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The Association Between Malnutrition And Gingivitis Among Residents In St. Louis, Missouri

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This is to certify that the doctoral study by

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Walden University
2025

Abstract

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MS, Western Illinois University, 2020

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

Malnutrition and gingivitis are common diagnoses in primary medical and dental care. The purpose of this quantitative study was to understand the association between malnutrition and gingivitis among residents in St. Louis, Missouri. The study was based on the social ecological model (SEM). The cross-sectional design involved secondary data (N = 2,553) from a Federally Qualified Health Center in St. Louis, Missouri that included de-identified patient demographic and diagnosis information of St. Louis City residents with a medical and dental visit in 2024. This study examined the relationship between malnutrition and gingivitis while controlling for ethnicity, preferred language, race, and zip code. Data were evaluated using multiple logistic regression. Individuals with a body mass index (BMI), less than 18.5 (underweight) or greater than 25 (overweight or obesity) are 1.452 times more likely to have gingivitis than those with a normal weight BMI of 18.5-24.9. Individuals who identify as Black (OR = 1.494, 95% CI [1.189, 1.877]) or Hispanic as well as those who have a preferred language of English (OR = 1.519, 95% CI [1.150, 2.007]) are more likely to have an unhealthy BMI. Four field-based products were created: a policy brief, community health intervention plan, visual intervention framework, and informational fact sheet. The results of the analysis and the field-based products will be used to promote social change by informing public health practitioners about the influence of race, ethnicity, and preferred language on the prevalence of malnutrition and/or gingivitis. This study contributes to positive social change by providing evidence for a stronger connection between medical and dental care that will improve access to healthcare services for vulnerable and at-risk populations.

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Dedication

I dedicate this research study to my friends, family, and colleagues who encouraged me to keep pushing through on this doctoral journey. Your unwavering support inspires me to keep stiving for greatness.

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I would like to acknowledge the support and feedback provided by Dr. Twanda Wadlington (Dr. T.) throughout this capstone journey as my committee chair and Dr. Gwendolyn Francavillo as my committee member. As members of my committee, they have provided direction, correction, and guidance that have helped me to become a better researcher and public health professional. Thank you both for your continuous support throughout this capstone and doctoral journey!

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Section 1: Foundation of the Study and Literature Review

Malnutrition and gingivitis are conditions that are often studied individually by medical and dental professionals due to their influence on health as it pertains to other diagnosable conditions including chronic diseases. The purpose of this quantitative study was to evaluate the association between malnutrition and gingivitis, while controlling for race and ethnicity, preferred language, and zip code among dental patients in St. Louis, Missouri. I identified if there is an association between malnutrition and gingivitis and how variables at differing levels in the social ecological model (SEM) influence the risk of a person developing those conditions. The results from this study can be used by medical and dental providers about the need to discuss access to food and dietary habits in the patient's preferred language, with regard to their economic status.

In this section, I discuss the foundation of this study, including the problem, purpose, and research questions, followed by a review of the literature. Subsequent sections include the theoretical framework, limitations, scope and significance of the study, and a review of the literature. This section concludes with a summary and conclusion.

Background

Food insecurity is one cause that can lead to malnutrition; if there is not enough food available, there will likely not be enough nutrients to maintain an optimal nutrition status. In the United States, food insecurity rates increased significantly from 12.8% in 2022 to 13.5% in 2023 with increases in nearly every household composition category, race and ethnicity, household income level, area of residence, and geographic region

(Rabbitt et al., 2024). In Missouri, the prevalence of food insecurity is roughly 12.7% indicating that the state prevalence is similar to the national average, however, the prevalence of very low food security is 5.8%, placing Missouri in the top 10 states with the highest prevalence of very low food security (Rabbitt et al., 2024). In addition to increases in food insecurity, there has also been an increase in the number of malnutrition related mortalities nationwide (Mostafa et al, 2023) Individuals who are over 85 years of age, identify as Non-Hispanic White or female, and those living in the Western region of the United States as well as those who live in urban communities are disproportionately affected by malnutrition-related mortality (Mostafa et al., 2023).

Gingivitis is a type of periodontal disease that reflects personal oral hygiene practices as well as other modifiable habits and conditions including smoking, pregnancy, and diabetes mellitus (Gasner & Schure, 2023). Found in approximately 90% of the global population, gingivitis is treatable; however, if left untreated, gingivitis can progress into periodontal disease, leaving the individual with irreversible damage (CDC, 2024; Gasner & Schure, 2023). Individuals who have incomes below 100% of the federal poverty level, and those who identify as Mexican American or Non-Hispanic Black are disproportionately affected by gingivitis (CDC, 2024).

St. Louis, Missouri is a metropolitan area that has historically been racially divided, but also a welcoming place for immigrants and refugees. The population of St. Louis City is approximately 281,754 individuals of whom an estimated 45.7%, 43.1%, and 3.4% of the population identify as White, Black, or Asian respectively (U.S. Census Bureau, 2023). It is estimated that 6.6% of those living in St. Louis City are foreign-born

persons; however, an estimated 8.9% of the population speak a language other than English in the home (U.S. Census Bureau, 2023). The percentage of individuals experiencing poverty is 19.8%; however, the percentage of individuals living below the poverty line ranges from 4.5% to 49.4% when broken down by zip code (City of St. Louis, 2020; U.S. Census Bureau, 2023). In comparison, the population of St. Louis County is approximately 987,059 people, of whom 66.9%, 25.3%, and 5.1% identify as White, Black, and Asian respectively (U. S. Census Bureau, 2023). Approximately 8.1% of individuals living in St. Louis County are foreign-born and 10.3% speak a language other than English in the home (U.S. Census Bureau, 2023). In St. Louis County, an estimated 9.7% of individuals are living below the poverty line (U.S. Census Bureau, 2023) As is the case with many urban areas, there are micro-communities in St. Louis, often based on ethnicity, preferred language, or socioeconomic status, that reflect the diversity of the metropolitan area, making St. Louis an ideal location for the study.

Problem Statement

There is compelling evidence that suggests there is a relationship between food choice and dental care (Papathanasiou et al., 2023; Staufenbiel et al., 2023; Woelber & Vach, 2023). Subsequently if quality or nutritious food is not an option, individuals are forced to do what is necessary to survive, thus adding nutritional status as a health concern. Given current inflation rates and the cost of food and other supplies increasing, there is concern that individuals are unable to purchase needed materials to maintain their nutritional needs and oral health, thus increasing the incidence of malnutrition and gingivitis. Untreated gingivitis can progress into periodontitis and lead to irreversible

damage including tooth and gum damage surrounding the infected area (Gasner and Schure, 2023). Malnutrition can be linked to oral health practices in that individuals who have a higher decayed, missing, or filled teeth (DMFT) score are more susceptible to poorer nutrition outcomes (Mostafa et al., 2023). Subsequently, individuals with a higher DMFT score are more likely to experience low self-esteem, reduced quality of life, and challenges securing and maintaining employment (Kaur et al., 2017; Tiwari et al., 2022).

Purpose of Study

The purpose of this study was to use prominent factors relating to the individual, interpersonal, and community levels in the SEM to identify if there is an association between the social ecological factors and the clinical diagnoses of malnutrition and gingivitis. I used a quantitative, cross-sectional study design to evaluate the association between malnutrition and gingivitis while controlling for race, ethnicity, zip code, and preferred language.

My study is a foundational study using SEM to address oral and primary health care in a metropolitan city with a diverse population. The field-based products I created as a result of this study (see Section 4) will hold significance for policy makers and public health practitioners by highlighting the impact of social ecological factors on health outcomes. Additionally, I will provide the field-based products to the health center executive board who will disseminate the information related to the treatment and prevention of malnutrition and gingivitis to others in the organization and the target population.

Research Questions and Hypotheses

Research Question 1: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code?

Null Hypothesis ($H_0$1): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Alternative Hypothesis (H_a1): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Research Question 2: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race?

Null Hypothesis ($H_0$2): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis (H_a2_a): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis (H_a2_b): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a2_C): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling preferred language.

Research Question 3: Is there a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis ($H_0$3): There is not a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a3): There is a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

Research Question 4: Is there a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis ($H_0$4): There is not a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a4): There is a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Theoretical Framework

The Social Ecological Model

The foundation for SEM was originally developed in the 1970's by Urie Bronfenbrenner and further developed by Kenneth McLeroy in the 1980's to understand how human behavior is influenced by systems at the micro-, meso-, exo- and macrosystems levels (Rosa & Tudge, 2013; Sallis & Owen, 2015; Scarneo et al., 2019). Bronfenbrenner believed that the environment and systems in which an individual participates play a vital role in their development (Rosa & Tudge, 2013). SEM has been applied to various studies in an effort to identify and understand barriers and issues that influence the individual, interpersonal, community, and policy levels of society

(Konstantopoulou et al., 2020). The following sections describe in detail each of the levels of SEM from the innermost to the outermost levels.

Individual Level

The innermost component of the SEM is the individual level, composed of demographic and biological characteristics that make up an individual (Johnson et al., 2021; Sallis & Owen, 2015). Bronfenbrenner described the individual level as the microsystem because of the proximity of the components to the individual (Rosa & Tudge, 2013).

Interpersonal Level

Encapsulating the individual level is the interpersonal or relationship level, referred to by Bronfenbrenner as the mesosystem, which is comprised of characteristics including the family and close personal connections that provide support to the individual (Johnson et al., 2021; Rosa & Tudge, 2013).

Organizational Level

The organizational level was not always included in SEM as it was not part of Bronfenbrenner's original design (Rosa & Tudge, 2013). Many researchers, such as Johnson et al (2021), Rosa and Tudge (2013), and Ruby et al. (2024) describe a four level SEM design that excludes the organizational in their research study. For studies that include the organizational level in the approach, the organizational level is representative of things or activities in which the individual is involved such as a school, university, or other institution (Scarneo et al., 2019). The organizational level also includes entities and concepts that enable behavior change, such as attitudes and beliefs that are influenced by

culture, as well as language barriers and access to information through preferred language (Sethi et al., 2021; Zhang and Ma, 2024)

Community Level

The exosystem, or community level is the next level of the SEM; this level includes a person's physical environment, such as their neighborhood, workplace, or school environment (Johnson et al., 2021; Rosa & Tudge, 2013; Sallis & Owen, 2015).

Societal Level

The final level, enveloping all other levels, is the macrosystem, or societal level (Johnson et al., 2021; Rosa & Tudge, 2013). The societal level consists of policies, codes, and other overarching regulations that influence how the inner levels of SEM operate (Johnson et al., 2021; Sallis & Owen, 2015).

Advantages and Disadvantages

When applying SEM to public health research, there are both advantages and disadvantages. One advantage of SEM is that not all layers of the model are required to effectively carry out a study, such as those studies that exclude the organizational level of SEM (Johnson et al., 2021; Rosa & Tudge, 2013; Ruby et al., 2024).

A disadvantage of conducting a research study using SEM is that the layers can be ambiguous in that one factor could be classified in multiple levels based on how the researcher defined the factor (Johnson et al,. 2021; Liu et al., 2024; Scarneo et al., 2019).

Theoretical Framework in Early Related Studies

Since the development of SEM by Urie Bronfenbrenner in the late 1970s and further revision in the 1980s by Kenneth McLeroy, SEM has been applied to a number of

public health topics including family development and child abuse as well as chronic pediatric diseases (Kazak, 1989). Cochran and Brassard (1979) also researched the impact of family networks and how those structures influence the family, further supporting Bronfenbrenner's concept of the exosystem.

Recent Studies Using Theoretical Framework

For more than 30 years, SEM has been applied to research focused on the ecological tenants related to human development and the influence of factors varying in proximity to the individual (Konstantopoulou et al., 2020; Scarneo et al., 2019). In recent years, SEM has been applied to sports medicine, dental care and oral health, as well as screening and medication adherence practices (Konstantopoulou et al., 2020; Liu et al., 2024; Ruby et al., 2024; Scarneo et al., 2019).

Relationship of SEM and Current Study

The study focused on identifying if there is a relationship between malnutrition and gingivitis while controlling for zip code, preferred language, race, and ethnicity. Race and ethnicity are personal characteristics that influence individual identity, however, the density of one's own race in the community can also influence health behavior practices (Johnson et al., 2021). Applying this concept to language, individuals who live in an area where their preferred language is the common language of the community, may choose health behavior practices based on the influence of those who share a common language in their intrapersonal relationships and community. Gingivitis is a preventable condition that can be influenced by malnutrition or other dietary habits (Papathanasiou et al., 2023). As such, SEM was an appropriate framework for this study because of the focus on the

relationship between ecological factors at the individual, interpersonal, and community levels on malnutrition and gingivitis diagnoses.

Nature of Study

The nature of this study was quantitative research given that the data was analyzed using statistical analysis to describe the relationship between the variables and provide a summary of the data. An appropriate approach for this study was a cross-sectional, observational design. In this design, I identified the subjects from the secondary data source based on specific inclusion and exclusion criteria. Given the purpose of this study, to understand if there is an association between malnutrition and gingivitis among those residing in St. Louis, Missouri, a cross-sectional, observational study was a logical approach. I used data from a local Federally Qualified Health Center in St. Louis, Missouri for this study. In order to answer the research questions posed in this study using statistical analysis, I analyzed the data using descriptive statistics and logistic regression. Logistic regression, including multiple logistic regression was considered the most appropriate statistical test because the data analysis provided information about the change in odds of being diagnosed with gingivitis and/or malnutrition as each of the variables, race, ethnicity, zip code, and preferred language change (Warner, 2021). Each of the diagnoses could be coded as a binary variable: gingivitis could be coded as presence of gingivitis or absence of gingivitis. Malnutrition as measured by average BMI could be coded as normal weight and unhealthy weight to include underweight, overweight, and obesity. Based on the number of responses for each diagnosis code, malnutrition and/or gingivitis could also be coded by level of severity.

Literature Search Strategy

Maintaining good oral hygiene and a healthy diet through nutrition are practices that everyone should pursue; however, there are several factors that influence whether a person is able to sustain those practices. The purpose of this study was to identify the association between factors at the individual, interpersonal, and community levels that may influence adherence to the recommended oral hygiene and nutrition practices. In this section, I reviewed and applied the relationship and relevance of recent literature are to the scope of the study. I also described the literature search strategy, theoretical framework, including the use of the framework in recent studies, and the relationship of the framework to the current study, as well as a summary and conclusion of the literature review.

I found the literature reviewed for this study by using a multi-database search provided through the Walden University library. I included the Medline, Directory of Open Access Journals, and CINAHL Plus databases in the search. To find the articles that could be included in the literature review, I used the following keywords: *malnutrition and gingivitis, malnutrition or poor diet or poor nutrition or under nutrition and gingivitis or gum disease or gum inflammation, malnutrition or poor diet or poor nutrition or under nutrition and gingivitis or gum disease or gum inflammation and United States or America or USA or US, oral health or dental health or dental care or oral care and social ecological model or social ecological theory or socioecological model, gingivitis and nutrition.* To limit the findings from each of the searches, I applied the following limitations to the search criteria: peer-reviewed articles that were published

within the last five years. Articles that were clinical in nature were excluded from the literature review as well as articles that were focused on the biological tenants of malnutrition and gingivitis, or individual case studies were removed from the literature review. I synthesized and analyzed the remaining articles.

Literature Review Related to Variables

Malnutrition

Nutrition status refers to the foods an individual consumes in addition to the measure of vitamins and other nutrients in the body (Strączek et al., 2023). Malnutrition is the term used to describe an imbalance of nutrients in the body in comparison to what is needed for daily bodily function (Strączek et al., 2023). Research indicates that oral health conditions, such as gingivitis and periodontal diseases, can be attributed to nutrition status (Isola, 2020; Kareem et al., 2024, Woelber & Vach, 2023). Further, studies have shown that diets high in sugar and carbohydrates can increase an individual's risk of developing gingivitis (Woelber et al., 2024). In order to assess nutritional status in a simplistic, cost-effective approach, body mass index (BMI) has been a first line response to measure and track nutritional status (Al-Kalisi et al., 2022; Budzyński & Szukay, 2022). Low BMI has commonly been associated with malnutrition in underweight individuals; however, with the rise in obesity rates, malnutrition has also been associated with high BMI in overweight and obese individuals (Kobylińska et al., 2021).

Gingivitis

Gingivitis, a mild form of periodontal disease, is a clinical diagnosis indicating inflammation of the gingiva (Gasner & Schure, 2023).When treated in a timely manner, gingivitis is reversible; however, untreated gingivitis can lead to periodontitis, a chronic inflammatory response in the body that causes irreversible damage (Gasner & Schure, 2023). Approximately 90% of the population has or has previously been diagnosed with gingivitis (Gasner & Schure, 2023). Studies indicate that individuals who have a balanced diet that includes at least five servings of fruits and vegetables each day have a decreased risk of developing gingivitis (Gare et al., 2023; Tedjosasongko et al., 2022). Likewise, insufficient access to healthy foods can increase the risk of developing gingivitis and other oral health conditions (Kareem et al., 2024).

Zip Code

Where an individual lives can influence their ability to access many things including medical and other health care services as well as grocery and other convenience stores. Luo et al. (2024) found that living in a poorer neighborhood was a risk factor for dental health. Individuals who reside in more rural areas tend to have less access to larger healthcare organizations and other chain businesses than those in suburban and metropolitan areas. Farley et al. (2023) identified transportation and distance from a healthcare facility as barriers to accessing timely health care services, indicating that those who lived farther away from the facility were less likely to seek care.

Ethnicity and Race

In the United States, ethnic and racial characteristics have been found to be significant predictors of oral health practices. Luo et al. (2024) found that first generation immigrants, particularly those from a minority racial group were less likely to seek oral health services, including preventative health care services and subsequently had higher prevalence of dental caries.

Preferred Language

Preferred language refers to the language an individual prefers to use for communication. Sethi et al. (2021) identified language barriers, including the use of technical medical jargon as barriers to achieving optimal health outcomes. Of the articles reviewed, preferred language or language barriers were not a significant focus of the research, indicating that identifying the influence of preferred language on health outcomes could address a gap in the literature.

Use of Research Design, Secondary Data, and Chosen Dataset

After reviewing the literature related to the variables in this study, I selected a research design and identified a dataset. Previous studies including Al Kalisi et al. (2022), Gare et al. (2023), Kareem et al. (2024), Kaur et al. (2017), Liu et al. (2024), Sayeed and Varghese (2024), Şen et al. (2024), and Tiwari et al. (2022) applied a quantitative, cross-sectional research design with a primary data set. The following studies Achmad et al. (2020), Farley et al. (2023), Johnson et al. (2021), Luo et al. (2024), Mostafa et al. (2023), and Woelber et al. (2024) used a quantitative approach and a secondary data set.

The results of the literature review indicate that a quantitative, cross-sectional research design using a secondary data set was the appropriate approach for this study.

Definitions

Table 1

Summary of Variables From 2024 FQHC Data Report

Variable Name	Definition
Zip Code	Zip code of residence at time of encounter
Race	Race of individual
Ethnicity	Ethnicity of individual
Preferred Language	Language in which the person prefers to communicate for medical/dental encounters
Sex	Sex of individual
Age	Age of individual based on age at time of encounter
Gingivitis	Presence or absence of gingivitis diagnosis
Periodontitis	Presence or absence of periodontitis diagnosis
Malnutrition	Average BMI of individual during 2024

Assumptions

My first assumption was that the secondary data provided by the health center was reliable and valid. My assumption was based on the long-standing history of the organization, including the partnership between the health center and dental school, of which, both organizations are nationally recognized and ranked highly for their commitment to excellence. Given that this study used secondary data, another assumption I made was that the data were collected by individuals who were trained to collect and input the information into the electronic dental record. Staff at the institution providing the data set completed orientation training that included strategies to reduce bias in documentation.

Scope and Limitations

Scope

The scope of this study was the use of SEM as the theoretical framework. Although SEM was discovered in the 1970s to understand human development, the model has since been used to understand how ecological factors influence public health behaviors and subsequent health disparities (Johnson et al., 2021; Rosa & Tudge, 2013; Ruby et al., 2024). Although other frameworks could be applicable to the study, there is a gap in the literature relating to the influence of ecological factors on the association between malnutrition and gingivitis.

The target population focused on individuals residing in St. Louis at the time of their dental visit. Although the findings of this study may not be generalizable to all populations, given that St. Louis is part of a metropolitan area, the results may be generalizable to other metropolitan areas in the United States. Given that all data was collected from individuals residing in the United States, the data may not be generalized to other countries.

Limitations

The data collection process was a limitation of this study because of the use of secondary data. As such, this study was not part of the foundational data collection process and therefore the definition and value of each variable is determined by the organization that provided the data. During the data collection process, there was the potential for threats to internal validity including information bias, recall bias, and prevarication bias. Information bias occurs when there is a measurement error in the

assessment process, such as when multiple providers care for one patient over time and have varying diagnoses of a particular disease (Friis & Sellers, 2014). Recall bias occurs when participants who experience a particular diagnosis have an increased awareness of the condition and are more likely to remember specific information about the condition (Friis & Sellers, 2014). As an example, someone who has been exposed to poor oral hygiene practices or experienced a negative outcome from poor oral hygiene practices may be more aware of factors related to oral health. Prevarication bias, also known as lying bias, occurs when an individual falsifies information by under- or overestimating exposure to a variable (Friis & Sellers, 2014). Related to malnutrition, a parent may over- or under- estimate the amount of nutritious food their child is consuming to hide the appearance of food insecurity.

Another limitation to the study was that the data collected is specific to those who received dental services at the local health center during a specific period of time. This factor could pose a threat to external validity because of the specified inclusion criteria for participation in the study. This threat to external validity is known as selection bias because there could be a distortion between the city population and the selected population, if the sample is not representative of the larger population (Friis & Sellers, 2014).

Significance

Previous studies have evaluated the relationship between race, ethnicity, or access to dental health care services; however, nutrition was not a focus in any of the studies (Luo et al., 2024; Osuh et al., 2023). Studies that focused on oral health and nutrition had

a very specific target population, such as those from a demographic group or those with chronic kidney disease (Al-Kalisi et al., 2022; López-Cisneros et al., 2022). The significance of this study is that it can provide insight into the multiple factors influencing malnutrition and gingivitis rates. The results can also guide future researchers on the importance of social and ecological factors that influence individual, interpersonal, and community level public health decisions (Prasad et al., 2019). From a practical standpoint, the results of this study can be applied to potentially help healthcare organizations and other public health entities identify barriers to achieving optimal nutrition and oral health status so that preventive measures can be established in at-risk, vulnerable communities.

The social change implication of this study is that the results of this study will provide evidence of the connection between specific socioecological factors and the prevalence of malnutrition and/or gingivitis. Previous studies have highlighted the disconnect between oral health and primary health care as an area of improvement for the health care system (Prasad et al., 2019). This study will add to the body of literature highlighting the disconnect between dental and medical care, subsequently providing policy makers and healthcare leaders with data to support the integration of dental care into primary health care. Additionally, this connection of information can promote a stronger link between the need for nutritional education and dental education among specific populations and demographic communities. Using this information, health care providers can offer more equitable resources to their patients and subsequently improve

access to health care services and education for vulnerable and at-risk populations (Prasad et al., 2019).

Summary and Conclusions

In this section, I introduced the public health problem in relation to the current study as well as how the study will help address the gap in literature. The purpose of this study was to identify the relationship between malnutrition and gingivitis and how demographic characteristics including race, ethnicity, preferred language, and zip code influence the prevalence of malnutrition and/or gingivitis. This study can be used to support the need for the integration of nutrition education during dental healthcare visits and likewise dental hygiene education during primary medical encounters. Additionally, the results of this study can offer insight into the role of socioecological factors as it pertains to malnutrition and gingivitis diagnoses.

In this section I also outlined the literature search strategy as well as a review of relevant literature , including current literature related to the study. In the literature review section, I described each of the variables in the study as well as the theoretical framework and methodology that was used to support the current study. The results of the literature review provided the necessary evidence to identify the gap in the literature and support the need for the current study.

Section 2: Research Design and Data Collection

Malnutrition and gingivitis rates have been a concern in the United States because of the long-term implications that can result from either diagnosis. The purpose of this study was to identify how various socioecological factors ranging in proximity to the individual influence the incidence of malnutrition and gingivitis. In this section I described the research design, methodology, and data analysis plan that was used to answer the research questions. Additionally, I described the internal and external threats to validity as well as the ethical procedures that are relevant to the proper collection and storage of information related to the study.

Research Design and Rationale

The purpose of the research was to identify how specific socioecological factors influence gingivitis and malnutrition diagnoses among residents of St. Louis, Missouri. For this reason, I used a quantitative cross-sectional, observational approach as the research design for this study. Based on the nature of the study, I selected a quantitative study to analyze and summarize the data statistically, as well as to identify any patterns in the data, and finally to describe any patterns or relationships between the variables. Given the number of participants in the data set and the type of data used for the study, a qualitative approach would not be feasible. Additionally, qualitative research focuses more on observational data than measured data, indicating that a quantitative approach is more effective for this study (Taherdoost, 2022). Previous research concerning oral health and/or nutritional status studies including Achmad et al. (2020), Al-Kalisi et al. (2022), Kareem et al. (2024), Kaur et al. (2017), López-Cisneros et al. (2022), Sayeed

and Varghese (2024), Şen et al. (2024), and Tiwari et al. (2022) support the use of a quantitative, cross-sectional design. The variables related to the study design are listed below in Table 2, Variables Related to Study Design.

Table 2

Variables Related to Study Design

	Variable Name	Definition
Dependent Variables	Malnutrition	Average BMI of individual in 2024
	Gingivitis	Presence or absence of gingivitis and/or periodontitis diagnosis
Independent Variables	Gingivitis	Presence or absence of gingivitis and/or periodontitis diagnosis
	Preferred Language	Language in which the person prefers to communicate for medical/dental encounters
Covariates	Race	Race of individual
	Ethnicity	Ethnicity of individual
	Zip Code	Zip code of residence at time of last encounter in 2024
	Age	Age of individual in December 2024
	Preferred Language	Language in which the person prefers to communicate for medical/dental encounters

Methodology

Target Population

The target population for this study was individuals residing in St. Louis, Missouri who have received dental services at a Federally Qualified Health Center in the heart of St. Louis. St. Louis is a diverse, metropolitan city that exhibits similar characteristics to other urban, metropolitan areas in the United States. Previous studies have focused on specific demographic characteristics or age groups including Al-Kalisi et al. (2022) focusing on the Yemeni population; Gare et al. (2023) focused on individuals

who were 3 months pregnant, Konstantopoulou et al. (2020) focused on nursing home residents, López- Cisneros et al. (2022) focused on peritoneal dialysis patients, Osuh et al. (2023) focused on Nigerian residents living in an urban slum, and Zapodeanu et al. (2024) focused on elderly patients however, this study will focus on individuals, regardless of age, race, or ethnicity who reside in St. Louis, Missouri.

Sample and Sampling Procedures

Data analyzed for this study was from a secondary data source in St. Louis, Missouri. The source of the data was a Federally Qualified Health Center (FQHC) located in St. Louis that provides dental health services to more than 9,000 patients each year. The FQHC is accredited by the Joint Commission, ensuring that patients are receiving high quality dental health care. The sample included a non-duplicated, de-identified list of individuals who received dental health care services in 2024. Individuals who reside outside of St. Louis City were considered ineligible for the study and excluded from the sample.

Power Analysis Calculation

G*Power 3.1 is a program that is used to determine the minimum sample size needed to identify if there is a statistically significant relationship between gingivitis and malnutrition among residents of St. Louis, Missouri (Intellectus360, 2024). The population of the target population, residents of St. Louis City, is approximately 281,754 (U.S. Census Bureau, 2023). I selected an alpha level of 0.05 and confidence interval of 0.95 based on previous research that was based in multiple logistic regression including Luo et al. (2024), Mostafa et al. (2023) Şen et al. (2024), and Tiwari et al. (2022). An

odds ratio of 0.65 is established from the mean values in Luo et al. (2024), (2023) Şen et al. (2024), and Tiwari et al. (2022). Based on these values, 301 is the minimum sample size for this study; however, all possible cases above the minimum sample size will be included in the sample size.

Access to the Data Set

Access to the data set was granted by the organization and confirmed with a letter of commitment for the provision of de-identified data. To ensure that all privacy and ethical responsibility was maintained, an organizational liaison pulled the data from the electronic health records system. Any identifying information in the initial report was removed by the organizational liaison to maintain HIPAA and compliance regulations. The data exported were provided in an Excel spreadsheet that is compatible with SPSS version 29 for analysis.

Instrumentation and Operationalization of Constructs

Instrument

The data set was generated via documentation in each individual chart at the time of their visit or encounter at any of the health centers located in St. Louis, Missouri. The electronic health record (EHR) system used by the health center is NextGen version 6.2021.1. The EHR contains clinical notes, data, and diagnosis codes, among other information related to the patient including each encounter they have with their healthcare provider; however, for the purposes of the study, only relevant data was extracted and de-identified by the designated health center personnel. The data extracted from the EHR were as follows: malnutrition diagnosis codes, gingivitis diagnosis codes,

race, ethnicity, preferred language, interpreter required, date of birth, gender, and zip code. The data set was de-identified and processed by a member of the health center Information Technology team before being made available for the study.

Operationalization

For the purposes of this study, gingivitis was the independent variable, and malnutrition was the dependent variable. Gingivitis could be coded by the presence or absence of a diagnosis, making it a dichotomous variable. Based on the number of responses for each of the gingivitis diagnosis codes, gingivitis could also be grouped based on severity of diagnosis, making the variable categorical. Likewise, malnutrition could be coded by the presence or absence of a diagnosis, making it a dichotomous variable.

The covariates race, ethnicity, zip code and preferred language are nominal categorical variables because each variable represents a specific group, rather than a numerical value (Laerd Statistics, n.d.). Although zip code is a numerical value, it is representative of a specific area or group within the geographic area. Given the number of zip codes in St. Louis, it was necessary to group zip codes together and recode the group, further strengthening the identification of the variable as categorical. Age of the participant is a continuous variable, and gender is a dichotomous variable.

Research Questions and Hypotheses

Research Question 1: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code?

Null Hypothesis ($H_0$1): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Alternative Hypothesis (H_a1): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Research Question 2: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race?

Null Hypothesis ($H_0$2): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis (H_a2_a): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis (H_a2_b): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a2_C): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling preferred language.

Research Question 3: Is there a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis ($H_0$3): There is not a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a3): There is a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

Research Question 4: Is there a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis (H_04): There is not a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a4): There is a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Statistical Analysis Plan

The data was analyzed using version 29 of SPSS. Descriptive statistics were applied to glean information about the sample; however, if data was missing from any of the categories for an individual, I excluded the case from the analysis to avoid any bias or unintended effect on the results of the study. I categorized the average BMI for an individual into the following categories: underweight (>18.5), normal weight (18.5-24.9), overweight (25-29.9), and obesity (30 or greater) (NIH, n.d.). For the purposes of this study, I regrouped individuals with an underweight, overweight, and obesity BMI into a new category, unhealthy weight if there was not sufficient data for the analysis with each category listed individually. The normal weight category remained the same and the data was analyzed as a dichotomous variable, normal weight and unhealthy weight. I analyzed

gingivitis as a dichotomous variable with 0 being the absence of gingivitis and 1 being the presence of gingivitis at any level of severity.

To analyze the age variable I grouped the ages into the following categories: 0-5 years, 6-18 years, 19-35 years, 36-54 years, and 55 and over years. I grouped the race and ethnicity variables into the following categories: White, Black, Hispanic, Asian and Other, Multiple, and Refused. For binomial logistic regression, I recategorized race into Black and non-Black. The Hispanic category included Mexican, Mexican American, Chicano(a), Puerto Rican, Cuban, and another Hispanic/Latino(a) origin. The Asian and Other category included the following racial identities: Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, Native Hawaiian, Other Pacific Islander, Guamanian or Chamorro, Samoan, American Indian, and Alaska Native. The Multiple categories included racial identities that are comprised of more than one race. The Refused category included entries marked as refused or unknown, or for entries in which no entry is listed.

Sex of the individual is a categorical variable in which the participant identifies as male, female, other, or unreported. Preferred language is a categorical variable in which the participant's preferred language is identified. I grouped the preferred languages as follows: English, Spanish, Arabic, European, African, Asian, and Other. In order to have sufficient data for zip code, I regrouped the numerical zip codes into the following categories: North St. Louis City and South St. Louis City.

Statistical Assumptions: Multiple Logistic Regression

In order to conduct a logistic regression analysis there are six assumptions that must be met. Given that the regression analysis explained the association between the dependent and independent variables, the first assumption is that the dependent variable must be nominal or categorical (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). The second assumption is that the independent variables may be either, continuous, nominal or dichotomous, or categorical (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). For binary logistic regression, the dependent variable must only have two values; however, if the variable has three or more values, multinomial logistic regression can be applied (Meloun & Militký, 2011). The third and fourth assumptions state that there must be statistical independence between the observations of the outcome variables and there is no multicollinearity meaning that the variables are mutually exclusive and exhaustive in that a study participant cannot be a member of more than one group or category (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). The fifth and sixth assumptions require that between the continuous independent variables, there is a linear relationship, the dependent variable has undergone logit transformation, and that there are no outliers or values that could significantly influence or skew the results of the study (Laerd Statistics, n.d.).

Rationale for Inclusion of Covariates

The covariates that were considered for this study include race, ethnicity, preferred language, and zip code. Using the social ecological model (SEM), each of the covariates were identified in multiple portions of SEM. Race and ethnicity are ways in

which an individual may identify; however, that may also be part of how an organization or community identifies (Scarneo et al., 2019). Similarly, preferred language is the language in which a person prefers to communicate; however, preferred language may also influence which organizations an individual is able to support, or influence which interpersonal network and communities a person with a specific preferred language is able to engage (Scarneo et al., 2019). Finally, zip code encompasses the individual, interpersonal, organizational, community, and societal levels of SEM. A person's home residence, place of work, worship, and business all have a zip code associated with each edifice. The diversity of St. Louis is such that stating residence in the city or county does not imply as much as referring to a specific part or zip code in the metropolitan area because there are population shifts and differences that can be identified in a zip code analysis (City of St. Louis, 2020).

Threats to Validity and Ethical Procedures

External Validity

Exhibiting external validity implies that the results from this study will be generalizable to other populations outside of the target population, individuals receiving dental care services at a local health center in St. Louis, Missouri (Friis & Sellers, 2014). Given the population of St. Louis and the urban environment, a threat to external validity for this study is that the results may not be generalizable to smaller, more rural communities. Additionally, the inclusion criteria for participation in the study is that the individuals must have had a dental encounter in 2024 to be included in the study. This could lead to a sampling error that may affect the external validity of the study if the

study participants are not a representative sample of the overall population of St. Louis. Altogether, the circumstances related to the sample and secondary data source that were used for this study indicate that a threat to external validity may occur in the study and thus make the results unique to this study and not generalizable to other studies or in other contexts (Friis & Sellers, 2014).

Internal Validity

Internal validity refers to the proper selection of participants as well as a lack of measurement error (Friis & Sellers, 2014). For this study, a threat to internal validity is that the diagnosis of malnutrition and/or gingivitis as well as the outcome of the demographic factors is reliant upon the documentation in the electronic dental record. Given that there are multiple team members involved in the registration and treatment of each person, it is likely that there may be some documentation differences, despite the presence of standard operating procedures, likely due to factors related to staffing and time shortages as well as insufficient training (Kasaye et al., 2022). A trained medical professional completes the diagnosis documentation; however, the demographic factors, although documented on legal identification cards, may also be self-reported by the individual, thus leading to information bias, a threat to internal validity (Friis & Sellers, 2014). To mitigate this threat, specific data, including the annual Uniform Data System report is audited each year by the Bureau of Primary Health Care (BPHC) to ensure that the system is capturing valid and reliable information (Health Resources & Service Administration, 2024).

Construct Validity

Construct validity refers to the alignment of the study results with the theoretical model (Friis & Sellers, 2014). SEM does not indicate that there should be any type of motion between the variables, but that it serves as a framework to help researchers understand how various factors including individual, physical environment, and socioecological characteristics influence specific populations (Johnson et al., 2021). This evidence suggests that there are not any threats against construct validity in this study.

Ethical Considerations

Gaining access to the data was not a concern for this study as a letter of commitment granting access to the de-identified data was obtained prior to the development of the research proposal. Given that the original data contained protected health information, a member of the health center team removed any identifying information from the data export prior to providing it for analysis. This action removed the potential ethical concern and HIPAA violation that protected health information is shared to an unauthorized party. To reduce the risk of unintentionally sharing the data because of a cybersecurity issue, the data was stored in a secure location that is not accessible to anyone. Additionally, to ensure that the study was conducted in an ethical manner, the Institutional Review Board (IRB) at Walden University reviewed the proposal and provided approval for the study.

Summary and Conclusions

In this section I described the quantitative, cross-sectional, observational study design that was used for this study. I used secondary data from the electronic health

records of patients at a local health center in St. Louis for the study. In this section I also described the use of the program G*Power 3.1, the electronic health record instrument, as well as specific details related to each of the variables in the study and how I will code each variable. Further, in this section I defined the data analysis plan that included descriptive statistics and logistic regression analysis. Finally, I concluded this section with a discussion about threats to validity that could influence the results of the study and the ethical considerations that are necessary to ensure that all data related to the study is handled appropriately. Moving forward, in the next section I have provided a breakdown of the results and findings of the study.

Section 3: Presentation of the Results and Findings

Food insecurity is one factor that can lead to malnutrition. In the United States, malnutrition rates increased between 2022 and 2023 from 12.8% to 13.5% (Rabbitt et al., 2024). The state of Missouri is among the top 10 states in the United States with the highest prevalences of food insecurity at 12.7% and very low food security at 5.8% (Rabbitt et al., 2024). Nationwide, there has been an increase in malnutrition related mortalities with urban communities, such as St. Louis, being disproportionately affected by such mortalities (Mostafa et al., 2023). The purpose of this study was to identify if there is an association between malnutrition and gingivitis while controlling for zip code, race, ethnicity, and preferred language. I analyzed secondary data provided by a St. Louis health center was analyzed to address the research questions. Utilizing the social ecological model (SEM), each of the research questions I developed addressed the association between malnutrition and/or gingivitis. I analyzed the research questions using descriptive statistics, binary logistic regression, and multinomial logistic regression through SPSS version 29. If a p-value was 0.05 or less, I described the results as statistically significant. I also applied associated odds ratio for additional interpretation of the data.

Data Collection

Institutional Review Board

Maintaining ethical standards that align with the expectations of Walden University as well as federal regulations is imperative to the credibility of the study. The Institutional Review Board (IRB) conducted an ethics review and approved the study on

June 3, 2025. The study was approved by the IRB prior to any access or evaluation of the secondary data set to maintain an ethical approach to the research study.

Recruitment, Response Rates, and Discrepancies

Participants in the research study were recruited from the health center that provided the secondary data set. Individuals who had a medical or dental encounter between January 1, 2024, and December 31, 2024, were eligible for inclusion in the data set, totaling 44,891 unique individuals. Another inclusion criterion was that the individual had to reside in a St. Louis City zip code; individuals residing outside of St. Louis City were excluded from participation. The following were identified as zip codes that are partially or entirely located in St. Louis City: 63101, 63102, 63103, 63104, 63106, 63107, 63108, 63109, 63110, 63111, 63112, 63113, 63114, 63115, 63116, 63118, 63120, 63136, 63139, 63147, 63155, 63156, 63157, 63158, 63163, 63164, 63166, 63169, 63177, 63178, 63179, and 63188 (Daly, 2020). The number of city residents with either a gingivitis or periodontitis diagnosis code and an average BMI is 2,553 participants. Given the number of total participants, N = 44,891, and the number of eligible participants, n = 2,553, the response rate for this study was 5.68% and meets the minimum sample size that was calculated using G*Power 3.1.

Results

Descriptive Statistics

Utilizing a power analysis, G*Power 3.1, the minimum sample size for this study is (n = 301). Given that the population of St. Louis City is 281,754, all eligible participants were included in the sample size yielding a final sample size of 2,553

participants. I analyzed the data set and generated the frequency distribution for each of the following variables: malnutrition as measured by BMI category, gingivitis (presence/absence), gingivitis diagnosis (GDX), periodontitis diagnosis (PDX), zip code, preferred language, race, ethnicity, age group, current gender, and interpreter required. Tables 3 through 10 highlight the frequency of the following variables malnutrition as measured by BMI, Gingivitis, Zip Code, Race, Ethnicity, and Preferred Language. Tables 11 through 13 include other notable information about the data set including age, gender, and interpreter required.

Table 3

Malnutrition – BMI

	N	%
Underweight	370	14.5%
Normal Weight	653	25.6%
Overweight	553	21.7%
Obesity	977	38.3%

Table 4

Gingivitis

	N	%
Presence of Gingivitis	468	18.3%
Absence of Gingivitis	2085	81.7%

Table 5

Gingivitis Diagnosis (GDX)

	N	%
No	2434	95.3%
Yes	119	4.7%

Table 6

Periodontitis Diagnosis (PDX)

	N	%
No	2181	85.4
Yes	372	14.6%

Table 7

Zip Code

	N	%
North	1334	52.3%
South	1219	47.7%

Table 8

Race

	N	%
Black	1954	76.5%
White	274	10.7%
Asian and Other	269	10.5%
Multiple	19	0.7%
Refused	37	1.4%

Table 9

Ethnicity

	N	%
Not Hispanic	2291	89.7%
Hispanic	210	8.2%
Unreported	52	2.0%

Table 10

Preferred Language

	N	%
English	2186	85.6%
Spanish	163	6.4%
Arabic	27	1.1%
Asian and Other Languages	136	5.3%
African Languages	37	1.4%
European Languages	4	0.2%

Table 11

Age

	N	%
0 to 5 years	177	6.9%
6 to 18 years	491	19.2%
19 to 35 years	607	23.8%
36 to 54 years	674	26.4%
55 and older years	604	23.7%

Table 12

Gender

	N	%
Male	952	37.3%
Female	1589	62.2%
Other	2	0.1%
Missing	10	0.4%

Table 13

Interpreter Required

	N	%
No	2196	86.0%
Yes	357	14.0%

Statistical Test: Multiple Logistic Regression

To analyze each of the questions, I used SPSS version 29 and ran crosstabs for the variables in each of the research questions to ensure that sufficient data was available to accurately answer each of the questions. Due to the amount data available in each of the categories, language group had to be regrouped into English and Non-English and zip code was regrouped into north and south zip codes. I applied multiple logistic regression to the data set to obtain a Goodness-of-Fit table, Likelihood Ratio Tests table, and the Parameter Estimates table to answer each of the research questions (Laerd Statistics, n.d.).

Statistical Assumptions: Multiple Logistic Regression

In order to conduct a logistic regression analysis, there are six assumptions that must be met. Given that the regression analysis will explain the association between the dependent and independent variables, the first assumption is that the dependent variable must be nominal or categorical (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). The second assumption is that the independent variables may be either, continuous, nominal or dichotomous, or categorical (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). For binary logistic regression, the dependent variable must only have two values; however, if the variable has three or more values, multinomial logistic regression can be applied (Meloun & Militký, 2011). The third and fourth assumptions state that there must be statistical independence between the observations of the outcome variables and there is no multicollinearity meaning that the variables are mutually exclusive and exhaustive in that a study participant cannot be a member of more

than one group or category (Laerd Statistics, n.d.; Meloun & Militký, 2011; Warner, 2021). The fifth and sixth assumptions require that between the continuous independent variables, there is a linear relationship, the dependent variable has undergone logit transformation, and that there are no outliers or values that could significantly influence or skew the results of the study (Laerd Statistics, n.d.).

Research Question 1

Research Question 1: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code?

Null Hypothesis ($H_0$1): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Alternative Hypothesis (H_a1): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for zip code.

Preliminary analyses indicate that there is no multicollinearity between the variables as noted in Table 14, Collinearity Diagnostics for Research Question 1.

Table 14

Collinearity Diagnostics for Research Question 1

				Variance Proportions		
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Gingivitis	North/South Zip Code
1	1	2.482	1.000	.02	.03	.06
	2	.427	2.410	.03	.09	.86
	3	.090	5.244	.95	.88	.08

a. Dependent Variable: Malnutrition/BMI Category

Multinomial logistic regression was conducted. The Model Fitting Information for Research Question 1, $p < .001$, indicates a good fit for the data set. The Likelihood Ratio Test in Table 15 indicates that dental diagnosis is statistically significant, $p < .001$, but zip code is not statistically significant, $p = .072$, meaning that zip code is not a significant predictor for this research question.

Table 15

Likelihood Ratio Test – Research Question 1

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	72.038	.000	0	
Zip Code	79.044	7.007	3	.072
Gingivitis	169.873	97.835	3	<.001

Table 16, Parameter Estimates – Research Question 1 further highlights that BMI category and Dental Diagnosis are significant; however, zip code is not statistically significant.

Table 16

Parameter Estimates – Research Question 1

BMI Category[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Intervals for Exp(B) Lower Bound	Upper Bound
Underweight	Intercept	-.358	.091	15.595	1	<.001			
	Zip Code	-.214	.131	2.652	1	.103	.808	.624	1.044
	Gingivitis	-1.309	.279	22.036	1	<.001	.270	.156	.466
	No Gingivitis	0[b]			0				
Overweight	Intercept	-.306	.087	12.469	1	<.001			
	Zip Code	.082	.116	.502	1	.478	1.086	.865	1.363
	Gingivitis	5.40	.151	12.767	1	<.001	1.716	1.276	2.307
	No Gingivitis	0[b]			0				
Obesity	Intercept	.350	.074	22.377	1	<.001			
	Zip Code	-.139	.102	1.858	1	.173	.871	.713	1.063
	Gingivitis	.630	.134	22.002	1	<.001	1.878	1.443	2.445
	No Gingivitis	0[b]			0				

[a] The reference category is: Normal Weight

[b] This parameter is set to zero because it is redundant

The outcome of the analysis is as follows: χ^2 (6, N = 2553) = 105.109, p = <.001 indicating the model could distinguish between underweight, normal weight, overweight, and obesity. The model explained between 4.0% (Cox & Snell R^2) and 4.3% (Nagelkerke R^2) of the variance in weight status. Gingivitis was a significant predictor of malnutrition as evaluated using BMI. The associated odds ratio for underweight (OR=.270 95%CI [.156, .466] suggests that residents of St. Louis City who are underweight are .27 times less likely to have a gingivitis diagnosis than those who have a normal weight BMI. The associated odds ratio for overweight (OR=1.716 95%CI [1.276, 2.307] suggests that residents of St. Louis City who are overweight are 1.716 times more likely to have a gingivitis diagnosis than those who have a normal weight BMI. The associated odds ratio for obesity (OR= 1.878 95%CI [1.443, 2.445] suggests that residents of St. Louis City

who are obese are 1.878 times more likely to have a gingivitis diagnosis than those who have a normal weight BMI.

Research Question 2

Research Question 2: Is there a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race?

Null Hypothesis ($H_0 2$): There is no relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis ($H_a 2_a$): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Alternative Hypothesis ($H_a 2_b$): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis ($H_a 2_C$): There is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling preferred language.

Due to insufficient data, I recoded the malnutrition and race variables after running crosstabs to mitigate any errors from the lack of sufficient data. As such, malnutrition, evaluated using average BMI, was recoded into normal weight and unhealthy weight, including underweight, overweight, and obesity; race was recoded into Black and non-Black. The change in number of outcomes for the dependent variable, malnutrition, required a change in analysis from multinomial logistic regression to

binomial logistic regression. When testing for multicollinearity, as shown in Table 17, Collinearity Diagnostics – Research Question 2, race and preferred language have values greater than .5, indicating that there is collinearity. Excluding preferred language from the analysis resolves the collinearity assumption.

Table 17

Collinearity Diagnostics – Research Question 2

				Variance Proportions				
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Gingivitis	Race	Ethnicity	Language
1	1	2.966	1.000	.01	.01	.04	.03	.03
	2	1.129	1.621	.04	.05	.03	.13	.07
	3	.473	2.503	.00	.00	.14	.83	.25
	4	.336	2.970	.00	.00	.79	.00	.65
	5	.095	5.576	.94	.93	.01	.00	.00

a. Dependent Variable: Malnutrition/BMI Category

The *p*-values for the independent variable and covariates, gingivitis, ethnicity, and race, found in Table 18, Variables in the Equation for Research Question 2, were .003, .039, and <.001 respectively.

Table 18

Variables in the Equation for Research Question 2

								95% Confidence Intervals for Exp(B)	
		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Step 1	Gingivitis	.373	.126	8.778	1	.003	1.452	1.135	1.858
	Ethnicity (Hispanic)	-.389	.188	4.261	1	.039	.678	.468	.981
	Race (non-Black)	.401	.117	11.852	1	<.001	1.494	1.189	1.877
	Constant	-1.445	.118	149.802	1	<.001	.236		

a. Dependent Variable: Malnutrition/BMI Category

Given that the *p*-values for gingivitis, ethnicity, and race are less than .05, the results of the study are statistically significant. The Hosmer and Lemeshow Test resulted

in a *p*-value of .749 indicating a good fit for this data set. The Omnibus Tests of Model Coefficients, Table 19, recorded a *p*-value of <.001.

Table 19

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	21.323	3	<.001
	Block	21.323	3	<.001
	Model	21.323	3	<.001

The outcome of the analysis is as follows: χ^2 (3, N = 2553) = 21.323, p = <.001 indicating the model could distinguish between individuals with an unhealthy weight and those with a healthy weight. The model explained between 0.8% (Cox & Snell R^2) and 1.2% (Nagelkerke R^2) of the variance in weight status and correctly classified 74.9% of the cases.

Gingivitis, ethnicity, and race were significant predictors. The associated odds ratio for gingivitis diagnosis (OR=1.452 95%CI [1.135, 1.858] suggests that residents of St. Louis City with an unhealthy weight are 1.452 times more likely to have gingivitis than those who have a healthy weight. The associated odds ratio for ethnicity (OR=.678 95%CI [.468, .981] suggests that non-Hispanic residents of St. Louis City are .678 times less likely to have an unhealthy BMI than Hispanic residents. The associated odds ratio for race (OR=1.494 95%CI [1.189, 1.877] suggests that residents of St. Louis City who identify as Black are 1.494 times more likely to have an unhealthy weight than residents who identify as non-Black. The findings from this analysis supported the alternative hypothesis, there is a relationship between gingivitis and malnutrition among dental patients in St. Louis while controlling for preferred language, ethnicity and race.

Research Question 3

Research Question 3: Is there a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis ($H_0$3): There is not a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a3): There is a relationship between preferred language and gingivitis among dental patients in St. Louis while controlling for ethnicity and race.

To assess this research question, I used SPSS to complete binomial logistic regression; however, preliminary analyses assessing collinearity as noted in Table 20, Collinearity Diagnostics – Research Question 3 indicate that preferred language and race are collinear because the variance proportions are greater than .5. As such, it is not possible to assess the relationship between preferred language and gingivitis while controlling for ethnicity and race. Excluding race from the analysis satisfies the collinearity assumption.

Table 20

Collinearity Diagnostics – Research Question 3

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Race	Ethnicity	Language
1	1	2.469	1.000	.05	.06	.06	.06
	2	.740	1.826	.73	.00	.21	.03
	3	.460	2.316	.14	.10	.72	.33
	4	.331	2.733	.09	.84	.00	.58

a. Dependent Variable: Gingivitis

The *p*-values for the independent variable and covariates, ethnicity and preferred language, found in Table 21, Variables in the Equation for Research Question 3, were .342 and .102 respectively.

Table 21

Variables in the Equation for Research Question 3

								95% Confidence Intervals for Exp(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Step 1	Ethnicity (Hispanic)	.225	.237	.902	1	.342	1.252	.787	1.991
	Language (non-English)	.296	.181	2.673	1	.102	1.344	.943	1.916
	Constant	1.440	.055	692.231	1	<.001	4.219		

a. Dependent Variable: Gingivitis

The Hosmer and Lemeshow Test had a *p*-value of .456 indicating a good fit for the data set. The Omnibus Tests of Model Coefficients found in Table 22 recorded a *p*-value of .032.

Table 22

Omnibus Tests of Model Coefficients – Research Question 3

		Chi-square	df	Sig.
Step 1	Step	6.898	2	.032
	Block	6.898	2	.032
	Model	6.898	2	.032

The outcome of the analysis is as follows: χ^2 (2, N = 2553) = 6.898, p = .456. The model explained between 0.3% (Cox & Snell R^2) and 0.4% (Nagelkerke R^2) of the variance in presence of gingivitis and correctly classified 81.7% of cases.

Neither preferred language nor ethnicity were significant predictors for this research question. Given the outcome of the analysis, there is not enough data to support the alternative hypothesis, and therefore, the null hypothesis cannot be rejected.

Research Question 4

Research Question 4: Is there a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race?

Null Hypothesis ($H_0$4): There is not a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

Alternative Hypothesis (H_a4): There is a relationship between preferred language and malnutrition among dental patients in St. Louis while controlling for ethnicity and race.

To assess this research question, I used SPSS to complete binomial logistic regression; however, preliminary analyses assessing collinearity as identified in Table 23, Collinearity Diagnostics for Research Question 4, indicate that preferred language and race are collinear because the variance proportions are greater than .5. As such, it is not possible to assess the relationship between preferred language and malnutrition while controlling for ethnicity and race. Excluding race from the analysis satisfies the collinearity assumption.

Table 23

Collinearity Diagnostics for Research Question 4

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Race	Ethnicity	Language
1	1	2.469	1.000	.05	.06	.06	.06
	2	.740	1.826	.73	.00	.21	.03
	3	.460	2.316	.14	.10	.72	.33
	4	.331	2.733	.09	.84	.00	.58

a. Dependent Variable: Malnutrition/BMI Category

The *p*-values for ethnicity and preferred language, found in Table 24, were .073 and .003 respectively.

Table 24

Variables in the Equation – Research Question 4

							95% Confidence Intervals for Exp(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Step 1	Ethnicity (Hispanic)	-.345	.193	3.213	1	.073	.708	.486	1.033
	Language (non-English)	.418	.142	8.675	1	.003	1.519	1.150	2.007
	Constant	-1.104	.050	492.116	1	<.001	.332		

a. Dependent Variable: Malnutrition/BMI Category

The Hosmer and Lemeshow Test had a *p*-value of .977 indicating a good fit for the data set. The Omnibus Tests of Model Coefficients found in Table 25 recorded a *p*-value of .013.

Table 25

Omnibus Tests of Model Coefficients for Research Question 4

		Chi-square	df	Sig.
Step 1	Step	8.636	2	.013
	Block	8.636	2	.013
	Model	8.636	2	.013

The outcome of the analysis is as follows: χ^2 (2, N = 2553) = 8.636, p = .013. The model explained between 0.3% (Cox & Snell R^2) and 0.5% (Nagelkerke R^2) of the variance in malnutrition as evaluated by BMI and correctly classified 74.4% of the cases.

Preferred language was the only significant predictor. The associated odds ratio of preferred language (OR=1.519 95%CI [1.150, 2.007] suggests that residents of St. Louis City whose preferred language is English are 1.519 times more likely to have an unhealthy weight compared to those whose preferred language is not English.

Summary and Conclusions

In this section, I analyzed the data set from the health center to answer the four research questions. A frequency table showed that the eligible population for the sample is (n=2,553). After completing the logistic regression, the results showed support for rejecting the null hypothesis for Research Question 1. For this research question, Table 16 shows that gingivitis was statistically significant and there was sufficient data to reject the null hypothesis and support the alternative hypothesis; zip code was not significant. For Research Question 2, there was sufficient evidence to reject the null hypothesis and accept the first alternative hypothesis, H_a2_a; all variables, gingivitis, ethnicity, and race, were statistically significant (Table 18). For Research Questions 3 and 4 there were issues of collinearity between preferred language and race. Race was removed from the analysis for both questions to resolve the collinearity assumption. In Research Question 3 neither race nor preferred language was a statistically significant variable (Table 21). As a result, there was not sufficient evidence to reject the null hypothesis for Research Question 3. In

Research Question 4, preferred language was statistically significant (Table 24) and provided sufficient evidence to reject the null hypothesis and accept the alternative hypothesis. The concluding section, Section 4, includes the interpretations of the findings related to this study in addition to the outcome of this study in relation to current literature. Section 4 also includes the limitations of the study, positive social change implications, and recommendations for future studies.

Section 4: Application to Professional Practice and Implications for Social Change

The clinical implications of gingivitis and malnutrition have been thoroughly researched independently in the United States and around the world with specific populations (Al-Kalisi et al., 2022, López-Cisneros et al., 2022; Osuh et al., 2023, Zhang & Ma, 2024). The purpose of this quantitative study was to identify if there was an association between malnutrition and gingivitis among St. Louis Residents, a diverse population with varying demographic backgrounds represented in the population. After running logistic regression on each of the four research questions, all the results provided support for the alternative hypotheses, with the exception of Research Question 3.

Interpretation of the Findings

Summary of the Current Study's Findings

The alternative hypotheses for Research Questions 1, 2, and 4 were supported; however, Research Question 3 was not supported so the data failed to reject the null hypothesis. For Research Questions 2, 3, and 4 race, ethnicity, and preferred language were listed as covariates; however, when testing the assumptions for logistic regression, there appeared to be collinearity between race and preferred language. For Research Question 1, zip code appeared to be a poor choice for a covariate because the Likelihood Ratio Test (Table 15) and the Parameter Estimates (Table 16) had a p-value > .05 indicating that zip code was not a significant predictor for this research question. The results from Research Question 2 suggest that St. Louis residents who have gingivitis or those who identify as Black are more likely to have an unhealthy (underweight, overweight, obesity) BMI than those who do not have gingivitis or identify as a race

other than Black. Non-Hispanic residents are less likely to have an unhealthy BMI than those who identify as Hispanic. For Research Question 3, the findings suggest that neither preferred language nor ethnicity were significant predictors. The findings for Research Question 4 suggest that residents of St. Louis City whose preferred language is English are more likely to have an unhealthy weight than those whose preferred language is a language other than English.

Findings as Compared to Literature Related to the Current Study's Chosen Variables

Research Question 1

The results from this study suggest that individuals with overweight or obesity BMI are more likely to have gingivitis than individuals with a normal weight. Zip code as a covariate was a poor predictor and in this data set was not a good fit to answer the research question. The results from this study suggest that there was a relationship between malnutrition and gingivitis, so the alternative hypothesis is accepted. This outcome supports the findings of Luo et al. (2024), Farley et al. (2023), and Mostafa et al. (2023). Additional research related to access to transportation, distance from healthcare facility, and income with a more geographically diverse population may provide evidence to support zip code as a covariate.

Research Question 2

The findings from the current study suggest that St. Louis residents who have an unhealthy BMI (underweight, overweight, or obesity) are more likely to have gingivitis than those who have a normal weight BMI. Individuals who identify as Black and those

who identify as Hispanic are also more likely to have an unhealthy BMI than those who identify as a race other than Black or non-Hispanic. This finding is consistent with the results from Luo et al. (2024) where it was found that those who identify as Black, Indigenous, and People of Color (BIPOC), including those who identify as Hispanic are less likely to seek preventive healthcare services. Previous studies did not focus on the influence of preferred language in a diverse population; however, Sethi et al. (2021) suggested that language, referring to technical jargon, is often a barrier to obtaining optimal health outcomes. After comparing the results of this study with previous studies, assessing health literacy in addition to preferred language may be beneficial in understanding the influence of preferred language as it relates to malnutrition and gingivitis.

Research Question 3

The findings of the current study suggest that language and ethnicity are not significant factors in assessing the relationship between preferred language and gingivitis. Although this outcome differs from the study conducted by Sethi et al. (2021) who identified language barriers as an obstacle that may hinder individuals from achieving optimal health outcomes, additional research that focuses on health literacy and language support such as the use of an interpreter may provide evidence to better understand the relationship between preferred language and gingivitis.

Research Question 4

The findings of the current study suggest that that residents of St. Louis City whose preferred language is English are more likely to have an unhealthy weight than

those whose preferred language is not English. In relation to current literature, preferred language or language barriers were not a significant focus of the research, indicating that additional research is needed to identify the influence of preferred language on health outcomes could address a gap in the literature. This research and outcome could be included as foundational literature for future research.

Findings Regarding the Theoretical Framework

The findings of the current study support the use of social ecological model (SEM) to understand the association between malnutrition and gingivitis while controlling factors that relate to social and ecological factors including zip code, race, ethnicity, and preferred language. These factors are related to the individual, interpersonal, and community levels of the SEM. An advantage of using SEM in this study is that the data provides insight into how the association between malnutrition and gingivitis shifts when controlling zip code, race, ethnicity, and preferred language and how identification with certain characteristics can influence health behavior practices (Johnson et al., 2021). A disadvantage of using SEM is that the covariates may align to a certain layer of the SEM framework for this study; however, in other research, the covariate may be assigned to a different layer depending on how the researcher defined the factor (Johnson et al., 2021; Liu et al., 2024; Scarneo et al., 2019). To fully understand the impact of the covariates as defined for this study, additional research with a larger, more diverse sample size is needed.

Limitations of the Study

Limitations of the study are related to the use of a secondary data set. As with any other large data set, such as this set, it is likely that there are multiple individuals entering data into the system to generate responses. Consequently, the interpretation of each variable may depend on the individual entering the data if clear criteria are not established at the beginning of the data entry process. Misclassification bias is also a limitation of this study given that information that was marked as missing or unreported, may have occurred due to human error such as the person recording the information was not familiar with the data that needed to be collected, or they were not comfortable asking the person for that information (Pham et al., 2019). Another limitation to this study was selection bias because all the participants were individuals who received healthcare and dental services at one healthcare facility in the St. Louis area. Additionally, this limitation may influence the outcomes of the study given that best practices, such as having an interpreter available for every individual who prefers to speak a language other than English, are standardized across the organization and may not be generalizable to other entities in the area. For Research Question 3 and Research Question 4, multicollinearity between preferred language and race was a limitation. Race was removed from the analysis to satisfy the multicollinearity assumption.

Recommendations for Future Studies

After reviewing previous studies in alignment with the outcomes from this study, future studies should include age and income as covariates to provide a better understanding of the association between malnutrition and gingivitis over various age

groups and income levels. Many studies focus on specific populations and certain age groups (Achmad et al., 2020; Al-Kalisi et al., 2022; Gare et al., 2023; Kareem et al., 2024; Kaur et al., 2017; Liu et al., 2024; Osuh et al., 2023; Staufenbiel et al., 2023). Including age as a covariate in a diverse population, such as St. Louis, could provide insight into malnutrition and gingivitis shifts over time. Additionally, including health literacy and the presence of an interpreter during clinical encounters as covariates could provide greater insight into the influence of preferred language on the association between malnutrition and gingivitis.

Policy Brief Memo

The Policy Brief Memo found in Appendix A, Field-Based Product 1 – Policy Brief Memo, is one tool that will promote positive social change in the community by providing policy makers with an approach to address malnutrition and gingivitis in the St. Louis community. Implementing a policy that focuses on addressing social ecological factors in healthcare encounters could support individuals by providing them with resources to address their personal needs. Further, by meeting social ecological needs, individuals may have additional resources available to manage their health and wellbeing.

Community Health Intervention Plan

The Community Health Intervention Plan found in Appendix B, Field-Based Product 2 - Community Health Intervention Plan, identifies a strategic plan for reaching transient populations through an integrated approach. By utilizing every encounter, whether medical or dental, as an opportunity to provide patient education and resources, clinicians are able to provide a more holistic approach to health care. Federally Qualified

Health Centers (FQHCs) are an ideal location for this intervention given the availability of medical and dental services within the health center. Additionally, FQHCs are often provided with funding to cover the cost of uninsured and uninsured individuals, meaning that the intervention will reach vulnerable populations. Further, FQHCs are equipped with staff including patient navigators, case managers, and outreach support who can implement interventions that support each layer of SEM. Additional support from the Department of Health will help guide the intervention and further expansion into private health practice.

Intervention Plan Framework

The Intervention Plan Framework found in Appendix C, Field-Based Product 3 – Intervention Plan Framework provides a visual of the intervention utilizing SEM. At the individual level, there should be an increase in access to medical and dental services through outreach, including marketplace and Medicaid applications, patient navigation, and case management. At the interpersonal level, there should be health education sessions that offer support to individuals and family members who want to prevent or manage medical and dental conditions. At the organizational level, the agency should integrate dental care practices such as fluoride for children and education about regular brushing and flossing into medical visits. At the community level there should be partnerships with local medical and dental schools to ensure continuity of practice among upcoming clinicians. At the societal level, additional metrics should be generated to support the overlap of medical and dental health education across all patient encounters.

Informational Fact Sheet

The Informational Fact Sheet found in Appendix D, Field Based Product 4 - Informational Fact Sheet provides an abbreviated review of gingivitis at the national level. The Fact Sheet also provides detailed information about malnutrition and statistics about malnutrition in Missouri. Further the fact sheet highlights strategies to avoid malnutrition and gingivitis.

Implications

An implication for social change that results from this study is awareness of the transient population that seeks healthcare services across multiple medical and dental establishments and the impact of sociological factors on health outcomes. By collecting medical information, such as height and weight to assess BMI or asking nutrition related questions to assess malnutrition during routine dental visits, healthcare providers are filling a gap that, if not addressed, could contribute to the number of individuals falling through the cracks of healthcare follow-up. Applying that process to this research study, if all the St. Louis City residents who had a dental encounter in 2024 also had a recorded BMI, the sample size of the study would have been approximately 7,100 participants.

Conclusion

Studies suggest that there is a relationship between food choice and dental care (Papathanasiou et al., 2023; Staufenbiel et al., 2023; Woelber & Vach, 2023). Individuals with poor dental outcomes, including a higher number of decayed, missing, or filled teeth, are more susceptible to poorer nutrition and health outcomes including low self-esteem and reduced quality of life (Kaur et al., 2017; Mostafa et al., 2023; Tiwari et al.,

2022). Individuals in urban communities such as St. Louis, those who are living below 100% of the Federal Poverty Level, and those who identify as Mexican American or Non-Hispanic Black are disproportionately affected by poorer health outcomes including malnutrition-related mortality and gingivitis (CDC, 2024; Mostafa et al., 2023). This study provided insight into the relationship between malnutrition and gingivitis while controlling for zip code, race, ethnicity, and preferred language; all characteristics that influence individuals at different levels. As a result, this study can inform public health and medical practitioners about the influence of social ecological factors. Additionally, this study can be used as evidence to promote access to healthcare services and a stronger link between medical and dental care. Social ecological factors should not impact the care or health outcomes that residents in St. Louis experience. This study is a step toward addressing the gap between malnutrition and gingivitis as it relates to social ecological factors including zip code, race, ethnicity, and preferred language.

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Appendix A: Field-Based Product 1 - Policy Brief Memo

Addressing the prevalence of preventable conditions through policy reform

Introduction

Malnutrition and gingivitis are preventable conditions that are often influenced by socioecological factors such as access to healthy, nutritious food, and access to dental care and preventative practices such as proper dental hygiene. In the United States, food insecurity rates have increased from 12.8% in 2022 to 13.5% in 2023 (Rabbitt et al., 2024). These increases were noted in nearly every household composition category, ethnicity, race, household income level, and geographic region (Rabbitt et al., 2024).

Scope of the Problem

In Missouri, 12.7% of residents experience food insecurity and 5.8% of residents experience very low food security (Rabbitt et al., 2024). Individuals whose preferred language is English or identify as Black or Hispanic are more likely to have an unhealthy weight. Gingivitis affects 90% of the global population, but individuals living below 100% of the Federal Poverty Level, those who identify as Mexican American or Non-Hispanic Black are disproportionately affected by gingivitis (CDC, 2024; Gasner & Schure, 2023).

Current Approaches

Current approaches to malnutrition in primary care often include referrals to specialized support and resources. Gingivitis is identified during routine dental cleaning and treated or maintained with good oral hygiene practice (CDC, 2024). There is often not an overlap in care between medical and dental practitioners and unless the practitioners use the same electronic health record platform, the health data is not easily shared between practices.

Proposed Program or Policy

Delayed diagnosis and treatment can lead to preventable conditions progressing into irreversible diseases (CDC, 2024). Addressing social ecological factors that may influence health outcomes at every medical and dental encounter is essential in reaching the most vulnerable individuals in St. Louis.

Major Constituencies

Key stakeholders for this initiative include leaders from primary healthcare organizations such as Federally Qualified Health Centers and private practices, educational institutions including medical and dental schools, and the St. Louis Department of Health.

Conclusions

The transient nature of patients in public primary health care implies that many individuals do not seek routine healthcare services and often encounter barriers to healthcare that hinder them from accessing timely services (U.S. Department of Health and Human Services, n.d.). Addressing social ecological factors at every visit could support the health outcomes of St. Louisans through early detection and treatment of preventable conditions.

Appendix B: Field-Based Product 2 - Community Health Intervention Plan

Addressing the prevalence of preventable conditions through policy reform

Problem Definition

Malnutrition and gingivitis are preventable conditions that are often influenced by socioecological factors such as access to healthy, nutritious food, and access to dental care and preventative practices such as proper dental hygiene. In the United States, food insecurity rates have increased from 12.8% in 2022 to 13.5% in 2023 (Rabbitt et al., 2024). These increases were noted in nearly every household composition category, ethnicity, race, household income level, and geographic region (Rabbitt et al., 2024).

Goal Setting

All patients at the Federally Qualified Health Center will have a recorded BMI in their health record at the next appointment.

All patients will be assessed for food insecurity at each visit and the corresponding result will be documented in their health record.

All medical providers will be trained on how to present the importance of good oral hygiene to their patients.

Target Population

Patients at Federally Qualified Health Centers (FQHC) will be the primary population served through this intervention. Medical and dental providers at the FQHCs will provide educational information to patients regarding the importance of good oral hygiene practices, and balanced, nutritious meals.

Intervention Strategies

Individual: Increase access to medical and dental services through outreach, including marketplace and Medicaid applications, patient navigation, and case management.

Interpersonal: Facilitate health education sessions to support individuals and family members who want to prevent or manage medical and dental conditions.

Organizational: Integrate dental care practices such as fluoride for children and education about regular brushing and flossing into medical visits.

Community: Partner with local medical and dental schools to ensure continuity of practice among upcoming clinicians

Societal: Develop metrics that support the overlap of medical and dental health education across all patient encounters.

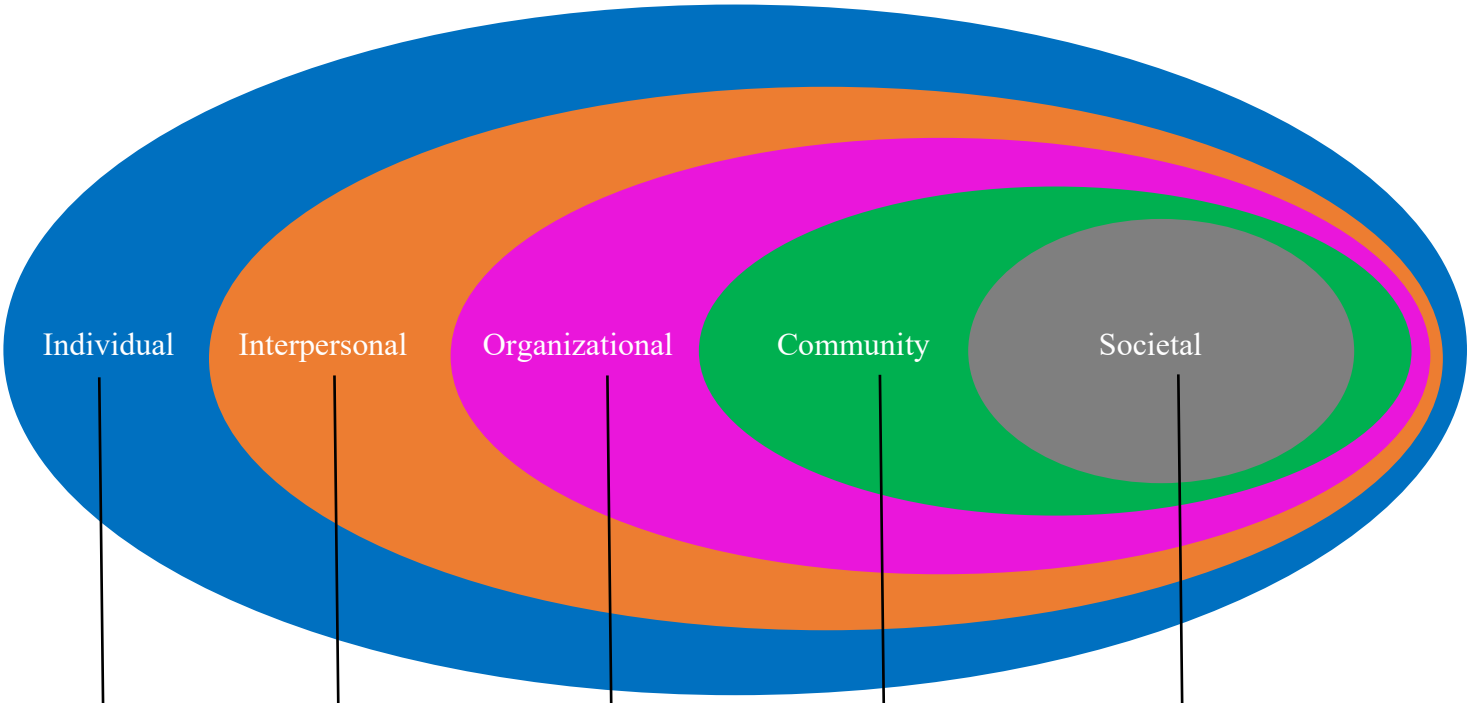
Implementation Plan

Medical and dental practitioners at the FQHC will undergo training that elaborates on the importance of addressing social ecological factors at every patient visit.

Evaluation Plan

Effectiveness of the intervention plan will be evaluated by the Information Technology (IT) and Quality teams. The IT team will pull a report that evaluates the number of individuals with dental encounters to validate if height and weight measurements to determine BMI are being captured. The Quality Team will analyze data from patients with both medical and dental encounters to determine if the intervention is effective at addressing malnutrition and gingivitis.

Appendix C:Field-Based Product 3 - Intervention Plan Framework



Individual	Interpersonal	Organizational	Community	Societal
Increase access to medical and dental services through outreach, including marketplace and Medicaid applications, patient navigation, and case management.	Facilitate health education sessions to support individuals and family members who want to prevent or manage medical and dental conditions.	Integrate dental care practices such as fluoride for children and education about regular brushing and flossing into medical visits.	Partner with local medical and dental schools to ensure continuity of practice among upcoming clinicians	Develop metrics that support the overlap of medical and dental health education across all patient encounters.

Appendix D: Field-Based Product 4 - Information Fact Sheet

The Association Between Malnutrition and Gingivitis



Gingivitis is a preventable condition that affects up to 90% of the global population. If left untreated, gingivitis can advance to periodontal disease, an irreversible condition with detrimental effects on medical and dental outcomes, as well as quality of life (Gasner & Schure, 2023). Individuals with incomes below 100% Federal Poverty Level, and those who identify as Mexican American or Non-Hispanic Black are disproportionately affected by gingivitis (CDC, 2024).

Malnutrition can be a result of food insecurity. In the United States, food insecurity rates increased from 12.8% in 2022 to 13.5% in 2023 (Rabbitt et al., 2024). Missouri is ranked as one of the top 10 states with the highest prevalence of very low food security with 5.8% of the population experiencing very low food security and 12.7% experiencing food insecurity (Rabbitt et al., 2024). Urban communities, such as St. Louis, Missouri, are disproportionately affected by malnutrition related mortality (Mostafa et al., 2023).

Strategies to Avoid Gingivitis

- Maintain a healthy weight
  - Individuals with an overweight or obesity BMI are more likely to have gingivitis than those with a normal weight.
- Consume a balanced diet
- Practice good oral hygiene

Strategies to Avoid Malnutrition

- Maintain a healthy weight
  - Those who identify as Black are more likely to have an unhealthy BMI
- Incorporate fruits and vegetables into daily dietary intake