.0289***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.5725)		

Logistic Regression Model for Dental Related Variables Associated with Low Oral Health

Knowledge

Table 29 displays the dental related variables that were statistically significantly

associated with low oral health knowledge. Controlling for participants' last visit to a dental

provider, their self-perception of the health of their teeth and gums, and where they go for dental

treatment, resulted in two variables being statistically significantly associated with low oral health

knowledge. Participants who self-reported their last visit to a dental provider was >12 months

ago were 1.90 times as likely to have low oral health knowledge compared to participants who

visited a dental provider ≤12 months ago (95% CI=1.17-3.09; p=0.0096). Additionally,

participants who perceived the status of their teeth and gums as fair, poor, or didn't know, were

2.09 times as likely to have low oral health knowledge than participants who perceived the status

of their teeth and gums to be excellent, very good, or good (95% CI=1.32-3.31; p=0.0016). These

two variables were then included in the final logistic regression model to predict low oral health

knowledge (see section entitled "Final Logistic Regression Model For Demographic, Cultural,

and Dental Related Variables Associated with Low Oral Health Knowledge").

Table 29. Logistic regression model for dental related variables associated with low oral health

knowledge (325)*

Dental Related Variables	Low Oral Health Knowledge	
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?		
≤12 months	1.00**	
>12 months	1.90(1.17, 3.09)	0.0096***
Overall, how would you rate the health of your teeth and gums?		
Excellent/Very good/Good	1.00**	
Fair/Poor/I don't know	2.09(1.32, 3.31)	0.0016***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.9063)		

Final Logistic Regression Model Assessing the Demographic, Cultural, and Dental Related

Variables Associated with Low Oral Health Knowledge

Table 30 displays the final logistic regression model associated with predicting low oral

health knowledge. This model was developed based on the statistically significant variables from

the aforementioned logistic models that were created for each domain (Table 27, Table 28, and

Table 29). When controlling for education, dental insurance, health literacy, language

acculturation, importance of receiving treatment from a dental provider who speaks Spanish or is

of Hispanic/Latino ethnic background, timing of the last visit to a dental provider, and self-perception of the health of one's teeth and gums showed that three variables were statistically significantly associated with low oral health knowledge. Holding the other variables constant demonstrated that participants with <12th grade education were 4.29 times as likely to have low oral health knowledge than participants with a college degree (95% CI=1.96-9.38; p=0.0003). Participants without dental insurance were 2.20 times as likely to have low oral health knowledge compared to participants with private dental insurance (95% CI=1.17- 4.16; p=0.0259). Lastly, participants who reported that receiving care from a dental provider who speaks Spanish is very important were 1.86 times as likely to have low oral health knowledge than participants who reported that receiving care from a dental provider who speaks Spanish was somewhat or not important (95% CI=1.01-3.43; p=0.0449). Moreover, an interaction was found between education and preference for a Spanish speaking dental provider (results not shown).

Table 30. Final logistic regression model for demographic, cultural, and dental related variables associated with low oral health knowledge (n=248)*

| Variables | Low Oral Health Knowledge | |
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
What is your highest level of education?		<0.0001***
College Degree	1.00**	
<12th grade	4.29(1.96, 9.38)	0.0003***
High School Diploma/GED	1.49(0.77, 2.90)	0.2657
What type of dental insurance do you have?		0.0428***
Private	1.00**	
None	2.20(1.17, 4.16)	0.0259***
Other (Medicaid/Dental Wellness Plan)	1.16(0.51, 2.66)	0.5359
How important is it for you that your dental provider speaks Spanish?		
Somewhat/Not important	1.00**	
Very important	1.86(1.01, 3.43)	0.0449***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.9858)		

Results Summary-Oral Health Knowledge

While numerous variables were statistically significantly associated with low oral health

knowledge at the bivariate level within each domain, only 2-3 variables were significantly

associated with oral health knowledge within the individual domain logistic regression models.

After combining all of significant variables from each domain for the final model, the results

indicated that having less than a 12th grade education, lack of dental insurance, and a preference

for receiving care from a Spanish speaking dental provider were associated with low oral health

literacy.

Participants' Beliefs Regarding What Can Cause Dental or Mouth Problems

In addition to assessing knowledge via the Comprehensive Measure of Oral Health

Knowledge questionnaire, participants' beliefs regarding what can cause dental or mouth

problems were also assessed. Table 31 shows the percentage of participants who correctly

identified causes of dental or mouth problems. In general, participants understood that diet,

bacteria, and general overall health could impact oral health. Participants also understood the

importance of preventive care. However, there were two main areas of incorrect knowledge.

Fifty percent of participants believed that having children takes the calcium out of teeth, with an

additional 21% being unsure if the statement was correct or incorrect.   Similarly, 59% of

participants believed that oral health problems are a normal part of aging, and an additional 18%

were unsure if the statement was true.

Table 31. Personal beliefs regarding what can cause dental or mouth problems (n=338)*

Variable	Frequency	Valid Percent (%)
People can inherit bad teeth/gums		
Yes**	**143**	**43.73**
No**	**107**	**32.72**
Unsure	77	23.55
Having children takes the calcium out of teeth		
Yes	165	49.70
No	**96**	**28.92**
Unsure	71	21.39

Table 31-Continued

Variable		Frequency	Valid Percent (%)
Eating a lot of sugar, candy, or snacks			
	Yes	**320**	**96.39**
	No	9	2.71
	Unsure	3	0.90
Bacteria			
	Yes	**305**	**92.42**
	No	14	4.24
	Unsure	11	3.33
Taking a lot of medications			
	Yes	**179**	**54.24**
	No	58	17.58
	Unsure	93	28.18
Drinking a lot of pop/soda/coke			
	Yes	**310**	**93.37**
	No	9	2.71
	Unsure	13	3.92
It is normal part of aging			
	Yes	193	58.84
	No	**75**	**22.87**
	Unsure	60	18.29
Not going to the dentist regularly			
	Yes	**297**	**90.00**
	No	24	7.27
	Unsure	9	2.73
Not brushing or flossing regularly			
	Yes	**314**	**93.73**
	No	13	3.88
	Unsure	8	2.39
Having a dry mouth			
	Yes	**166**	**52.37**
	No	51	16.09
	Unsure	100	31.55
*Not all totals equal 338 due to missing data. **The original "correct" answer was "no." However, some research suggests that the answer should be "yes." **Bold response indicates correct answer**.			

Summary-Personal Beliefs Regarding What Can Cause Dental or Mouth Problems

Results from the non-CMOHK questions demonstrate that participants were generally

able to correctly identify the causes of oral health problems such as: eating a lot of sugar, candy,

or snacks; bacteria; and not brushing or flossing regularly. However, there were some

misconceptions such as the belief that having children takes the calcium out of teeth and that oral health problems occur as a normal part of aging.

<div align="center">Dental Utilization</div>

This section contains information pertaining to participants' utilization of dental care as defined by the question "How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?" The results were collapsed into two categories: regular utilization (at least one dental visit within the past 12 months) versus irregular utilization (last dental visit more than 12 months ago). Descriptive, bivariate, and logistic regression results associated with irregular attendance are presented in this section. Similar to the oral health knowledge section, the bivariate and logistic regression results are presented by each domain (i.e. demographic, cultural, and dental). Additionally, frequency distributions pertaining to participants' experiences at their last dental visit are also included within this section.

<div align="center">Frequency Distributions</div>

<div align="center">Dental Utilization</div>

Self-reported responses indicated that 65% of participants had visited the dentist within the past year (i.e. regular attendees) while 35% of participants indicated irregular attendance (Table 32). Among the irregular attendees, 6% had visited the dentist more than five years ago, and 1% could not remember when they had gone to the dentist. Four percent indicated they had never visited the dentist. (Note: Results >100% due to rounding).

Table 32. Self-reported dental utilization among participants (n=338)*

Variable	Frequency	Valid Percent (%)
How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?		
6 months or less	153	45.67
More than 6 months, but not more than 1 year ago	64	19.10
More than 1 year ago, but not more than 2 years ago	40	11.94
More than 2 years ago, but not more than 5 years ago	43	12.84
More than 5 years ago	20	5.97
Never	12	3.58
I don't know	3	0.90
*Not all totals equal 338 due to missing data.		

Experiences at the Dental Office

Participants overwhelmingly reported positive experiences at their last dental visit (Table 33). The majority of the participants responded that they strongly agreed that at their last dental appointment, the dentist and/or dental staff spent enough time with them, listened carefully to what they had to say, explained things is a way that was understandable, and showed respect for what they had to say. Seventy-seven percent reported that they strongly disagreed being treated unfairly because of their race/ethnicity. However, only 47% strongly agreed to "During my last dental appointment the dentist or staff asked me how I would like to learn about dental health."

Table 33. Self-reported experiences at last dental appointment (n=338)*

Variable	Frequency	Valid Percent (%)
During my last dental appointment the dentist spent enough time with me.		
Strongly agree	206	66.88
Somewhat agree	87	28.25
Somewhat disagree	12	3.90
Strongly disagree	3	0.97
During my last dental appointment the dentist or staff treat me unfairly because of my race/ethnicity.		
Strongly agree	28	9.40
Somewhat agree	12	4.03
Somewhat disagree	26	8.72
Strongly disagree	232	77.85
During my last dental appointment the dentist or staff listened carefully to me.		
Strongly agree	237	77.96
Somewhat agree	54	17.76
Somewhat disagree	7	2.30
Strongly disagree	6	1.97
During my last dental appointment the dentist or staff explained things in a way I could understand.		
Strongly agree	240	77.92
Somewhat agree	45	14.61
Somewhat disagree	9	2.92
Strongly disagree	14	4.55

Table 33-Continued

Variable	Frequency	Valid Percent (%)
During my last dental appointment the dentist or staff showed respect for what I had to say.		
Strongly agree	254	82.20
Somewhat agree	43	13.92
Somewhat disagree	7	2.27
Strongly disagree	5	1.62
During my last dental appointment the dentist or staff asked me how I would like to learn about dental health.		
Strongly agree	145	47.23
Somewhat agree	63	20.52
Somewhat disagree	44	14.33
Strongly disagree	55	17.92
*Not all totals equal 338 due to missing data.		

Bivariate Analyses

The results of the bivariate analyses are presented below and are organized by each domain (i.e. demographic, cultural, and dental characteristics). Statistically significant associations ($p<0.05$) between dental utilization (regular attendance vs. irregular attendance) and each variable are indicated by asterisks in the tables. Narrative text describing the statistically significant associations is written in a manner to indicate which variables are associated with irregular dental utilization.

Demographic Variables Associated with Irregular Dental Utilization

Table 34 displays the associations between the demographic variables and dental utilization. Participants who were male were more likely to be irregular dental attendees than female participants (43% vs. 31%; p=0.03). Participants with an education level of <12th grade, high school diploma or GED were more likely to be irregular dental attendees than those with a college degree (40% vs. 39% vs. 26%; p=0.0382). Participants who earned ≤$25,000 per year, or reported that they did not have dental insurance were more likely to be irregular dental attendees than participants who earned >$25,000 per year and had dental insurance (p<0.05 in each

instance). Participants who self-reported having limited health literacy were more likely to have irregular dental utilization compared to participants with adequate health literacy (47% vs. 30%; p=0.004). Additionally, participants who had a low score on the oral health knowledge section were more likely to have irregular dental attendance compared to participants with high oral health knowledge (44% vs. 25%; p=0.0004). Participant's age, residence (metropolitan vs. non-metropolitan), marital status, and college enrollment status were not statistically associated with dental utilization. Additionally, whether help was needed with completing the questionnaire was also not statistically associated with dental utilization.

Table 34. Demographic variables associated with dental utilization (n=338)*

| Demographics | | Dental Utilization | | |
	N	≤12 months n (%)	>12 months n (%)	p-value
Age				0.0986
18-35	166	100(60.24)	66(39.76)	
36-55	140	99(70.71)	41(29.29)	
56-71	25	17(68.00)	8(32.00)	
Gender				0.03**
Male	107	61(57.01)	46(42.99)	
Female	224	154(68.75)	70(31.25)	
In which town or city do you live?				0.3514
Non-metropolitan	108	72(38.10)	36(32.73)	
Metropolitan	191	117(61.90)	74(67.27)	
What is your marital status?				0.5147
Single	111	70(63.06)	41(36.94)	
Married	194	131(67.53)	63(32.47)	
Other	26	15(57.69)	11(42.31)	
What is your highest level of education?				0.0382**
<12th grade	103	62(60.19)	41(39.81)	
High School Diploma/GED	118	72(61.02)	46(38.98)	
College Degree	110	81(73.64)	29(26.36)	
Are you currently enrolled as a student in a college or university?				0.0759
Yes	67	49(73.13)	18(26.87)	
No	233	146(61.34)	92(38.66)	

Table 34-Continued

Demographics	Dental Utilization			
	N	≤12 months n (%)	>12 months n (%)	*p*-value
About how much is your yearly household income?				<0.0001**
≤$25,000	166	86(51.81)	80(48.19)	
>$25,000	147	118(80.27)	29(19.73)	
What type of dental insurance do you have?				<0.0001**
None	126	51(40.48)	75(59.52)	
Other (Medicaid/DWP)	44	35(79.55)	9(20.45)	
Private	132	116(87.88)	16(12.12)	
Health Literacy				0.004**
Limited	103	55(53.40)	48(46.60)	
Adequate	203	142(69.95)	61(30.05)	
Oral Health Literacy (CMOHK)				0.0004**
Low (0-14)	166	93(56.02)	73(43.98)	
High (15-23)	161	120(74.53)	41(25.47)	
Survey completed by:				0.45
Team Member	89	55(61.80)	34(38.20)	
Participant	240	159(66.25)	81(33.75)	
**Statistically significant (p<0.05) using chi-square test				
Note: statistical analyses were conducted based on all non-missing values				

Cultural Variables Associated with Irregular Dental Utilization

Table 35 displays the associations between the cultural variables and dental utilization.

Participants who have lived in the United States for fewer years were more likely to report

irregular dental utilization compared to those who have lived in the United States for a longer

period of time (16 years vs. 20 years; p=0.0001). Additionally, participants who reported that

having a dental provider that is Spanish speaking or of Hispanic/Latino descent is very important

were more likely to report irregular dental utilization than those who reported that is somewhat or

not important (40% vs. 23% and 42% vs. 28%, respectively; p=0.0015, 0.0228, respectively).

Furthermore, participants who reported that they wanted, needed, or brought a translator to their

last dental visit were also more likely to have irregular dental utilization compared to those who

reported a translator was not needed (40% vs. 24%, respectively; p=0.0032). Participants who

completed the survey in Spanish were also more likely to have irregular dental utilization than

participants who completed it in English (40% vs. 26%; p=0.01). Variables not statistically

associated at the p<0.05 level included participants' birth country and acculturation levels (i.e.

behavioral and cultural and language).

Table 35. Cultural variables associated with dental utilization (n=338)*

Cultural Variables		Dental Utilization		
	N	≤12 months n(%) N=217	>12 months n(%) N=118	p-value
In what country were you born?				0.0838
United States	90	65(72.22)	25(27.78)	
Other	245	152(62.04)	93(37.96)	
How many years have you lived in the United States?				0.0001**
Mean (years)		20.26 years	15.64 years	
Acculturation (Behavioral and Cultural)				0.0571
Low (1-2.99)	237	147(62.03)	90(37.97)	
High (3-5)	93	68(73.12)	25(26.88)	
Language Acculturation				0.094
Low (1-2.99)	261	163(62.45)	98(37.55)	
High (3-5)	74	54(72.97)	20(27.03)	
How important is it for you that your dental provider speaks Spanish?				0.0015**
Very important	161	97(60.25)	64(39.75)	
Somewhat/Not important	152	117(76.97)	35(23.03)	
How important is it for you that your dental provider is of Hispanic/Latino descent?				0.0228**
Very important	74	43(58.11)	31(41.89)	
Somewhat/Not important	237	171(72.15)	66(27.85)	
If your dentist only speaks English, was a translator provider to you during your last dental visit?				0.0032**
Didn't need one	173	131(75.72)	42(24.28)	
Wanted/Needed/Brought	138	83(60.14)	55(39.86)	

Table 35-Continued

Cultural Variables	Dental Utilization			
	N	≤12 months n(%) N=217	>12 months n(%) N=118	p-value
Survey read to participant in:				0.01**
Spanish	226	136(60.18)	90(39.82)	
English	109	81(74.31)	28(25.69)	
** Statistically significant (p<0.05) using chi-square test Note: statistical analyses were conducted based on all non-missing values				

Dental Variables Associated with Irregular Dental Utilization

Table 36 presents the associations between the dental related variables and dental utilization. Participants who reported never being told by a doctor or dentist that they had tooth decay were more likely to be report irregular dental utilization than those who had been told they had decay (43% vs. 29%; p=0.0083). Participants who perceived the health of their teeth and gums as fair or poor or did not know the status of their oral health were more likely to report irregular dental utilization compared to participants who reported good, very good, or excellent oral health status (48% vs. 24%, respectively; p<0.0001). Participants who reported seeking dental care at places other than a private practice, community health center, or college of dentistry were more likely to report irregular dental utilization compared to participants who had a dental home (p<0.05 for each instance). Further, participants who reported that they were never compliant with attending scheduled dental appointments were more likely to report irregular dental utilization compared to participants who reported they are always compliant with attending dental appointments (50% vs. 26%; p=0.0501). Variables not associated with dental utilization included: periodontal disease and tooth loss experience, country of preference when seeking dental care, and likelihood of asking questions to your dentist when something is not understood.

Table 36. Dental related variables associated with dental utilization (n=338)*

Dental Related Variables	N	≤12 months n(%) N=217	>12 months n(%) N=118	p-value
Has a doctor or dentist ever told you that you had tooth decay?				0.0083**
Yes	203	145(71.43)	58(28.57)	
No	116	66(56.90)	50(43.10)	
Has a doctor or dentist ever told you that you had periodontal disease?				0.2723
Yes	42	31(73.81)	11(26.19)	
No	276	180(65.22)	96(34.78)	
Have you lost all of your upper and lower natural permanent teeth?				0.8220
Yes	19	12(63.16)	7(36.84)	
No	306	201(65.69)	105(34.31)	
Overall, how would you rate the health of your teeth and gums?				<0.0001**
Excellent/Very good/Good	174	133(76.44)	41(23.56)	
Fair/Poor/I don't know	160	84(52.50)	76(47.50)	
If you had a toothache, where would you go for treatment?				<0.0001**
Private dental office	151	117(77.48)	34(22.52)	
Community Health Center/College of Dentistry	118	70(59.32)	48(40.68)	
ER/Private doctor/CHC/COD/Folk healer/Home remedies/Other/No place to go	65	30(46.15)	35(53.85)	
In which country do you normally seek dental care?				0.7402
Only in the U.S.	235	154(65.53)	81(34.47)	
Only in native country/Both equally/More in the U.S. than outside U.S./More outside the U.S. than the U.S./I don't seek dental care	99	63(63.64)	36(36.36)	
How often are you compliant with attending your dental appointments?				0.0501**
Never	16	8(50.00)	8(50.00)	
Occasionally/Sometimes/Often	144	92(63.89)	52(36.11)	
Always	150	111(74.00)	39(26.00)	
When you do not understand information presented to you by your dentist, how likely are you to ask questions?				0.8986
Very Likely	227	154(67.84)	73(32.16)	
Somewhat/Not Very Likely	82	55(67.07)	27(32.93)	
**Statistically significant (p<0.05) using chi-square test Note: statistical analyses were conducted based on all non-missing values				

Logistic Regression Analyses

Three domain-specific logistic regression models were developed to assess the relationship

between irregular dental utilization and the predictor variables that were statistically significant

(p≤0.05) at the bivariate level in each domain (i.e. demographic, cultural, and dental). Variables

showing significant associations (p<0.05) in the domain-specific logistic regression models were

used to develop a final model. The results from these analyses are presented by each domain and

the final logistic model.

Logistic Regression Model for Demographic Variables Associated with Irregular Dental

Utilization

Table 37 presents the demographic variables that were statistically significantly

associated with irregular dental utilization (p<0.05). Controlling for gender, education, annual

income, type of dental insurance, health literacy, and the individual's oral health knowledge score

demonstrated that three variables were statistically significantly associated (p ≤0.05) with

irregular dental utilization. Holding all other variables constant, males were 2.46 times as likely

to have low oral health knowledge than females (95% CI: 1.26-4.80; p=0.0086). Participants who

reported an annual income of ≤$25,000 were 2.97 times as likely to have irregular dental

utilization compared to participants with an annual income of >$25,000 (95% CI: 1.48, 5.94;

p=0.0022). Lastly, participants without dental insurance were 6.70 times as likely to have

irregular dental utilization compared to participants who had private dental insurance (95% CI:

3.19-14.09; p<0.0001). These three variables were then included in the final logistic regression

model to predict irregular dental utilization. (See section entitled "Final Logistic Regression

Model For Demographic, Cultural, and Dental Related Variables Associated with Irregular

Dental Utilization").

Table 37. Logistic regression model for demographic variables associated with irregular dental utilization (n=253)*

Demographic Variables	Irregular Dental Utilization	
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
Gender		
Female	1.00**	
Male	2.46(1.26, 4.80)	0.0086***
About how much is your yearly household income?		
>$25,000	1.00**	
≤$25,000	2.97(1.48, 5.94)	0.0022***
What type of dental insurance do you have?		<0.0001***
Private	1.00**	
None	6.70(3.19, 14.09)	<0.0001***
Other (Medicaid/Dental Wellness Plan)	1.20(0.44, 3.26)	0.0856
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.1449)		

Logistic Regression Model for Cultural Variables Associated with Irregular Dental Utilization

Table 38 demonstrates that only one cultural variable was statistically significantly associated (p<0.05) with irregular dental utilization in the logistic regression model after controlling for the number of years the participant has lived in the United States, the perceived importance of receiving care from a dental provider who speaks Spanish or is of Hispanic/Latino ethnicity, whether a translator was provided or needed during their last dental appointment, and the language in which the questionnaire was completed. Participants who reported that it was very important to receive their dental care from a Spanish speaking dental provider were 1.87 times as likely to report irregular dental utilization compared to participants who reported that it was somewhat or not important to receive care from a Spanish speaking dental provider (95% CI: 1.13-3.09; p=0.0150). This variable was then included in the final logistic regression model to predict irregular dental utilization. (See section entitled "Final Logistic Regression Model For

Demographic, Cultural, and Dental Related Variables Associated with Irregular Dental

Utilization")

Table 38. Logistic regression model for cultural variables associated with irregular dental

utilization (n=299)*

Cultural Variables	Irregular Dental Utilization	
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
How important is it for you that your dental provider speaks Spanish?		
Somewhat/Not important	1.00**	
Very important	1.87(1.13, 3.09)	0.0150***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=N/A)		

Logistic Regression Model for Dental Related Variables Associated with Irregular Dental

Utilization

Table 39 displays the variables that were statistically significantly associated (p<0.05)

with irregular dental utilization after controlling for tooth decay experience, where participants go

for dental treatment, and compliance with attending scheduled dental appointments. Participants'

self-perception of the health of their teeth and gums was not considered for inclusion in the model

due to collinearity with tooth decay experience. Holding all other variables constant revealed that

participants who reported they have been told by a doctor or dentist that they had tooth decay

were 1.95 times as likely to have irregular dental utilization than those who have not been told the

same (95% CI: 1.11-3.43; p=0.0200). Additionally, participants who reported that they sought

dental care at an emergency room, private doctor's office, with a folk healer or home remedies, or

had not place to go were 3.75 times as likely to report irregular dental utilization compared to

participants who sought care within a private practice setting (95% CI: 1.84-7.63; p=0.0172).

These two variables were then included in the analyses to determine the final logistic regression

model to predict irregular dental utilization. (See section entitled "Final Logistic Regression

Model For Demographic, Cultural, and Dental Related Variables Associated with Irregular

Dental Utilization").

Table 39. Logistic regression model for dental related variables associated with irregular dental

utilization (n=296)*

Dental Related Variables	Irregular Dental Utilization	
	Odds Ratio Estimate (95% Confidence Interval)	p-value
Has a doctor or dentist ever told you that you had tooth decay?		
Yes	1.00**	
No	1.95(1.11, 3.43)	0.0200***
If you had a toothache, where would you go for treatment?		0.0005***
Private dental office	1.00**	
CHC/COD	3.03(1.65, 5.60)	0.1050
ER/Private doctor/Folk healer/Home remedies/Other/No place to go	3.75(1.84, 7.63)	0.0172***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.7980)		

Final Logistic Regression Model For Demographic, Cultural, and Dental Related Variables

Associated with Irregular Dental Utilization

Table 40 displays the final logistic regression model that incorporated all of the variables

that were statistically significantly associated with irregular dental utilization from the

aforementioned three models (Table 37, Table 38, and Table 39). Controlling for gender, income,

dental insurance, importance of receiving treatment from a dental provider who speaks Spanish,

history of tooth decay, and where participants seek dental services demonstrated that four

variables were statistically significantly associated with irregular dental utilization in the final

model. Holding all other variables constant, male participants were 2.34 times as likely to report

irregular dental utilization than female participants (95% CI: 1.20-4.59; p=0.0129). Participants

who reported an annual income of ≤$25,000 were 2.40 times as likely to report irregular dental

utilization compared to participants who made >$25,000 yearly (95% CI: 1.18-4.87; p=0.0156).

Additionally, participants without dental insurance were 8.40 times as likely to report irregular

dental utilization compared to participants with private dental insurance (95% CI: 3.62-19.50;

p<0.0001). Lastly, participants who reported being told by a doctor or dentist that they had tooth

decay were 3.08 times as likely to report irregular dental utilization compared to those who have

not been told they had tooth decay (95% CI: 1.45-6.57; p=0.0035). Moreover, interactions were

found between gender and income and insurance and tooth decay experience (results not shown).

Table 40. Final logistic regression model for demographic, cultural, and dental related variables

associated with irregular dental utilization (n=253)*

Variables	Irregular Dental Utilization	
	Odds Ratio Estimate (95% Confidence Interval)	*p*-value
Gender		
Female	1.00**	
Male	2.34(1.20, 4.59)	0.0129***
About how much is your yearly household income?		
>$25,000	1.00**	
≤$25,000	2.40(1.18, 4.87)	0.0156***
What type of dental insurance do you have?		<0.0001***
Private	1.00**	
None	8.40(3.62, 19.50)	<0.0001***
Other (Medicaid/Dental Wellness Plan)	1.11(0.36, 3.38)	0.0607
Has a doctor or dentist ever told you that you had tooth decay?		
Yes	1.00**	
No	3.08(1.45, 6.57)	0.0035***
*Missing data **Reference level of each variable ***Significant at p<0.05 Hosmer-Lemeshow Goodness of fit test (p=0.0577)		

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Results Summary-Dental Utilization

Although 65% of participants reported visiting the dentist within the previous 12 months, 35% of participants reported irregular dental utilization (i.e. visiting the dentist more than 12 months ago). In general, participants reported being treated respectfully at their last dental encounter. While many variables were statistically significantly associated with dental utilization at the bivariate level, only four variables were statistically significant in the final model. Furthermore, three of the four variables were related to the participants' demographic characteristics. This study concluded that being male, earning $\leq$$25,000 per year, not having dental insurance and having a history of tooth decay were the most likely to predict irregular dental utilization.

CHAPTER V-DISCUSSION

The purpose of this cross sectional study was to determine the oral health knowledge and dental care utilization among a convenience sample of Hispanic adults (18+ years of age) in Iowa. The first aim of the study was to examine if a difference in oral health knowledge exists among Hispanics who prefer to predominately read or speak in Spanish *vs.* those who read and speak in English and Spanish (bilingual) or English only. The second aim was to assess whether a difference in dental care utilization existed among participants based on their level of oral health knowledge. The Comprehensive Measure of Oral Health Knowledge (CMOHK) survey was used to assess oral health knowledge.[67] Dental utilization was categorized as regular attendance (i.e. last dental visit within the past 12 months) versus irregular attendance (i.e. last dental visit more than 12 months ago). Independent variables were categorized into three domains: 1) demographic, 2) cultural, and 3) dental. Descriptive analyses were calculated for all dependent and independent variables to determine the characteristics of the study sample and to determine which questions were the most frequently missed on the CMOHK survey. Next, bivariate analyses were conducted to assess associations among the dependent variables (i.e. oral health knowledge score and dental care utilization) and the independent variables in the study. Independent variables that were statistically significantly associated ($p<0.05$) with the dependent variables in the bivariate analyses were considered for inclusion within the final logistic models. The logistic regression models were developed to describe the relationships between the outcome variables (i.e. oral health knowledge and dental care utilization) and the independent variables, when controlling for other independent variables.

In this study, the mean age of the participants was 36 years of age. This is higher than the mean age of the Hispanic population in state of Iowa (23.1 years of age); however, the mean age for the state includes children under the age of 19, which make up the largest percentage of the Hispanic population living within the state.[15] In contrast, the mean age of the entire state is 38.1 years of age.[15] This study found that 69% of the participants had a high school degree or

higher, which is more than the percentage of Hispanics in Iowa age 25 and over with at least a

high school education (59.9%).[15] In contrast, 91.2% of all Iowans age 25 and over report the

same.[15] In Iowa, the Federal Poverty Guidelines establish $24,250 as 100% poverty for a family

of 4.[92] While this study did not assess family size, it did find that 53% of participants had an

income of ≤$25,000. Given that the average family size of Latinos living in Iowa is 3.92,[15] it can

be assumed that many of the participants who reported incomes of ≤$25,000 are living in poverty.

Indeed, state data would support this assumption given that 21.3% of Iowan Latinos were found

to be living in poverty in 2014.[15] In comparison, only 12% of all Iowans report the same.[15] This

study found that 38% of the participants did not have any dental insurance. In 2008, it was found

in a national study that among people with health insurance, 26% did not have dental insurance.[93]

Thus, the percentage of people without dental insurance was higher among this study population

compared to national data.

Using an adaptation of Chew et al. *Brief Screening Question*[62] to assess health literacy,

this study found that 33% of participants indicated they had low health literacy. Validation of the

Brief Screening Questions was done with a sample of 1,796 patients attending a veteran

outpatient center in four different locations across the United States.[63] Although it was a different

population than what was studied in the present study, it was found that the best question to use to

assess limited health literacy was the one used for the present study (How confident are you

filling out medical forms by yourself?). Similarly, another study by Wallace et al. determined that

the use of this question was accurate in detecting limited health literacy in a predominantly White

female sample residing in the state of Tennessee.[94] Specifically, Wallace et al. found that 17.7%

of the sample had low health literacy. However, as previously mentioned, the study sample was a

different population than the one we studied. The 2003 National Assessment of Adult Health

Literacy found that the 44% of Hispanics had below basic health literacy levels,[27] thus the

findings from this study were somewhat lower than national findings. Nonetheless, the

participants in this study were more likely than other populations surveyed in the 2003 NAAL

study to have low health literacy (e.g. Blacks-24% and Whites-9%).[27] In contrast, Brice et al. and

Boyas found higher mean levels among their sample of Hispanic adults indicating high health

literacy levels.[7, 8] Because each study used varying health literacy instruments, it is impossible to

make direct comparisons among studies. Nonetheless, the findings from this study suggest that

health care practitioners should be aware of the potential for low health literacy when treating

Hispanic patients, especially if they have other variables associated with low health literacy such

as lower levels of educational attainment or income.

Of the 54 million Hispanics living in the United States, approximately 36% are foreign-

born.[35] In contrast, 73%of the participants in this study were born outside of the United States.

Among those who were born elsewhere, 83% were born in Mexico. Similarly, most Hispanics in

Iowa who were not born in the United States are also from Mexico (78%).[15] Although nearly

three-fourths of participants were originally from another country, nearly one-half of participants

had lived in Iowa for more than 20 years.

In 2012, it was reported that 73.9% of the Hispanic population in the United States five

years of age and older spoke Spanish at home,[35] which can impact acculturation. Acculturation is

defined as how much an individual has integrated to the Anglo/American culture.[21] Within this

study, 72% of participants received a low total acculturation score (behavioral and cultural),

while 78% of participants received a low language acculturation score. Additionally, 65% of

participants chose to complete the questionnaire in Spanish, and 45% of participants stated that

they wanted, needed, or had to bring a translator to their last dental appointment. As such, it is

important that the dental team consider patients' cultural beliefs and language needs when

treating Hispanic populations within Iowa, as they may be barriers to understanding dental

treatment needs and navigating the healthcare system.

Sixty-five percent of participants reported visiting a dental provider within the past 12

months. This is similar to national data, which found that 61% of adults visited a dentist in

2013.[95] While the percentage of participants in this study who went to the dentist was similar to

national data, the percentage is too low for both populations. Furthermore, nearly 10% of the

participants in this study had either never gone to the dentist or gone to the dentist more than 5

years ago. It is important that the lack of dental utilization is addressed. Although the majority of

the participants responded that they would seek dental care at a private dental office, community

health center, or dental school if they had a toothache, there was a small percentage of

participants (14.3%) that reported they would seek dental treatment elsewhere. This is of concern

since getting treatment elsewhere, at an emergency room for example, only temporarily alleviates

the problem and prevents the patient from arresting the problem.

<u>Oral Health Knowledge</u>

The first purpose of the study was to assess the oral health knowledge, which is a

component of oral health literacy,[3] of Hispanic adults (18+ years of age) in Iowa. While previous

studies have assessed health literacy levels of Hispanics within the United States, either with a

mixed ethnicity population or with a solely Hispanic population, a similar study assessing the oral

health literacy or oral health knowledge of an exclusively Hispanic population had yet to be

studied. For this study, the *Comprehensive Measure of Oral Health Knowledge* (CMOHK)[67]

questionnaire was translated into Spanish so that participants could participate in the study

regardless of language preference (i.e. English or Spanish). The mean oral health knowledge

score among the study sample was 14 of 23 questions. Stated another way, 51% of the

population received a low score (0-14 questions answered correctly).

The CMOHK questionnaire has also been used in two different studies.[67, 76] The first

study, conducted by Macek et al. found that among their study population of low income,

predominately African American, Baltimore adults, approximately 29% of participants received a

low score (0-11 questions answered correctly), while 28% percentage received a fair score (12-14

questions answered correctly).[67] When combining the low and fair scores together, the percentage

of participants in Macek et al. study with low oral health knowledge was slightly higher than the

participants in this study (57% vs. 51%, respectively).[67] In contrast, only 34% of the population in

McQuistan et al. study of elderly Iowan adults who were seeking care within the University of Iowa College of Dentistry had low oral health knowledge (0-15 questions answered correctly).[76] Although the scoring systems are slightly different among the three studies, it appears that the elderly, predominately Caucasian, non-Hispanic Iowans had a higher level of oral health knowledge than the participants in both this study and the Macek et al. study.[76] It is important to mention that the original scoring system used by Macek et al. would have categorized this study's mean score as "fair."[67] However, personal communication with the author revealed that he believes a distribution of "poor, fair, good" is too specific for the instrument's sensitivity, thus he is using a "low vs. high" scoring system in current research.[90]

Further, in the present study, approximately 53% of the participants reported having an annual income of ≤$25,000, and 67% had an education level of a high school diploma or less. Macek et al. found in their study that more than half of the participants had an income of <$25,000 and about half of the sample had a high school diploma.[67] In contrast, the McQuistan et al. study reported that 31.4% had an income of <$25,000, and 31.3% had less than high school education.[76] Looking at these findings and comparing them to one another, we see a trend with having low oral heal knowledge and less income and education, as depicted in the present study and Macek et al. study. Additionally, when we compare these trends to health literacy studies, such as the 2003 National Assessment of Health Literacy in Adults, this same low health literacy trend was noted among individuals with low income and education levels.[27]

The *Comprehensive Measure of Oral Health Knowledge* questionnaire consisted of six categories of questions pertaining to general dental knowledge, children's oral health disease and prevention, oral disease prevention, dental treatments, periodontal health, and oral cancer. While participants understood some categories better than others (e.g. oral disease prevention vs. oral cancer), at least 40% of participants or more were likely to incorrectly answer at least one question per category for each of the categories. For example, only 60% of participants were able to correctly answer the main purpose of adding fluoride to the drinking water. The Center for

Disease Control and Prevention has recently recognized community water fluoridation as one of the 10 great public health achievements of the 20th century due to its significant contribution in reducing tooth decay in children and adults.[96] Therefore, the dental team should educate patients about the benefits of fluoride; especially since the Hispanic population is one of the racial and ethnic groups who suffer disproportionately from preventable oral health diseases, such as caries, compared to whites.[19]

Only 49% of the participants were able to identify tooth decay in a picture. Given that 24.2% of Hispanic children have untreated caries,[95] it is imperative that parents are able to identify decay to prevent such disparity. If parents or caregivers are unable to identify a carious lesion, then it may lead to future poor oral health outcomes. Another oral health disparity among Hispanic adults is periodontitis.[19, 97] Mexican-American adults and non-Hispanic blacks have higher prevalence of periodontal disease than their white counterparts.[97, 98] Given that periodontitis is a multifactorial disease, it is important that Hispanics understand which risk factors are associated with the development of periodontitis.[99] However, only 60% of the subjects were able to correctly identify that smoking cigarettes may cause periodontal disease, and only 45% were able to correctly identify that it may also be caused by diabetes. Since Hispanics are at higher risk for developing diabetes,[14] it is important that dental providers educate their patients about the link between periodontitis and diabetes. Lastly, this study found that oral cancer knowledge was also low among the participants. Interestingly, there was a similar lack of knowledge about these topics (i.e. children's oral health, periodontal disease, and oral cancer) among both the Macek et al. study and the McQuistan et al. study.[67, 76] This indicates that there is a general lack of knowledge about these topics, and public-wide awareness campaigns, as well as collaboration with other health providers, should be considered. For example, obstetricians should advise pregnant mothers to seek dental exams in order to screen for periodontal disease.[100] Another collaboration should be between pediatricians and nurses who frequently encounter children during routine well child exam.[101] They could screen for potential caries risk factors,

educate caregivers about their children's oral health, and provide preventive modalities to vulnerable populations.[101]

In order to determine which variables were associated with low oral health knowledge, bivariate and logistic regression analyses were conducted. At the bivariate level, many variables from each domain showed statistical significance. The following variables within the "demographic" domain were statistically associated with low oral health literacy: being older in age, self-reporting low health literacy, being male, needing the assistance of a team member to complete the questionnaire, completing fewer years of education, earning ≤$25,000 per year, and not having dental insurance. Language, acculturation, and duration of time living within the United States were also associated with oral health knowledge. These variables were all categorized as being within the "cultural" domain. Specifically, participants who: completed the questionnaire in Spanish; were identified as having low behavioral/cultural and language acculturation levels; preferred receiving dental treatment from a Latino/Hispanic or Spanish speaking dental provider; and needed a translator at a recent dental appointment were likely to have low oral health knowledge. Additionally, participants who were born outside of the United States and had lived fewer years in the United Sates were more likely to have low oral health knowledge than participants who were born in the United States or had lived in the United States for a longer period of time. "Dental" variables were also associated with low oral health knowledge at the bivariate level. Specifically, participants who self-reported that their oral health status was "fair, poor, or I don't know" were more likely to have low oral health knowledge than those who reported their oral health was "excellent, very good, or good." Participants who reported receiving dental care at place other than a dental office, visiting a dental provider more than 12 months ago, or seeking dental care only when feeling pain or when something needs to get fixed were more likely to report low oral health knowledge compared to participants who reported seeking routine, preventive care.

When considering all of the statistically significant variables from the bivariate analyses together, the final logistic model found three variables to be statistically significantly associated with oral health knowledge when holding all other variables constant. Specifically, participants with less than a 12th grade education were more likely to have lower oral health knowledge than participants who had a college education. Additionally, participants without dental insurance were more likely to have low oral health knowledge than participants with private dental insurance. Lastly, participants who preferred their dentist be able to speak Spanish were more likely to have low oral health knowledge than participants for whom this was less important. Although only three variables were found to be statistically significantly associated with low oral health knowledge in the final model, it is important to address the variables that were significant in the bivariate analyses as many of these same variables have been found to be significant in the literature. For example, pipelines should be developed to recruit more Hispanic people into the dental profession (e.g. assistants, hygienists, dentists). Dental offices should hire bilingual staff when possible and use professional translators when needed. Additionally, dental teams should consider the significant variables from the bivariate analyses as "red flags" that could indicate the need to assess oral health knowledge more carefully when treating patients who exhibit the aforementioned traits.

As previously mentioned, a larger percentage of participants in this study had a lower oral health knowledge using the CMOHK than participants in the McQuistan et al. study,[76] which also used the CMOHK to assess oral health knowledge. This is consistent with other studies that have found race and ethnicity to be significantly associated with oral health literacy. For example, Lee et al. found that minority participants were more likely to have lower mean oral health literacy levels than white participants.[77] Similarly, non-white subjects in a study conducted by Atchison et al. also had lower mean oral health literacy scores than whites.[70] Although these studies did not specifically assess Hispanics in their studies, this study reflects a trend of low oral health literacy among minorities.

Previous health literacy and oral health literacy studies have also found an association between age and oral health knowledge. For example, the NAAL 2003 study found that older individuals (65 years or older) had the lowest average health literacy score compared to the other age groups (age 16-64).[27] Boyas also saw this similar trend where older age was correlated with lower health literacy scores.[8] Lee et al. and Sabbahi et al. did not find an association with oral health literacy scores and age.[60, 74, 77] In contrast to other studies, Vann et al. saw a trend in low oral health literacy among younger age groups when compared to the older age groups. However, this study's oldest age group consisted of participants who were 26-31 years of age; therefore, it is unknown if older individuals would have had lower oral health literacy scores since they were not included in the study.[78] More recently, McQuistan et al. found that there was a trend toward the oldest participants having lower oral health knowledge, however their findings were not significant.[76] In contrast, Macek et al. found the association of lower oral health knowledge among younger age groups.[67] Further, statistical significance was shown when comparing the younger and older age groups. Since these findings vary, providers should not overlook that oral health literacy levels may be low regardless of age.

As mentioned, this study found that participants with less than a high school education were more likely to have low oral health knowledge than participants with more education. Low levels of education have been reported as being associated with low literacy, health literacy, and oral health literacy. For example, in both the 1992 and 2003 National Assessment of Literacy, increased levels of education revealed higher average prose, document, and quantitative literacy scores.[2] Similarly, the 2003 National Assessment of Health Literacy demonstrated that adults with an education of a high school degree or GED or higher had higher health literacy than adults with less than high school educaiton.[27] Oral health literacy studies have also found this association. Lee et al., Vann et al., Atchison et al., McQuistan et al., and Macek et al., have all reported low oral health literacy levels among participants with less than a high school education.[67, 70, 76-78] Given that 31% of the participants in this study reported not completing high

school, and this trend is reflected among Hispanics in both Iowa [15] and national data,[26] it is important to consider education levels when interacting with patients and participants in public health campaigns. However, it is also important to remember that literacy is topic specific,[2] thus even people with high levels of education may still have low health literacy or low oral health literacy.

Low levels of acculturation, including language, were also associated with low oral health knowledge in this study. This variable has also been associated in previous social science and health literacy studies and helps to explain the impact acculturation has regarding understanding the health care system.[8, 21, 102] In health literacy studies, low acculturation levels have been correlated with low health literacy levels.[8] Furthermore, Atchison et al. found that individuals whose native language was not English were more likely to have lower oral health literacy scores than native English speakers.[70] Betancourt et al. explains that acculturation is influenced by experience.[21] If participants have had limited experience with dental care due to language barriers associated with low acculturation levels, it could help explain the lower levels of oral health knowledge within this population. Additionally, different cultural beliefs and values may influence one's oral health knowledge. Although the only cultural variable that was significant in the final model was the preference for having a Spanish speaking provider, dental teams should consider the potential for low oral health knowledge when their patients request forms in Spanish or they request a translator be provided at dental appointments. Further, this is an example of the need for more Hispanics in the healthcare fields as it may help patients understand their treatment needs and feel at ease with a provider who is familiar with their cultural beliefs.

This study found that dental insurance was associated with low oral health knowledge, both at the bivariate level and within the final model. Other oral health literacy studies have also looked at this variable; however, a significant association was not found. In the Atchison et al. study, mean oral health literacy scores for participants with insurance vs. self-pay were not

significantly different.[70] Similarly, McQuistan et al. did not find an association with oral health knowledge scores and insurance status.[76] As the next section explains, participants with dental insurance were more likely to have visited the dentist within the past 12 months compared to those without dental insurance. It is unknown whether those with higher levels of oral health knowledge are more likely to purchase dental insurance because they understand the value of it, or whether those with dental insurance are more likely to have higher levels of oral health knowledge because of their more frequent use of the dental health care system, which could then increase dental knowledge. Nonetheless, providers should be cognizant that patients without dental insurance may be more likely to have low oral health knowledge, and therefore should use dental visits as an opportunity to increase the knowledge of their patients. Furthermore, the Hispanic population may not be aware of the health insurance opportunities and services offered by companies or the government. Therefore, insurance companies should provide information that is marketable to the Hispanic population, such as providing information in an easy to understand format in both English and Spanish.

Previous oral health literacy studies have looked at the association of oral health literacy and self-perceived health and oral health status. This study found that participants who rated their oral health as "fair, poor, or I don't know" were more likely to have low oral health knowledge than participants who self-reported better oral health. In the Vann et al. and the Miller et al. studies, caregivers who reported their children's oral health status as poor or fair were more likely to have lower oral health literacy and knowledge scores.[78, 79] Similarly, in another study by Lee et al., adults' self-reported health status was correlated with oral health literacy scores.[60] It is unknown if individuals perceive their teeth and gums as poor or fair health because they have experienced a lot of dental treatment need in the past and therefore have this assumption or if their perception is due to lack cosmetic satisfactoriness. Nevertheless, oral health literacy intervention programs should emphasize that the ultimate outcome is oral health with esthetics a secondary benefit to oral health.

In this study, participants were asked if they sought routine dental care vs. episodic dental care. More than half of the participants who reported that they sought episodic care (e.g. seeking care due to pain or discomfort, when something needs to get fixed) were more likely to have low oral health knowledge. This may be the first time that this variable has been assessed, as other studies have specifically used regular vs. irregular use of dental services (≤12 months vs. >12 months). Therefore, dental providers should emphasize the important role yearly exams play in dental disease prevention.

The association of health literacy levels and oral health knowledge was significant in this study. One other study has also looked at this association and similarly, found this association.[60] When developing oral health literacy interventions, it is important to educate people that health conditions and oral health status are often intertwined. This is due to the fact that individuals may have high health literacy, but at the same time have low oral health literacy. Therefore, including such topics will help in understanding that oral health impacts overall health.

Gender was another variable that was analyzed in the study. It was determined that males had lower oral health knowledge than females. Other health literacy and oral health literacy studies have also looked at this variable, however, results have varied. For example, the 2003 National Assessment of Health Literacy in Adults also determined that overall, men had lower health literacy scores than women.[27] However, when the 2003 NAAL specifically looked at gender difference within the Hispanic population, no differences were found.[27] In the Atchison et al. study, mean oral health literacy scores were not significantly different among males or females.[70] Similarly, Lee et al., Sabbahi et al. McQuistan et al., and Naghibi Sistani et al. did not find an association with gender and oral health literacy.[60, 74-76] In contrast, Macek et al. determined that there were a higher percentage of males than females in the poor and fair scoring category.[67] Thus, when planning oral health literacy intervention programs, they should be developed regardless of gender since the existing literature has showed mixed results in regards to this association.

Variables that were not statistically significant at the bivariate level in the present study included town or city of residence, marital status, country in which participants seek care, dental appointment compliance, and likelihood of asking a dental provider questions when something is not understood. Lee et al. also looked at marital status in their study, and it was determined that this variable was not associated with oral health literacy.[77] For the other aforementioned variables, this study may be the first oral health literacy study to examine their association with oral health literacy. Further, it is important to determine if residence is significant in future studies as individuals may have less opportunity to improve their oral health knowledge if they live in rural towns due to the lack of dentists located in such locations, therefore giving individuals less opportunity to increase oral health knowledge.

Overall, the findings from this study were similar to those from literacy, health literacy, and oral health literacy studies. The final oral health knowledge multivariable regression model indicated that participants with less than a high school education, a lack of dental insurance, and a preference for a Spanish-speaking provider had higher odds of having low oral health knowledge compared to their counterparts. Additionally, many of the statistically significant associations at the bivariate level also mirrored the findings of other studies. This study is significant in that it assesses the oral health knowledge of a population that is comprised solely of Hispanics, which has often been overlooked or not addressed within oral health literacy studies, and it examines associations with oral health literacy that have previously not been studied.

<div align="center">Dental Utilization</div>

The second aim of this study was to assess the relationship between oral health knowledge and dental care utilization. In the United States, the percentage of Hispanics that have visited a dentist in the past year is the lowest compared to other racial and ethnic groups (Hispanics=59.4%, American Indian/Alaskan Native=60%, Black/African American=61%, Asian only=67%, and White=67.1%).[103] There are many reasons for less dental care utilization within the Hispanic population. For example, specific cultural and sociodemographic barriers affect

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healthcare utilization such as: language barriers, [39] Hispanic health care workforce issues,[21] differing health beliefs/perceived need,[24] acculturation,[39] transportation challenges, [25] and lack of dental insurance.[31] Because very few studies have examined the oral health literacy of Hispanic populations, it is unknown whether low oral health literacy is associated with irregular dental care utilization within the Hispanic population. However, it is known that individuals with low health literacy are less likely to utilize preventive general health visits. [3]

Overall, 65% of the participants in this study reported visiting a dental provider within the past 12 months, which is higher than national data. However, nearly 10% had either never gone to the dentist or gone to the dentist more than 5 years ago. The American Dental Association recommends visiting the dentist twice a year because dental problems can be diagnosed, which can lead to prevention of future disease.[104] Participants with low oral health knowledge may be less likely to visit the dentist due to a lack of understanding regarding the importance of frequent dental visits in order to prevent dental disease. Furthermore, if they are unable to visually identify oral health problems, such as early childhood caries or periodontal disease, they may not realize they have a problem that needs dental attention. As such, there is a need to bring awareness to Hispanics about the importance of routine preventive dental visits.

Existing theoretical frameworks have been developed to determine and address dental utilization patterns. Mejia et al. developed the "Conceptual Framework for Hispanic Oral Health," which is a simplified theoretical framework created for the purpose of determining the relationship between factors associated with utilization of dental services.[102] The authors included interpersonal and community theories into the framework. Additionally, constructs of social support and social networks were added in order to illustrate how they relate to the culture and values of Hispanics in the United States. Furthermore, enabling factors were included in the model to illustrate how the Latino community contrasts with other racial and ethnic communities in the United States.

Bivariate analyses revealed that many variables were statistically significantly associated with irregular dental attendance (i.e. a dental visit more than 12 months ago). The variables that were significant in this study reflected variables that have been assessed in the conceptual framework proposed by Mejia et al.[102] For example, Mejia et al. determined that gender, education, income, insurance status, and dental insurance status should be viewed as individual enabling factors that affect dental care utilization.

In the current study, men were found to visit the dentist less frequently than women, which has also been found in previous studies. Macek et al. compared dental care visits looking at data from the National Health Interview Survey (NHIS), National Health and Nutrition Examination Survey (NHANES), and National Health Expenditure surveys (NMCES, NMES, MEPS).[105] All surveys were consistent in determining that men utilized services less frequently than women.[105] The data that were looked at in the Macek et al. study ranged from 1971-1996.[105] and when compared to more recent data, this trend still exists. For example, data from the Behavioral Risk Factors Surveillance System (1995-2008) reported that 71.3% of females and 67.4% of males reported a dental visit in the past years.[106] Similarly, National Health Interview Survey data from 1997-2013 reported that 60.8% of females visited a dentist in the past years compared to 60.5% of males.[95]

Participants with low health literacy were more likely to report irregular dental attendance than participants with higher health literacy. The Institute of Medicine reports that individuals with low health literacy have fewer opportunities to learn about disease prevention.[3] Therefore, if individuals have low health literacy, they may be less aware that attending preventive dental appointments can lead to future oral disease prevention. General healthcare providers should stress the importance of these visits, provide prevention-based education, and should identify patients in their practice that could have low health literacy as it has the ability to impact all realms of healthcare.

Further, participants with a low oral health knowledge score were also more likely to report irregular dental attendance. Similarly, oral health literacy studies have also looked at this variable. Miller et al. reported that caregivers who had not previously taken their child to a dentist had significantly lower oral health literacy mean scores compared to caregivers who had taken their children to dentists.[79] In another study by Lee et al., the lowest mean oral health literacy scores were among participants who reported going to the dentist more than five years ago.[78] Relatedly, Sabbahi et al. found an association with the frequency of dental visits and oral health literacy scores.[74] However, in contrast, more recently McQuistan et al. and Burgette et al. reported that dental utilization was not a predictor of oral health literacy in their study.[76, 107] Considering the mix of the aforementioned findings, future studies should be conducted to further assess the relationship between oral health literacy and dental utilization. These studies should try to assess whether individuals are not utilizing dental services due to low oral health knowledge, or if they have low oral health knowledge due to less dental utilization. Regardless, the dental team should use dental visits to educate patients about the importance of preventive visits and homecare, especially if they have a history of irregular attendance.

Participants without any dental insurance were more likely to have irregular dental attendance than participants who had dental insurance. Similar results have been found in other studies. For example, a study conducted in Australia by Srivastava et al. determined a positive association between dental insurance and dental visits.[108] Wall et al. also reported this relationship showing that dental utilization declined due to lack of private insurance, and an increase in public coverage (Medicare/Medicaid) and noninsured rates from 1997-2010.[109] Specifically, among Hispanic adults, lack of dental insurance or limited availability of dental insurance is a barrier for health and dental care access. For example, Flores et al. reported that lack of health insurance prevented this group from seeking health care.[24] Similarly, Solis et al. determined that lack of health insurance availability prevented participants from having a routine place for health care.[37] Studies that have looked at dental utilization among Hispanics have also determined that lack of

dental insurance prevents individuals from accessing preventive dental services.[31, 38, 39, 46] As such, dental insurance plays an important role in determining when individuals seek or access preventive or treatment orientated dental care services.

The Affordable Care Act has made it possible for individuals to obtain health insurance. However, dental insurance has not been mandated for adults with this act. Additionally, individuals who are undocumented do not qualify for such benefits.[110] Thus, continued oral health disparities will likely continue to exist among Hispanics in the United States until insurance becomes more widely available to everyone. Although the percentage of individuals enrolled in Medicaid/CHIP has increase 24% since the implementation of the Affordable Care Act,[111] very few participants in this study had public insurance, such as Medicaid or the Dental Wellness Plan, an Iowa-based dental insurance expansion program. While it is unknown whether the participants in this study were eligible for the aforementioned dental insurance programs, strategies need to be developed or improved to increase individuals' participation in dental insurance programs.

Similar to the oral health knowledge analyses, this study examined associations between cultural variables and irregular dental attendance. Within the current study, individuals with low levels of acculturation were more likely to report irregular dental attendance. Similarly, participants who chose to complete the questionnaire in Spanish, preferred a Spanish speaking provider or a provider of Hispanic/Latino descent, and needed assistance from a translator at their last dental visit were more likely to visit a dentist less frequently. Additionally, participants who had lived in the United States fewer years were also likely to report irregular dental attendance. These findings corroborate the findings of Mejia et al.'s theoretical framework,[102] since the aforementioned are barriers that prevent healthcare access. Mejia et al. explains the above-mentioned variables are individual enabling factors that may be associated with a person's health. As such, they may contribute to certain health beliefs that lead to existing oral health disparities and therefore should be considered when dental providers are treating this population. In order to address oral health disparities and to make health care available and with good quality, Mejia et

al. and Betancourt et al. suggest providing linguistically and culturally appropriate care and increasing the Hispanic health care workforce,[21, 102] as it makes healthcare access easier to navigate for this population.

This study did not find an association with country of birth and dental utilization, which may be because most or all of the participants were citizens or legal residents (note: this variable was not queried on the questionnaire). In contrast, Mejia et al. and Durden et al. have found that country of birth and being undocumented in the United States are associated with dental care and health care utilization.[47, 102] Because undocumented individuals are ineligible to obtain public insurance due to their immigrations status,[112] and they are unable to obtain employment that offers private insurance, they often do not have the means to pay for dental care.[47] Furthermore, they may not be familiar with the health care system in the United States, which is compounded by language barriers.[47] There is even less hope for young undocumented immigrants. The Deferred Action for Childhood Arrivals (DACA) programs gives young undocumented immigrants temporary legal status.[113] However, they are excluded from receiving benefits from the Affordable Care Act's Medicaid expansion. Raymond-Flesch et al. interviewed 61 DACA-eligible Latinos to determine their health or health care access. Participants reported that they turn to family members and folk healers rather than seeking care from health providers due to fear of discrimination and deportation.[114] One way to help address the problem of lack of access to care for undocumented immigrants could be to increase their awareness about free and reduced cost dental treatment at events such as Mission of Mercy and locations such as free dental clinics, community health centers, and dental schools.

Variables associated with dental experiences and perceived oral health status were assessed in this study. This variable is incorporated in the social construct of Mejia et al. theoretical framework which describes how individuals approach health care and thus can be influenced by their own perception of health, personal beliefs and attitude of health, and experiences with the dental healthcare system.[102] For example, in the current study, participants

who reported "fair" or "poor" oral health status were more likely to have less irregular dental visits than participants who reported better oral health. Without a dental exam, it is unknown whether the participants who perceived their oral health as fair or poor believed this because they knew their oral health was poor or whether they assumed it was poor since they had not been to a dentist recently. Given that 46% of participants indicated that they perceived their oral health as "fair or poor," it is important to determine what barriers are impacting individuals' ability to access dental care. With more frequent utilization, individuals may be able to improve their oral health status.

When asked where participants typically seek dental care, the majority indicated they would seek dental care at a private dental office, community health center, or dental school. However, approximately 20% indicated that they would seek care at an emergency room, private doctor's office, through a folk healer, would use home remedies, or did not have a place to go. It was found that participants who reported seeking dental care someplace other than a traditional dental clinic were more likely to report irregular dental attendance. This may be due, in part, to not having a dental home or understanding where to seek dental care.[37] It may also be due to a lack of available time to seek dental care due to work or family constraints.[32] Additionally, it may be due to cultural beliefs influenced by family, friends, and/or lack of knowledge.[28-31, 34, 115]

Dental appointment compliance has been examined in other studies. Variables such as self-paying for dental care (rather than having insurance), having a resident dental provider instead of a faculty dental provider at a university based dental clinic, residing in a rural area, and being an adolescent parent have been associated with failed dental appointments.[116] This study showed a statistically significant association between being less compliant with scheduled dental appointments and irregular dental utilization. Obviously, if one is likely to be non-compliant with attending appointments, they would have less opportunity to seek routine dental care. Because several (five) of the towns that were assessed were in Dental Health Provider Shortage Areas,[117] it may be that participants have a difficult time accessing dental health care. It is important that

when dental care is available, Hispanics seek care and are compliant with follow-up appointments to address oral health problems. Increasing oral health knowledge pertaining to where to access care and the importance of primary and secondary prevention may help increase compliance, as well as addressing additional barriers such as language and finances.

Tooth decay experience was determined to be associated with dental utilization in this study at the bivariate level and in the final logistic regression model. Individuals who had never been told by a doctor or dentist that they had tooth decay were more likely to be irregular dental attendees. Since an oral exam was not conducted, it is unknown whether the participants truly did not have tooth decay or whether they were unaware of their tooth decay since they had irregular dental attendance. The latter may be more plausible since other studies that have looked at this variable have found similar results. For example, Jaidee et al. found that factory workers in Thailand with a history of tooth decay were less likely to report receiving dental care in the prior year compared to participants without tooth decay.[118] Similarly, among British adults, Aldossary et al. determined that "former and never regular attenders" had "significantly higher DMFT score and numbers of decayed and missing teeth" than regular attenders.[119] Alternatively, it may be that people who have been told they do not have tooth decay may be less likely to seek routine care since they know that (at least at that point in time) they do not have oral health problems. One way to increase awareness of oral health problems is with collaboration of medical providers. Since oral health is connected to overall systemic health, medical providers should also be screening for oral diseases when patients are getting physical exams in order to prevent further disease progression.[120]

The final logistic regression model found that being male, having an annual income of ≤$25,000, not having dental insurance, and not having a history of tooth decay experience had higher odds of irregular dental utilization than females, having an annual income >$25,000, having dental insurance, or having a history of tooth decay. As indicated above, other studies

have also found gender,[95, 105, 106] income,[121, 122] and insurance[24, 31, 39, 108, 109] to be associated with

dental care utilization. Furthermore, these variables are present in Mejia et al.'s proposed

Conceptual Framework for Hispanic Oral Health, with an emphasis on risk markers and

individual enabling factors.[102] Based on the results from this study, efforts should be made to help

low income individuals identify low cost dental care, especially if they do not have dental

insurance. When possible, individuals should be assisted with applying for dental insurance with

the hope that they will have better access to dental care, and thus, more frequent utilization,

especially preventive care. It is hoped that as dental care utilization increases, dental disease

among Hispanics will decrease, thus reducing oral health disparities.

<u>Limitations</u>

This study is one of the first studies to solely assess the oral health literacy levels of a

Hispanic population using a validated tool. Additionally, it is one of the few large-scale oral

health literacy studies to be conducted in the Midwest. Although this study was able to collect

valuable information, there are limitations to this study. First, this was a cross-sectional study,

meaning that the data gathered was collected at one point in time and subject to change over time.

Additionally, while this study can assess associations with both of outcomes of interest (i.e. oral

health knowledge and dental care utilization), causality cannot be assumed.

For this study, oral health knowledge was scored as low (0-14 points) and high (15-23

points). The reason for the dichotomous levels were due to recommendations from the developer

of the survey, Macek et al.,[67] who has begun to move away from the original scoring levels of

poor (0-11 points), fair (12-14 points), and good (15-23 points) oral health knowledge since a

lack of discrimination has been noted among the poor and fair scores in recent studies. However,

removing the "fair" group means that it is now no longer possible to assess differences between

participants with lower scores (i.e. the original poor group) and higher scores (i.e. the original

good group). Different results may have been found if participants who scored near the mean,

which happens to coincide with the original "fair" score, were eliminated from analysis. Future

studies should consider assessing the differences between the participants with the highest and lowest scores, while eliminating participants with scores near the mean. Alternatively, studies could assess oral health knowledge as a continuous variable. Utilizing various analysis methods will help determine the best method of determining differences among participants.

Another limitation is that oral health literacy is composed of reading ability, reading comprehension, and knowledge. Within this study, only oral health knowledge was assessed. As such, the findings from this study only present a partial understanding of oral health literacy among participants. Future studies should be conducted to assess the relationship between knowledge, reading ability, word recognition, and reading comprehension.

Participants in this study were primarily recruited from Catholic churches that provided services in Spanish. Therefore, the study was composed of a convenience sample of participants. The people who chose to participate may have had some knowledge about oral health and therefore were more likely to choose to participate than individuals who felt they did not know as much about oral health. As such, the results of this study could be over-estimating the amount of oral health knowledge within the Hispanic population in Iowa. Furthermore, attendance at church may be associated with increased oral health knowledge and utilization due to social capital. In contrast, because participants were primarily recruited after participating in Spanish mass, the participants in this study may have overrepresented the findings of Hispanics who primarily speak Spanish. Indeed, over 70% of the participants chose to complete the survey in Spanish. Lastly, the participants were primarily recruited from towns in eastern and central Iowa, thus they may not represent the knowledge and utilization patterns of Hispanics across the state. If the study been composed of a random sample of Hispanics in Iowa, from a variety of settings and towns, the results may have been more representative of Iowa's Hispanic population, thus leading to greater generalizability.

Similarly, the Hispanic population within the United States encompasses many subgroups, making it a diverse population. Therefore, the results of this study cannot be

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generalized to the entire Hispanic population living within in the United States. For example, the majority of the participants in this study were foreign born, with a predominance of participants born in Mexico. While these demographics are representative of Hispanics living in Iowa,[15] other regions in the United States experience immigrants from other Latin American countries. For example, Hispanics in New York and New Jersey are more likely to have ties to Puerto Rico, while the majority Hispanic population in Florida is likely to have ties to Cuba.[123] Furthermore, the lifestyles and experiences of Hispanics living in various parts of the United States may be different than Hispanics living in Iowa.

In addition, different results may have been found in this study if a question had been asked to assess generational differences among participants. Since generational differences, such as demographics, identity, attitudes, and experiences exist, asking a question about generation may have shown that first and second generation Hispanics may have had different oral health knowledge and utilization patterns than Hispanics who identified as third generation or older.[124]

Although generation status was not assessed, acculturation was measured using an acculturation scale developed by Marin et al.[83] More recent studies suggest that it is acceptable to use "years residing in the United States" as a measure of acculturation.[125] While this study also assessed "years residing in the United States," only mean values were used to determine associations with the two outcome variables. If years had been categorized into "≤ 5 years vs. > 5 years" or categorized into multiple levels, different results may have been found since more recent immigrants may have less oral health knowledge and be less likely to understand the United States health care system than participants who have lived in the United States for longer periods of time.

The questions asked in the *Comprehensive Measure of Oral Health Knowledge* were from a variety of topics that included dental anatomy, disease prevention in children and adults, dental treatments, periodontal disease, and oral cancer. Participants had the lowest knowledge in the periodontal disease and oral cancer topics. While administering the questionnaire, many

participants mentioned that they did not know understand why it was necessary to know specific information from the questionnaire especially if they had never experienced a dental problem such as a root canal or oral cancer. This feedback from participants was important to gather because it provided insight about the appropriateness of the questionnaire and how questions should potentially be modified based on different racial and ethnic groups and dental experiences.

Another limitation of the study is that dental utilization was self-reported, thus participants may have provided incorrect answers pertaining to when they last visited the dentist. This may have been intentional, in order to provide socially desirable answers, which could have inflated the number of participants who visited the dentist within the past twelve months. Alternatively, participants may not have truly remembered the last time they visited the dentist and accidentally provided incorrect information. While obtaining dental records would provide the most accurate information pertaining to the last dental visit, the practicality of that is near impossible given that many participants did not seek routine care, did not have dental insurance, and sometimes sought care outside of the United States.

Furthermore, it is also important to address the definition of dental utilization in this study. Regular attendees of dental care were defined as those who visited a dentist or dental provider $\leq$ 12 months ago, and irregular attendees were defined as those who visited a dentist or dental provider more than 12 months ago. However, this nomenclature may be misleading. Participants who visited a dentist within the past year may have visited the dentist to get treated for pain and not because it was a regular, annual preventive visit.

It is known that women tend utilize dental services more frequently than men. Additionally, some studies have found that women have higher health literacy than men. A preponderance of participants in this study (67%) were female. If a more equal representation of males and females had been present in this study, the results may have shown different levels of oral health knowledge and utilization among participants. Furthermore, the significant associations between gender and the dependent variables may have varied. However, it is

expected that insurance, income, and history of tooth decay would still play a predominate role in the final regression model since running that model without gender showed that they were significantly associated with utilization, even when gender was not considered for inclusion in the model (data not shown).

The lack of a non-Hispanic control group in this study for comparison is another limitation. It is unknown if the oral health knowledge levels and dental utilization patterns found in this study are similar to, higher, or lower than other racial and ethnic groups in the state of Iowa. Therefore, future studies should include a variety of populations to assess differences.

Lastly, approximately one third of the study sample reported having a college degree or higher. However, national data has shown that only 13.8% of Hispanics had a college degree or higher in 2014.[35] Thus, the participants in this study were more educated than the general Hispanic population in the United States. Given that oral health knowledge is associated with education, the results of this study may be higher than Hispanics nationally.

Policy Implications

Hispanic populations within the United States suffer from oral health disparities. One of the goals of Healthy People 2020 is to improve the health of all Americans, increase quality of life, and eliminate health disparities.[98] A specific objective in Healthy People 2020 is to improve the health literacy of the population.[126] Improving the oral health literacy of the Hispanic population may be one way to reduce oral health disparities since associations have been found linking higher levels of oral health literacy levels to better oral health outcomes.[78, 79] In order to increase the populations' oral health literacy levels, efforts have been made by various organizations. For example, the American Dental Association's "Health Literacy in Dentistry Action Plan 2010-2015" set principles, goals, and strategies to improve oral health literacy. Their focus has been to train and educate the public in order to make the public aware of the relationship between health literacy and oral health and how it can lead to improved oral health outcomes. They have also advocated for health literacy programs and interventions to public

policy leaders to emphasize the importance of low health literacy as a public health concern. The

Agency for Healthcare Research and Quality (AHRQ) has also developed the "Health Literacy

Universal Precautions Toolkit" and made it available for healthcare providers and healthcare

organizations. The goal of this tool is to help "primary practices reduce the complexity of health

care, increase patient understanding of health information, and enhance support for patients of all

health literacy levels".[127] Ultimately, one of the goals among academicians and others, such as the

ADA and the AHRQ, is to inform policy makers about the importance of dental disease

prevention and the potential for increasing prevention by implementing oral health literacy

interventions.

     Dental providers and the dental team should strive to improve their communication skills

so that patients know how to navigate the dental health care system and better understand their

dental needs. The dental team can use methods such as listening carefully to patients, using the

'teach-back' method to ensure that patients understand what has been discussed between the

provider and the patient, using short statements and visual aids while explaining treatment

options, and avoiding dental jargon.[128] Unfortunately, a national study of dentists found that the

majority of dentists do not use these communication techniques.[129] In addition to the

aforementioned communication techniques, the dental team should provide an interpreter to

patients for whom their primarily language is not English. This is important to ensure the patient

understands what the dental team is saying and also so that the patients are able to ask questions

in their native languages. Further, when planning a program to increase oral health knowledge,

such interventions should focus on populations with low oral health knowledge. The focus should

be on oral health awareness and disease prevention so that individuals can become aware of

treatments and opportunities to arrest dental disease and prevent it from occurring it in the future.

However, oral health knowledge interventions should also include individuals with high levels of

oral health knowledge as they may have low health literacy. Thus, this can help connect oral

health to overall systemic health.

Improving dental care utilization is another approach to reducing oral health disparities among the Hispanic population. This study found that irregular dental care utilization was associated at the bivariate level with low oral health knowledge. Thus, improving oral health knowledge could increase dental care utilization. Additionally, it is important to reduce some of the barriers to care faced by Hispanics. The percentage of Hispanic dentists within the United State is very limited.[21] Bringing in bilingual Hispanic healthcare providers to health professional shortage areas could help address language barriers faced by some patients. Additionally, increasing the percentage of the Hispanic dental workforce within the United States could also help minimize some of the cultural differences experienced by Hispanic patients and non-Hispanic providers. Outreach from colleges and universities should pursue Hispanic students to inform and prepare them for the opportunities in dental healthcare so that the workforce increases.

However, there are other barriers within acculturation, such as the health beliefs of individuals. Those who are born outside of the United States or have resided in the United States for many years may combine health beliefs from both cultures. The difficulty in addressing cultural health beliefs is that some of these beliefs are passed down from generation to generation affecting the way health care is utilized. Therefore, it is important to understand the oral health beliefs of Hispanic populations in order to develop culturally appropriate educational interventions that both address misconceptions about oral health and are culturally acceptable by the targeted population.

Comparing the findings of this study to other dental utilization studies show that the predictor variables in the final regression model for this study were similar to existing literature. In other words, Hispanics' dental utilization patterns are not much different than Whites in the United States. For example, a lack of dental insurance is often found to be associated with irregular utilization of dental care services. Given that Hispanics have the highest medical uninsured rates of any other racial and ethnic group in the United States,[45] the lack of medical and

dental insurance can be a barrier to care within the Hispanic population. With the Affordable

Care Act "individuals who are lawfully present immigrants are now eligible to purchase private

health insurance and receive premium tax credits (which help make the cost of health insurance

more affordable) through the new insurance exchanges."[130] As such, they are now able to

purchase health insurance through an employer, the marketplace, or be eligible for

Medicaid/Medicare. Unfortunately, the Affordable Care Act does not include dental benefits for

adults,[110] thus the percentage of Hispanics with dental insurance is unlikely to increase.

Furthermore, the Affordable Care Act does not extend to undocumented immigrants. In 2014,

there were 11.3 million undocumented immigrants in the United States,[131] thus there is still are

large number of people who are ineligible for both health insurance and dental insurance. As a

result, health care utilization, including dental care, will continue to be problematic for this

population unless the other barriers to care can be overcome.

CHAPTER VI-CONCLUSION

Nationally, Hispanics are the largest racial or ethnic group, representing 17.4% of the population.[132] The U.S. Census Bureau projects that the percentage of Hispanics in the United States will continue to increase. [9] Similarly, Hispanics are the largest racial or ethnic group in Iowa (5.6%),[15] and this population is expected to increase to 13% by the year 2050. Unfortunately, Hispanics suffer from oral health disparities, such as untreated tooth decay in children and periodontal disease among adults.[88] Therefore, it is important to assess the potential factors, such as low oral health knowledge and irregular dental utilization, which may be contributing to these disparities.

This study is novel in many ways. It is one of the first oral health literacy studies in the United States to focus on a predominately Midwestern population, and it is composed of participants from both metropolitan and non-metropolitan areas. More importantly, it is the first oral health literacy study among the published literature to focus solely on a Hispanic population. It was found that 51% of participants had low oral health knowledge, and that 35% of participants reported visiting the dentist more than one year ago. Furthermore, nearly 10% of all participants reported visiting a dentist more than 5 years ago or never at all. These findings underscore the importance of assessing the oral health literacy of Hispanic populations and its association with infrequent dental utilization.

While many participants were aware of caries preventive measures and general dental knowledge, a majority of participants lacked knowledge pertaining to children's oral health, periodontal disease, and oral cancer. Several variables showed an association with low oral health knowledge at the bivariate level, including: older age, low health literacy, less education, lack of dental insurance, low acculturation, preference for a Spanish speaking or Hispanic dental provider, seeking dental treatment at a place other than a dental clinic, and visiting a dental provider more than 12 months ago. Examining the variables simultaneously in a logistic regression model revealed that three variables were found to be associated with low oral health

knowledge: having less than a 12th grade education, a lack of dental insurance, and a preference for receiving care from a Spanish speaking dental provider.

Approximately 35% of the participants reported irregular dental care (i.e. a dental appointment >12 months ago). Low oral health knowledge was associated with irregular dental care in the bivariate analyses. Additionally, being male, reporting low health literacy, completing fewer years of education, earning less than $25,000 per year, lacking dental insurance, living in the United States fewer years, preferring a Spanish speaking or Hispanic dental provider, requesting a translator at a prior dental visit, completing the survey in Spanish, reporting a history of tooth decay, seeking dental treatment at a place other than a dental clinic, having a perception of poor or fair oral health, and lack of compliance with dental treatment were also related with infrequent dental care. Results from the final logistic regression analyses indicated that being male, earning $\leq$$25,000 per year, not having dental insurance and having a history of tooth decay were the variables most likely to predict irregular dental utilization.

Increasing the oral health knowledge of Hispanics may help decrease oral health disparities and improve oral health outcomes among this population. Given the association between oral health and general health, increasing oral health literacy may also help decrease general health disparities. Dental providers who provide care to Hispanic populations should be aware of the characteristics that were found to be associated with low oral health knowledge within this study and should use universal precaution communication techniques with all patients, especially those who are more likely to have low oral health knowledge.

Forty-two percent of participants in this study stated that it was very important or somewhat important to have a dentist of Hispanic descent, while 70% of participants stated that it was very important or somewhat important that their dentist speaks Spanish. Patients with limited English proficiency should be scheduled for longer appointment times and provided with an interpreter. This gives an opportunity for the patient to ask questions and also helps ensure that the patient understands the proposed preventive and treatment regimens, thus increasing oral

health knowledge. Concurrently, providers should speak with patients using layperson terms or defining dental terms when used. Once a treatment has been explained, the provider should verify with the patient that she has understood the treatment. This can be accomplished with "teach back," which asks the patient to repeat the information back to the provider. Lastly, efforts should be made to increase the number of Hispanics within the dental healthcare workforce to better reflect the demographics of this country and to address the cultural beliefs and potential language barriers of Hispanic patients.

We hope that our findings add to the body of literature pertaining to oral health literacy and dental utilization and that they help reduce the oral health disparities within the Hispanic community. This may be achieved by using the results of this study to assist public policy makers in establishing community-wide oral health literacy programs to improve oral health knowledge and by addressing the multiple variables associated with infrequent dental utilization.

Do you identify as being Latino or Latina or Hispanic?
Are you between the ages of 18-64?
If yes, we want your help!

The University of I Iowa College Of Dentistry is conducting a research study to assess: 1) what amount of knowledge Latino adults have about dentistry and oral health, and 2) their opinions about dental visits. We will use this information to develop programs to increase dental knowledge.

If you agree to participate, we would like you to complete an in-person survey that is available in English and Spanish. You are free to skip any questions that you prefer not to answer. It will take about 30-45 minutes to complete the survey.

You can complete the survey in your hometown or in Iowa City.

You will receive a $15 gift card for completing the survey.

If you would like to participate in the study, please call Dr. McQuistan at 319-335-7524 or email her at michelle-mcquistan@uiowa.edu.

Thank you very much for your consideration of this research study.

Gracias!

Daisy Patino, RDH   Michelle McQuistan DDS, MS
Graduate Student   Associate Professor
Dental Public Health   University of Iowa
University of Iowa

¿Te identificas como latino o latina o hispano? ¿Tienes entre 18 y 64 años? En ese caso, ¡Queremos tu ayuda!

El colegio dental de la Universidad de Iowa está llevando a cabo una encuesta para evaluar: 1) el nivel de conocimientos que la población adulta latina tiene sobre la salud dental, y 2) sus opiniones sobre las visitas dentales. Usaremos esta información para desarrollar programas y así incrementar el conocimiento dental de los latinos.

Si está dispuesto/a a participar, nos gustaría que completara la encuesta en persona. Tiene la opción de no responder las preguntas que desee. La encuesta está disponible en ingles y español y la puede completar en su pueblo/ciudad o en Iowa City.

Recibirá una tarjeta de regalo de $15 completar la encuesta.

Si a usted le gustaría participar en el estudio, por favor, llame a la Doctora Mcquistan al 319-335-7524, o envíele un correo electrónico a michelle-mcquistan@uiowa.edu.

Muchas gracias por su consideración en este estudio de investigación.

Gracias!

Daisy Patino, RDH   Michelle McQuistan DDS, MS
Graduate Student   Associate Professor
Dental Public Health   University of Iowa
University of Iowa

Has a doctor or dentist ever told you that you had tooth decay?

1. Yes
2. No
3. I don't know

Has a doctor or dentist ever told you that you had periodontal disease?

1. Yes
2. No
3. I don't know

Has a doctor or dentist ever told you that you had mouth cancer?

1. Yes
2. No
3. I don't know

Have you lost all of your upper and lower natural permanent teeth?

1. Yes
2. No
3. I don't know

What is another name for the roof of your mouth?

1. Gingiva
2. Canine
3. Palate
4. Gland
5. I don't know

This picture shows the inside of a person's mouth. The arrow points to something hanging from the back of the throat. What is this structure called?

1. Incisor
2. Tonsil
3. Sinus
4. Uvula (YEWV-you-la)
5. I don't know

How many **baby teeth** does a child **usually** get?

1. 10
2. 20
3. 32
4. 45
5. I don't know

How many **permanent teeth** does an **adult usually** get?

1. 10
2. 20
3. 32
4. 45
5. I don't know

How old are children when they get their **first adult** tooth?

1. About 1 year old
2. About 3 years old
3. About 6 years old
4. About 13 years old
5. I don't know

As you understand it, what is the **main** purpose of braces?

1. Replacing missing teeth
2. Preventing tooth decay
3. Making teeth whiter
4. Straightening crooked teeth
5. I don't know

As you understand it, what is the **main** purpose of adding fluoride to the public drinking water?

1. It kills germs in the water
2. It makes the water taste better
3. It protects teeth from tooth decay
4. It protects teeth from gum disease
5. I don't know

As you understand it, what is the **main** purpose of dental implants?

1. Replacing missing teeth
2. Preventing tooth decay
3. Making teeth whiter
4. Straightening crooked teeth
5. I don't know

This picture shows different parts of a tooth. To what part of the tooth is the arrow pointing?

1. Incisor
2. Dentin
3. Premolar
4. Enamel
5. I don't know
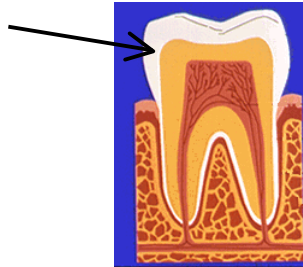
According to the American Dental Association, how often should adults **who have their own teeth** visit the dentist?

1. Every month
2. Two times per year
3. One time per year
4. When they have a toothache
5. I don't know

In order to prevent tooth decay, people should avoid food with a lot of which of the following?

1. Salt
2. Spices
3. Fat
4. Sugar
5. I don't know

What is the **main** reason infants should not be put to bed with a bottle that contains fruit juice?

1. The child's teeth might not come in at the right time
2. The child might get gum disease
3. The child might get tooth decay
4. The child might get crooked teeth
5. I don't know

What is the **best** way a person can prevent tooth decay **at home**?

1. Using a toothpick after every meal
2. Drinking sugar-free soda
3. Rinsing with a mouthwash like Listerine
4. Brushing and flossing every day
5. I don't know

When a person has a **small** cavity, how does the dentist usually treat it?

1. Prescribing antibiotics
2. Placing a filling in the tooth
3. Pulling the tooth
4. Adding a dental implant
5. I don't know

When a person has a **large** cavity, sometimes he or she needs a root canal. Which of the following describes what a root canal is?

1. Removing the tooth enamel
2. Removing the tooth dentin
3. Removing the tooth nerve
4. Removing the tooth cusp
5. I don't know

This picture shows the inside of a child's mouth. What do you think is wrong?

1. Gum disease
2. Tooth decay
3. Cold sores
4. Mouth cancer
5. I don't know

This picture shows some gums that are puffy and red. What do you think this condition is called?

1. Gingivitis
2. Periodontitis
3. Canker (KAYN-ker) sores
4. Leukoplakia (Lou-ko-PLAY-kia)
5. I don't know
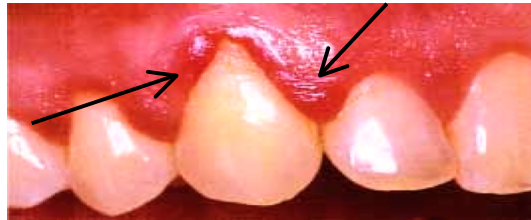
Which of the following behaviors may cause periodontal disease?

1. Biting your fingernails
2. Eating spicy foods
3. Drinking too much coffee
4. Smoking cigarettes
5. I don't know

Which of the following is the **best** way to remove tartar from a person's teeth?

1. Eating hard food like apples
2. Rinsing with a mouthwash like Listerine
3. Brushing and flossing
4. Getting a dental cleaning
5. I don't know

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This picture shows some teeth with receding gums. What do you think this condition is called?

1. Fluorosis
2. Periodontal disease
3. Halitosis (hal-i-TOE-sis)
4. I don't know
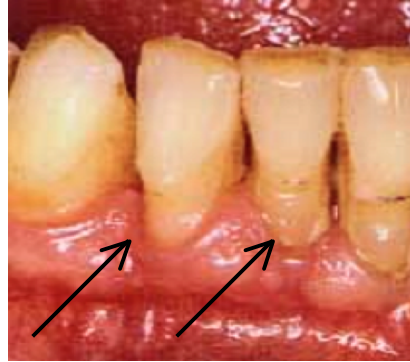
Periodontal disease is **more** likely to occur in people with which of the following conditions?

1. High cholesterol
2. Hepatitis
3. High blood pressure
4. Diabetes
5. I don't know

What is the **most** common sign of cancer inside the mouth?

1. A sore that last more than two weeks
2. Pain when you open your mouth
3. Gums that bleed when you brush
4. Teeth that have black spots on them
5. I don't know

Which of the following groups is **most** likely to get cancer inside their mouth?

1. Men younger than 40 years of age
2. Women younger than 40 years of age
3. Men older than 40 years of age
4. Women older than 40 years of age
5. I don't know

APPENDIX C. QUESTIONNAIRE

Are you currently enrolled as a student in a college or university?

1. Yes
2. No

ID#:_____

Date: __ __ - __ __ - __ __
     m m   d d   y y

Location:_____

Participant Age: ___ ___ years

Participant Gender:

1. Female
2. Male

Survey completed by:

1. Team member
2. Participant
3. Team member and participant

Survey read to participant in:

1. Spanish
2. English
3. Spanish and English

Comprehensive Measure of Oral Health Knowledge will be administered first

Answers:

c1.	c5.	c9.	c13.	c17.	c21.	c25.
c2.	c6.	c10.	c14.	c18.	c22.	c26.
c3.	c7.	c11.	c15.	c19.	c23.	c27.
c4.	c8.	c12.	c16.	c20.	c24.	

Oral Health Knowledge Score: _____

Knowledge start time: _____

Knowledge finish time: _____

1. How confident are you filling out medical forms by yourself?

   1. Never (0%)
   2. Occasionally (25%)
   3. Sometimes (50%)
   4. Often (75%)
   5. Always (100%)

2. In the following situations, which language(s) do you prefer to use: **only Spanish (1), Spanish better than English (2), both equally (3), English better than Spanish (4), or only English (5)?**

	Only Spanish	Spanish better than English	Both equally	English better than Spanish	Only English
A. In general, what language(s) do you read and speak?	1	2	3	4	5
B. What was the language(s) you used as a child?	1	2	3	4	5
C. What language(s) do you usually speak at home?	1	2	3	4	5
D. In which language(s) do you usually think?	1	2	3	4	5
E. What language(s) do you usually speak with your friends?	1	2	3	4	5
F. In what language(s) are the TV programs you usually watch?	1	2	3	4	5
G. In what language(s) are the radio programs you usually listen to?	1	2	3	4	5
H. In general, in what language(s) are the movies, TV, and radio programs you prefer to watch and listen to?	1	2	3	4	4

Question 2-Continued

For the following questions, please circle the category that best describes your social preference:
All Latinos/Hispanics (1), More Latinos than Americans (2), About half and half (3), More Americans than Latinos (4), or All Americans (5).

	All Latinos/ Hispanics	More Latinos than Americans	About half and half	More Americans than Latinos	All Americans
I. Your close friends are:	1	2	3	4	5
J. You prefer going to social gatherings/parties at which the people are:	1	2	3	4	5
K. The persons you visit or who visit you are:	1	2	3	4	5
L. If you could choose your children's friends, you would want them to be:	1	2	3	4	5

Behavioral and Cultural Total: ____/12=____

Language Proficiency (a,c,d,e) Total:____/4=_____

3. In which town or city do you live?   _____

4. In what country were you born?

                                                  1. United States
                                                  2. Other:_____

5. How many years have you lived in the United States?

                                                  __ __ Years

6. What is your marital status?

    1. Single
    2. Partnered
    3. Married
    4. Widowed
    5. Separated
    6. Divorced
    7. Other

7. What is your highest level of education?

    1. 8th grade or less
    2. Some high school, but didn't graduate
    3. High school diploma or GED
    4. Two year college degree
    5. Four year college degree
    6. Graduate degree

8. About how much is your yearly household income?

    1. $0-$5,000
    2. $5,001-$10,000
    3. $10,001-$15,000
    4. $15,001-$20,000
    5. $20,001-$25,000
    6. $25,001 - $35,000
    7. $35,001 - $45,000
    8. $45,001 - $55,000
    9. $55,001- $65,000
    10. $65,001 - $75,000
    11. $75,0001 or more

9. What type of dental insurance do you have?

    1. Medicaid of Title 19
    2. Commercial or Private (ex. Delta Dental or Blue Cross Blue Shield)
    3. Dental Wellness Plan
    4. None
    5. Other_____
    6. Not sure/don't know

10. There are many things that can cause problems to your teeth and your mouth. Which of the following items do you think can cause dental or mouth problems? Please circle **Yes (1), No (2), or Unsure (3)** to the following:

	Yes	No	Unsure
A. People can inherit bad teeth/gums	1	2	3
B. Having children takes the calcium out of teeth	1	2	3
C. Eating a lot of sugar, candy, or snacks	1	2	3
D. Bacteria	1	2	3
E. General overall health affects the mouth	1	2	3
F. Taking a lot of medications	1	2	3
G. Drinking a lot of pop/soda/coke	1	2	3
H. It is normal part of aging	1	2	3
I. Not going to the dentist regularly	1	2	3
J. Not brushing or flossing regularly	1	2	3
K. Having a dry mouth	1	2	3
L. Other: Please describe:			

11. Overall, how would you rate the health of your teeth and gums?

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor
6. Don't know

12. When did you last brush your teeth?

1. This morning
2. Last night
3. I don't brush my teeth
4. I can't remember
5. Other:_____

13. When you brush your teeth, what do you put on your toothbrush?

1. Toothpaste
2. Baking soda
3. Nothing
4. I don't brush my teeth
5. Other:_____
   _____

14. Which of the following resources do you use to get most of your information about oral and dental health? Circle **Yes (1) or No (2)**

	Yes	No
A. Radio/Television	1	2
B. Internet	1	2
C. Newspaper/Magazine	1	2
D. Health newsletters/pamphlets	1	2
E. Dentist/dental hygienist	1	2
F. Physician/nurse	1	2
G. Friends, relatives, neighbors	1	2
H. WIC centers	1	2
I. Headstart	1	2
J. Health department	1	2
K. Other: Please describe:		

15. If you had a toothache, where would you go for treatment?

   1. Emergency Room
   2. Private doctor's office
   3. Private dental office
   4. Community Health Center
   5. University of Iowa College of Dentistry
   6. Folk healer
   7. I would use home remedies
   8. Other_____
   9. I don't have a place to go

16. In which country do you normally seek dental care?

   1. Only in the U.S.
   2. Only in my native country
   3. Both equally
   4. More in the U.S. than outside the U.S.
   5. More outside the U.S. than in the U.S.
   6. I don't seek dental care

17. How long ago was your last visit to a dentist, dental hygienist, or other dental care provider?

   1. Never
   2. 6 months or less
   3. More than 6 months, but not more than 1 year ago
   4. More than 1 year ago, but not more than 2 years ago
   5. More than 2 years ago, but not more than 5 years ago
   6. More than 5 years ago
   7. I don't know

18. Which statement below best describes when you go to the dentist?

    1. I go to the dentist regularly (at least every 12 months)
    2. I go only when I have pain or discomfort
    3. I go only when I need something fixed
    4. Other:_____
    5. I have never been to the dentist-**Please stop survey**

If you answered, **"I have never been to the dentist"** in question 18, please **STOP** here.

Thank you for your participation!

If you have ever been to a dentist, please continue with the survey.

19. How important is it for you that your dental provider speaks Spanish?

    1. Very important
    2. Somewhat important
    3. Not important

20. How important is it for you that your dental provider is of Hispanic/Latino descent?

    1. Very important
    2. Somewhat important
    3. Not important

21. If your dentist only speaks English, was a translator provided to you during your last dental visit?

    1. I didn't need a translator
    2. None present, but I wanted a translator
    3. No, I had to bring my own
    4. Yes, the entire appointment
    5. Yes, part of the appointment

22. How often are you compliant with attending your dental appointments?

    1. Never (0%)
    2. Occasionally (25%)
    3. Sometimes (50%)
    4. Often (75%)
    5. Always (100%)

23. When you do not understand information presented to you by your dentist, how likely are you to ask questions?

   1. Very likely
   2. Somewhat likely
   3. Not very likely

Please rate your agreement with the following statements. During my last dental appointment:
Strongly Agree (1), Somewhat Agree (2), Somewhat Disagree (3), or Strongly Disagree (4)

	Strongly Agree	**Somewhat Agree**	**Somewhat Disagree**	**Strongly Disagree**
24. The dentist spent enough time with me.	1	2	3	4
25. The dentist or staff treated me unfairly because of my race/ethnicity.	1	2	3	4
26. The dentist or staff listened carefully to me.	1	2	3	4
27. The dentist or staff explained things in a way I could understand.	1	2	3	4
28. The dentist or staff showed respect for what I had to say.	1	2	3	4
29. The dentist or staff asked me how I would like to learn about dental health.	1	2	3	4

The survey has ended. Thank you for your participation!

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