ZIP Code and its Impact on the Oral Health Status and BMI of Pediatric Patients

BY

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THESIS

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

FIGURE PAGE

LIST OF ABBREVIATIONS

ECC	Early childhood caries
NHANES	National Health and Nutrition Examination Survey
HSHG	Healthy Smiles Healthy Growth
PSB	Parental supervised brushing
SES	Socioeconomic status
BMI	Body mass index
SDoH	Social determinants of health
dmft	decayed, missing, and filled primary teeth
UIC COD	University of Illinois Chicago, College of Dentistry
EHR	Electronic Health Record
PI	Principal investigator
ASA	American Society of Anesthesiologists

SUMMARY

Many families in Illinois are affected by food insecurity, with 11.9% of children having difficulty accessing healthy food in Cook County. For communities located in food deserts, the distance to a grocery store is twice as far as a fast-food restaurant, which makes fast food more accessible than fresh foods. Food deserts and food insecurity have been shown to have an association with low SES, which is a strong determinant of caries in the pediatric population. In Illinois, the rate of untreated decay in children is higher than the national reported data. Children residing in Chicago had the highest rate of obesity when compared to other school districts in Illinois. The aims of this study were to identify associations between food deserts and caries experience in young children (age 3-4 years) receiving dental care at UIC COD and to identify associations between food deserts and BMI in the same patient population.

This cross-sectional chart review utilized axiUm, the UIC COD Electronic Health Record, and the patient's age, sex, ZIP code, dmft score, and height, and weight were retrieved. Food deserts were determined using the United States Department of Agriculture Food Access Research Atlas and BMI was determined using the Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen.

When the results were analyzed based on age, in the three-year-old population, patients that lived in a food desert were more likely to be underweight, overweight, or obese (p=0.000). Three-year-old females had significantly higher caries experience than males (p=0.008). Four-year-old patients who did not reside in a food desert had an increased dmft index score.

Young children living in a food desert are more likely to be underweight, overweight, or obese rather than at healthy weight. The etiology of caries is multifactorial and can be influenced by many other factors that were not examined in this study. Further work needs to be done to study this relationship.

I. INTRODUCTION

A. Dental caries in children

Dental caries is the most common chronic disease affecting children in the United States[1]. Early childhood caries (ECC) is defined as having the presence of one or more decayed, missing (due to caries), or filled tooth surfaces in any primary tooth in child from birth to 71 months of age[2]. ECC is mainly caused by a diet high in sugars, which results in a dysbiosis of oral microorganisms[3]. The caries process is exacerbated by poor oral hygiene and insufficient removal of plaque from the teeth. Dental caries can lead to oral pain, and it can also cause problems with speech and difficulty eating, which can impact one's nutrition[4]. Along with the child, caregivers and the entire family can be impacted by this disease[4,5]. Research has consistently concluded that quality of life of the child and the caregiver can be negatively impacted by dental caries[6].

Results from the 2015-2016 National Health and Nutrition Examination Survey (NHANES) reported that the prevalence of dental caries in primary or permanent teeth was 45.8% for children aged 2-19 years. Prevalence of total caries was lowest in the 2-5 years age group (21.4%) compared to 6-11 years (50.5%) and 12-19 years (53.8%). Hispanic children (ages 2-19 years) had the highest prevalence of total caries while non-Hispanic black children in the same age range had the highest prevalence of untreated dental caries[7]. Studies have also consistently reported that the prevalence of untreated dental caries and caries experience increases as family income levels decreased[7].

A systematic review was conducted by Hooley et al that evaluated the parental influence on the development of dental caries in children aged zero to six years[8]. They found lower family income, fewer number of adults in the household being employed, and lower social class is associated with a higher severity of dental caries. Single parent homes experienced an increase in the development of dental caries in children, which could be due to lower family income, but also familial stress. Parents exhibiting higher levels of education were more in control of their children's sugar intake and children were found to be at a lower risk of developing caries. Different cultures are associated with different dietary habits which can influence health outcomes. Being a minority or an immigrant is associated with higher risk of caries in children.

B. Oral Health Status, Beverage Consumption, and BMI of Children in Illinois

The Healthy Smiles Healthy Growth (HSHG) survey from the 2018-2019 school year collected oral health and height and weight data from third-grade school children in Illinois. The consumption of water and sugar-sweetened beverages was also recorded for this population. Caries experience, measuring both untreated and treated decay, decreased by 21% from 2013-14 to 2018-2019. The untreated caries rate remained the same from 2013-2014 (22.2%) and it is higher than the national reported data (15.3%). Asian children had the highest rate of untreated dental caries (28.8%), followed by African American children (26.7%). Approximately 4% of these children (roughly 5,600 third-graders) required emergency dental treatment, which doubled from 2013-2014. Twenty-two percent of third-grade children in the Chicago Public School District had treatment needs and there was a rampant caries rate of 2.2%. Rampant caries describes the severity of the disease and is used for children that have seven or more treated or untreated teeth. Treatment needs and rampant caries rate is similar for urban and suburban schools. Rural schools have a rampant caries rate of three percent and similar treatment needs as urban schools. Dental disease and the need for dental treatment increased with the consumption of sugar-sweetened beverages, while drinking water more than three times per day was noted as potential protective factor.

Rates of overweight and obese third-grade children in 2018-2019 was 32.6%, down from 41% in 2003-2004. Hispanic/Latino children were more affected with 50% of children being overweight or obese. Children qualifying for the Free and Reduced Meal Program were more overweight and obese. Children residing in Chicago had the highest rate of obesity (22.4%) when compared to other school districts in Illinois. When overweight and obesity rates were examined together, children attending Chicago Public Schools had the highest rate (38.3%) in Illinois[9].

C. Parental influence on diet and oral health in toddlers

Parents and primary caregivers have strong influence on the eating habits of young children. Eating behaviors during the first five years of life set the foundation for future dietary patterns, giving parents the major responsibility of shaping children's experiences associated with their diet. During this important time of development, children are learning what to eat, when to eat, and how much to eat. These eating patterns are influenced by the family's attitude, cultural beliefs, and the environment in which they reside[10]. Parents are ultimately in charge of the meals that the family eats, serving as models for developing culturally appropriate dietary habits and eating patterns.

Previously, women had the responsibility of feeding the family. Now, more women are employed, with both parents in the working environment, and have less time dedicated for feeding the family. Due to this, more young children are fed by someone other than the parent, such as a grandparent, relative, or organized childcare. A larger number of meals are also prepared and consumed away from home, which could be due to convenience or the lack of availability of fresh groceries[11]. These meals that are prepared away from home are generally larger in portion size, more energy dense and higher in fat[12].

Since caries is a preventable disease[13], one of the methods to prevent caries is the manual removal of plaque by consistent toothbrushing. Parental supervised brushing (PSB) is brushing twice a day with fluoridated toothpaste with the help or supervision of a parent, from the time when the first tooth erupts to at least seven years of age[14]. PSB has been associated with lower caries rate[8]; however, there are many barriers reported by parents for facilitating PSB. Some of the common barriers include: not recognizing the importance of primary teeth[15], difficultly establishing a routine[16], managing children's challenging behavior, and taking a passive role about reminding children to brush their teeth, and not supervising them due to the presence of multiple familial and environmental stressors that impact their everyday lives[17].

D. Malnutrition and food insecurity

The ability to access healthy foods is highly dependent upon where a person lives. Access to healthy food options is more likely to be a problem for individuals from low socioeconomic status (SES). Low SES is associated with malnutrition and food insecurity[18,19]. According to the Academic Pediatrics Journal, malnutrition occurs due to harmful changes in dietary intake, or malfunction of the metabolic and digestive systems[19].

Under-nutrition, over-nutrition, and nutrient imbalances are all forms of malnutrition. Under-nutrition is inadequate intake of nutrients and over-nutrition is intake of nutrients beyond the required needs[20]. Increased consumption of fermentable carbohydrates, typically in the form of dietary sugars, is associated with an increased dental caries risk[21]. Cheese, milk, plain yogurt, and fiber-rich fruits and vegetables can help reduce caries progression, and in some cases, can rebuild enamel[22].

Food insecurity is defined as having insufficient access to food, which leads to food shortages, hunger, and unhealthy eating habits[23]. Food insecurity is found in both rural and urban communities, such as Chicago[19]. Excessive consumption of low-cost, low nutrient-dense foods, such as snacks and beverages high in sugar, salt, and fat, lead to an increased consumption of calories and a higher body mass index (BMI)[24]. Children from low-income, food-insufficient families who consumed less fruits were more over-weight compared to higher-income, food-sufficient households[25].

E. Food insecurity in Chicago

According to the 2018 “Map the Meal Gap Study”, 138,410 (11.9%) children have difficulty accessing healthy food in Cook County. The overall food insecurity rate in Cook County is 10.1%. Seventy percent of families in Cook County are income-eligible for nutritional programs[26]. Food insecurity data from the 2009 “Map the Meal Gap Study” collected for 77 communities in Chicago and 119 Cook County Suburbs, showed the neighborhoods in Chicago with the highest rates of food insecurity were Riverdale (40.8%), Washington Park (34%), Englewood and North Lawndale (both at 31.2%). The poverty rate in these neighborhoods ranged from 43.3% (Englewood) to 61.5%

(Riverdale). Riverdale had an unemployment rate of 21.2%. These neighborhoods are predominantly occupied by African-American residents[27].

F. <u>BMI and its effect on overall health and dental health</u>

BMI is the measurement of an individual's weight in relation to their height. The BMI helps with estimation of body fat. The categories are classified as underweight, healthy, overweight, and obese. Since children are constantly growing, BMI for children is calculated using their height, weight, age, and sex. These results are then plotted on a growth chart based on sex to interpret the BMI relative to other children of the same age and sex. For children and teenagers, BMI is frequently used as a screening tool rather than a diagnostic tool[28].

Higher BMI in children is associated with adverse health conditions, such as high blood pressure, type II diabetes mellitus, and serum lipids that are associated with cardiovascular disease in adulthood[29]. Obesity in childhood also causes dyslipidemia, chronic inflammation, endothelial dysfunction, and increased thrombotic events[29–31].

Dental caries and high BMI are both chronic conditions, affect a large number of youth, and are multifactorial diseases[32]. Both of these affect the quality of life and have a high cost for society[33]. There seems to be an association between dental caries and high BMI, as both conditions share similar risk factors, such as unhealthy diets that are high in sugary snacks and beverages[34]. While several studies seem to suggest there is a link, the results are conflicting[35]. Some studies have shown that there is a positive correlation between BMI and DMFT[36], whereas other studies have found underweight BMI status to be associated with severe caries experience[37]. In addition, other studies found no relationship between BMI and caries experience[38].

G. Food Deserts

Food deserts are defined as geographic areas where access to healthy, fresh, affordable foods is limited or non-existent[39]. They are characterized as areas with both low income and poor food access. Approximately 54.4 million Americans, 17.7 percent of the American population, live between 0.5 mile to 10 miles from the nearest supermarket[40]. Another characteristic of food deserts is that they are commonly found in minority communities, more specifically African American and Brown communities[41]. One's ability to access and purchase healthy foods is influenced by the neighborhood in which one lives. Opening of supermarkets in affluent areas offers their community members more variety, better quality, and price options for fresh foods[42]. Businesses in these areas also tend to operate for longer hours and offer more parking options. This has led to smaller, neighborhood grocery stores being forced to close down in low income neighborhoods. This also means that fresh, healthy food options are more accessible to those who own a car or who can readily access public transportation[43].

Low SES and minority populations are faced with many such problems. In rural communities, convenience and corner stores offering high-caloric, low nutrient dense foods outnumber supermarkets and grocery stores. The healthier food options that are available at both supermarket and grocery stores tend to be more expensive at convenience stores[44]. This is a common occurrence in urban areas as well. A study conducted in Brooklyn, NY found that there were no supermarkets located in predominantly African American areas. The majority of the stores had canned and frozen fruits and vegetables, compared to organic produce found in predominately white neighborhoods[45].

H. Food Deserts in Chicago

Mari Gallagher Research and Consulting Group looked at the impact of food deserts on public health in Chicago in 2006[46]. When food access was analyzed by race at the census-defined blocks level, the majority of African-American communities had the lowest access to chain grocery stores, independent and smaller grocery stores, and all grocery stores, but about equal access to fast food restaurants. In these predominantly African-American communities, fewer people own cars and rely more on public transportation, rides, and walking to reach food venues.

When food access was analyzed by census tract, residents living in majority White, Latino, and Diverse tracts traveled the shortest distance to any type of grocery store, about 0.39 miles. For people living in majority African-American tracts, a chain grocer was 0.77 miles away, and a small or independent grocer was 0.81 miles away. For this same group, the distance to a grocery store is twice as far as a fast-food restaurant, which makes fast food more accessible than fresh foods. Since these blocks and tracts are segregated by race, these patterns can be geographically plotted on a map. The South and West sides have less access than the North side. Low access tracts in the South side sometimes overlap, causing areas of food deserts. These food deserts are predominately in African-American tracts and the most vulnerable populations in these areas are single mothers and children. It was reported that one out of three children aged three years or older resided in these food deserts.

This study also looked at food balance score, which is a ratio of the distance of the closest grocery store divided by the distance to the closest fast-food venue. A higher score indicates a worse outcome, meaning one is closer to a fast-food venue and farther away from a grocery store. African-American tracts had the highest food balance score compared to other racial groupings. Communities that are more exposed to fast-food restaurants have an increased risk of developing chronic health conditions and suffering from premature death.

A study was conducted in Chicago, Illinois that looked at the food and beverage availability in four underserved communities with pre-dominantly low-income and African-American residents. The authors found that almost all of the food stores offered sugar-sweetened beverages. Overall, these underserved communities had less availability of healthy food and beverages[47].

I. Residing in a food desert and its impact on oral and systemic health

Living in a food desert is an important social determinant of health (SDoH). Social determinants of health are conditions in the environments in which people are born, live, learn, work, play, worship, and age. The SDoH can affect health, functioning, and quality of life outcomes[48]. These SDoH have been the target of many community-level interventions to reduce rates of morbidity, mortality, and improve health outcomes[49]. As mentioned previously, lack of access to supermarkets causes residents to consume foods that are energy dense and can be easily acquired from convenience stores or fast-food restaurants[50]. Based on a survey given to parents of food-insecure children in urban and non-urban areas in South Carolina, parents are likely to reduce the children's meal size, consume low-quality foods, and make changes to how the food is acquired, such as relying on coupons or discounted foods. The most commonly decreased foods identified include protein foods, specifically meat and eggs, with also fruits and vegetables. The foods increased include grains and starches, such as noodles, and low-cost protein foods, such as beans and hot dogs[51]. Diets high in fat and sugar lead to poorer health outcomes, such as increased risk of cardiovascular disease[52], obesity[50], diabetes mellitus[53], and hypertension[54].

Food deserts and food insecurity have been shown to have an association with low SES[49], which is a strong determinant of caries in the pediatric population[25]. Families residing in food insecure households have diets that are significantly higher in fat and fruit juice intake[21], which is a risk factor for dental caries in children[55]. Since there is a clear link between low SES and dental caries, and low SES and food insecurity, there can be a potential independent association between food insecurity and dental caries. From the NHANES 2011-12 and 2013-14, adults who experienced food insecurity had higher odds of untreated dental decay, suggesting that food insecurity could be a risk factor for dental caries[56]. We want to explore this potential relationship in young children since they have less self-efficacy on food choices.

J. Objectives/Aims

The aims of this study were to:

1) Identify associations between food deserts, identified by zip code, and caries experience, measured as decayed, missing, and filled teeth (dmft) scores, in young children (age 3-4 years) receiving dental care at UIC COD.
2) Identify associations between food deserts, identified by zip code, and BMI in young children (age 3-4 years) receiving dental care at UIC COD.

K. Hypotheses

Null hypotheses:

1) No association exists between a child living in a food desert and their caries experience.
2) No association exists between a child living in a food desert and their BMI.

Alternative hypotheses:

1) A positive association exists between children living in a food desert and their caries experience. (i.e. children living in a food desert will have increased caries experience)
2) A positive association exists between children living in a food desert and their BMI. (i.e. children living in a food desert will have increased BMI)

II. MATERIAL AND METHODS

A. Study Design and Procedures

Protocol #2020-0991 was approved for exemption by the UIC Institutional Review Board (Appendix A). The study sample included patients ages three and four years old who were seen for a comprehensive dental exam at the UIC COD Pediatric Dental clinic between January 1, 2017 and December 31, 2019. The Pediatric Dental clinic included both the Pre-Doctoral clinic and Post-Graduate clinic. The study was a cross-sectional chart review that utilized the UIC COD Electronic Health Record (EHR), axiUm. Pertinent information was retrieved from patients' electronic dental records within axiUm and was entered into an approved data collection Excel spreadsheet table (Appendix B). Race and ethnicity were not collected because this information is not routinely captured in the patient's axiUm chart in these clinics.

B. Subject Enrollment

Since the study subjects came from a pre-existing electronic database at UIC COD and there was no intervention, no recruitment effort was required to enroll subjects into the study. The EHR of minors was reviewed, however no additional information was collected nor additional contact was made with those individuals or their guardians for the chart review. A list was generated of axiUm chart numbers of patients ages 3-6 years old who had been identified in the axiUm system as having a comprehensive examination between January 1, 2017 and December 31, 2019. The selected charts were identified by running a report of all of the patients ages 3-6 with a completed D0150 CDT code during the specified time period. Each patient in the UIC COD is only allowed one comprehensive examination, with every other exam being charted as a periodic exam. This list was shared with the principal investigator (PI) directly from the IT Department (axiUm Support Staff) at the UIC COD via a password protected UIC email account. 2017 was selected as the start year, because the patient's height and weight were not routinely collected and documented in charts prior to this time. The PI reviewed the axiUm charts of these individuals and determined their eligibility based upon the eligibility criteria listed below. After some preliminary statistic tests were run, it was decided that the sample size be limited to only three- and four-year-old patients due to five- and six-year old patients being in mixed dentition.

1. <u>Inclusion Criteria</u>

- Patients must have been seen at the Pediatric Dentistry Post-Graduate or Pre-Doctoral clinic and be either three or four years old.
- They had at least one fully erupted primary tooth.
- They had a comprehensive examination between January 1, 2017 and December 31, 2019.
- The patient records demonstrated that the patient was American Society of Anesthesiologists (ASA) Physical Status Classification 1 or 2. (Appendix C)
- The ZIP code for the patient's residence had to be within the city of Chicago, Illinois.

- The patient's EHR had to include the height and weight of the patient.

2. <u>Exclusion Criteria</u>

- Children with no erupted teeth.
- Children with one or more permanent teeth.
- Children seen for visits other than a comprehensive exam, such as children seen for emergency visit appointments as their first visit.
- Charts that were incomplete and had missing variables, such as the patient's residential zip code, completed odontogram, health history, or height and weight.
- Patients with underlying diseases that can influence their caries experience or BMI.
    - This information was indicated in the EHR "Pediatric Exam" form, and "Medical History" tab.
    - The information on diseases was further verified by the note entry.
    - Examples of underlying diseases include heart disease, cancer, cerebrovascular disease, diabetes, hypertension, obstructive sleep apnea, thyroid disease, Prader-Willi syndrome, and any special needs or syndromes.
    - History of resolved medical conditions or well-controlled diseases, such as premature birth with no complications,

past minor surgical history with no complications, or well-controlled asthma, were considered as healthy for the purpose of this study.

- AxiUm charts that were locked due to financial reasons or administrative disputes.

C. Food Desert Determination

ZIP Code was collected to help identify food deserts located within Chicago, Illinois. Food deserts were determined by utilizing the United States Department of Agriculture Food Access Research Atlas[57]. The atlas identifies low-income and low-access census tracts using four measures of low access. For this project, low-income and low-access areas were assessed using one measurement. Low-income census tracts where a significant number or share of residents were more than ½ mile from the nearest supermarket were identified as food deserts. The ZIP Code was entered into the Atlas to see if it fell within a low-income census tract.

D. BMI Calculation

BMI was determined using the Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen.[58] The age (in years) and sex was entered into the BMI calculator. Height was entered in inches and weight was entered in pounds. The results were categorized into underweight (less than the 5th percentile), healthy weight (5th percentile up to 85th percentile), overweight (85th to less than the 95th percentile), and obesity (equal to or greater than the 95th percentile) using the same BMI Percentile Calculator for Child and Teen.

E. **dmft Calculation**

The dental caries status was captured by using the dmft index[59]. The numbers of decayed, missing due to caries, and filled teeth in the primary dentition were summed for the patient's dmft. Scores for the dmft index range from 0 to 20 in children[60]. The EHR's odontogram as marked on the date of the patient's comprehensive exam provided the data used to calculate dmft. Unerupted, exfoliated due to age, supernumerary, or congenitally missing teeth were not included in the patient's dmft. Decalcifications on the teeth were not included in the calculation.

F. **Statistical Analysis**

Several different statistical tests were included in the analysis. Descriptive statistical analysis was conducted for all variables. Chi-square and Fisher's exact tests were conducted to test for relationships between categorical variables. T-tests and ANOVA were conducted to compare means between groups. Statistical significance was set at a p-value of <0.05. BMI categories of underweight, overweight, and obesity were grouped together as "unhealthy" weight for contrast to normal "healthy" weight according the Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen. The recoding of the continuous count of dmft, yielded three categories of caries experience, 0 (no caries experience), 1-10 (caries experience), and 11-20 (high caries experience). The analyses were performed for the total sample, for stratification by the individual groups at ages three and four years, and for those specific age groups when they were further stratified by sex.

III. RESULTS

One hundred and four charts were included for the analytical dataset after applying the inclusion and exclusion criteria. The distribution of the sample demographics is exhibited in TABLE I and Figures 1-6. Of the 104 patient charts included, 51 patients (49.0%) were female and 53 patients (51.0%) were male. The mean age of the patients was 3.5 years (SD = .50). Twenty-two patients did not live in a food desert, while 82 lived in a food desert. The mean dmft index score was 8.3 (SD = 4.69). For dmft categories, 7.7% (8 patients) had no caries experience (dmft =0), 56.7% (59 patients) had caries experience (dmft 1-10) and 35.6% (37 patients) had high caries experience (dmft 11-20). The mean height was 42.1 inches (SD = 3.58) and the mean weight was 42.8 pounds (SD = 10.68). The mean BMI was 16.9 (SD = 2.69). For BMI categories, 54.8% (57 patients) were healthy while the remaining 45.2% (47 patients) were either underweight (5 patients, 4.8%), overweight (18 subjects, 17.3%), or obese (24 patients, 23.1%).

TABLE I. DEMOGRAPHICS OF SAMPLE PATIENTS FROM THE UIC COD PEDIATRIC DENTISTRY CLINIC

Characteristic	N (%)
Total	104 (100%)
Sex	
Female	51 (49.0%)
Male	53 (51.0%)
Age	
Mean = 3.53	
SD = 0.502	
3	49 (47.1%)
4	55 (52.9%)
BMI Categories	
Underweight	5 (4.8%)
Healthy	57 (54.8%)
Overweight	18 (17.3%)
Obese	24 (23.1%)
Weight Categories	
Underweight, overweight, or obese	47 (45.2%)
Healthy	57 (54.8%)
dmft	
Mean = 8.32	
SD = 4.69	
0	8 (7.7%)
1	5 (4.8%)
2	3 (2.9%)
3	2 (1.9%)
4	6 (5.8%)
5	5 (4.8%)
6	4 (3.8%)
7	10 (9.6%)
8	11 (10.6%)
9	4 (3.8%)
10	9 (8.7%)
11	5 (4.8%)
12	10 (9.6%)
13	6 (5.8%)
14	11 (10.6%)
15	2 (1.9%)
16	1 (1.0%)
18	1 (1.0%)
20	1 (1.0%)
dmft Category	
0 (no caries experience)	8 (7.7%)
1-10 (caries experience)	59 (56.7%)
11-20 (high caries experience)	37 (35.6%)
Food Desert	
Yes	82 (78.8%)
No	22 (21.2%)

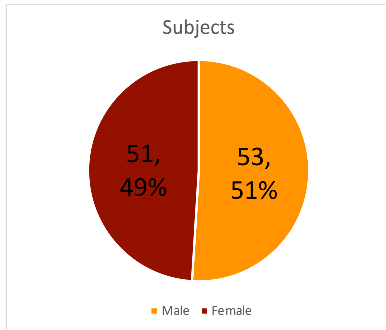

Figure 1. Sex of Sample Patients from the UIC COD Pediatric Dentistry Clinic

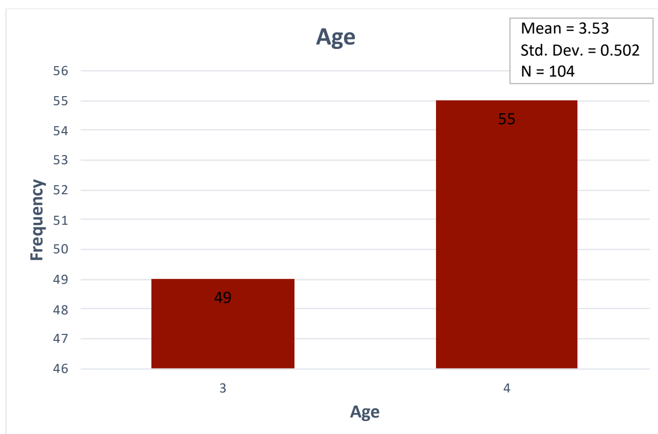

Figure 2. Age of Sample Patients from the UIC COD Pediatric Dentistry Clinic

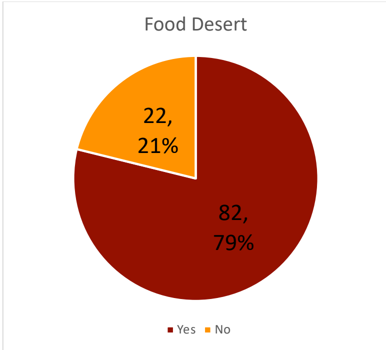

Figure 3. Presence of Food Desert

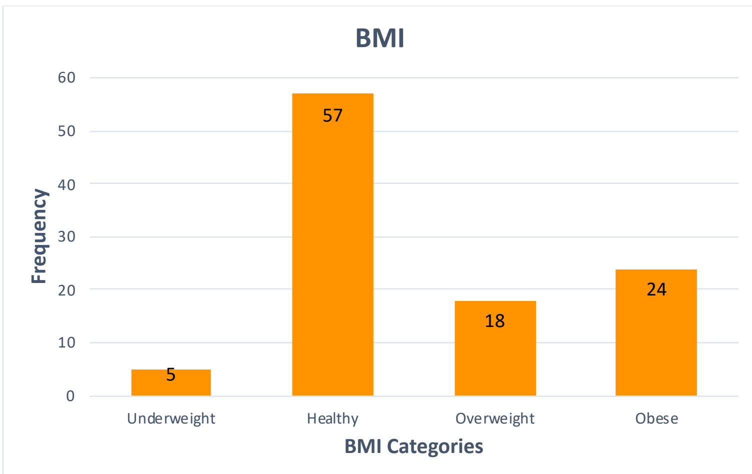

Figure 4. BMI Categories of Sample Patients from the UIC COD Pediatric Dentistry Clinic

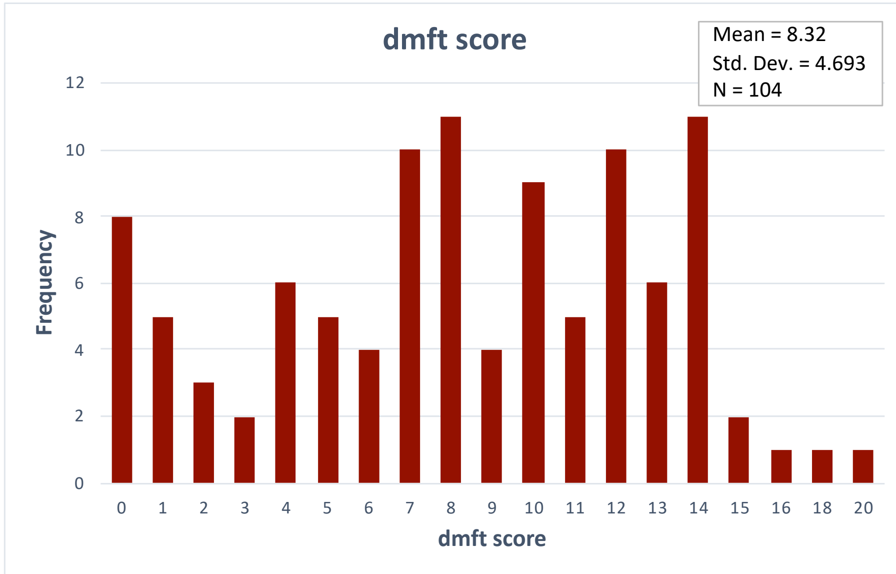

Figure 5. dmft score of Sample Patients from the UIC COD Pediatric Dentistry Clinic

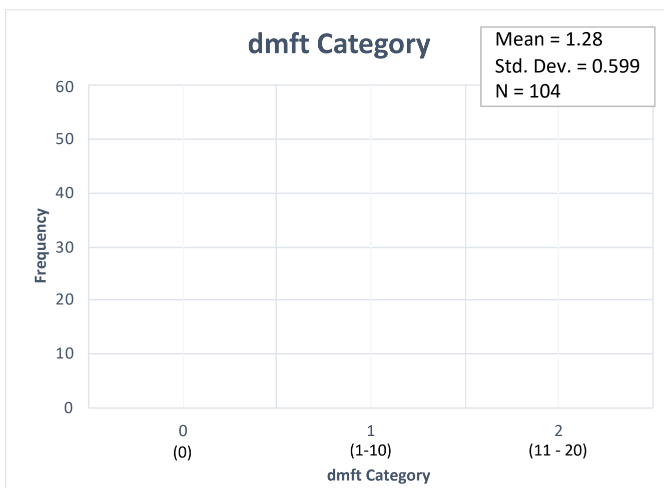

Figure 6. dmft Category of Sample Patients from the UIC COD Pediatric Dentistry Clinic

For the full sample of patients aged three to four years, no statistically significant difference between residing in a food desert or not and a patient's caries experience (based on the dmft categories) (p=0.739) (

TABLE *II*) or the patient's dmft index (p=0.138) was found. No statistically significant association between residing in a food desert or not and a patient's BMI category (p=0.530) was found (

TABLE *III*). No statistically significant association was found between residing in a food desert and BMI after underweight, overweight, and obese were grouped together (p=0.156) (

TABLE IV). No statistically significant association was found between a patient's caries experience (based on the dmft categories) and their BMI category (p=0.922) (

T*ABLE* V). No statistically significant association was found between a patient's dmft index and their weight category (p=0.929).

TABLE II. PRESENCE OF FOOD DESERT AND CARIES EXPERIENCE (dmft CATEGORY) IN SAMPLE POPULATION

			dmft = 0 (no caries experience)	dmft = 1-10 (caries experience)	dmft = 11-20 (high caries experience)	Total	Chi-Square p-value
All Patients	Food Desert	N	1	12	9	22	p = 0.739
		Y	7	47	28	82	
		Total	8	59	37	104	

TABLE III. PRESENCE OF FOOD DESERT AND BMI CATEGORIES IN SAMPLE POPULATION

			Underweight	Healthy	Overweight	Obese	Total	p-value
All Patients	Food Desert	N	1	15	3	3	22	p = 0.530
		Y	4	42	15	21	82	
		Total	5	57	18	24	104	

TABLE IV. PRESENCE OF FOOD DESERT AND WEIGHT CATEGORY IN SAMPLE POPULATION

			Underweight, Overweight, or Obese	Healthy Weight	Total	p-value
All Patients	**Food Desert**	**N**	7	15	22	p = 0.156
		Y	40	42	82	
		Total	47	57	104	

TABLE V. *CARIES EXPERIENCE AND BMI CATEGORIES IN SAMPLE POPULATION*

			Underweight	Healthy Weight	Overweight	Obese	Total	p-value
All Patients	**Caries Experience**	**dmft = 0 (no caries experience)**	1	5	1	1	8	p = 0.922
		dmft = 1-10 (caries experience)	2	32	11	14	59	
		dmft = 11-20 (high caries experience)	2	20	6	9	37	
		Total	5	57	18	24	104	

For the sample females, the mean height was 42.2 inches (SD = 3.60), the mean weight was 43.5 pounds (SD = 10.80), and the mean BMI was 17.1 (SD = 3.19). For males, the mean height was 42.0 inches (SD = 3.59), the mean weight was 42.1 pounds (SD = 10.62), and the mean BMI was 16.6 (SD = 2.11). For females 51.0% (26 patients) were healthy while the remaining 49.0% (25 patients) were either underweight (4 patients, 7.8%), overweight (8 patients, 15.7%), or obese (13 patients, 25.5%). For males 58.5% (31 patients) were healthy while the remaining 41.5% (22 patients) were either underweight (1 patient, 1.9%), overweight (10 patients, 18.9 %), or obese (11 patients, 20.8%). Chi-square tests revealed no significant difference between BMI categories (p=0.459) or dmft categories (p=0.134) based upon sex.

A. Stratified analysis by year of age:

1. Three Year Old Patients

For patients three years of age, 49 were identified. Ten subjects (20.4%) did not live in food deserts, while 39 (79.6%) lived in a food desert. Twenty-six patients (53.1%) were female and 23 patients (46.9%) were male.

The mean dmft index score was 8.6 (SD = 4.7). For dmft categories, 6.1% (3 patients) had no caries experience (dmft =0), 59.2% (29 patients) had caries experience (dmft 1-10) and 34.7% (17 patients) had high caries experience (dmft 11-20). Three patients (6.1%) were underweight, 25 (51%) were healthy, 9 (18.4%) were overweight, and 12 (24.5%) were obese. Descriptive statistics for three-year old patients are exhibited in TABLE VI.

TABLE VI. DEMOGRAPHICS OF THREE-YEAR-OLD PATIENTS FROM THE UIC COD PEDIATRIC DENTISTRY CLINIC

Characteristic	N (%)
Total	49 (100%)
Sex	
Female	26 (53.1%)
Male	23 (46.9%)
BMI Categories	
Underweight	3 (6.1%)
Healthy	25 (51.0%)
Overweight	9 (18.4%)
Obese	12 (24.5%)
Weight Categories	
Underweight, overweight, or obese	24 (49.0%)
Healthy	25 (51.0%)
dmft	
Mean = 8.55	
SD = 4.739	
0	3 (6.1%)
1	3 (6.1%)
2	1 (2.0%)
3	2 (4.1%)
4	1 (2.0%)
5	1 (2.0%)
6	2 (4.1%)
7	8 (16.3%)
8	4 (8.2%)
9	2 (4.1%)
10	5 (10.2%)
11	2 (4.1%)
12	4 (8.2%)
13	2 (4.1%)
14	6 (12.2%)
15	1 (2.0%)
16	1 (2.0%)
20	1 (2.0%)
dmft Category	
0 (no caries experience)	3 (6.1%)
1-10 (caries experience)	29 (59.2%)
11-20 (high caries experience)	17 (34.7%)
Food Desert	
Yes	39 (79.6%)
No	10 (20.4%)

The data analysis was further conducted stratified by sex. Twenty-one females resided in a food desert while five did not. Eighteen males lived in a food desert while five did not.

The mean dmft score was 7.9 (SD = 3.8) for females and 9.3 (SD = 5.6) for males. For female dmft categories, zero patients had no caries experience (dmft =0), 76.9% (20 patients) had caries experience (dmft 1-10) and 23.1% (6 patients) had high caries experience (dmft 11-20). For male dmft categories, 13.0% (3 patients) had no caries experience (dmft =0), 39.1% (9 patients) had caries experience (dmft 1-10) and 47.8% (11 patients) had high caries experience (dmft 11-20).

The mean BMI was 17.4 (SD = 2.5) for females and 16.4 (SD=2.3) for males. For female patients, 2 (7.7%) were underweight, 11 (42.3%) were healthy, 5 (19.2%) were overweight, and 8 (30.8%) were obese. For male patients, 1 (4.3%) was underweight, 14 (60.9%) were healthy, 4 (17.4%) were overweight, and 4 (17.4%) were obese. Descriptive statistics for three-year old patients stratified by sex are exhibited in TABLE VII.

TABLE VII. DEMOGRAPHICS OF THREE-YEAR-OLD PATIENTS FROM THE UIC COD PEDIATRIC DENTISTRY CLINIC BY SEX

		Male	Female	p-value
Food Desert	**Yes**	18 (78.3%)	21 (80.8%)	p=0.553
	No	5 (21.7%)	5 (19.2%)	
	Mean Height	41.7 inches (SD = 4.0)	40.9 inches (SD = 3.2)	p=0.431
	Mean Weight	40.9 pounds (SD = 10.7)	41.4 pounds (SD = 7.4)	p=0.834
	Mean BMI	16.4 (SD=2.3)	17.4 (SD = 2.5)	p=0.147
BMI Category	**Underweight**	1 (4.3%)	2 (7.7%)	p=0.580
	Healthy	14 (60.9%)	11 (42.3%)	
	Overweight	4 (17.4%)	5 (19.2%)	
	Obese	4 (17.4%)	8 (30.8%)	
	Mean dmft	9.3 (SD = 5.6)	7.9 (SD = 3.8)	p=0.329
dmft Category	**0 (no caries experience)**	3 (13.0%)	0 (0%)	p=0.008
	1-10 (caries experience)	9 (39.1%)	20 (76.9%)	
	11-20 (high caries experience)	11 (47.8%)	6 (23.1%)	

For patients three years of age, no statistically significant difference in the presence of food desert and caries experience was found (p=0.508). No statistically significant association between residing in a food desert or not and dmft index (p=0.853). There was a statistically significant association between residing in a food desert or not and BMI category (p=0.007) (Table VIII). When BMI categories were grouped together for unhealthy weights (underweight, overweight, and obese), there was a significant difference between residing in a food desert and having unhealthy weight (p=0.000). This is shown in TABLE IX).

Table VIII. PRESENCE OF FOOD DESERT AND BMI CATEGORIES IN THREE-YEAR-OLDS

		Underweight	Healthy	Overweight	Obese	Total	p-value
Food Desert	N	0	10	0	0	10	p = 0.007
	Y	3	15	9	12	39	
Total		3	25	9	12	49	

TABLE IX. PRESENCE OF FOOD DESERT AND WEIGHT CATEGORIES IN THREE-YEAR-OLDS

		Underweight, Overweight, or Obese	Healthy Weight	Total	p-value
Food Desert	N	0	10	10	p = 0.000
	Y	24	15	39	
	Total	24	25	49	

Of the 39 three-year-olds who lived in a food desert, the group was 53.8% female and 38.5% had a healthy weight. 5.1% had no caries experience (dmft=0), 56.4% had caries experience (dmft 1-10) and 38.5% had high caries experience (dmft 11-20). The mean was BMI=17.3 (SD = 2.6) and mean dmft=8.6 (SD = 4.5). The majority (71.4%) of females were at an unhealthy weight, whereas males split 50-50 unhealthy-healthy (p=0.149). The mean BMIs were similar (p=0.290) with females 17.7 (SD = 2.7) and males 16.8 (SD = 2.4), as were the mean dmfts (p=0.783) with females 8.43 (SD = 3.8) and males 8.8 (SD = 5.3). There was a statistically significant difference between sex and caries experience (p=0.008). The distributional relationship of caries suggests opposing u-shaped curves by sex (likelihood ratio p=0.047, Figure 7).

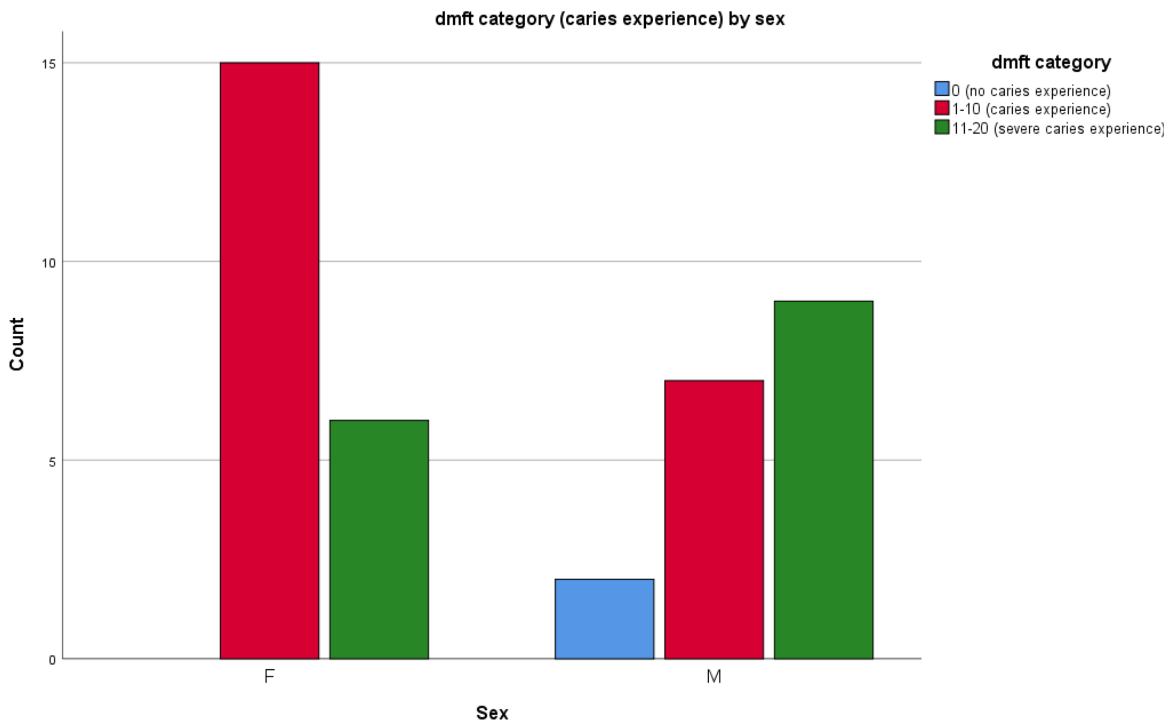

Figure 7. dmft Category by sex (3 year olds)

2. **Four Year Old Patients**

For four-year-old patients, 55 were identified. Twelve patients did not live in food deserts, while 43 lived in a food desert. Twenty-five patients were female and 30 patients were male.

Dmft index average score was 8.1 (SD = 4.7). For dmft categories, 9.1% (5 patients) had no caries experience (dmft =0), 54.5% (30 patients) had caries experience (dmft 1-10) and 36.4% (20 patients) had high caries experience (dmft 11-20). Two subjects (3.6%) were underweight, 32 (58.2%) were healthy, 9 (16.4%) were overweight, and 12 (21.8%) were obese. Descriptive statistics for four-year old patients are exhibited in

TABLE ***X***.

TABLE X. DEMOGRAPHICS OF FOUR-YEAR-OLD PATIENTS FROM THE UIC COD PEDIATRIC DENTISTRY CLINIC

Characteristic	N (%)
Total	55 (100%)
Sex	
Female	25 (45.5%)
Male	30 (54.5%)
BMI Categories	
Underweight	2 (3.6%)
Healthy	32 (58.2%)
Overweight	9 (16.4%)
Obese	12 (21.8%)
Weight Categories	
Underweight, overweight, or obese	23 (41.8%)
Healthy	32 (58.2%)
dmft	
Mean = 8.1	
SD = 4.7	
0	5 (9.1%)
1	2 (3.6%)
2	2 (3.6%)
4	5 (9.1%)
5	4 (7.3%)
6	2 (3.6%)
7	2 (3.6%)
8	7 (12.7%)
9	2 (3.6%)
10	4 (7.3%)
11	3 (5.5%)
12	6 (10.9%)
13	4 (7.3%)
14	5 (9.1%)
15	1 (1.8%)
18	1 (1.8%)
dmft Category	
0 (no caries experience)	5 (9.1%)
1-10 (caries experience)	30 (54.5%)
11-20 (high caries experience)	20 (36.4%)
Food Desert	
Yes	43 (78.2%)
No	12 (21.8%)

These results were further stratified by sex. Twenty-one females resided in a food desert while four did not. Twenty-two males lived in a food desert while eight did not.

The mean dmft score was 7.7 (SD = 4.9) for females and 8.4 (SD = 4.5) for males. For female dmft categories, 12.0% (3 patients) had no caries experience (dmft =0), 56.0% (14 patients) had caries experience (dmft 1-10) and 32.0% (8 patients) had high caries experience (dmft 11-20). For male dmft categories, 6.7% (2 patients) had no caries experience (dmft =0), 53.3% (16 patients) had caries experience (dmft 1-10) and 40.0% (12 patients) had high caries experience (dmft 11-20).

The mean BMI was 16.8 (SD = 3.8) for females and 16.8 (SD=2.0) for males. For female patients, 2 (8.0%) were underweight, 15 (60.0%) were healthy, 3 (12.0%) were overweight, and 5 (20.0%) were obese. For male patients, none were underweight, 17 (56.7%) were healthy, 6 (20.0%) were overweight, and 7 (23.3%) were obese. Descriptive statistics for four-year old patients stratified by sex are exhibited in

TABLE ***XI***.

TABLE XI. DEMOGRAPHICS OF FOUR -YEAR-OLD PATIENTS FROM THE UIC COD PEDIATRIC DENTISTRY CLINIC BY SEX

		Male	Female	p-value
Food Desert	**Yes**	22 (73.3%)	21 (84.0%)	p=0.268
	No	8 (26.7%)	4 (16.0%)	
	Mean Height	42.2 inches (SD = 3.3)	43.5 inches (SD = 3.6)	p=0.152
	Mean Weight	43.1 pounds (SD = 10.7)	45.6 pounds (SD = 13.3)	p=0.441
	Mean BMI	16.8 (SD=2.0)	16.8 (SD = 3.8)	p=0.952
BMI Category	**Underweight**	0 (0%)	2 (8.0%)	p=0.387
	Healthy	17 (56.7%)	15 (60.0%)	
	Overweight	6 (20.0%)	3 (12.0%)	
	Obese	7 (23.3%)	5 (20.0%)	
	Mean dmft	8.4 (SD = 4.5)	7.7 (SD = 4.9)	p=0.579
dmft Category	**0 (no caries experience)**	2 (6.7%)	3 (12.0%)	p=0.710
	1-10 (caries experience)	16 (53.3%)	14 (56.0%)	
	11-20 (high caries experience)	12 (40.0%)	8 (32.0%)	

For patients four years of age, no statistically significant difference was found between living in a food desert or not and caries experience (p=0.142) or BMI category (p=0.490). There was a statistically significant association between residing in a food desert or not and dmft index (p=0.026) (

TABLE **XII**). When BMI categories were grouped together for unhealthy weights (underweight, overweight, and obese), there was no significant difference between residing in a food desert and having unhealthy weight (p=0.163) (TABLE XIII). No statistically significant difference was found between sex and residing in a food desert (p=0.268), BMI category (p=0.387), or caries experience (p=0.710).

TABLE XII. PRESENCE OF FOOD DESERT AND MEAN dmft INDEX IN FOUR-YEAR-OLDS

	Food Desert	N	Mean	Std. Deviation	p-value
dmft index	**N**	12	10.7	4.2	p = 0.026
	Y	43	7.3	4.6	

TABLE XIII. PRESENCE OF FOOD DESERT AND BMI CATEGORIES IN FOUR-YEAR-OLDS

		Underweight, Overweight, or Obese	Healthy Weight	Total	p-value
Food Desert	**N**	7	5	12	p = 0.163
	Y	16	27	43	
	Total	23	32	55	

IV. DISCUSSION

Residing in a food desert has many health implications, including an increased risk for certain diseases and cancers[46]. This study aimed to evaluate a possible relationship between living in a food desert and its potential effects on BMI and caries experience in our clinic population. We accepted the null hypothesis and found no association between residing in a food desert and BMI or caries experience. However, when the data was stratified by age, for three year olds we found a statistically significant difference between residing in a food desert and BMI when underweight, overweight, obese categories were grouped together.

We did not find any statistically significant differences between residing in a food desert and BMI in children three and four years of age. Previous studies have found similar results. When BMI was examined in a group of children that were followed from kindergarten to eighth grade, no relationship was found between BMI and the food environment[61].

The availability of supermarkets does not necessarily guarantee that residents will shop there. Hillier et al interviewed 198 low-income Hispanic and African American parents from two urban neighborhoods in North Philadelphia about where they do their food shopping. The study revealed that they rarely shop at the closest supermarket and travel on average 1.58 miles for non-WIC food shopping and 1.07 miles for WIC shopping[62]. Pearson et al found that distance to the nearest supermarket, supermarket fruit and vegetable price, socio-economic deprivation, and difficulties associated with grocery shopping were not associated with either fruit or vegetable consumption[63]. Cultural influences may play a greater role in setting dietary habits. A study found that opening a supermarket in a food desert increased geographic accessibility but it did not necessarily reduce the distance traveled to get groceries. Even with the opening of new supermarkets, residents continue shopping at their regular shopping venues[64].

When BMI was grouped together with underweight, overweight, and obese, we did not find a statistically significant difference for residing in a food desert and BMI. Previous studies have shown that living in closer proximity to a supermarket was associated with a lower prevalence of obesity and being overweight, while the presence of convenience stores was associated with higher rates of obesity and being overweight[65,66]. However, this data looked primarily at adults while our study was focused on children. Eating habits of children are influenced by the physical and social environment in which they live. Children have less control over their food choices and rely heavily on their parents and caregivers. Children's preference and dietary intake is largely influenced by the foods that are introduced and readily available to them. In school-age children, the consumption of fruits and vegetables is positively associated with the fruits and vegetables that are readily accessible in their home and during school lunches[67]. The amount of food available at home is also an influencing factor for children's intake of certain foods. Customary feeding practices used by parents and caregivers for infants and young children include feeding frequently and rapidly when children are in distress, offering favorite foods, and force-feeding children to encourage them to eat as much as possible. These feeding-practices are influenced by specific cultures and again, relates to the different variety and amount of food that is offered and accessible[10].

We did not find a significant difference between residing in a food desert and caries experience. One potential reason could be that the patient population seen at UIC COD Pediatric Dental Clinics is mostly referral based. Many of the children referred to the clinic have rampant caries and general dentists, even some pediatric dentists, feel overwhelmed by the burden of disease and refer these patients to our clinic for more advanced behavior management like sedation or general anesthesia. Our patient population is also primarily minority and over 94% Medicaid, meaning that many of these patients come from low SES households. Research has consistently indicated that minority and low-income in the US, Illinois and Chicago, are more likely to have increased dental caries prevalence, unmet dental needs and caries severity[8]. We might expect different results regarding caries experience if this study was carried out in a private practice dental clinic.

The etiology of caries is dependent on many factors including the presence of fermentable sugar, environmental and host factors, and the presence of cariogenic microbial flora[68]. Fox et al found that infants as early as seven months of age have shown dietary habits that are seen in older children and adults. About 18% to 33% of infants and toddlers between seven to twenty-four months of age consumed no vegetables, and 23% to 33% consumed no fruits. Potatoes, in the form of french fries, were the most common vegetable eaten by toddlers. By nineteen to twenty-four months, 20% of toddlers consumed candy, 44% consumed a sweetened beverage, and 62% consumed a baked dessert[69]. Parents and caregivers should be encouraged to offer nutrient-dense foods, such as green, leafy vegetables, fruits, cheese, and non-sweetened yogurt. Along with toothbrushing and flossing demonstrations, dietary and nutritional counseling should be an essential component of an infant's first oral health visit to prevent cavities and potential chronic diseases related to weight.

We found a significant difference between residing in a food desert and having an unhealthy weight in three-year-olds (p=0.007). We examined this age group further because we recognize that they have minimal self-efficacy on food choices and for performing basic oral hygiene practices. Fontana et al interviewed the caregivers of toddlers to gain more information about caries risk factors in this specific age group. They found that family caries experience, such as having other children with caries, transmission-related behaviors, diet, health beliefs, and low family income are all risk factors for caries progression in very young children. This study did not find streptococci mutans count, baseline caries, dental plaque, and gingivitis to be risk factors associated with caries progression[70]. This suggests that diet may have a more important role in caries progression.

Children's dietary quality is greatly influenced by the parenting style. The three parenting styles, authoritarian, permissive, and authoritative, were further classified in terms of feeding practices[71]. Authoritarian parents are more restrictive for certain foods and force the child to eat other foods. This type of parenting does not take into account the child's preference and parents attempt to control the child's eating. Permissive parents allow the child to eat whatever they want with no control over quantity. Authoritative parents encourage the child to eat heathier food, but also give the child options from which the child can make the decision. Authoritarian parents may use rewards or threats to force the child to eat fruits and vegetables, while authoritative parents may use reasoning with the child and explain why it is important to eat their fruits and vegetables[72].

Authoritarian parents often try to increase the amount of nutrient-dense foods eaten and restrict unhealthy junk foods. The intention is meant to promote healthy dietary habits and prevent obesity, but this can have negative consequences on children's food preference. In pre-school aged children, restrictive feeding practices were associated with over-eating and increased weight status[73]. In three- to five-year-old children, when food was restricted for a certain amount of time, they had more desire to obtain and consume the restricted food. When they were finally given access, they were more likely to take larger portions of the restricted food and overindulge[74]. In the same age group, using certain foods, usually sweets, as rewards for good behavior can promote children to have preference for sweets, rather than nutrient dense foods[67]. With more focus on clearing the plate, larger food portion sizes, and using food as rewards, children's ability to respond to hunger and satiety is reduced[73]. In a study focused on African American and Hispanic pre-school children, authoritative feeding was positively associated with consumption of dairy and vegetables. Authoritarian feeding was negatively associated with consumption of vegetables[72].

For three-year-old females that resided in a food desert, we found that majority experienced unhealthy BMI (71.4%) compared to males that were split 50-50 for healthy vs unhealthy BMI. Not many studies have been conducted on gender differences in BMI in this age group. When looking at international data from 188 countries, 125 countries reported a higher prevalence of obesity in males than females in children five to nine years of age. In the United States, 9.4% of children zero to five years of age are overweight. The trend is similar for obesity in males vs females in the five to nine year age group, with males (25.1%) having a higher prevalence of obesity compared to females (20.3%)[75].

A. Limitations of the Study

Limitations of the study included the sample size of 104 patient charts. Due to many of the patient charts missing either height, weight, or both, they were excluded from this study. After data analysis, we decided to restrict our sample to patients ages three and four years only, instead of 3-6 years, excluding an additional 46 patient charts. Children that are five or six years of age will likely be in mixed dentition, because they can start exfoliating primary teeth and have eruption of permanent teeth. The six-year molars do not replace any primary teeth, therefore, the chance of having a higher caries experience may exist for children with six-year molars. Children that are five or six years of age also have stronger preferences for their diet, while 3-4 year old children relatively still rely on the parents and caregivers. When children become older, parents often skip parental supervised brushing and generally only remind children to brush their teeth. The efficacy of toothbrushing is not being monitored in the older age group as much.

Cross sectional studies are also limited because of their inability to determine causation. Though our data was significant when comparing the BMI (healthy vs unhealthy) of children aged three who lived in food deserts with those who did not live in food deserts, we cannot demonstrate that living in a food desert actually caused the child's unhealthy BMI. Given the number of factors that impact a person's weight, height, and BMI, identifying a single causative factor is extremely difficult. The same is also true when examining caries experience. There are numerous factors that can influence a person's oral health status, which include diet, oral hygiene practices, and social determinants outside of their individual control. As stated earlier, our patient population is also a limitation of this study. Our patients are faced with many individual, structural and social barriers, making them more likely to live in a food desert, to have an unhealthy BMI and to suffer from oral disease.

B. **Future Studies**

The relationship of dental caries, low SES, and food insecurity is complex and more studies are needed to examine this relationship, specifically focusing on children. Using a patient population that is not university based might be ideal. Since very young children are more likely to visit health care providers compared to dentists, perhaps these studies can be conducted in a primary care setting. We focused on the Chicago urban area, but these disparities also affect rural areas. The present study could be continued with the inclusion of ethnicity to develop more targeted strategies, albeit the data completeness of this variable in the EHR is known to be weak.

V. CONCLUSION

Young children living in a food desert are more likely to be underweight, overweight, or obese rather than at healthy weight. In our patient sample, we did not find a statistically significant difference between living in a food desert and caries experience or BMI, therefore we accepted the null hypothesis that there is no association between a child living in a food desert and their caries experience or their BMI. The etiology of caries is multifactorial and can be influenced by many other factors that were not examined in this study. Further work needs to be done to study this relationship.

Previous studies have confirmed that diet plays an important role in the weight status, as well as in the development and progression of dental caries. As dental providers, not only are we responsible for the evaluation and treatment of oral disease, but we play an important role in the education of parents and caregivers about ways to prevent oral disease and systemic health problems due to weight status. During the initial infant oral health examination and every periodic recall examination, emphasis should be placed on nutritional counseling and other preventive measures.

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APPENDICES

APPENDIX A

Claim of Exemption from the IRB

August 8, 2020

Dhwani Patel
Pediatric Dentistry

RE: **Protocol # 2020-0991**
"ZIP Code and its Impact on the Oral Health Status and BMI of Pediatric Patients"

Dear Dhwani Patel:

Your Claim of Exemption was reviewed on **August 8, 2020** and it was determined that your research meets the criteria for exemption as defined in the U.S. Department of Health and Human Services Regulations for the Protection of Human Subjects [45 CFR 46.104(d)]. You may now begin your research.

Exemption Granted Date: August 8, 2020
Sponsor: None

The specific exemption category under 45 CFR 46.104(d) is: 4

Waiver of HIPAA Authorization:
A waiver of HIPAA Authorization has been granted [45 CFR 164.512(i)(1)(i)] for the use of protected health information (PHI) for research purposes. Please note that this research has been determined to meet the criteria for exemption under category 4. Under the revised Common Rule regulations (2018 Requirements, effective January 21, 2019), research involving secondary analysis of UIC medical records data qualifies for exempt category 4 when the research is limited to the collection and analysis of UIC protected health information within the UIC covered entity per HIPAA. The exemption does not apply to the research use of PHI from non-UIC entities, or to research that involves disclosure of UIC PHI outside of the UIC covered entity. Any future plans to disclose PHI outside of the UIC covered entity will require a protocol amendment and re-review by the IRB.

You are reminded that investigators whose research involving human subjects is determined to be exempt from the federal regulations for the protection of human subjects still have responsibilities for the ethical conduct of the research under state law and UIC policy.

Please remember to:

APPENDIX A (continued)

- → Use your research protocol number (2020-0991) on any documents or correspondence with the IRB concerning your research protocol.
- → Review and comply with the *policies* of the UIC Human Subjects Protection Program (HSPP) and the guidance **Investigator Responsibilities**.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact me at (312) 355-2908 or the OPRS office at (312) 996-1711. Please send any correspondence about this protocol to OPRS via *OPRS Live*.

Sincerely,
Charles W. Hoehne, B.S., C.I.P.
Assistant Director, IRB #7
Office for the Protection of Research Subjects

cc: Marcio Da. Fonseca
Brittaney Hill

APPENDIX B

Data Collection Table

Chart Number	ID	Age	Sex	Zip Code	Food Desert (Y/N)	dmft score	Height (in)	Weight (lb)	BMI	Comments

*Chart numbers were removed after data collection.

APPENDIX C

American Society of Anesthesiologists Classification System

ASA PS Classification	*Definition*	*Pediatric Examples, Including but not Limited to:*
ASA I	A normal healthy patient	Healthy (no acute or chronic disease), normal BMI percentile for age
ASA II	A patient with mild systemic disease	Asymptomatic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI percentile for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations
ASA III	A patient with severe systemic disease	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition. Full term infants <6 weeks of age.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.
ASA V	A moribund patient who is not expected to survive without the operation	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.

VITA

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