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Exploring geographic proximity to fast-food restaurants and convenience stores with dental caries in patients at the University of Nevada Las Vegas School of Dental Medicine

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EXPLORING GEOGRAPHIC PROXIMITY TO FAST-FOOD RESTAURANTS
AND CONVENIENCE STORES WITH DENTAL CARIES IN PATIENTS
AT THE UNIVERSITY OF NEVADA LAS VEGAS
SCHOOL OF DENTAL MEDICINE

by

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A thesis submitted in partial fulfillment
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Master of Public Health
School of Community Health Sciences
Division of Health Sciences

Graduate College
University of Nevada, Las Vegas
May 2011
THE GRADUATE COLLEGE

We recommend the thesis prepared under our supervision by

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entitled

Exploring Geographic Proximity to Fast-Food Restaurants and Convenience Stores with Dental Caries in Patients at the University of Nevada Las Vegas School of Dental Medicine

be accepted in partial fulfillment of the requirements for the degree of

Master of Public Health
School of Community Health Sciences

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May 2011
ABSTRACT

Exploring Geographic Proximity to Fast-food Restaurants and Convenience Stores with Dental Caries in Patients at the University of Nevada Las Vegas School of Dental Medicine

by

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Dental caries is present worldwide and has afflicted over 90% of all adults in the United States. Biological determinants of the disease are well understood but social determinants and how they interact with biological factors are not. Programs designed to reduce incidence and prevalence of caries often target certain individuals and involve behavioral change. Some programs are more successful when environmental and societal issues are also addressed (Watt, 2002). Biological and behavioral processes leading to caries should include the modification of social factors to enhance results of prevention programs designed to reduce caries in populations. Preventing disease comes not only from treating individuals but also from the modification of environmental factors facilitating disease occurrence along with community education.

This project examined whether the relationship between the prevalence of dental caries among patients at the University of Nevada, Las Vegas School of Dental Medicine and the number of fast-food and convenience stores within a one-half mile and one mile distance from their place of residence. One goal was to map the distribution of caries for the dental school patient population by geographic region using their place of residence.
The other goal was to determine if a relationship existed between prevalence of dental caries in patients and the location of fast-food and convenience stores based on geographic data. It is anticipated that future research will provide an exploration of the social determinants of caries in the dental school patient population and development of programs designed to reduce oral health disease and inequalities. Analysis of the demographics and caries percentage of the dental school patient population revealed patients live across the entire Las Vegas community and dental caries is widespread. Combined with the significant relationship between convenience stores within one mile of patient residence and caries percentage, this information should aid future research and dental school patient education.
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CHAPTER 1
INTRODUCTION

Background and Significance

Dental caries is present in 91% of all adults in the United States. Worldwide estimates place the prevalence of the disease at 60% - 90% of persons (Edelstein, 2006). Southern Nevada is host to the majority of the state’s population (CDC, 2008). Until 2004, when the University of Nevada, Las Vegas School of Dental Medicine (UNLVSODM) opened its clinics for dental patients, citizens of the area had few options for low-cost dental treatment. This research project examined whether geographic proximity to fast-food restaurants and/or convenience stores was associated with the presence of dental caries.

Statement of Purpose

The goals of this retrospective study included mapping dental caries prevalence across geographic regions in southern Nevada and identifying whether fast-food and convenience store location is related to caries levels.

Dental patients who seek care at UNLVSODM clinics often have a lower socioeconomic status in the community (Hill, 2010). With a lower socioeconomic status comes a greater likelihood of decreased oral health (Antunes et al., 2006). It was anticipated that certain geographic regions of southern Nevada will have a higher prevalence of dental caries possibly related to a higher number of fast-food and convenience stores. Information gathered from the study will be used to develop further research questions to better understand environmental determinants of dental caries in dental school patients in southern Nevada. This should aid in the development of programs to help reduce dental caries in southern Nevada.
Research Questions and Hypotheses

1. What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of fast-food restaurants based on geographic location of the restaurants and patients’ place of residence?
   
   Hypothesis 1: There is a relationship between dental caries prevalence in UNLVSODM patients and the number of fast-food restaurants based on geographic location of restaurants and patients’ place of residence.

2. What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of convenience stores based on geographic location of the stores and patients’ place of residence?
   
   Hypothesis 2: There is a relationship between dental caries prevalence in UNLVSODM patients and the number of convenience stores based on geographic location of stores and patients’ place of residence.
Dental caries has been experienced by over 90% of adults in the United States (Beltran-Aguilar et al, 2005). Its prevalence could be considered a pandemic because it affects between 60% and 90% of adults worldwide (Edelstein, 2006). Nevada has an estimated population of 2.5 million persons. Approximately 1.8 million live in Clark County or southern Nevada (CDC, 2008).

Minimal published evidence exists describing the distribution of dental caries in adults throughout southern Nevada. This information is important if risk factors and social determinants of caries are to be researched so that programs can be developed to decrease the prevalence of caries in the population. The UNLVSODM began clinic operations and patient treatment in 2004. Financial reasons are often the driving force for those who receive treatment as the fees are less than those of most private dental offices.

It has been shown that geographic differences in caries levels varied widely in different populations and caries is prone to influences of sociodemographic and geographic inequalities (Antunes et al, 2006). Social gradients in oral health have been found to be universal with each level of social status having better health than the one directly below it (Watt, 2007). Watt (2007) also stated that simply identifying risk factors for poor oral health will not fully decrease oral health inequalities across populations. A study by Thomson et al. (2004), found socioeconomic status played a key role in oral health. In the cohort study, participants were evaluated at age five and twenty-six. Those in the high socioeconomic group at both childhood and adulthood enjoyed the higher levels of oral health than those who had ever been in the lower...
socioeconomic group (Thomson et al., 2004). And social determinants of oral health need to be identified and modified if oral health is to improve in populations. Phenomenon such as social cohesion and participation, economic security, conditions encountered in childhood, healthy work life, and environmental health are examples of such determinants that can affect oral health of individuals and populations. Access to care, Medicaid, Medicare, and insurance are also important forces.

Many authors felt new theories about oral health inequalities were needed to better develop caries prevention programs (Batchelor et al., 2002; Holst et al., 2001; Patrick et al., 2006). Current behavioral theories, however, are not always effective in explaining how to develop programs to increase oral health and decrease oral health inequalities across populations (Batchelor et al., 2002; Burt, 2005; Holst et al., 2001; Watt, 2002). Many theories focus on biological factors of caries development such as oral hygiene, diet, smoking, and other health issues. Prevention programs often target “high-risk” individuals for management of their behavior and how to effect change. But changing an individual’s behavior can be difficult without modification of their environment (Watt, 2002).

Political and social policies need development to increase the oral health of populations while public policy needs to address oral health inequalities. Qualitative research is needed to understand how and why people live their lives and choose certain behaviors. Different societal groups should be researched so that their potential health disparities are better understood. Epidemiology is more than numbers. Oral health should be measured using quality of life data and not just disease statistics (Sisson, 2007). Issues such as transportation, time off work, cultural values, past dental experiences,
housing, income, education, social capital, occupation, community structure, social support network, and availability of health services are all social determinants of oral health (Patrick et al., 2005).

The difficulties in researching these areas are many. There are few theoretical frameworks to explain the determinants of oral health in populations. The process of caries in populations is complex and the combination of biological and social factors is not well understood (Holst et al., 2001). Researchers have a solid background and understanding of biological factors relating to the caries process, but studies are needed to show how societal effects influence this process. It is widely held that Streptococcus mutans is an etiological agent in the formation of dental caries but not all people with a high S. mutans bacterial count will develop caries (Burt, 2005). It has also been demonstrated that not all children who have poor oral hygiene will develop caries, although most will (Burt, 2005). Fermentable carbohydrates in the diet are related to the dental caries process. Progressive demineralization of tooth structure (enamel, dentin, and cementum) is the effect of changes to the pH environment to dental plaque deposits on teeth. Fermentation of carbohydrates by the bacteria in dental plaque lowers the oral pH by producing organic acids such as lactic acid. As the oral pH lowers, tooth structures begin to dissolve (Irish, 2008). In this context, fast-food restaurants and convenience stores sell many products that contain fermentable carbohydrates. History has shown that preventing most disease comes not only from treating individuals but modifying environmental factors facilitating disease occurrence (Holst et al., 2001).

Geographic targeting is another concept positioned between individual and population approaches to disease prevention. Caries prevalence increases as social deprivation rises
in geographic areas (Burt, 2005). Such an approach seeks to help communities within a larger population whose social determinants of oral health affect them more negatively when compared to those around them. Caries prevention efforts should be aimed at populations, not just individuals, and should include political, societal, and social changes.

This project focused on the distribution of caries throughout the population of dental school patients at the University of Nevada, Las Vegas School of Dental Medicine from year to year. Geographic regions were mapped with caries prevalence levels analyzed. It was posited that certain regions would have significantly higher rates of caries than others based on their proximity to fast-food restaurants and convenience stores. This data collection and analysis was necessary to determine where the caries was located and to what extent they existed in the population. The analyses also help answer questions regarding the relationship between caries level and geographic living areas of patients. Results will allow further research into certain populations and communities to discover the social determinants of oral health inequalities. Geographic targeting of certain regions or communities to learn more of their social structure and how biological and behavioral factors interact to reduce oral health is such an example. An understanding of environmental determinants of oral health can assist in determining appropriate programs to help improve the oral health of the population.
CHAPTER 3

METHODOLOGY

Research Design and Sampling Procedure

The design of the study was cross-sectional. Participants were selected from an existing database of UNLVSODM patients who had received a dental examination between January 1, 2007 and December 31, 2008. The number of missing teeth, number of teeth with dental caries, age, race, and address of residence were obtained from the initial dental examination. All patients who met the inclusion criteria were selected for the study.

The research questions to be answered were: 1. What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of fast-food restaurants based on geographic location of the restaurants and patients’ place of residence? 2. What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of convenience stores based on geographic location of the stores and patients’ place of residence?

Geographic living area based on address of residence, location of fast-food restaurants, and location of convenience stores were the predictor variables. Prevalence of dental caries was the outcome variable. Age and race were confounding variables.

The sample consisted of patients at the UNLVSODM. Inclusion criteria are those listed in the above section while exclusion criteria were patients who had not received a dental examination during the 2007 and 2008 calendar years. A total of 4707 patients were initially selected for potential inclusion in the study. Sample data were obtained from the Information Technology department at the dental school.
Protection of Human Subjects

The study was granted approval from the University of Nevada, Las Vegas Institutional Review Board (Appendix B). Informed consent was given by patients during the initial visit to the UNLVSDM. Patients were at minimal risk during the study. The dental school Office of Information Technology was responsible for supplying the data requested by the researcher. A single individual in that department performed this task. Chart numbers were used as identifiers instead of patient names. Addresses of patients’ residences were geocoded and converted to geographic coordinates in order to display the location on a map of Clark County. This created the necessary format for GIS mapping of patients’ residences and created anonymity for patients whose addresses were private information. The number of missing teeth and dental caries lesions were the only health information in the data. There was no risk of patients’ general medical information being released in the data as it was not requested or supplied. Patients were not contacted by any individual at the dental school to participate in the study and only the faculty advisor and graduate student researcher had access to the data. Data were stored in the researcher’s home computer and were maintained safely under password protection from other individuals.

Benefits from patient participation in the study included knowledge gained regarding the distribution of dental caries across a large segment of the dental school population. Variables such as age, race, and address allowed demographic information to be obtained from the existing supply of patients that have received an examination at the school over a two-year period. Results from the study may be shared with colleagues of the researcher (who is a faculty member at the UNLVSDM) to educate them about dental
caries rates in the school’s patient population. Public health programs could be designed by faculty to assist the Las Vegas community in prevention and treatment of dental caries.

Data Collection

The data were contained in an electronic patient record program, Salud, and were converted to an Excel spreadsheet upon the request of the researcher. Data for each individual included a patient record number, race, age, address, and dental codes for teeth that were missing or had dental caries. The researcher was responsible for re-formatting the data by calculating how many teeth for each patient were missing and how many teeth for each patient had dental caries. Each patient was then assigned a “dental caries percentage” indicating what percentage of remaining teeth had dental caries. Patients had given prior informed consent by providing electronic signatures on the dental school’s forms that were completed during the initial visit to the school (Appendix A).

Data for fast-food restaurants were obtained from a list of Clark County Businesses coded 700.102 (Restaurant, Non-Resort, seating for 50 or more), and 702 (Restaurant, Category 2, seating for 12 or more). City of Las Vegas Businesses coded R05 (Restaurant, Take-out Only), R07 (Restaurant, seating under 45), and R09 (Restaurant, seating 45 or more) were also obtained. The researcher refined the fast-food restaurants from these initial lists to include only Arby’s, Burger King, Carl’s Jr., Del Taco, El Pollo Loco, In-n-Out Burger, Jack-in-the-Box, Kentucky Fried Chicken, Long John Silver’s, McDonald’s, Popeye’s, Sonic Drive-in, Taco Bell, and Wendy’s. The list was refined because there were many restaurants listed that were unknown as to whether or not they
could be considered “fast-food”. The fourteen restaurants chosen for the study were all known to be considered “fast-food”.

Data for convenience stores were obtained from a list of Clark County Businesses coded 703 (Convenience Store) and the City of Las Vegas Businesses coded C15 (Convenience Store).

Data Refinement

After initial data collection, the number of fast-food restaurants was refined to include only those with a Las Vegas address. This reduced the total number of the fourteen chosen fast-food restaurants to 141. Convenience stores were similarly reduced to those only located in the city of Las Vegas which numbered 298.

Patient residence addresses were first limited to those with a Las Vegas address. This resulted in 4707 addresses. These addresses were used to create an address locator using Clark County 2009 centerline data downloaded from the Clark County Assessor’s Office Geographic Information System (GIS) Database. This created a rule database for finding addresses which had usable geocoded GIS X–Y coordinate points. There were 2161 geocoded addresses from the initial 4707 that were used as refined patient residence address in the study. Circular buffer zones with a half-mile and one-mile radius were created using the geocoded patient addresses to include the fast-food restaurants and convenience stores within those distances from each patient’s residence. A one-to-many function was used to account for each buffer zone potentially containing multiple restaurants and stores.

An Excel database was created using the 2161 patients that included the number of convenience stores within one-half mile and one mile of each patient’s residence. The
number of fast-food restaurants within one-half and one mile of each patient’s residence along with race, age, and percentage of teeth with dental caries were included. This database was used for statistical analysis with SPSS (v15.0) program.

**Statistical Analysis**

Multiple statistical tests were used to analyze the data and answer the research questions. Demographic data were obtained using age, race, and address to determine where patients lived, how old they were, and what race they identified themselves to be. Frequencies were calculated for the demographic data and for the number of fast-food restaurants and convenience stores located within one-half and one mile of each patient’s residence.

Pearson Correlation tests were run to answer the two research questions. The first research question investigated if a relationship existed between percentage of teeth that had dental caries and the number of fast-food restaurants within one-half and one mile of a patient’s residence. Caries percent for each patient was initially calculated by dividing the number of teeth with dental caries by the total number of teeth. This yielded data with a range from zero to 100 percent. Frequency data plots had a non-normal distribution and hence violated the assumptions of the Pearson tests. The caries percent data were converted to caries percent log data using log$_{10}$. A constant of 0.5 was added to all caries percentages before data conversion to manage the 0% caries level in 12% of the patients. This created a normal distribution of data for the Pearson tests.

Pearson Correlation tests were run for the second research question to determine if a relationship existed between the percentage of teeth that had dental caries and the number of convenience stores within a half-mile and one mile of the patient’s residence. Tests
were run using the caries percent log$_{10}$ data that was used to answer the first research question. Hypotheses for the research questions were accepted or rejected based on the results of the Pearson tests. A one-way ANOVA and a post hoc Tukey’s test of multiple comparisons were run to determine if a difference existed between racial groups regarding dental caries percentages. Race and proximity to fast-food restaurants and convenience stores was also analyzed. Further demographic analysis took place with a Pearson Correlation test to identify any relationship between patient age and dental caries percentage. The researcher expected there would be a relationship between these characteristics from his experience with patients in the UNLV SODM clinics.
CHAPTER 4
RESULTS

Demographics of the Study

After refinement of the initial data, the study sample consisted of 2161 individuals. They had each received a dental examination at the UNLVSODM between January 1, 2007 and December 31, 2008. The ages of study participants ranged from 5 to 96 years with a mean age of 38.4 years (SD=24.37). Data for this study were skewed positively to the right as 40.5% of participants were ages 8 to 22. Patients reported one of five choices for race. White was the most common choice at 45.3% of participants while 24.5% chose Hispanic. There were 11.8% African American participants and 3.8% Asian. The choice of Other Race was selected by 14.5% of individuals. Caries percent for each patient ranged from zero to 100% of teeth having dental caries (Table A1). The mean was 18.2% (SD=19.17). Data were positively skewed with a platykurtic form between 30 and 100 percent.

Patient residences were scattered throughout Las Vegas and Clark County. The mean number of fast-food restaurants within one-half mile from patient residence was 1.0 (SD=0.32). The range was zero to six restaurants (Table A2). The mean number of fast-food restaurants within one mile of patient residence was 1.2 (SD=0.83). That range was zero to 8 restaurants (Table A3). The mean number of convenience stores within one-half mile of patient residence was 1.2 (SD=0.75). The range was zero to 12 (Table A4). The mean number of convenience stores within one mile of patient residence was 2.1 (SD=2.27). This range was zero to 19 (Table A5).
Research Question One

The first research question was: What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of fast-food restaurants based on geographic location of the restaurants and patients’ place of residence? No significant correlation was found for either the half-mile (r=-0.02, p=0.31) or one mile (r=0.01, p=0.96) radii.

Research Question Two

The second research question was: What is the relationship between dental caries prevalence in dental patients of the UNLVSODM and the number of convenience stores based on geographic location of the stores and patients’ place of residence? There was no significant correlation for the half-mile radius (r=0.01, p=0.61); however a significant correlation was found for the one mile radius (r=0.07, p=0.01), though the magnitude of this correlation is small.

Tests for Age and Race

A Pearson Correlation for dental caries percent and age was statistically significant (r=-0.10, p=0.01). There was a negative relationship between the two with lower age positively correlated with a higher percent of teeth with dental caries. A one-way ANOVA was run to compare dental caries percent across the five racial groups (F=3.90, p=0.01). A Tukey’s test of multiple comparisons was run across the groups and yielded one statistically significant result between White and Hispanic races (q=3.81, p=0.01). There was a significantly higher percent of dental caries in Hispanics than Whites. Comparisons between the other races did not result in statistically significant differences in percentage of teeth with dental caries.
A Pearson Correlation test for race and proximity to fast-food restaurants and convenience stores yielded statistically significant results between race and convenience stores within one mile of patient residence ($r=0.10$, $p=.01$). A one-way ANOVA was run with a post-hoc Tukey’s test of multiple comparisons resulting in statistically significant results between multiple racial groups. The African American group had a significantly higher number of convenience stores located within one mile of their residences than the White group did ($q_s=0.45$, $p=.05$). The Hispanic group had a significantly higher number of convenience stores located within one mile of their residences than the White group ($q_s=0.75$, $p=0.01$), Asian group ($q_s=1.07$, $p=0.01$), and the Other group ($q_s=0.44$, $p=0.05$).
CHAPTER 5
DISCUSSION AND CONCLUSION

Relationship between Residence and Fast-Food Restaurants

Working at the UNLVSODM since its clinics opened in 2004, the researcher has seen a high level of dental caries in patients. There are nutritional questions posed to patients during examinations that reveal whether or not fast-food is consumed regularly. The researcher witnessed many patients who reported fast-food consumption on a regular basis. This was the impetus for study. As reported in the literature, dental caries is pandemic, affecting over 90% of adults in the United States and over 60% of adults worldwide (Edelstein, 2006).

The first research question asked if a relationship existed between geographic location of patient residence and fast-food restaurants within one-half and one mile of this based on dental caries percentage. The researcher expected that patients with higher dental caries percentages would have more fast-food restaurants near their residence than those patients with lower caries percentages. This was not the case for either the one-half or one mile radius buffer zones. There was no significant relationship between dental caries percentage and how many restaurants were within one-half or one mile of a patient’s residence.

This result may have been due to the relatively high number of patients (92.5%, Table A3) that had either one or no fast-food restaurants within one mile of their residence. This uneven distribution of restaurants throughout the sample population made it less probable that differences among the population would exist when so few patients had more than one restaurant in the analyses. Most patients simply did not have multiple fast-
food restaurants near enough their residence to allow for detection of a significant relationship to exist between the number of restaurants and dental caries percentage.

The majority of patients had zero to 10 percent of their teeth containing dental caries (Table A1). Coupling this statistic with the high percentage of patients who had only one or no restaurant within one mile of their residence indicates many patients had a relatively low dental caries percentage and lived near a minimal number of restaurants. While this is encouraging for the oral health of patients, the size of this group may have been too large to allow any relationship to exist between the variables. Too few patients with caries lived near a large number of fast-food restaurants to detect a relationship between the two.

Another reason for the lack of significant findings in this area could have been the large distribution of patients throughout Las Vegas (i.e. sample patient residences were located throughout the city rather than concentrated areas). Figure B2 shows the location of patient residences and how widely distributed they appear across the area. The literature provided information that dental caries levels varied widely in different populations and it is prone to geographic inequalities (Antunes et al., 2006). With such a wide distribution of patients geographically, no group existed that suffered from geographic inequalities that would have affected dental caries percentage. The researcher thought a high percentage of patients would live in a smaller number of areas throughout the city. This did not appear to be the case as no high-concentration area of patients in the study existed.
Relationship between Residence and Convenience Stores

Initial concern for the oral health of people of southern Nevada came from the researcher’s experience living in Las Vegas and literature review. A large number (n = 298) of convenience stores were present in Las Vegas. Working with patients at the UNLV SODM since 2004, the researcher has witnessed many patients with dental caries, especially patients under 21 years of age. With the caries process in populations being a complex combination of biological and social factors, it was of interest to discover any relationships regarding caries and outside variables for dental school patients (Holst et al., 2001).

The second research question asked if a relationship existed between geographic location of patient residence and convenience stores within one-half and one mile of this based on dental caries percentage. The researcher expected there would be a positive relationship between the dental caries percentages among patients in the study and how many convenience stores were within one-half and one mile radii of their residences. There was no relationship between these variables in the one-half mile radius. However there was a statistically significant relationship between these variables at the one mile radius.

There was a positive correlation between dental caries percentage and the number of convenience stores within one mile of patient residences. The number of stores within one mile of residences ranged from zero to 19 for patients in the sample. This was a wider range than that for fast-food restaurants. Convenience stores sell products like soda, candy, and snack foods that are high in fermentable carbohydrates. The number of stores near patient residences coupled with ease of accessing products with known dental
caries agents helped explain the positive relationship. It was stated that young individuals frequent convenience stores and feel more comfortable buying from them rather than larger stores (McNeal, 1979). Young people are also consumers and have many products advertised toward them that do not promote dental health (McNeal, 1979). As presented in Table A6, there were a high number of patients age 21 and under (40.7%). With 34.6% of patients having two or more convenience stores within one mile of their residences (Table A5), it was postulated by the researcher that many young patients lived near multiple convenience stores.

The statistically significant negative correlation between dental caries percentage and age meant lower age was associated with a higher caries percentage. The combination of higher caries percentage with decreasing age and convenience store location near those under 21 helped explain the correlation discovered in the study.

A Pearson Correlation yielded a relationship between race and the number of convenience stores within one mile of patient residence. African Americans (11.8% of patients in the sample) had a higher number of convenience stores within one mile of their residences than Whites (45.3% of the sample). A relationship existed between the Hispanic group and three other racial groups. Hispanics (24.5% of patients in the sample) had higher numbers of convenience stores within one mile of their residences than the White, Asian (3.8% of the sample), and Other (14.5% of the sample) groups. These results indicate some addresses in the study may be clusters of patients who identify with the same racial group. The Hispanic patients appear to live in areas of Las Vegas where more convenience stores are located in close proximity to their residences than the other racial groups (except African Americans).
Significance to Dentistry in Southern Nevada

Minimal published research was located by the researchers regarding dental caries in adult populations in southern Nevada. Some research was located for pediatric populations. The University of Nevada, Las Vegas School of Dental Medicine opened in 2002. Clinical treatment of patients began in 2004. Thousands of patients have been treated at the school presenting with a wide variety of dental diseases. This study allowed demographic information regarding patient dental caries percentage, age, race, and address of residence to be analyzed. Geographic Information System mapping provided visual aid to understand where patients who come to the school for treatment live (Figure B2).

With 2161 patients in the final study sample, reasonably good external validity of results to the population of patients treated at the dental school existed. The school’s curriculum is tied to the needs of its patients. Knowing demographic information about the people treated at the school should aid future development of student and faculty research as well as community-based programs to help improve dental health of southern Nevadans. The dental school has resources and the commitment to provide dental care for patients in its clinics. Better understanding of the patient population by the school’s faculty should lead to interactions with students that help increase the care delivered to the community. Patient education regarding convenience store products and the cariogenic nature of them should occur as part of patient education during dental visits to the school. School outreach programs should be bolstered knowing dental caries percentages and demographics of the patients at the school.
Some UNLVSODM graduates will stay in southern Nevada and practice. Adding to their knowledge regarding patients treated at the dental school should help increase their awareness of dental need in the community. This should lead to involvement in organized dentistry groups by the graduates to help treat individuals who may not have resources to be seen in private practice. Organized dentistry serves the community by educating dentists about local, state, and national issues regarding oral health.

Limitations of the Study

There were multiple limitations to the study. Socioeconomic status (SES) of patients was not considered. This variable is considered to be a factor in access to health care and health status (Watt, 2007). In the electronic patient record, there was no indicator for SES that could be accessed in the data. Therefore this variable was not considered in the study. It would have been interesting to analyze dental caries percentage with SES and see if any relationship existed. Also not considered were dental caries type and severity. Dental caries percentage used only the number of teeth that had a carious lesion. This means a tooth with a small lesion was counted the same as one that had a larger lesion. The number of teeth present was not considered in the dental caries percent. A person with two remaining teeth with dental caries in both teeth would have a 100% rating. Comparing this to a patient with twenty remaining teeth but ten carious lesions would mean this individual would have a caries percentage of only 50%. So even though the second person in the example had more carious lesions, the caries percentage was lower because more teeth remained. Thus patients with fewer teeth needed fewer carious lesions on those teeth to have a comparatively high caries percentage than patients with more remaining teeth.
Research questions focused on the relationship between geographic location of patient residence and fast food plus convenience stores. The question of how frequently patients visited and consumed products at these establishments was not considered. Time at current residence was also not a variable in the study. It is unknown how long patients lived where they indicated and this may have affected the frequency and duration of usage of the stores close to their residences. Someone who lived close to multiple fast food restaurants and convenience stores may not have lived at the residence indicated very long. This makes the analyzed relationship between the two more difficult and less accurate.

Because the above mentioned limitations existed in the study, results indicate only if a relationship exists between geographic location of residence and fast food restaurants plus convenience stores. The statistics run were basic and intended to be used to guide further research in the area if indeed a relationship did exist. The external validity of the study was lowered as only patients of the University of Nevada, Las Vegas School of Dental Medicine were included. The sample of 2161 patients may or may not be an accurate representation of dental patient in southern Nevada.

Recommendation for Further Research

Mapping the geographic location of patient residences allowed for the development of an understanding of where patients of the dental school lived. Knowing this demographic information, future community outreach programs and the research associated with them should target the entire Las Vegas community since patients live all over the area. It also indicated there is dental need by individuals throughout the city and not just those within a small radius of the school.
The positive relationship between geographic location of patient residence and convenience stores within one-half and one mile and dental caries percentage has spurred the researcher’s interest in environmental modification to change behavior of people (Watt, 2002). Over 34% of patients had two or more convenience stores within one mile of their residence (Table A5). Future research efforts would involve assessment of outcomes in the literature involving zoning regulations of convenience stores in various areas. Prevention of disease by modifying environmental factors along with treating sick individuals is an important postulation and a guide for future efforts (Holst et al., 2001).

Socioeconomic status of patients in the sample and its relationship to residence and dental caries rate would be interesting to explore. Knowing any relationships between these variables would increase understanding about dental need in the Las Vegas community for outreach clinics and educational programs based on income. It is clear from the initial study results that there is a community-wide distribution of dental caries, especially among those under 21 years of age. Concentration on southern Nevada’s youth in further research could benefit younger patients with school education and treatment programs designed to promote oral health.
APPENDIX A

TABLES RELATED TO STUDY DEMOGRAPHICS

Table A1

Dental Caries Percentage

<table>
<thead>
<tr>
<th>Percent Carious Teeth</th>
<th>Frequency</th>
<th>Percent Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>919</td>
<td>42.5</td>
</tr>
<tr>
<td>10 - 19</td>
<td>540</td>
<td>25.0</td>
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<tr>
<td>20 - 29</td>
<td>291</td>
<td>13.4</td>
</tr>
<tr>
<td>30 - 39</td>
<td>163</td>
<td>7.6</td>
</tr>
<tr>
<td>40 – 49</td>
<td>89</td>
<td>4.1</td>
</tr>
<tr>
<td>50 – 59</td>
<td>63</td>
<td>3.0</td>
</tr>
<tr>
<td>60 – 69</td>
<td>34</td>
<td>1.5</td>
</tr>
<tr>
<td>70 – 79</td>
<td>15</td>
<td>0.7</td>
</tr>
<tr>
<td>80 – 89</td>
<td>14</td>
<td>0.7</td>
</tr>
<tr>
<td>90 – 100</td>
<td>33</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table A2

Fast-Food Restaurants: Half-Mile from Residence

<table>
<thead>
<tr>
<th>Restaurants</th>
<th>Frequency</th>
<th>Percent Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>2126</td>
<td>98.4</td>
</tr>
<tr>
<td>2 - 3</td>
<td>26</td>
<td>1.2</td>
</tr>
<tr>
<td>4 - 6</td>
<td>9</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table A3

Fast-Food Restaurants: One Mile from Residence

<table>
<thead>
<tr>
<th>Restaurants</th>
<th>Frequency</th>
<th>Percent Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>2000</td>
<td>92.5</td>
</tr>
<tr>
<td>2 - 3</td>
<td>106</td>
<td>4.9</td>
</tr>
<tr>
<td>4 - 5</td>
<td>19</td>
<td>0.9</td>
</tr>
<tr>
<td>6 - 8</td>
<td>36</td>
<td>1.7</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table A4
Convenience Stores: Half-Mile from Residence

<table>
<thead>
<tr>
<th>Stores</th>
<th>Frequency</th>
<th>Percent Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>1944</td>
<td>90.0</td>
</tr>
<tr>
<td>2 - 3</td>
<td>162</td>
<td>7.5</td>
</tr>
<tr>
<td>4 - 6</td>
<td>49</td>
<td>2.3</td>
</tr>
<tr>
<td>7 - 12</td>
<td>6</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table A5
Convenience Stores: One Mile from Residence

<table>
<thead>
<tr>
<th>Stores</th>
<th>Frequency</th>
<th>Percent Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1</td>
<td>1417</td>
<td>65.6</td>
</tr>
<tr>
<td>2 - 3</td>
<td>371</td>
<td>17.1</td>
</tr>
<tr>
<td>4 – 5</td>
<td>231</td>
<td>10.7</td>
</tr>
<tr>
<td>6 – 7</td>
<td>69</td>
<td>3.2</td>
</tr>
<tr>
<td>8 – 10</td>
<td>35</td>
<td>1.6</td>
</tr>
<tr>
<td>11 – 19</td>
<td>38</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table A6
Patient Age

<table>
<thead>
<tr>
<th>Patient Age in Years</th>
<th>Frequency</th>
<th>Percent of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 - 10</td>
<td>117</td>
<td>5.5</td>
</tr>
<tr>
<td>11 - 21</td>
<td>761</td>
<td>35.2</td>
</tr>
<tr>
<td>22 - 35</td>
<td>258</td>
<td>11.9</td>
</tr>
<tr>
<td>36 - 50</td>
<td>273</td>
<td>12.6</td>
</tr>
<tr>
<td>51 - 65</td>
<td>345</td>
<td>16.0</td>
</tr>
<tr>
<td>66 - 96</td>
<td>407</td>
<td>18.8</td>
</tr>
<tr>
<td>Total</td>
<td>2161</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Figure B1. Clark County map showing the study area (blue dots indicate address).
Figure B2. GIS map of UNLVSODM patient addresses in the Las Vegas area (green dots indicate address).
Figure B3. An example of a GIS map of convenience stores in eastern Las Vegas used in the study (red dots indicate convenience stores).
Figure B4. An example of a GIS map of fast-food restaurants in eastern Las Vegas used in the study (yellow dots indicate restaurants).
Figure B5. An example map of eastern Las Vegas showing half-mile buffer zones around patient addresses with fast-food restaurants and convenience stores (black circles indicate buffer zones, green dots indicate patient addresses, red dots indicate convenience store location, and yellow dots represent fast-food restaurants).
Figure B6. An example map of eastern Las Vegas showing one mile buffer zones around patient addresses with fast-food restaurants and convenience stores (black circles indicate buffer zones, green dots represent patient addresses, red dots indicate convenience store locations, and yellow dots represent fast-food restaurants).
APPENDIX C

PATIENT CONSENT FORMS

University of Nevada, Las Vegas

School of Dental Medicine

Screening Information Sheet

In order that you fully understand the purposes and procedures of your screening appointment, PLEASE READ THE FOLLOWING:

The purpose of the screening appointment today is to determine your dental needs and to evaluate your suitability as a dental school patient. Students and faculty will examine your mouth. At this time the exam is only a screening exam and not a comprehensive examination. If the faculty member determines that your problems are not the type that our students need to experience at this time or can successfully treat, they will explain this to you and suggest that you seek dental treatment elsewhere.

If your problems are of the type that our students can successfully treat and need to experience at this time, we will ask you to complete a comprehensive dental examination with radiographs (x-rays) at a later date. Following your examination we will try to match your dental needs with the needs of a particular student. This is not always possible. At times your care may be provided by several students working under the supervision of a Team Leader. In some cases you may need services beyond the capability of our students or beyond the scope of the school's mission. In those cases we will inform you as early as possible and recommend alternative sources of care.

Because all care is provided by students, treatment time is considerably longer than with a private dentist. Depending on how much care you need completing treatment with our patients may require a year or longer. Students must be available for their student dentist a minimum of two half days per month. If you do not make yourself available, cancel or break appointments, or uphold your responsibilities as a patient, your care may be terminated.

The School of Dental Medicine charges for all provided services. Scale fees are less than private practice. Payment is required when services are rendered. The approximate cost of your treatment will be determined after a full examination.

Our staff will call to make an appointment for you should you be accepted today. We cannot determine at this time when you will be seen. You may obtain the staff at 774-2400 should you have questions or comments. If you feel that your dental problems need more immediate treatment, we suggest that you seek dental treatment elsewhere.

We will be happy to answer any questions that you may have concerning your screening appointment.

THANK YOU FOR COMING IN TODAY!

I HAVE READ THE ABOVE, UNDERSTAND IT AND HAVE NO FURTHER QUESTIONS AT THIS TIME.

Date Signed (Print Date; US).
CONSENT FOR MEDICAL TREATMENT AND USES AND
DISCLOSURES OF THE PATIENT HEALTH INFORMATION FOR
TREATMENT, PAYMENT AND HEALTHCARE OPERATIONS (TPO) AT
THE UNLV SCHOOL OF DENTAL MEDICINE

I give my permission to the University of Nevada Las Vegas School of Dental Medicine
("Provider") and its employees, volunteers, agents and independent contractors to
evaluate, interview, examine, perform laboratory procedures, make clinical photographs
and to treat my dental condition, as they deem necessary. I understand that in case of
a life-threatening emergency, this consent may be implied for the time of the
emergency.

I understand that Provider is a teaching institution; therefore dental residents,
post-doctoral dental students, pre-doctoral dental students, dental hygiene students
and dental assisting students may participate in my care under the supervision of a
physician/dentist. I understand that other outside medical professionals may also be
consulted as deemed necessary for my care.

For coordination of my care and services, I understand that I may be provided with
referrals to off campus specialists and the Provider may assist other treating
physicians/dentists in the provision of my care.

- Informed Consent: If my condition requires an outpatient surgical procedure, the
  practitioner responsible for my care will explain to me the procedure to be performed,
  the general nature and extent of risks involved in such procedure and the alternative
  methods, if any.

- Consent for Minor Students: If you are a minor, we must have the signature of the
  parent or legal guardian (appointed by a court of law) on this form before any general
treatment may begin, and such consent must be effective until you reach legal age in
the State of Nevada (18 years old). Your parent or legal guardian must sign this
consent form and receive a Notice of Privacy.

- Exemptions to this consent may be granted under NRS 129.030 for a
  life-threatening emergency or a serious health hazard; in other situations where a minor
  has been living apart from parents; to emancipated minors with court supporting
documents; for family planning, contraceptive methods, and screening for sexually
  transmitted infections under NRS 442.255, NRS 129-060 and federal and state
  constitutional law, and counseling and treatment of alcohol and substance abuse under
  NRS 129.050.

APPOINTMENT POLICY:
- I agree to arrive at least fifteen (15) minutes prior to my appointment.
- I understand that my appointment may be cancelled if I'm late.
- I will check-in at the reception window upon my arrival.
- I understand I may be terminated from the program if I cancel three (3) appointments
during the course of my treatment.
- I agree to call 48 hours in advance to cancel or reschedule an appointment.

I understand and agree that Provider may use or disclose protected health
information for treatment, payment and operations in accordance with the Notice
of Privacy Practices that I have received and any posted amendments to that
Notice. I understand that Provider will not use or disclose protected health
Patient Consent for Proposed Treatment Plan

1. A treatment plan has been presented to me and I have been informed of reasonable alternative treatments. Questions related to the material and treatment have been answered to my satisfaction. Expected risks and benefits of treatment and of no treatment have been explained. I understand that there are no guarantees related to any treatment.

2. I understand that the success of this treatment will be limited, or even fail, if I fail to progress through this treatment in a timely manner, or fail to maintain health and home care instructions, with routine maintenance and examination visits. I agree to cooperate completely with the recommendations of the student doctor while under their care, realizing that failure to do so could result in less than optimum results.

3. I understand that the fees quoted in the plan are estimates of the cost of treatment, may change at any time, and are payable at the time of treatment.

4. I understand that dental students will provide my treatment under the direction and supervision of School of Dental Medicine faculty.

5. I have read and freely consent to the above treatment plan subject to necessary changes as treatment progresses. My signature below indicates my understanding and consent.

[Full Patient Name][Patient No]
Date Signed [Print Date US]
UNLV School of Dental Medicine

CONSENT FOR MINORS FORM

UNLV School of Dental Medicine is required to obtain informed consent from a person with legal authority to consent prior to providing treatment to a minor (under 18 years old). The school must secure proper consent understanding that there may be various legal arrangements between a minor and a person with legal authority to consent.

Consent by a Parent (No Legal Guardian/Conservator)

A parent may consent to dental treatment of a child at any time as long as the parent-child relationship is not subject to the jurisdiction of a court or has not been terminated by court order. A parent can approve either routine or emergency dental treatment.

Parent(s) name (please print):

If the parents of the minor are divorced or otherwise not married indicate the following:

Consent by a Legal Guardian/Conservator

A legal guardian/conservator must produce a certified copy of a court order or divorce decree that appoints them and delineates the scope of their authority as guardian/conservator to consent to dental treatment on behalf of this minor. Please print your name and describe your legal relationship to the patient and the scope of your authority to consent on behalf of this minor.

Name (please print): Relationship:

A person with legal authority to consent must sign the original treatment plan.

The treatment plan referenced is dated: (MM/DD/YYYY) Treatment is planned to begin on: (MM/DD/YYYY)

If we can't reach you about changes in the child's treatment, are there others you would allow to give consent in your absence (age 18 or over)?

If we can't reach you about changes in the child's treatment, are there others you would not allow to give consent in your absence (age 18 or over)?

UNLV School of Dental Medicine requires that minors be accompanied to every appointment because treatment may vary from the treatment plan at times significantly. By signing this form and the electronic dental record treatment plan consent form, you are giving consent on behalf of a minor for the School of Dental Medicine clinicians to continue with dental care as indicated in the treatment plan and/or in the best interests of the minor, even if you are not present at the appointment.

I represent that I have legal authority to consent for dental treatment of the above-named minor. I give my consent to UNLV School of Dental Medicine to treat the above-named minor in its clinics even if I am not present at an appointment.

Date Signed: [Print Date/USA]
Biomedical IRB – Expedited Review
Approval Notice

NOTICE TO ALL RESEARCHERS:
Please be aware that a protocol violation (e.g., failure to submit a modification for any change) of an IRB approved protocol may result in mandatory remedial education, additional audits, re-consenting subjects, researcher probation, suspension of any research protocol at issue, suspension of additional existing research protocols, invalidation of all research conducted under the research protocol at issue, and further appropriate consequences as determined by the IRB and the Institutional Officer.

DATE: March 1, 2010
TO: Dr. Chad Cross, School of Community Health Sciences
FROM: Office for the Protection of Research Subjects
RE: Notification of IRB Action by Dr. John Mercer, Chair
Protocol Title: Understanding Dental Caries in Dental School Patients in Southern Nevada
Protocol #: 1001-3359

This memorandum is notification that the project referenced above has been reviewed by the UNLV Biomedical Institutional Review Board (IRB) as indicated in regulatory statutes 45 CFR 46. The protocol has been reviewed and approved.

The protocol is approved for a period of one year from the date of IRB approval. The expiration date of this protocol is February 21, 2011. Work on the project may begin as soon as you receive written notification from the Office for the Protection of Research Subjects (OPRS).

PLEASE NOTE:
Attached to this approval notice is the official Informed Consent/Assent (IC/IA) Form for this study. The IC/IA contains an official approval stamp. Only copies of this official IC/IA form may be used when obtaining consent. Please keep the original for your records.

Should there be any change to the protocol, it will be necessary to submit a Modification Form through OPRS. No changes may be made to the existing protocol until modifications have been approved by the IRB.

Should the use of human subjects described in this protocol continue beyond February 21, 2011 it would be necessary to submit a Continuing Review Request Form 60 days before the expiration date.

If you have questions or require any assistance, please contact the Office for the Protection of Research Subjects at OPRSHumanSubjects@unlv.edu or call 895-2794.
REFERENCES


Hill, C (2010). Personal discussions with University of Nevada, Las Vegas School of Dental Medicine patients from 2004 to 2010 in a clinical treatment setting.


VITA
Graduate College
University of Nevada, Las Vegas

Charles Kennedy Hill

Degrees:
Bachelor of Science, Psychology, 1992
Arizona State University

Doctor of Dental Medicine, 1996
Southern Illinois University

Thesis Title: Exploring Geographic Proximity to Fast-food Restaurants and Convenience Stores with Dental Caries in Patients at the University of Nevada Las Vegas School of Dental Medicine

Thesis Examination Committee:
Chairperson, Chad Cross, Ph.D,
Committee Member, Timothy Bungum, Ph. D.
Committee Member, Michelle Chino, Ph. D.
Graduate Faculty Representative, William Davenport, Ph. D