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Identifying Modern Diet Behaviors and Tendencies with Ultra Processed Foods in The United States Contributing to the Increasing Hispanic Childhood Overweight/Obesity Epidemic

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ABSTRACT

Identifying Modern Diet Behaviors and Tendencies with Ultra Processed Foods in The United States Contributing to the Increasing Hispanic Childhood Overweight/Obesity Epidemic

By

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Introduction: Childhood overweight/obesity, a serious and escalating problem in the US. This explores how childhood overweight/obesity disproportionately affects Hispanic children in the US. In the years 2017 – 2020 the CDC reported obesity prevalence to be 19.7% and affected about 14.7 million children and adolescents. Obesity prevalence was 26.2% among Hispanic children, 24.8% among non-Hispanic Black children, and 16.6% among non-Hispanic White children. Childhood obesity is associated with some modern lifestyle tendencies, like eating behaviors. Many products distributed by the big food industry are Ultra Processed Foods (UPF) which can potentially influence the modern diet trend and behaviors that could contribute to Hispanic childhood obesity in the United States.

Aim: This study's purpose is to explore some of the modern diet trend behaviors involving UPFs could be contributing to Hispanic childhood obesity in the United States, and explore how socioeconomic status can disproportionally affect Hispanic children as well as the association between UPF consumption and its capacity to affect a child's body and overall health due to the unhealthy ingredients and processes UPFs undergo before they make it to the table

Methods: Secondary data was analyzed using the 2017 – 2018 National Health and Nutrition Examination Survey (NHANES) surveys. This is a cross-sectional program of studies designed to assess adults' and children's health and nutritional status across the country.

Results: In the sample obtained from the NHANES more than double the number of Non-Hispanic White children fell in the high-income category compared to Hispanic children. The majority of children had between 1 – 4 meals within the last 30 days not home prepared or from a fast food or pizza place and they had high BMI for age-sex values**.** More than half of the sample with all characteristics included had BMI by age-sex values that fell in the obesity category in both ethnicities according to CDC's guidelines and BMI for age-sex values.

Discussion: Addressing Hispanic childhood obesity in the US. Requires an approach where many levels of infrastructure are involved. This is from the national or governmental level with policies and laws all the way to the individual level by educating individuals to make better decisions when feeding their children. As Hispanic childhood obesity rates are high it is crucial to work on reversing this epidemic. There is still a need for more focused studies to try and understand what type of UPFs Hispanic children are eating and how they could be affecting their bodies in terms of adiposity levels.

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Author's Statement Page

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Chapter I: Introduction

1.1 Background

Childhood overweight/obesity, a serious and escalating pandemic, in the present affects children worldwide, in developed and underdeveloped countries. Sedentary lifestyles, urbanization, and unhealthy food habits are some of the principal factors behind it (Seidell & Halberstadt, 2015). There is an increased risk of developing non-communicable diseases (NCDs) as well as significant potential comorbidities (e.g., diabetes and cardiovascular disease). This worldwide epidemic brings important consequences which include psychiatric, psychological and psychosocial adversities (Di Cesare et al., 2019).

Overweight and obesity are defined by the World Health Organization (WHO) "as abnormal or excessive fat accumulation that presents a risk to health." The diagnosis and definition of obesity in children can be complex as obesity is not defined by a standard threshold like the adult measurement (CDC, 2022). Instead, when measuring children and teens, BMI is age- and sex-specific and is normally referred to as BMI-for-age. A child's weight status is different from adult BMI categories. Children's body composition can vary with age and between boys and girls (CDC, 2022). At present, BMI is commonly used to identify obesity in children as it is a practical alternative to direct measures of body fat, but it has significant limitations. One primary limitation is that BMI is not a direct measure of adiposity in the body (Tyson and Frank 2018). As such, BMI can over emphasize the degree of overweight, specifically in tall lean children. If this was the case, alternative measurements could be implemented, such as the waist-hip ratio, dial energy x-ray absorptiometry (DXA), and densitometry (underwater weighing) (Sweeting, 2007). Even though different methods for measuring body fat in children are available, they are far more complex to use (Tyson and Frank,

2018). From 1975 – 2016, the prevalence rates for overweight or obese children and adolescents aged 5-19 years old increased more than fourfold from 4% to 18%. (World Health Organization: WHO, 2020). Currently, 1 in 5 children and adolescents are affected in the United States (CDC, 2022).

Obesity in U.S. Hispanic Populations

According to the 2020 Census there are 62.1 million Hispanic/Latinos living in the United States making it the second largest racial or ethnic group after non-Hispanic Whites (The Office of Minority Health, 2023). The term Hispanic will be used to reference both Hispanic and Latino in the present document. To give an idea of childhood obesity rates and difference in prevalence between race/ethnicity. During the years 2017 – 2020 the CDC reported the obesity prevalence among children to be 19.7% or about 14.7 million children. Obesity prevalence was 26.2% among Hispanic children, 24.8% among non-Hispanic Black children, 16.6% among non-Hispanic White children and 9% among non-Hispanic Asian children (CDC, 2022).

Increasing obesity rates among Hispanics may contribute to the incidence of health adversities related to this ethnic/racial group. Non-communicable diseases like diabetes type 2, metabolic disorders, pulmonary disorders, and more have been associated with childhood obesity (Sahoo et al., 2015). In the future, Hispanic childhood obesity in the United States could pose a serious threat to the minority group's health, the public health system, and even the economy of the country. In the literature, it has been shown that individuals who are overweight/obese at an early age are much more likely to remain overweight or obese into adulthood (Costa et al., 2018).

Obesity and Processed Foods

As childhood obesity rates have grown over recent decades, and over the same period of time modifications to how foods are produced and increasing availability of transportation facilities have been observed (Costa et al., 2018). The path the food industry has taken, could contribute to an obesogenic environment. Ultra-processed foods are incredibly easily available and are practical. Additionally, industrialization and urbanization have intensified the evolution of a sedentary and ultra-processed fast food-ready lifestyle. The NOVA classification system by Monteiro et al., introduced the use of the term ultra-processed foods (UPFs) in 2009, since then it has gained popularity and nowadays is widely used to identify a group of foods with food substances not commonly used in culinary preparations, such as hydrolyzed protein, modified starches, and hydrogenated or interesterified oils, and additives whose purpose is to imitate sensorial qualities of unprocessed food to cover up undesirable tastes (Gibney, 2018).

Different food processing-based classification systems have been developed in recent decades striving to categorize the current and new food characteristics arising within the food industry. Some examples of these systems are the IARC-EPIC system (European level), the IFIC and UNC system (United States), the NIPH system (Mexico), and the NOVA system (Brazil) (Carretero et al., 2020). The NOVA food classification system with its identification of different characteristics of foods is the classification system that by far has been most widely applied to scientific literature (Lawrence & Baker, 2019). Its classifications are accepted today by international organizations such as the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) (Carretero et al., 2020). At present the NOVA classification consists of 4 food categories or groups. Group 1 (unprocessed and minimally processed foods). Group 2 (processed culinary ingredients). Group 3 (processed foods) can

include canned or bottled vegetables, legumes (pulses) preserved in brine, whole fruit preserved in syrup, some types of processed animal foods such as ham, bacon, pastrami, and smoked fish, most freshly baked breads, and simple cheeses to which salt is added. Lastly, group 4 (ultra-processed foods) some common UPFs are carbonated soft drinks, candies, mass produced packaged breads and buns, sweet, fatty or salty packaged snacks, sweetened breakfasts such as cereals, pre-prepared meat, pasta and pizza dishes, poultry and fish 'sticks' and 'nuggets', sausages, burgers, and other reconstituted meat products, baby formula, powered and packaged instant soups, noodles and desserts. Sugar, oils and fats, and salt, used to make processed foods, are often ingredients of UPFs, commonly in combination (Monteiro et al., 2018).

Taking time to identify the different characteristics of UPFs as they have evolved into a trend in the modern diet behaviors of society can help understand how UPFs have become effortlessly present in modern diet tendencies. In this study UPFs as identified by the NOVA system will be the main factors when investigating modern diet trends, UPFs have established themselves as a type of food that does not need much time to prepare. In addition, they are much cheaper than many whole foods, and are incredibly accessible as they have the typical characteristics of having a long shelf life (Monteiro et al., 2019). Nowadays, the majority of convenient stores, super markets, shops, and more have a vast variety of UPFs available. On the other hand, it has become expensive and difficult to incorporate whole foods, fresh fruits, and vegetables into everyday diet (Lustig, 2020). Since parents are spending more time at work, in traffic, and managing everyday life outside the house, they end up having less time to cook for their children. UPFs become an easy option to feed their kids. Children are now more exposed to fast-food, cereals, pizza, burgers, and many more ready-to-eat foods. The nutrition literature and authoritative reports increasingly recognize the concept of UPFs, as a descriptor of unhealthy

diets (Carlos A Monteiro et al., 2019). UPFs already make up more than half of the total dietary energy consumed in high-income countries such as the USA, Canada, and the UK and between one-fifth and one-third of total dietary energy in middle-income countries such as Brazil, Mexico, and Chile (Monteiro et al., 2019).

1.2 Study Purpose

This study's purpose is to explore some of the modern diet trend behaviors that could be contributing to Hispanic childhood obesity in the United States. These behaviors could be influenced by modern food industries. Secondly, this study will strive to explore the association between UPFs consumption and its capacity to affect a child's body and overall health due to the unhealthy ingredients and processes UPFs undergo before they make it to the table. Considering the prevalence of obesity among Hispanic minority groups, this study will examine how socioeconomic status impacts the availability and choices of food for Hispanic children in their everyday life. The Hispanic minority is the second largest racial/ethnic group in the country, and is projected to keep growing, this topic is of great importance to public health as it is inevitable to think of the potential obesity increasing rates in the future (The Office of Minority Health, 2023). Having a focus on early recognition of childhood obesity can aid society to become more aware of the adverse effects of modern diet habits containing UPFs and the association with obesity.

1.3 Study Questions

The questions this study is seeks to answer are:

1. How are modern diet tendencies contributing to the Hispanic childhood epidemic in the United States?

2. What are the odds of being overweight/obese for a child if his/her diet mostly consists of Ultra-processed foods?

3. How does the disproportionately socioeconomic status contributes to the Hispanic childhood obesity epidemic?

Chapter II: Literature Review

2.1 Ultra-processed food industry

Industrial food production has shifted diets of entire populations from primarily whole foods to mostly ultra-processed food-like substances. UPFs have the potential to be addictive. Great amounts of sugar, salt, fat, artificial flavorings, and so forth are incorporated making these foods hyperpalatable, consequently making customers attached to this type of foods (Schneider, 2021). In addition, they are easy to access, ready-to-heat and -eat foods, which fits in with the busy modern lifestyles. The industrial manufacturing processes and ingredients used in UPFs are designed to make highly profitable products with long shelf life, low-cost ingredients, and powerfully branded products (Schneider, 2021). As food has evolved to be so easily available for consumption, low in nutritional value, high in caloric contents and empty calories, economical convenience, and so pleasing to taste buds, we can see some type of diet trend and with those trends there has been an increase in childhood obesity among Hispanic children as well (Liem & Russell, 2019). These diet tendencies can include grabbing a quick meal for everyone in the house from a drive-through (fast-food), getting frozen food which is so convenient because it is ready made and parents only have to toss it in the oven or microwave. These types of practices to feed children have gained popularity as people also greatly decreased healthy habits such as buying fresh whole foods and cooking their own meals at home.

The complex links between UPFs and childhood obesity could be a big setback for public health. There are many associations and correlations identified in studies. Although more investigation is needed for some associations, it is inevitable to feel overwhelmed. UPFs are practical for parents, economical, and addictive, but different literature also relates other factors. Influencing children to want modern industrial-produced processed foods is an example of the millionaire marketing strategy. The massive advertising campaigns selling UPFs such as sugary

cereals, tasty snacks, fast food and candy could push children towards unhealthy eating behaviors and possible lifetime habits. Children's dietary exposures are crucial to later taste preferences (Schneider, 2021).

Minority racial groups have been targeted by big food companies as part of their marketing strategy taking advantage of low-income and low-education racial/ethnic minority communities. Low-income minority communities can buy a significant amount of UPFs compared to whole foods with the same amount of money at supermarkets, and since the majority of the working-class population spends a great deal of time going out of their house doing some kind of physical job and returning tired. UPFs companies have managed to design their product as practical as possible. Which could influence on people's decisions on what to eat. This makes these communities the perfect target group for big food to sell their unhealthy products. In the United States, food marketers spent $333 million on Black—targeted television and $787 million on Spanish language-targeted television in 2017 alone (Nguyen et al., 2020). The modern tendencies of diet have been influenced by different factors including the marketing strategy of big food to promote not only UPFs but by making products instant and with none or little elaboration. Probably, incentivizing the shift of less whole food cooking and more consuming ready-to-heat and-eat meals.

2.2 Associations of increased UPFs consumption and childhood overweight/obesity

Various literature suggests that UPFs may contribute to weight gain in children, especially in the latest decades as these types of foods have become more popular (Neri et al., 2022). One of the biggest jumps in UPF consumption came from ready-to-heat and-eat dishes, which accounted for about 11% of daily calories in 2018, compared with 2% in 1999 (NIH, 2021). A recent multicountry study (i.e., Argentina, Brazil, Chile, Colombia, Mexico, the United Kingdom, and United States). This suggests that childhood obesity is not only a US problem, but

it affects children globally. Critically, the one strong common variable across countries was increased UPFs consumption. Although culture and lifestyle are different in these countries, UPFs still have the same altering processes, ingredients, and components. The dietary share of UPFs or their relative contribution to total energy intake as the main exposure of interest while exploring the prevalence of childhood obesity was shown to be a robust indicator of the overall quality of the different national diets (Neri et al., 2022).

UPFs typically include various additives and tend to be more energy-dense and nutritionally poorer (e.g., high in levels of sugar, saturated fats, and salt but low in levels of protein, dietary fiber, and micronutrients) compared with less processed alternatives (Chang et al., 2021). A number of studies have reported an association between adult obesity and UPFs consumption, with a positive association between increased weight among those who had higher UPFs consumption (Askari et al., 2020). Although there is limited literature concerning the association between higher consumption of UPFs and elevated risks for obesity among children. There are some emerging studies exploring how childhood obesity can be affected due to UPFs consumption. A reference to this, is a cohort study conducted in British children assessing consumption of UPF where the findings suggested that higher consumption of UPFs in childhood is associated with more rapid progression of weight, BMI, and waist circumference (Chang et al., 2021).

The prevalence of the combined categories of overweight and obesity among children from 1976-1980 was 15%. The prevalence from 2017-2018 for childhood overweight and obesity combined increased to 35% (Fryar et al., 2021). The prevalence of childhood overweight/obesity in children under 18 years has more than doubled. In 2018 there were approximately 73.4 million children under 18 years of age in the United States and in 1980 there

were approximately 63.7 million children under the age of 18 (U.S. Census Bureau, n.d.). Although the children's population has grown by a little more than 10 million when comparing overweight/obesity prevalence of 15% in 1980 with the 35% in 2018, we are able to see how childhood overweight/obesity prevalence has grown excessively over the years. The consumption of UPFs, such as sugary ready-to-eat cereals, soft drinks, sweets, and others, has been linked to body fat among children (Costa et al., 2018).

During the 1970s some policies were shifted. Previously, Farm Bills paid agricultural producers to protect their farm land and leave a part unplanted to prevent overproduction and maintain crop prices high enough for farmers to make a living. The new policies shifted to rewarding farmers for producing as much food as possible and the calories available in the food supply per capita produced domestically, plus imports, less exports rose from about 3200 per day to 4000 which is roughly twice the amount of what a normal person needs a day (Nestle, 2022). Due to such a large amount of food production, companies had to expand their sales. Provoking a new sales strategy, they had to sell 4000 calories a day per capita. To make this happen new products came into play, snacking was promoted, and fast-food outlets multiplied and portion sizes increased (Nestle, 2022). The policy shift may not be the only factor leading to the childhood overweight/obesity epidemic, but it could have contributed to the normalizing of oversized food portions and snacking on UPFs products like packed cookies, pop tarts, and chips. The ultimate goal of the food industry is to increase sales, and UPFs have probably been their most valuable discovery, because UPFs are cheap to make and therefore profitable, addictive, and have a long shelf life. Minority groups, low socioeconomic groups, and children

2.3 Disparities and Hispanic childhood overweight/obesity

The potential link known between socioeconomic status and race/ethnicity could be contributing in different ways to the US Hispanic childhood obesity epidemic. UPFs have become a cheap food option and are widely available in all types of neighborhoods. Limited attention has been given to small to medium-sized Hispanic/Latin stores known as "tiendas". Many of the literature found about tiendas take place in California where most of the Hispanics are of Mexican origin (Sanchez-Flack et al., 2016). A study assessing the difference and availability of produce in 10 tiendas and 15 supermarkets concluded that there was no significant difference between accessing fresh fruits and vegetables between supermarkets and tiendas. They found supermarkets to have more options as far as low-fat alternatives for whole milk, lean ground meat, and fiber products such as whole grain bread (Emond et al., 2012). Tiendas tend to have more Mexican produce compared to other Hispanic foods (Sanchez-Flack et al., 2016). Also, most tiendas are smaller in size when compared with supermarkets, but larger than convenience stores, and mostly independently owned (Emond et al., 2012). This could influence on the quantity or variability of food groups available in tiendas. On the other hand, a study in New York assessing a Hispanic neighborhood food resource where the main Hispanic population was of Puerto Rican origin. There were 0 supermarkets, none farm produce stores, and 4 grocery stores (tiendas) in the Hispanic neighborhood studied. In the non-Hispanic neighborhood there were 4 supermarkets, 2 farm produce stores, and 1 grocery store. In most of the Hispanic stores, fruits and vegetables were dark green or orange colored. Although fruits and vegetables were available in Hispanic stores, prices were generally higher than prices at non-Hispanic neighborhood supermarkets. High fiber bread was available in 1 Hispanic store and in 7 of the non-Hispanic neighborhood stores. Lastly, all 13 stores in the Hispanic neighborhood accepted

SNAP or WIC. In the non-Hispanic neighborhood 8 out of 19 stores accepted one of the two food assistance programs mentioned (Lopez-Class & Hosler, 2010). It is difficult to understand the level of disparities of all Hispanic neighborhoods as they can be different. States in the US have different Hispanic origin populations which can make it challenging to approach disparities in underserved Hispanic neighborhoods. Leading to a delayed situation where more studies are needed in order to understand how to approach the Hispanic childhood obesity epidemic from the healthy food availability perspective. Fruits and vegetables are main ingredients of traditional Hispanic cuisine. Hispanics with limited income might be challenged to maintain their dietary habits and adopt a more UPFs diet which is characterized as high in empty calories and low in fiber (Lopez-Class & Hosler, 2010).

Chapter II: Methods and Procedures

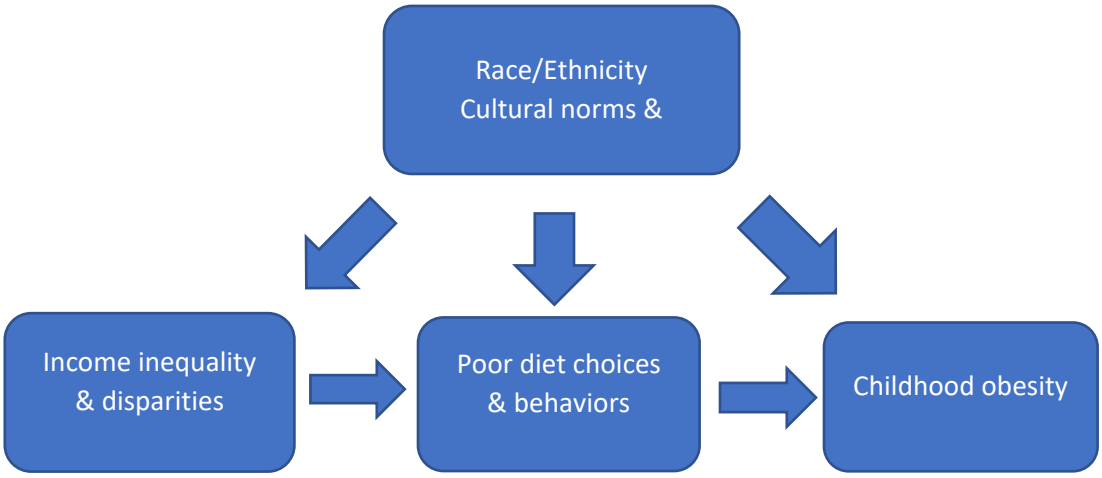

Figure 1. Directed Acyclic Graph (DAG) for Hispanic childhood obesity caused by race/ethnicity disparities

3.1 Data origin

This secondary data analysis was done using the 2017 – 2018 National Health and Nutrition Examination Survey (NHANES) surveys. The NHANES is a unique survey in that it combines interviews and physical examinations. It is a cross-sectional program of studies designed to assess the health and nutritional status of adults and children in the US. It is conducted with non-institutionalized participants across the country and is a major program of the National Center for Health Statistics (NCHS) which is part of the Centers for Disease Control and Prevention (CDC). The NHANES program began in the early 1960s and conducts diverse surveys that focus on different population groups and health topics. Since 1999 the survey has become continuous and focuses on emerging needs. The NHANES conducts surveys and exams on a nationally representative sample of about 5,000 persons each year. People who are part of the sample are located in counties across US. The surveys' focus is to obtain information related

to demographics, socioeconomic status, dietary behaviors, and other health related conditions (CDC, 2022).

3.2 Study Sample

For the purpose of this study the sample only included children aged 9 – 15 years old. A subset was obtained from the dataset NHANES 2017-2018 surveys. A total of 392 children in that age range who had no missing information in the survey were included. They were either Hispanic or NH-White. The Mexican-American and Other Hispanic categories were merged to create one. Hispanic sample size is 167. This sample consists of 77 males and 90 females, whereas the sample size for NH-Whites is 225 with 114 males and 111 females (reference group). A total of 7 variables (participant identification number, BMI, gender, race/ethnicity, age, income level, number of meals from fast-food or pizza place, and number of meals not home prepared) were selected from the NHANES 2017 – 2018 surveys.

In the case of this sample retrieved form the NHANES 2017 – 2018 dataset site. No IRB approval is required due to its origin. The Institutional Review Board at Georgia State University has determined that the NHANES datasets are not a designated human subject research.

3.3 Statistical Analysis

The analyses for the current study were done using the SAS software, version 9.4. Provided by Georgia State University to students. Firstly, the dependent variable (BMI) was selected, which in the case of children, it is age- and sex-specific, referred to as BMI-for-age. This variable is in the datafile labeled DEMO_J in the NHANES 2017 – 2018 dataset. Then independent variables were selected (race/ethnicity, socioeconomic status, number of meals from fast food or pizza place, number of meals not home prepared, gender, and age) were also retrieved from three different datafiles DEMO_J Doc, body measures datafile labeled BMX_J

Doc, and diet behavior and nutrition datafile labeled DBQ_J Doc. All these files were downloaded from the NHANES website which are compatible with SAS and ready to download. After importing datasets into the SAS software all three datafiles were merged into one dataset and then sorted by the variable participant's identification number (SEQN). Additional variables had to be created such as the BMI-for-age for each specific age and gender of children, since the values for the percentiles to define underweight, healthy weight, overweight, and obese differ in each of the age years being studied here. Appendix 1 shows the specific percentile values to identify these categories.

The frequencies of the variables mentioned above were calculated using the PROC FREQ procedure for the categorical variables. Similarly, the PROC UNIVARIATE procedure was used to quantify the different continuous variables. The measurement of association used was multivariate regression analysis. This analysis allowed to identify the strength of association between the dependent variable (BMI) and the independent variables (race/ethnicity, socioeconomic status, number of meals from fast food or pizza place, number of meals not home prepared, gender, and age). This was done using the PROC REG procedure in SAS software.

Chapter IV: Results

4.1 Descriptives

For this analysis, a sample of 392 children was used. The Mexican American and other Hispanic categories of the variable race/ethnicity (RIDRETH1) from NHANES dataset were combined to create one category named Hispanics. There were 167 Hispanics of which 77 were males and 90 were females. In addition, there were 225 non-Hispanic Whites of which 114 were males and 111 were females. Eligible children had to be between the ages 9 – 15, either Hispanic or Non-Hispanic Whites, and have no missing data in the questionnaires or exams. Income levels were low income ($0 - $44,999) with 175 observations 82 Hispanic and 93 Non-Hispanic White, Median Income ($45,000 – 74,999) with 87 observations, 45 Hispanic and 42 Non-Hispanic, and High Income ($75,000 +) with 130, 40 Hispanic and 90 Non-Hispanic White. The average BMI for males was M=26.3 with a standard deviation of (SD=7.5), and the average BMI for females was M=26.2 with a standard deviation of (SD= 7.1). Descriptives and frequencies are shown in table 1. Below.

Table 1.

Sample Characteristics		*N*	*Percent*
Gender			
	Male	191	48.7%
	Female	201	51.3%
Race/Ethnicity			
	Hispanic (MA & other Hispanics)	167	42.6%
	NH-White	225	57.4%
Age			
	9	72	18.4%
	10	69	17.6%
	11	71	18.1%
	12	43	11.0%
	13	48	12.2%
	14	53	13.5%
	15	36	9.2%
Income Level			
	Low Income (0-$44,999)	**175**	**44.6%**
	Hispanic	82	
	NH-White	93	
	Median Income ($45,000-$74,999)	**87**	**22.2%**
	Hispanic	45	
	NH-White	42	
	High Income ($75,000 +)	**130**	**33.2%**
	Hispanic	40	
	NH-White	90	
Number of meals not home prepared			
	1 – 4	346	88.3
	5 – 8	33	8.4%
	9 – 12	9	2.3%
	13 +	4	1%
Number of meals from fast food or pizza place			
	0	59	15.1%
	1 - 3	296	75.5%
	4 - 6	32	8.2%
	7+	5	1.2%
BMI	**9-15 yrs.**	**M, (SD)**	
	Males	**26.3, (7.5)**	
	Hispanic	26.7, (7.9)	
	NH-White	26.1, (7.3)	
	Females	**27, (8.3)**	
	Hispanic	27.9, (9.5)	
	NH-White	26.2, (7.1)	

4.2 Frequencies and Percentiles

The BMI by age-sex for Hispanic males, Hispanic females, Non-Hispanic White males and females were gathered to have a better understanding of the differences between gender, race, and age. Since BMI by age-sex is very specific for each year, the total averages for each year of age (9 – 15) were computed using SAS 9.4. PROC FREQ, PROC MEANS, and PROC PRINT were used in order to produce the numbers for BMI by age-sex for each category. Table 2 shows BMI averages and standard deviations for Hispanic females and males according to their age. All of the averages of BMI by age-sex in Hispanic females and males turned out to be higher than the 85th percentile value according to the CDC to be the cutoff point for childhood overweight. If the BMI by age-sex of a child is between the 85th percentile and 95th percentile values given by the CDC, the child is considered to be overweight. When a child's BMI by age-sex value is above the 95th percentile value assigned by the CDC, then the child is considered obese. The averages of BMI by age-sex at almost all ages in Hispanics were above the 95th percentile BMI by age-sex values assigned by the CDC (CDC, 2022). Appendices 1 & 2 can show the BMI by age-sex specific values. The percentile ranges for underweight, healthy weight, overweight and obesity created by the CDC are shown in Appendix 3. The different values of BMI by age-sex for Non-Hispanic White females and males from ages 9 – 15 years are presented in table 3. Similarly, the averages of BMI by age-sex were well above the 85th percentile values provided by the CDC. In the Non-Hispanic White averages for BMI by age-sex for ages 12, 13, and 14 years, values under the 95th percentile for obesity were slightly below the cutoff point for obesity.

Table 2. Hispanic children BMI by age-sex. Age 9-15 years from NHANES dataset 2017-2018

Age (%)	Females (N)	Males (N)	Females BMI M, (SD)	Males BMI M, (SD)	Female BMI (Min – Max)	Male BMI (Min – Max)
9 (19.2%)	17	15	26.6 (11.4)	25.9, (7.2)	14.3 – 57.4	15.6 – 38.1
10 (18.6%)	16	15	29.4, (9.8)	27.5, (8.5)	15.1 – 47.6	13.6 – 44.3
11 (21.6%)	19	17	25.8, (7.6)	23.1, (6.4)	14.0 – 44.8	14.8 – 34.9
12 (10.8%)	9	9	31.5, (14.6)	27.0, (5.0)	16.4 – 66.2	20.9 – 35.3
13 (10.2%)	13	4	27.8, (8.2)	27.4, (12.3)	13.3 – 44.5	15.9 – 40.4
14 (11.2%)	9	10	27.9, (8.6)	32.4, (10.5)	16.6 – 44.6	16.6 – 56.5
15 (8.4%)	7	7	28.4, (4.7)	26.7, (4.9)	21 – 32.8	18.6 – 33.0
Totals	90	77	27.9, (9.5)	26.7, (7.9)	13.3 – 66.2	13.6 – 56.5

Table 3. Non-Hispanic White children BMI by age-sex. Age 9-15 years from NHANES dataset 2017-2018

Age (%)	Females (N)	Males (N)	Females BMI M, (SD)	Males BMI M, (SD)	Female BMI (Min – Max)	Male BMI (Min – Max)
9 (17.8%)	16	24	24.3, (7.4)	26.8 (6.9)	15.7 – 38.9	15.6 – 37.6
10 (16.9%)	23	15	27.2, (10.2)	27.6, (11.4)	14.2 – 58.8	15.4 – 53.5
11 (15.6%)	20	15	25.2, (5.9)	25.3, (7.4)	16.1 – 43.0	15.6 – 37.1
12 (11.1%)	12	13	27.3, (5.4)	24.7, (4.5)	16.8 – 34.3	15.8 – 31.8
13 (13.8%)	17	14	24.7, (5.3)	24.2, (6.0)	13.9 – 31.8	17.1 – 38.5
14 (15.1%)	14	20	26.9, (6.7)	25.8, (7.2)	16.3 – 38.8	13.5 – 42.7
15 (9.8%)	9	13	29.3, (3.8)	27.5, (6.2)	24.1 – 34.5	16.0 – 38.2
Totals	111	114	26.2, (9.5)	26.1, (7.3)	13.9 – 58.8	13.5 – 53.5

Tables 4 & 5 show the percentiles obtained from the children's sample for BMI by age-sex for Hispanic males, Hispanic females, Non-Hispanic White males and females. The percentiles give a sense of the amount or percentage of the sample having certain values for BMI by age-sex values. The 50^{th} percentile and 95^{th} percentile values were retrieved to show the means of BMI by age-sex of children. The 50^{th} percentiles for all

categories in the samples had BMI by age-sex values for overweight/obesity. This implies that at least 50% of the sample used for this study had a BMI by age-sex value that fell in the categories of overweight or obese according to the CDC's value guidelines. Meanwhile all of the 95^{th} percentile values obtained for each of the categories (race, age, sex) are well above the obesity cutoff value.

Table 4. Percentiles for BMI by age-sex, ages 9-15 years in Hispanic children. NHANES dataset 2017-2018

Age (%)	Females BMI 50% quantiles (Median)	Males BMI 50 % quantiles (Median)	Females BMI 95% quantiles	Males BMI 95% quantiles
9 (19.2%)	26.1	28.5	57.4	38.1
10 (18.6%)	27.9	25.9	47.6	44.3
11 (21.6%)	25.2	24.1	44.8	34.9
12 (10.8%)	28.2	25.9	66.2	35.3
13 (10.2%)	28.2	26.6	44.5	40.4
14 (11.2%)	26.2	31.7	44.6	56.5
15 (8.4%)	30.2	26.4	32.8	33.0
Totals	26.8	26.4	44.8	40.4

Table 5. Percentiles for BMI by age-sex, ages 9-15 years in NH-White children. NHANES dataset 2017-2018

Age (%)	Females BMI 50% quantiles (Median)	Males BMI 50 % quantiles (Median)	Females BMI 95% quantiles	Males BMI 95% quantiles
9 (17.8%)	22.7	26.2	38.9	35.8
10 (16.9%)	27.3	25.6	43.7	53.5
11 (15.6%)	24.0	23.4	37.8	37.1
12 (11.1%)	28.0	25.3	34.3	31.8
13 (13.8%)	26.2	22.7	31.8	38.5
14 (15.1%)	25.0	25.9	38.8	42.6
15 (9.8%)	28.4	25.3	34.5	38.2
Totals	26.1	25.3	37.4	38.5

4.3 Relationship Analysis

To test the relationship between BMI by age-sex in the 392-sample chosen for this study, multivariate regression was used. The procedure PROC REG was used to gather the P-values of each variable in relation to BMI values. The dependent variable BMI by age-sex (BMXBMI) was tested with the independent variables (race/ethnicity (RIDRETH1), number of meals not home prepared (DBD895), number of meals from fast food or pizza place (DBD900), and income level (INDHHIN2) were computed in a multivariate regression model. The p-values for the coefficients are as follows: RIDRETH1 (P-value 0.13), DBD895 (P-value 0.43), DBD900 (P-value 0.97), INDHHN2 (P-value 0.24). The P-values were not statistically significant therefore we fail to reject the null hypothesis (independent variables are not useful to predict the dependent variable). In other words, we fail to conclude that BMI is influenced by race/ethnicity, UPFs consumption or number of fast food or pizza consumed, and income level in the children sample used in this study obtained from the NHANES 2017 – 2018.

Table 6. Reduced multivariate regression model on BMXBMI

Parameter estimates

VARIABLE	LABEL	PARAMETER ESTIMATE	STANDARD ERROR	t-VALUE	Pr>[t]
INTERCEPT	Intercept	25.64165	2.93826	8.73	<.0001
DBD895	#of meals not home prepared	-0.15702	0.19944	-0.79	0.4316
DBD900	# of meals from fast food or pizza place	-0.01375	0.32219	-0.04	0.9660
RIDRETH1	Race/Hispanic origin	-0.68536	0.45719	-1.50	0.1347
INDHHIN2	Annual Household income	-0.11386	0.09609	-1.19	0.2367

Chapter V: Discussion

5.1 Summary of results

The aim of this study was to identify if modern diet tendencies could be associated with the Hispanic childhood obesity epidemic in the US, and to determine the presence of racial/ethnic and income levels disparities in that association. As mentioned before a sample of 392 children was obtained from the nationwide cross-sectional survey NHANES 2017 – 2018. A comparison or reference race was also part of the sample and it was Non-Hispanic Whites. In the statistical analysis results did not show significant difference between the different race/ethnicity, UPFs consumption, or income level.

The sample had more non-Hispanic White children with a 57.4% and a 42.6% for Hispanic children. We were able to observe more than double the number of non-Hispanic White children who fell into the high-income category compared to Hispanic children. The majority of children had between 1 – 4 meals within the last 30 days not home prepared or from fast food or pizza place and they had high BMI for age-sex values. Which could indicate some type of relationship between BMI for age-sex, but this could be better studied with the same number of children in the other categories of higher number of meals not home prepared or from fast food or pizza place as there was a small number of children in the higher consumption levels. If the same number of children could be in low and high levels of UPFs consumption then there could be a more clearly comparison between levels of BMI and UPFs consumption. Lastly, the multivariate regression procedure results obtained were not statistically significant the P-values were above the 0.05 significance.

5.2 Strengths and Limitations

The strengths of this study include easy access to the datasets available from the NHANES website. These datasets are ready to work with SAS and other statistical software. Also, it is a randomized, non-biased sample.

Limitations of this study are the fact that secondary data was used, and the use of parametric analyses on non-parametric data was likely. The eligible sample had a large number of children who had 1 – 4 meals from fast food pizza places and a small number of children who reported eating more than 4 meals from fast food or pizza places. This could have caused the little prediction for association in the analysis since there was a smaller number of children to compare in the different levels of consumption of fast food or pizza places. There is also a lack of UPFs variable options to choose from the secondary datasets and no specific UPFs variables to the Hispanic diet. Therefore, many UPFs were not included in the study as they were not part of the NHANES survey questions. Due to the small sample size and the nature of how it was collected it cannot be assumed to be generalizable to Hispanic children in the US.

5.3 Future Implications

Although this study did not obtain a strong association between UPFs and Hispanic childhood obesity, socioeconomic disparities, and race/ethnicity, it could be relevant to point that misleading results might be obtained due to small Hispanic samples or survey structures. Surveys could be adapted to be more culturally competent, and include UPFs consumed by Hispanic children. The Hispanic childhood obesity association between diet tendencies and obesity are relatively poor understood (Lin et al., 2003). Hispanic parents could influence in the younger generations to eat traditional foods from their culture, but the ingredients used are bought here in the US. Which could be more processed than they would be

in the native countries. Additionally, this study shows how even though the NHANES oversamples older people and Hispanics, the sample can still be underrepresented due to various situations. For example, the fact that there are different subgroups of Hispanics. This study could be a way to identify the need for more generalizable surveys made culturally competent for the different Hispanic subgroups. The Hispanic childhood obesity epidemic could benefit if approached with the ecological model method. Different levels such as public policy, community, organizational, interpersonal, and individual can help as they are interrelated which could create a domino effect from the higher levels to the individual level.

5.4 Conclusion

In conclusion, the results of this study did not support the hypothesis, which implied certain effects between UPFs or modern diet tendencies in Hispanic children and the rising obesity epidemic in this minority in the US. With the P-values from the multivariate regression procedure we are unable to reject the null hypothesis or draw any conclusions on the differences in disparities between Non-Hispanic White childhood obesity and Hispanic childhood obesity. However, a high number of Hispanic children fell under the obese category when compared with Non-Hispanic White children. There is still a need of more focused studies to try and understand what type of UPFs Hispanic children are eating and how they could be affecting their body in terms of adiposity levels.

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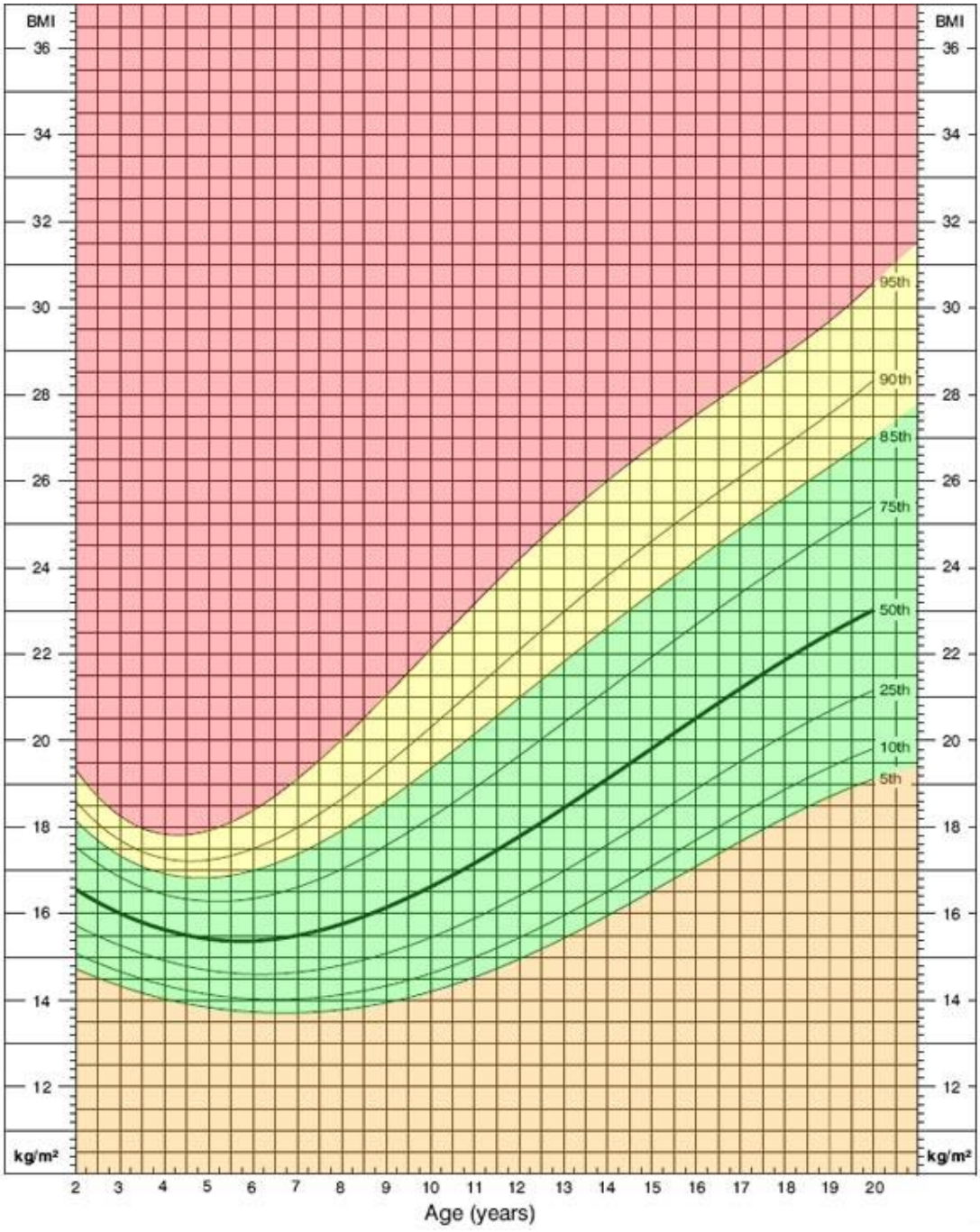
APPENDIX

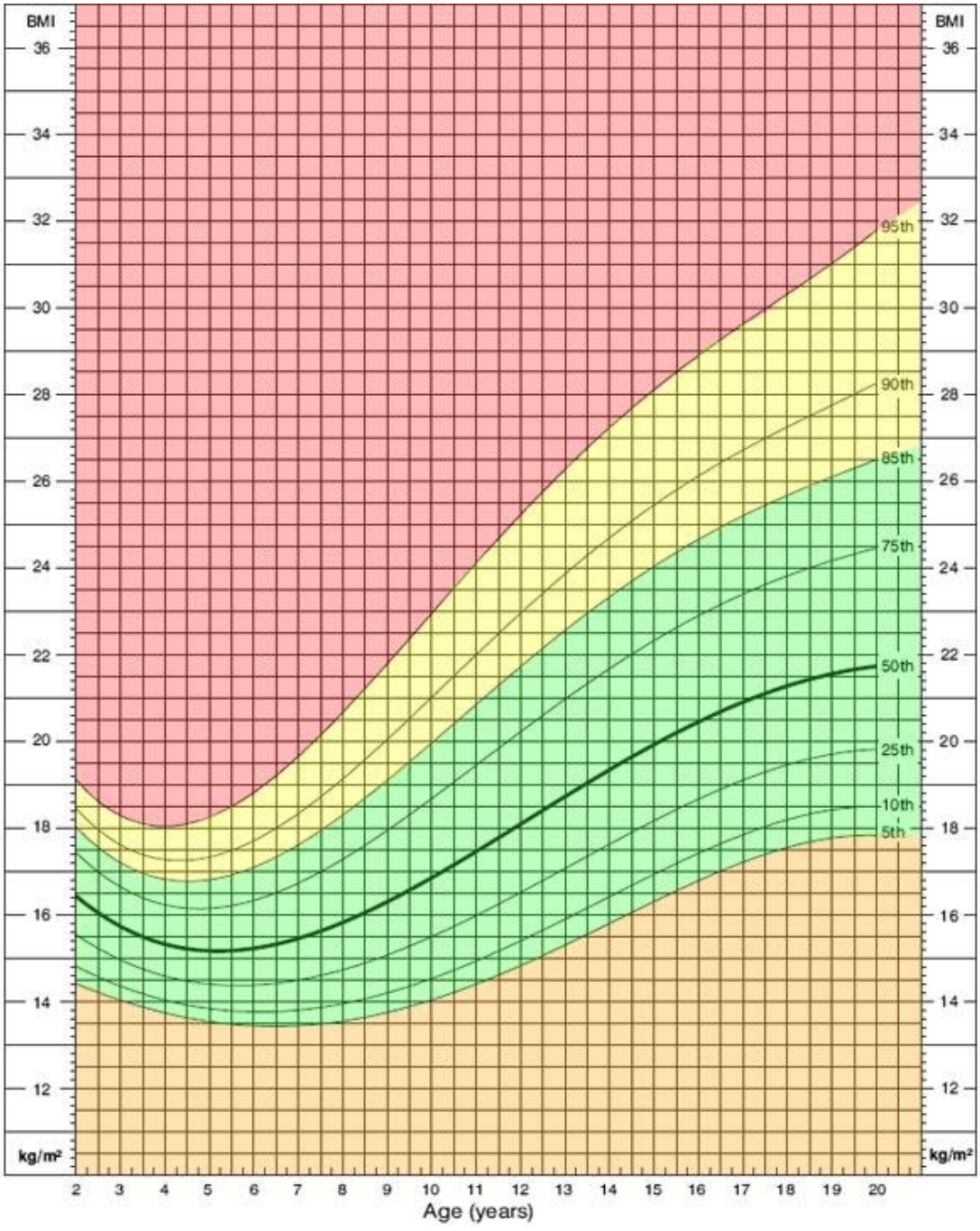
Appendix 1

Growth Chart for Boys



Appendix 2

Growth Chart for Girls



Appendix 3

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obesity	Equal to or greater than the 95th percentile

BMI-for-age weight status categories and the corresponding percentiles