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Acculturation and the potential impact on Obesity levels in first and second generation Immigrant children in the United States: A systematic Review

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2021

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Abstract

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By Annette Quansah

Acculturation is a process in which immigrants adopt the behaviors and habits of the host country.[1] Acculturation has an association with obesity in first- and second-generation immigrant children in the United States.[2] It is important to understand the association between acculturation and obesity because obesity is linked to adverse outcomes such as cardiovascular diseases, diabetes, musculoskeletal disorders, and cancer.[2] It is imperative to understand this association between acculturation and obesity in immigrant children because they are susceptible to developing obesity as duration in the United States increases.[3] This systematic review sought to examine the association between acculturation and obesity in first- and second-generation immigrant children in the United States using the protocol guided by the Preferred Reporting Systematic Reviews and Meta-Analyses (PRISMA).[4] Articles were identified through four search engines, Google scholar, NIH PubMed, NIH PMC, and Galileo and screened through Covidence. Studies included had to be conducted in children living in the United States and have measures of acculturation and weight status. 34 studies met the criteria and were assessed in this systematic review. 85% of studies were on Latino and or Hispanic children, 32% were on Asian children, 26% were on White children and 21% of the studies included Black children. Inverse associations between acculturation and obesity were found in 20 of the studies across all ethnic and or racial groups. 13 of the 29 studies including Latino and or Hispanic children, 5 of the 11 studies including Asian children, and 2 of the 7 studies including Black and or African had an inverse association between acculturation and obesity. Positive associations between acculturation and obesity were also found in 12 of the studies across all the ethnic and or racial groups. The unclear association between acculturation and obesity across studies may have been due to the differing acculturative measures. Some studies, primarily on Latino and or Hispanic children, while focused on the same racial and ethnic group had differing measures of acculturation. We therefore recommend using a standardized measure of acculturation that is built on a holistic framework and can be tailored to specific ethnic and racial groups.

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Thank you to my family and friends for guiding, supporting, and uplifting me throughout this thesis writing process. Therefore, I dedicate this thesis to my mother, sister, and best friend. Lastly, thank you to my thesis advisor, I genuinely appreciate her guidance and efforts throughout this writing process.

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Chapter 1: Introduction

Obesity amongst children in the United States has increased and immigration may be contributing to its rise. As of 2021, 18 million children in the United States are children of immigrants; comprising 26 % of all children.[5] Furthermore roughly one in six youth are obese with 17% of them being between the ages of 10 and 17.[6] In 2017, US immigrants under 18 were only 2.9% of the population while US adult immigrants were 45.3% of the population.[7] Children ages 2 to 19 most affected by obesity come from minority backgrounds with Hispanic children having an obesity prevalence of 26.2% and non-Hispanic Black children having an obesity prevalence of 24.8% as compared to their non-Hispanic white peers with an obesity prevalence of 16.6%.[8] Additionally, the prevalence of obesity in the United States is currently at 19.7%.[8] The number of children with obesity is also high, at 14.7 million.[8] In 2017, the prevalence of foreign-born individuals reached 13.6% of the total US population.[8] Furthermore, the number of children who are from immigrant families has increased since the 1990's, with 23% of U.S children being second generation in 2019.[9]

Acculturation is defined as a process where people, primarily immigrants, learn and incorporate the values, beliefs, language, customs, and mannerisms of a new country.[10] This can include behaviors that affect health such as dietary habit, activity levels and substance use.[10] Acculturation is measured by maternal nativity, nativity, generational status, duration in country, language use, proficiency or primary language spoken at home, acculturative stress, socialization and overall acculturation level. Evidence indicates an association between obesity and acculturation or parental acculturation amongst children of immigrants in the United States.[11,12] A study by McLeod noted an association between acculturation and obesity.[13] The study supported the lack of consensus as to this association which leaves room for speculation as to the

relationship between acculturation and obesity prevalence in first- and second-generation immigrant children.[13] Coincidingly, a study by Mendoza et al, assessed health disparities in children of immigrant families.[14] The study identified that the relationship between acculturation and obesity may intensify with time.[14] For example, the study found that immigrants who lived in the United States for longer than 15 years had a 4 fold increase in the chance of developing obesity compared to immigrants who resided for a less amount of time.[14] Given that immigrant children may spend a longer duration of their lifetime in the United States, the study of the association between acculturation and obesity in children can shed light on the specific behaviors and practices that may be adopted by first and second-generation immigrant children as their length of residence increases. Knowing what behaviors or influences are undertaken by this population during the acculturative process and how it contributes to obesity can then in turn influence appropriate interventions.

Problem statement: The lack of understanding in the associations between acculturation and obesity in migrant children is a problem because acculturation affects health behaviors that may influence weight in a positive or negative manner. There is a lack of knowledge about the association between acculturation and obesity in children. Understanding this association is important because as obesity is found to be associated with a longer duration of time in immigrants, the role of acculturation on obesity may be even more impactful on children who have a longer duration of exposure.

Purpose statement: This systematic review is intended as a scope of the existing literature to assess the association between acculturation and obesity in first- and second-generation immigrant children in the United States.

Research question: What is the association between acculturation on obesity in first- and second-generation immigrant children in the United States?

Significance Statement: Outcomes assessed in this systematic review can help researchers and practitioners understand the relationship between acculturation and obesity amongst first- and second-generation immigrant children in the United States. This would allow for a better understanding of how to assess the possible health risks immigrants face from migration and better serve these populations and improve preventive care.

Chapter 2: Comprehensive Review of the Literature

Acculturation has been associated with obesity in adults. For example, a study by Delavari et al linked the adoption of obesogenic behaviors to the host culture immersion that occurs with duration in the United States.[15] Often times immigrants have lower rates of obesity in their home country and this trend changes once residing in the United States.[15,16] Therefore understanding why obesogenic behaviors emerge from the acculturative process is important to understand why obesity may increase upon migration and worsen over time.[16] Associations have also been found between age at immigration and obesity. A study by Kaushal et al assessing the adversities of acculturation, found that adults who were immigrants at an earlier age had an increased likelihood of becoming obese.[16] In particular, obesity levels were 200% higher for those residing in the United States for 1 to 5 years and 480% higher for those residing in the United States for 10 to 15 years compared to those who are natives to the United States.[16] However, this study was retrospective and did not assess participants at age of arrival to the United States to assess the longitudinal impact of the acculturative process on obesity. Given that age at arrival is strongly associated with the risk of obesity, and increased duration leads to obesogenic behaviors in adults, understanding the association between acculturation and obesity in children is pertinent.[16]

Although Kaushal et al findings were in support of the notion that age at arrival and duration in the United States that impact obesity in adults, it is unclear as to the implications of acculturation in the outcomes of obesity in children. Furthermore, it is not clear whether acculturation has any effect on first and or second-generation children of immigrants. Therefore, the role of acculturation is ambiguous and not widely represented in today's literature surrounding obesity in children. A better understanding of the association between acculturation

and health behaviors can aid in understanding why certain behaviors are adopted in first- or second-generation immigrants and how these behaviors influence health outcomes.

It is important to understand how acculturation impacts obesity in children as existing evidence points to a strong association between obesity and negative outcomes in children. A study by Fruh found obesity to have a range of long-term effects on children as they transition to adulthood.[17] In particular, obesity can impact metabolic, respiratory, cardiovascular, gastrointestinal, reproductive and mental health, and can increase the risk of cancer.[17] Furthermore, a systematic review by Pulgaron et al assessing childhood obesity globally, found that rates of metabolic syndrome were as high as 40.4% in obese German children, but no comparative rate was given for non-obese German children.[18] Metabolic syndrome can lead to impaired glucose tolerance and trigger the onset of diabetes mellitus, a potentially lifelong comorbidity that can diminish quality of life.[19] Furthermore, obesity can cause adverse outcomes psychologically and behaviorally.[20] Attention deficit hyperactivity disorder (ADHD) has been found to be 2 times more likely in obese children compared to healthy weight peers.[20] Additionally, while it is difficult to determine temporality between behavioral problems and obesity in children, overweight girls were found to have 81% greater odds of reported behavior problems than girls who were not overweight.[20] Given the association between obesity and long-term comorbidities in children globally it is important to understand the impact of acculturation and obesity in children as this may have long term consequences for their overall health. The consequences of childhood obesity are startling, and having a raised BMI is a risk factor for cardiovascular diseases, diabetes, musculoskeletal disorders, and cancer.[21] Obesity is also associated with premature death in adulthood and psychological effects.[21] This systematic review focuses on the association between acculturation and obesity in

first- and second-generation immigrant children in the United States. To my knowledge there is only one other systematic review, by McLeod et al, that has explicitly assessed this relationship in children.[22] We add to the literature by assessing this association regardless of ethnicity and or race of first- and second-generation immigrant children in the United States.

Chapter 3: Procedure and Methods

Methods

Introduction

The research conducted in this systematic review was to assess the association between acculturation and obesity in first- and second-generation immigrant children in the United States. A detailed methodology and analysis of the research is described below.

Search Strategy

The search was conducted between November 21st and December 13th, 2022, with the use of the search engines Google scholar, NIH PubMed, NIH PMC, and Galileo. Key terms related to acculturation and obesity in first- and second-generation immigrant children were then compiled. Articles were screened for use and if they included the key words in their title, abstract, or subject descriptions they were eligible. The key words screened for in the search string are as follows:

"Adolescents" + "Children" + "Obesity" + "Acculturation" + "Immigrant" + "Immigrants" + "Immigration" + "United States"

Study Selection

Title and abstract screening: The primary screening tool used to assess the articles found was Covidence. Articles were downloaded and then automatically screened for duplicates. A cross check of eliminated studies was done to ensure no articles were accidentally erased. Articles titles and abstracts that were left or assessed to be non-duplicates were then read by the author to ensure they met the inclusion criteria. Inclusion and exclusion criteria at this stage of the process are as follows:

Inclusion criteria that had to be met was that some populations must classify as under the age of 18 or classified as adolescents or children. Participants are first or second or third - generation immigrants. At least one outcome where participants were classified as overweight or obese or included body mass index. Articles in English. Articles based in the United States. An explicitly stated measure of acculturation included. Scholarly Peer-Reviewed Journals

Exclusion criteria that had to be met was that all populations are over the age of 18 and not specified as adolescent or child. All populations were classified as adults. Participants not classified as first or second or third generation immigrants. No outcome where participants were classified as overweight or obese or body mass index not included. No explicitly stated measure of acculturation. Articles not in English. Articles not based in the United States. Articles not Scholarly Peer-Reviewed Journals. Articles classified as a systematic review or literature review or scoping analysis or case study.

Additionally, the use of inclusion terms in Covidence was added to ensure that the articles screened in the title and abstract portion were entirely relevant. Highlighted words in Covidence included: acculturation, obesity, immigrant, immigrants, immigration, migrant, United States, children, adolescents, adolescent, body mass index, BMI, obese, obesity, and overweight.

Full text review: Full texts of abstracts that made it through the abstract screening process were then reviewed and were accepted or rejected based on the same inclusion and exclusion criteria.

Population/ Participants: Participants in the studies reviewed had to be classified as a child, adolescent, or youth. Age parameters were not explicitly set as studies varied on an age range for adolescents. Participants also had to be considered a child/adolescent immigrant or

child/adolescent of an immigrant. If generational status as a first, second or third generation immigrant was included this would be indicative of that status.

Variables: Variables required in the studies reviewed were a measure of acculturation, overweight or obesity status or percentile or BMI of participants. Measure of acculturation had no set type because across the board acculturation varied. The only requirement was that acculturation was explicitly stated as a measurement and not alluded to. Specifically, there needed to be a cross examination of the two and analysis conducted of their correlation.

Outcome: The outcome had to be a positive, negative, or null association with acculturation to overweight or obesity status in first- and second-generation immigrant children in the United States. Preference was given to those that provided a quantitative outcome, but qualitative outcomes were also acceptable.

Study Design: Studies reviewed were primarily cross-sectional studies with some amount of cohort and longitudinal studies. Studies that were systematic reviews, case studies, ecological models or meta-analyses were excluded from the final pool but used as a comparison of findings in acculturation and obesity. Intervention based articles and book chapters were also excluded if they did not conduct research and were providing consultation.

Data extraction: Covidence was used to extract data from the studies. Extraction included the: title; author; year published; country; study design; number of participants; classification of participants; population description; aim of study; Inclusion & exclusion criteria; measure of acculturation; measure of obesity; qualitative & quantitative outcome (P-value, mean, percentage, beta coefficient, confidence interval, population count(n); measure of association between acculturation and obesity.

Quality Assessment: Studies garnered in the final extraction were assessed for quality and bias. This assessment was done using the NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.[23] This tool was chosen because it provides a comprehensive list of questions that are suitable for assessing risk of bias and quality in the extracted studies. All 34 studies were assessed using this tool to ensure synchronicity. The tool comprises of 14 questions that are as follows:[23]

1. Was the research question or objective in this paper clearly stated?[23]
2. Was the study population clearly specified and defined?[23]
3. Was the participation rate of eligible persons at least 50%?[23]
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?[23]
5. Was a sample size justification, power description, or variance and effect estimates provided?[23]
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?[23]
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?[23]
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?[23]
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?[23]

10. Was the exposure(s) assessed more than once over time?[23]

11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?[23]

12. Were the outcome assessors blinded to the exposure status of participants?[23]

13. Was loss to follow-up after baseline 20% or less?[23]

14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?[23]

Furthermore, determining quality and risk of bias will be done with a composite score. The score will have a maximum of 14 points and a minimum of 0. Questions will have three answer options of "yes," "no," or "not applicable." A point will be assigned to questions answered "yes," no point for questions answered "no," and questions answered "not applicable" will be null and not included in the maximum point calculation. A score of less than 7 points will deem the study as high risk of bias and low quality and a score of 8 or higher will deem the study as low risk of bias and high quality. However, in studies where the maximum points are reduced, if the study has a score that is 50% of the total score, it will be assessed as low risk of bias and high quality. A scoring system was not recommended by the creators of the NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies because a point system cannot give a true judgement of quality.[23] However, the point system is pertinent to this thesis because it gives an idea of what attributes each study has; therefore, we can assess its quality. Assessment of the results of the scoring is elaborated below and the result of the scoring follows in table 1 and table 2.

The results of the questionnaire led to equivalent results across all studies regardless of study type. Scores ranged from a low of 5 to a high of 11, with the total composite score varying

for studies due to some questions not being applicable. Questions that were uniformly not applicable for the studies were question number 12 and 13, with question 7 not being applicable to only two of the studies. Question 12 pertained to the blinding of outcome assessors which would not apply to the health and acculturative measures in the participants of the study. Question 13 assessed follow-up rate and the studies primarily took measures/exposures once for participants. Additionally, points were redacted for questions 6 and 7 for studies that were cross sectional as they generally provide weaker evidence than cohort studies for potential causal relationships and don't provide sufficient time to see an effect.[23] Question 6 assesses if the exposure or exposures of interest were measured prior to the outcomes.[23] Since cross-sectional studies usually measure both variables during the same period, the answer was no for cross-sectional studies that confirmed this, and a point was removed.[23] Question 7 assesses if there was a sufficient timeframe to see an effect.[23] Variables were measured succinctly, and analyses were not over a long period of time for the cross-sectional studies assessed. Therefore, a point was removed, if applicable as the results were instantaneous from cross analysis and not measured over time.

Table 1. Quality Assessment[23, 24-56]

Title	Author	1. Was the research question or objective in this paper clearly stated?	2. Was the study population clearly specified and defined?	3. Was the participation rate of eligible persons at least 50%?	4. Were all the subjects selecte\d or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	5. Was a sample size justification, power description, or variance and effect estimates provided?
Individual-, family-, and contextual-level variables do not explain the protective effect of parental nativity status on changes in 3–15-year-old children's BMI.	Acciai et al.	yes	yes	yes	yes	no
Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study.	Arandia et al.	yes	yes	yes	yes	no
Obesity and Obesogenic Behaviors in Asian American Children with Immigrant and US-Born Mothers.	Argueza et al.	yes	yes	yes	yes	no
Risk factors for overweight in five- to six-year-old Hispanic American children: A pilot study.	Ariza et al.	yes	yes	yes	yes	yes
Epidemiological Paradox or Immigrant Vulnerability? Obesity Among Young Children of Immigrants.	Baker E et al.	yes	yes	yes	yes	no
Maternal ratings of child health and child obesity, variations by mother's race/ethnicity and nativity.	Baker EH et al.	yes	yes	yes	yes	yes

The Association between Early Childhood Overweight and Maternal Factors.	Barroso et al.	yes	yes	yes	yes	no
Predictors of obesity in Latino children: acculturation as a moderator of the relationship between food insecurity and body mass index percentile.	Buscemi et al.	yes	yes	yes	yes	no
The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California.	Buttenheim et al.	yes	yes	yes	yes	yes
Early Adolescents' Psychosocial Adjustment and Weight Status Change: The Moderating Roles of Gender, Ethnicity, and Acculturation.	Chang et al.	yes	yes	yes	yes	no
The Association Between Family Meals and Early-Adolescents' Weight Status Change in the Context of Parental Discipline Practices: The Moderating Roles of Ethnicity and Acculturation.	Chang Y et al.	yes	yes	yes	yes	no
Healthy Living Behaviors Among Chinese American Preschool-Aged Children: Results of a Parent Survey.	Chomitz et al.	yes	yes	yes	yes	no
Family weight teasing, ethnicity, and acculturation: Associations with well-being among Latinx, Hmong, and Somali Adolescents.	Eisenberg et al.	yes	yes	yes	yes	no

Ethnicity and acculturation: do they predict weight status in a longitudinal study among Asian, Hispanic, and non-Hispanic White early adolescent females?	Fialkowski et al.	yes	yes	yes	yes	no
Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second-Generation Hmong Children.	Franzen-Castle et al.	yes	yes	yes	yes	no
Immigrant Neighborhood Concentration, Acculturation and Obesity Among Young Adults.	Ishizaw et al.	yes	yes	yes	yes	no
Generation and Acculturation Status Are Associated with Dietary Intake and Body Weight in Mexican American Adolescents.	Ji-Hong Liu et al.	yes	yes	yes	yes	yes
Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese American Children and Mothers.	Jyu-Lin Chen et al.	yes	yes	yes	yes	no
The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study /Study of Latino Youth (SOL Youth).	LeCroy et al.	yes	yes	yes	yes	no
Acculturation, physical activity, and obesity among Hispanic adolescents.	Liu et al.	yes	yes	yes	yes	yes

Measures of Acculturation and Relations to zBMI among Mexican-Origin Youth.	Loren et al.	yes	yes	yes	yes	no
Body Image, Assimilation, and Weight of Immigrant Adolescents in the United States: A Person-Centered Analysis.	McCullough et al.	yes	yes	yes	yes	no
Parent Perceptions of Child Weight Status in Mexican-Origin Immigrant Families: An Investigation of Acculturation, Stress, and Coping Factors	McLeod et al.	yes	yes	yes	yes	no
Investigating dietary acculturation and intake among US-born and Thailand/Laos-born Hmong American children aged 9-18 years.	Mulasi-Pokhriyal et al.	yes	yes	yes	yes	no
Adolescent obesity increases significantly in second and third generation U.S. immigrants: the National Longitudinal Study of Adolescent Health.	Popkin et al.	yes	yes	yes	yes	yes
Food Insecurity among Hispanic/Latino youth: Who is at risk and what are the health correlates?	Potochnick et al.	yes	yes	yes	yes	no
Obesity Risk in Children: The Role of Acculturation in the Feeding Practices and Styles of Low-Income Hispanic Families.	Power et al.	yes	yes	yes	yes	no
Acculturative stress and emotional eating in Latino adolescents.	Simmons et al.	yes	yes	yes	yes	no

Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status.	Singh et al.	yes	yes	no	yes	no
The influence of maternal acculturation on child body mass index at age 24 months.	Sussner et al.	yes	yes	yes	yes	no
Big boys and little girls: gender, acculturation, and weight among young children of immigrants.	Van Hook et al.	yes	yes	yes	yes	yes
Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children.	Villa-Caballero et al.	yes	yes	yes	yes	no
Growth status among low-income Mexican and Mexican American elementary school children.	Winham	yes	yes	yes	yes	yes
Acculturation, Dietary Practices and Risk for Childhood Obesity in an Ethnically Heterogeneous Population of Latino School Children in the San Francisco Bay Area.	Wojcicki et al.	yes	yes	yes	yes	yes

Title	Author	6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	10. Was the exposure(s) assessed more than once over time?
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Growth status among low-income Mexican and Mexican American elementary school children.	Winham	no	no	yes	yes	no
Acculturation, Dietary Practices and Risk for Childhood Obesity in an Ethnically Heterogeneous Population of Latino School Children in the San Francisco Bay Area.	Wojcicki et al.	no	no	yes	yes	no
		11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	**12. Were the outcome assessors blinded to the exposure status of participants?**	**13. Was loss to follow-up after baseline 20% or less?**	**14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?**	
Title	**Author**					

Individual-, family-, and contextual-level variables do not explain the protective effect of parental nativity status on changes in 3–15-year–old children's BMI.	Acciai et al.	yes	N/A	no	no
Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study.	Arandia et al.	yes	N/A	N/A	no
Obesity and Obesogenic Behaviors in Asian American Children with Immigrant and US-Born Mothers.	Argueza et al.	yes	N/A	N/A	no
Risk factors for overweight in five- to six-year-old Hispanic American children: A pilot study.	Ariza et al.	yes	N/A	N/A	no
Epidemiological Paradox or Immigrant Vulnerability? Obesity Among Young Children of Immigrants.	Baker E et al.	yes	N/A	N/A	no
Maternal ratings of child health and child obesity, variations by mother's race/ethnicity and nativity.	Baker EH et al.	yes	N/A	no	no
The Association between Early Childhood Overweight and Maternal Factors.	Barroso et al.	yes	N/A	N/A	no
Predictors of obesity in Latino children: acculturation as a moderator of the relationship between food insecurity and body mass index percentile.	Buscemi et al.	yes	N/A	N/A	no

The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California.	Buttenheim et al.	yes	N/A	N/A	no
Early Adolescents' Psychosocial Adjustment and Weight Status Change: The Moderating Roles of Gender, Ethnicity, and Acculturation.	Chang et al.	yes	N/A	N/A	no
The Association Between Family Meals and Early-Adolescents' Weight Status Change in the Context of Parental Discipline Practices: The Moderating Roles of Ethnicity and Acculturation.	Chang Y et al.	yes	N/A	N/A	no
Healthy Living Behaviors Among Chinese American Preschool-Aged Children: Results of a Parent Survey.	Chomitz et al.	yes	N/A	N/A	no
Family weight teasing, ethnicity, and acculturation: Associations with well-being among Latinx, Hmong, and Somali Adolescents.	Eisenberg et al.	yes	N/A	N	no
Ethnicity and acculturation: do they predict weight status in a longitudinal study among Asian, Hispanic, and non-Hispanic White early adolescent females?	Fialkowski et al.	yes	N/A	yes	no
Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second-Generation Hmong Children.	Franzen-Castle et al.	yes	N/A	N/A	no
Immigrant Neighborhood Concentration, Acculturation and Obesity Among Young Adults.	Ishizaw et al.	yes	N/A	N/A	no

Generation and Acculturation Status Are Associated with Dietary Intake and Body Weight in Mexican American Adolescents.	Ji-Hong Liu et al.	yes	N/A	N/A	no
Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese American Children and Mothers.	Jyu-Lin Chen et al.	yes	N/A	N/A	no
The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth).	LeCroy et al.	yes	N/A	yes	no
Acculturation, physical activity, and obesity among Hispanic adolescents.	Liu et al.	yes	N/A	N/A	no
Measures of Acculturation and Relations to zBMI among Mexican-Origin Youth.	Loren et al.	yes	N/A	N/A	no
Body Image, Assimilation, and Weight of Immigrant Adolescents in the United States: A Person-Centered Analysis.	McCullough et al.	yes	N/A	N/A	no
Parent Perceptions of Child Weight Status in Mexican-Origin Immigrant Families: An Investigation of Acculturation, Stress, and Coping Factors	McLeod et al.	yes	N/A	N/A	no

Investigating dietary acculturation and intake among US-born and Thailand/Laos-born Hmong American children aged 9-18 years.	Mulasi-Pokhriyal et al.	yes	N/A	N/A	no
Adolescent obesity increases significantly in second and third generation U.S. immigrants: the National Longitudinal Study of Adolescent Health.	Popkin et al.	yes	N/A	yes	yes
Food Insecurity among Hispanic/Latino youth: Who is at risk and what are the health correlates?	Potochnick et al.	yes	N/A	N/A	no
Obesity Risk in Children: The Role of Acculturation in the Feeding Practices and Styles of Low-Income Hispanic Families.	Power et al.	yes	N/A	N/A	no
Acculturative stress and emotional eating in Latino adolescents.	Simmons et al.	yes	N/A	N/A	no
Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status.	Singh et al.	yes	N/A	N/A	no
The influence of maternal acculturation on child body mass index at age 24 months.	Sussner et al.	yes	no	no	no
Big boys and little girls: gender, acculturation, and weight among young children of immigrants.	Van Hook et al.	yes	N/A	N/A	no

Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children.	Villa-Caballero et al.	yes	N/A	N/A	no
Growth status among low-income Mexican and Mexican American elementary school children.	Winham	yes	N/A	N/A	no
Acculturation, Dietary Practices and Risk for Childhood Obesity in an Ethnically Heterogeneous Population of Latino School Children in the San Francisco Bay Area.	Wojcicki et al.	yes	N/A	N/A	no

Table 2. Quality Assessment Scoring and Outcome[24-56]

Author	Score	Total	Rating	Note*
Acciai et al.	10.00	13.00	Low risk of bias, High quality	Question 12 not applicable, Maximum scoring adjusted to 13 points
Arandia et al.	9.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Argueza et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Ariza et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Baker E et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Baker EH et al.	11.00	13.00	Low risk of bias, High quality	Question 12 not applicable, Maximum scoring adjusted to 13 points
Barroso et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Buscemi et al.	9.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Buttenheim et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Chang et al.	9.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Chang Y et al.	10.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Chomitz et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Eisenberg et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Fialkowski et al.	11.00	13.00	Low risk of bias, High quality	Question 12 not applicable, Maximum scoring adjusted to 13 points
Franzen-Castle et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Ishizaw et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Ji-Hong Liu et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Jyu-Lin Chen et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
LeCroy et al.	9.00	13.00	Low risk of bias, High quality	Question 12 not applicable, Maximum scoring adjusted to 13 points
Liu et al.	10.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Loren et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
McCullough et al.	6.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points

McLeod et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Mulasi-Pokhriyal et al.	8.00	11.00	Low risk of bias, High quality	Question 7, 12 & 13 not applicable, Maximum scoring adjusted to 11 points
Popkin et al.	11.00	13.00	Low risk of bias, High quality	Question 12 not applicable, Maximum scoring adjusted to 13 points
Potochnick et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Power et al.	9.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Simmons et al.	7.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Singh et al.	5.00	11.00	Low risk of bias, High quality	Question 8, 12 & 13 not applicable, Maximum scoring adjusted to 11 points.
Sussner et al.	8.00	14.00	Low risk of bias, High quality	
Van Hook et al.	7.00	11.00	Low risk of bias, High quality	Question 7, 12 & 13 not applicable, Maximum scoring adjusted to 11 points
Villa-Caballero et al.	9.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Winham	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
Wojcicki et al.	8.00	12.00	Low risk of bias, High quality	Question 12 & 13 not applicable, Maximum scoring adjusted to 12 points
				*** Low risk of bias and high quality was determined if the score is 50% or above of the total possible points if a study had questions not applicable**

Screening results

The databases search rendered 3302 articles:

Galileo: n = 1976

NIH PMC: n = 691

Google Scholar: n = 619

NIH PubMed: n = 16

Covidence removed 1217 duplicates and 2084 articles remained for abstract title and screening. One reviewer conducted the abstract title and screening. 1876 studies were excluded due to the predetermined inclusion/exclusion criteria.

In total 207 full text studies were assessed for eligibility. Of these 34 articles met the criteria and were included in the systematic review. The reasons for excluding 173 full text articles are listed below.

Adult population: 44

No measure of acculturation: 42

No measure of Obesity, Overweight, BMI: 32

Systematic Review/Literature Review: 26

Wrong indication: 11

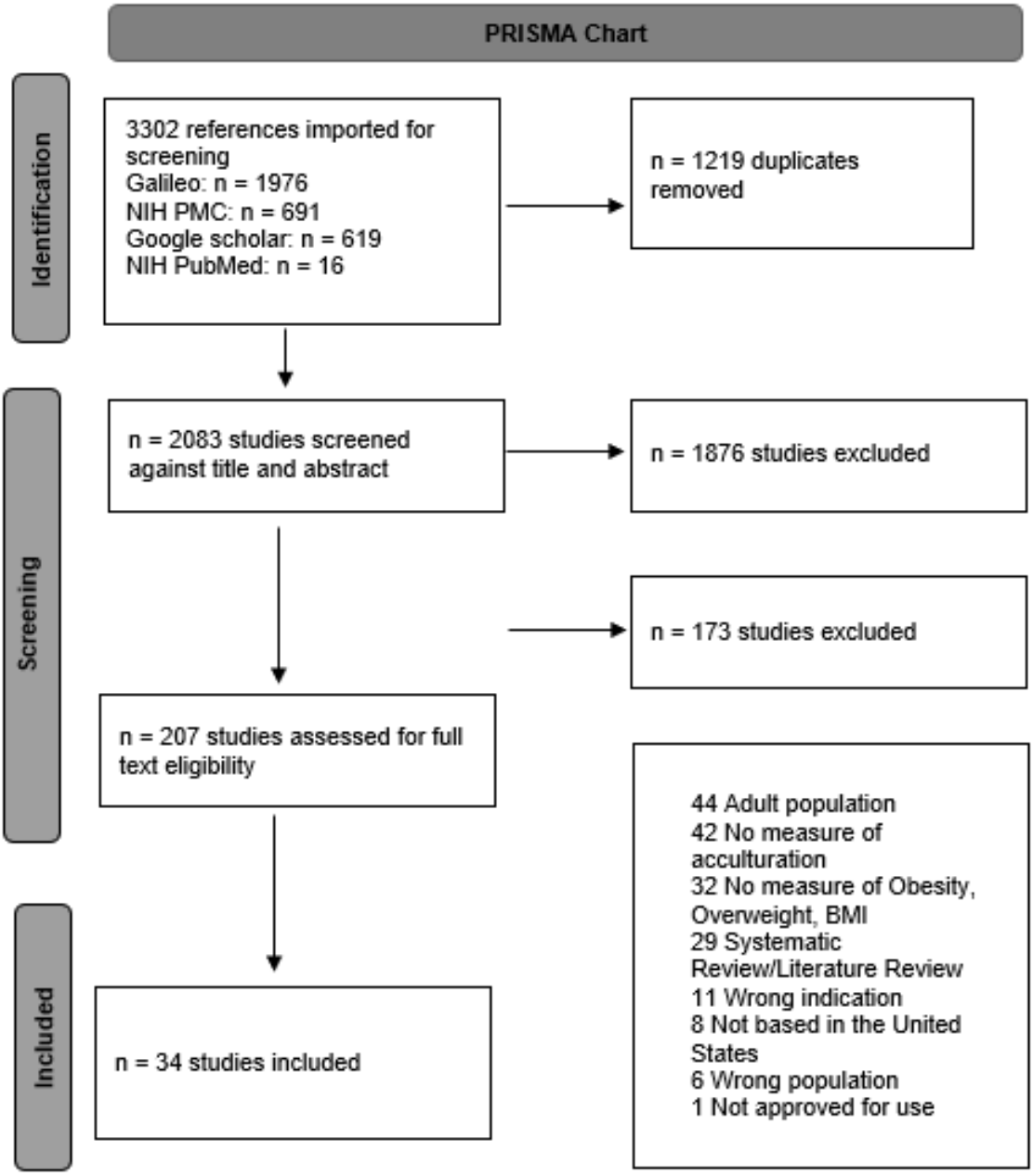
Not based in the United States: 8

Wrong population: 6

Not approved for use: 1

A PRISMA chart of the article screening process is provided in figure 1.[57]

Figure 1. PRISMA Chart[57]



Study characteristics

There were (n=34) studies that met the eligibility criteria. All studies, (n=34), were conducted in the United States and only one study (n=1) by Donna M. Winham et al had reference populations from another country.[58] The earliest study was conducted in 1998 by Barry M. Popkin et al, and the most recent study was in 2021 by Madison N LeCroy.[59,60] Studies varied in design with (n=25) studies being cross-sectional, and (n=9) studies being longitudinal. Detailed overview of measures and outcomes follows in Table 3.

Measures of Acculturation

There were several composite scales used to measure acculturation in populations with varying ethnic backgrounds. The Suinn-Lew Asian Self-Identity Acculturation scale, the Brief Acculturation Rating Scale for Mexican Americans (ARSMA-II), Marin's Short Acculturation Scale for Hispanics, the Social Attitudinal Familial and Acculturative stress scale for Children, the Acculturation Habits and Interests Multicultural Scale for Adolescents (AHIMSA), the Acculturative Stress Index and the Bidimensional Acculturation Scale (BAS) and the Acculturation Level Scale for Hmong.[61-71] These scales were identified in the literature and will be explored in Table 3.

Additional Primary Measures

Measure of weight status/health outcome was the primary variable that was assessed through BMI, weight, and or height. Socioeconomic status, education, disparities, physical activity, food insecurity, gender, maternal factors, dietary intake, ethnicity, and environment were secondary variables assessed in correlation to obesity. [24-56]

Table 3. Overview of studies[24-56]

Title	Author	Year Published	Country	Total number of participants	Aim of study	Measure of acculturation	Outcome
Individual-, family-, and contextual-level variables do not explain the protective effect of parental nativity status on changes in 3–15-year-old children's BMI.	Acciai et al.	2020	United States	363	Nativity status changes in BMI of second-generation children	Duration of stay in the United States - parental nativity status.	Second-generation children have healthier BMI trajectories than children of natives. OR of being in a higher BMI Z-score change category is 80% lower. Only 14% of second-generation children experience an increase in BMI score over time. "Interaction between parental nativity and race/ethnicity and zBMI: Non-Hispanic Blacks: OR-0.161, P-value-0.029 Hispanics: OR-0.074, P-value-0.000
Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study.	Arandia et al.	2018	United States	1298	Examined the relationship between acculturation, ethnic identity, and dietary quality in U.S. Hispanic/Latino youth.	AHIMSA Scale - Acculturation, Habits, and Interests Multicultural Scale for Adolescents. Acculturative Stress Index.	The overall obesity prevalence was 26.9%, including 10.2% who were severely obese. The highest prevalence was among unclassified youth (29.3%), followed by integrated youth (28.1%), compared to assimilated (25.2%) and separated/marginalized youth (20.5%), although differences were not statistically significant.
Obesity and Obesogenic Behaviors in Asian American Children with Immigrant and US-Born Mothers.	Argueza et al.	2020	United States	609	To examine the relationship between maternal nativity and time in the US (acculturation) and obesity and obesogenic behaviors among Asian American Children.	Maternal nativity: binary, immigrant and US-born. Maternal time in the US: ordinal variable: 5 levels: <5 years, 5–14 years, 15–24 years,25 years, and US-born.	Children with US-born mothers were not more likely to be obese than those with immigrant mothers. The likelihood of obesity did not increase with increasing maternal time in the US. "Maternal nativity -OR^3: immigrant-1.00, US born-0.27 (0.09-0.81) -AOR^4: immigrant-1.00, US born- 0.31 (0.10 -1.02) Maternal time in the US -OR^3: <5 years- 1.00 5-14 years- 0.26 (0.05-1.30) 15-24 years- 0.20 (0.04-1.12) >25 years- 0.19 (0.02-1.56) US born- 0.08 (0.01-0.41) -AOR^4: 5-14 years- 0.34 (0.05 - 2.28) 15-24 years- 0.34 (0.04-2.72) >25 years- 0.27 (0.02 - 2.96) US born- 0.12 (0.02 - 0.91) "
Risk factors for overweight in five- to six-year-old Hispanic American children: A pilot study.	Ariza et al.	2004	United States	250	The objective of this study was to determine the prevalence of and possible risk factors for overweight in a sample of 5- to 6-year-old Hispanic (predominantly Mexican American) children in Chicago, Illinois, to see if overweight is more common in more highly acculturated immigrant families.	12-item validated Acculturation Scale: language, media use, social relations	There was no significant correlation between acculturation score and child weight-for-height percentile. (Spearman's r=.08, P=.49)

Epidemiological Paradox or Immigrant Vulnerability? Obesity Among Young Children of Immigrants.	Baker E et al.	2015	United States	1010	To question the applicability of the immigrant epidemiological paradox to childhood obesity.	Maternal nativity Acculturation - language proficiency, age at arrival	Lower odds of obesity - third plus generation children Hispanic children (OR: 0.71, 95% confidence interval (CI): 0.53, 0.96 All children (OR: 0.72, CI: 0.58, 0.90) Second-gen children - LEP mothers - Lower odds of Obesity (OR: 0.65, CI: 0.43, 0.99 for Hispanics; OR: 0.75, CI: 0.56, 1.01 for all children).
Maternal ratings of child health and child obesity, variations by mother's race/ethnicity and nativity.	Baker EH et al.	2014	United States	21260	To examine whether indicators of child health in obesity are associated with maternal ratings of child health	Mothers' duration in the US- Less than 10 years, 10 or more years	Child obese "Native-born non-Hispanic Black: OR: 1.15, CI: (0.85, 1.54) Native-born Hispanic: OR: 0.97, CI: (0.59, 1.43) Foreign born Hispanic, US duration 10 or more years: OR: 1.63, CI: (1.14, 2.33) Foreign born Hispanic, US duration 0–9 years OR: 2.08, CI: (1.35,3.20)
The Association between Early Childhood Overweight and Maternal Factors.	Barroso et al.	2012	United States	374	To determine the association between maternal sociodemographic factors and child overweight and obesity in a sample of low-income Mexican American	Acculturation level	Lack of an association between acculturation and child weight status among young children of Mexican descent. Acculturation (ARSMA) and Child Weight: -OR 0.73, CI 0.48-1.11, P-value 0.139
Predictors of obesity in Latino children: acculturation as a moderator of the relationship between food insecurity and body mass index percentile.	Buscemi et al.	2009	United States	63	To assess the role of acculturation in the prediction of obesity	Marin's Short Acculturation Scale for Hispanics: language use, media, and ethnic social relations	Acculturation was found to be a significant moderator of the relationship between food insecurity and BMI percentile. The interaction between food insecurity and ACT was found to be directly associated with BMI percentile, b=.426, P=.003. (ACTotal = total acculturation score)

The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California.	Buttenheim et al.	2013	United States	25487	To evaluate the hypothesis that the immigrant advantage in obesity prevalence for Mexican-origin populations in the US does not hold for children and young adults	Duration and generation in the United States	The California Health Interview Survey found significantly higher age-adjusted odds of obesity in the 2nd generation (compared to3rd+) for the full sample. Child (ages 4–11)- AOR Female N=185 1st: 0.68(0.59) 2nd:1.01(0.50) 3rd:1.00 (–) US-born non-Hispanic white: 0.24 (0.14) Male N= 196 1st: 2.44 (2.05) 2nd:1.42 (0.86) 3rd:1.00 (–) US-born non-Hispanic white:0.35 (0.23) Adolescent (12-17)- AOR Female N= 215 1st:18.07 (16.00)** 2nd:1.81 (1.02) 3rd:1.00 (–) US-born non-Hispanic white: 1.41 (0.73) Male N= 222 1st: 1.19 (0.79) 2nd:0.76 (0.39) 3rd:1.00 (–) US-born non-Hispanic white: 0.61 (0.37)
Early Adolescents' Psychosocial Adjustment and Weight Status Change: The Moderating Roles of Gender, Ethnicity, and Acculturation.	Chang et al.	2014	United States	6860	To examine the relationship between psychosocial adjustment (i.e., internalizing behaviors, externalizing behaviors, interpersonal skills) and weight status change during early adolescence and possible moderating roles of gender, ethnicity, and acculturation	Hispanics were divided into 2 groups: acculturated and less acculturated. Less acculturated households were characterized by having either foreign-born mother who immigrated to the United States after the age of 13 and the children's primary home language was not English	Hispanic girls who were viewed by teachers displaying higher levels of externalizing behaviors were less likely to be Obese to Overweight/Healthy when compared with Stable Obese (more acculturated) for externalizing behaviors, the strength of the moderating effect is particularly strong for less acculturated Hispanic girls. Acculturated Hispanics Obese to Overweight/Healthy versus Stable Obese: OR- 0.98 (0.89-1.08) Healthy to Overweight/Obese versus Stable Healthy: OR- 1.07 (1.03-1.12) Less Acculturated Hispanics Obese to Overweight/Healthy versus Stable Obese: 0.93 (0.83–1.05) Healthy to Overweight/Obese versus Stables Healthy: 1.02 (0.96–1.08) "

The Association Between Family Meals and Early-Adolescents' Weight Status Change in the Context of Parental Discipline Practices: The Moderating Roles of Ethnicity and Acculturation.	Chang Y et al.	2015	United States	6860	Examines the interactions among family meals, parental discipline practices, ethnicity, and acculturation on weight status change in a diverse sample of early adolescents.	More vs. less acculturated Hispanic Assessed acculturation according to language and generational status	Stable Healthy - mean (SD) range (%) White:60 Black:47 More acculturated Hispanic:44 Less acculturated Hispanic:41 Stable Overweight - mean (SD) range White:26 Black:40 More acculturated Hispanic:38 Less acculturated Hispanic:48
Healthy Living Behaviors Among Chinese American Preschool-Aged Children: Results of a Parent Survey.	Chomitz et al.	2017	United States	132	To understand associations between diet, physical activity, parenting, and acculturation among Chinese American children	Survey language preference was used as a proxy for acculturation	Acculturation status was not a significant predictor of the health outcomes after adjustment by the child's age, gender, and income proxy Children of less acculturated parents also had higher mean BMI z-scores; however, the difference was not statistically significant. "English survey respondents Underweight (<5th percentile): 0% Normal (5th to <85th percentile): 16% Overweight (85th to <95th percentile): 2% Obese (≥95th percentile):0% Chinese survey respondents Underweight (<5th percentile):6.5% Normal (5th to <85th percentile):54.8% Overweight (85th to <95th percentile):14.5% Obese (≥95th percentile): 24.2% Regression coefficient (95% CI) for choosing Chinese version questionnaire, versus English version Child's BMI z-score based on parent-reported height and weight Unadjusted Beta: 0.36 (−0.42, 1.1.4) Adjusted Beta: 0.17 (−1.05, 1.39) "
Family weight teasing, ethnicity, and acculturation: Associations with well-being among Latinx, Hmong, and Somali Adolescents.	Eisenberg et al.	2019	United States	1577	To examine the prevalence of weight-based teasing by family members and associations with unhealthy weight control behaviors, body satisfaction, self-esteem, and depressive symptoms among adolescents from three immigrant communities (Latino, Hmong, and Somali	Proxy measures of acculturation: Survey Composite score (0–6). Each item was recorded (0–2). Students were asked: if they were born in the U.S. (2) or elsewhere (0); how long they have lived in the U.S. (≥ 10 years or always = 2, 1<5 years or 5<10 years = 1, <1 year = 0) [33]; and the language usually spoken in their home	Each unit of the acculturation score was inversely associated with 3.6 percentage points in the predicted prevalence of unhealthy weight control behaviors among girls. No significant interactions were noted between weight-based teasing and acculturation score in association with dependent variables.

Ethnicity and acculturation: do they predict weight status in a longitudinal study among Asian, Hispanic, and non-Hispanic White early adolescent females?	Fialkowski et al.	2015	United States	681	To longitudinally examine the relationship between overweight status greater than the 85th percentile according to the Centers for Disease Control and Prevention growth charts) and ethnic group, as well as acculturation (generation and language spoken in the home) in a sample of adolescent females	Acculturation was measured using two acculturation indicators: generation and language use	The probability of becoming overweight was not significantly associated with acculturation score at any of the time points for either Asian or Hispanic girls "Asian (18 months) OR: 0.27 CI: (0.07, 1.12) Hispanic (18 months) OR: 0.56 CI: (0.25, 1.27) "
Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second-Generation Hmong Children.	Franzen-Castle et al.	2014	United States	300	To determine influences (environmental, personal, and behavioral) on body mass index (BMI) and acculturation status among second-generation Hmong children using the social cognitive theory (SCT) as the theoretical framework	Acculturation level scale for Hmong	Acculturation scores were equally predicted by environmental, behavioral, and personal constructs for age and gender sub-groups. For acculturation assessment responses, B-US1 was less acculturated than B-US2, regarding language and diet. Also, the ability to speak and think in English was positively associated with BMI percentile. Approximately 50 %of children were classified as overweight/obese
Immigrant Neighborhood Concentration, Acculturation, and Obesity Among Young Adults	Ishizaw et al.	2016	United States	10063	To investigate the linkages between acculturation, neighborhood characteristics, and obesity among young adults, including the potential for residing in an immigrant	Immigrant status is partitioned out as a first-generation, second-generation, and third and higher generation Household language	First-generation young adults are less likely to be obese compared to the third and higher generations, which is consistent with the unhealthy assimilation model. In addition, in accord with past findings, Hispanic young adults had a higher likelihood of being obese compared to third and higher-generation Whites. "Logistic Regression Results Predicting Obesity: Odds Ratios Model 1: First generation: .65∗ Second generation: .92∗ "
Generation and Acculturation Status Are Associated with Dietary Intake and Body Weight in Mexican American Adolescents.	Ji-Hong Liu et al.	2012	United States	2286	To examine how the acculturation process, measured by generation status and language use, is associated with both diet and obesity among Mexican American adolescents aged 12–19 y old	Generation status and language preference 5-item Short Acculturation Scale for Hispanic	Adolescents in the second generation had higher BMI Z-scores than adolescents in the first and third generations. "Logistic regression model Model 1: OR CI First Gen- 1.0 Second Gen- 2.20 (1.64, 2.96) Third Gen- 1.51 (1.08, 2.09) "

Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese American Children and Mothers.	Jyu-Lin Chen et al.	2008	United States	65	To examine factors associated with health behaviors, including physical activity and dietary intake, of Chinese women who have immigrated to the United States and their children	Suinn-Lew Asian Self-Identity Acculturation Scale	Maternal acculturation was related to low body mass index in children. Children whose mothers had a low level of acculturation were more likely to be overweight than children whose mothers were highly acculturated. "Outcome: BMI Predictor: Acculturation R2: .07, B: -.273, CI: (-.4.05, -.17), P: .034 "
The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth).	LeCroy et al.	2021	United States	1466	To determine whether discordance in parent-child language acculturation (parent-child acculturation gap) was associated with poor youth cardiometabolic health	Brief Acculturation Rating Scale for Mexican Americans-II (Brief ARSMA-II) (AOS; Cronbach's α = 0.64 [child] and 0.86 [parent]) and the six-item Hispanic/Latino Orientation Scales (LOS; Cronbach's α = 0.84 [child] and 0.82 [parent])	Greater discordance in AOS scores was associated with elevated BMI percentile only (p-for-interaction < .01). The LOS acculturation gap was not associated with any outcome Discordance in Hispanic/Latino parent-child dyads' English use may relate to increased risk for childhood obesity. Beta (95% CI) for associations between youth and parent AOS scores and youth cardiometabolic risk factors in SOL Youth BMI percentile Youth: 11.66 (5.35, 17.98)** Parent: 17.76 (6.46, 29.05)* Interaction term: −4.49 (−7.05, −1.93) Beta (95% CI) for associations between youth and parent LOS scores and youth cardiometabolic risk factors in SOL Youth BMI percentile Youth: 1.34 (−0.61, 3.30) Parent:−0.43 (−3.08, 2.23)
Acculturation, physical activity, and obesity among Hispanic adolescents.	Liu et al.	2009	United States	4704	To examine how acculturation may influence participation in leisure-time physical activity and obesity among Hispanic adolescents	Generation status and language spoken at home	The prevalence of obesity did not differ by generational status Hispanic adolescents in households where English was not the primary language were more likely than adolescents in English-speaking households to be obese. Outcome 2: Obesity Generational status (Crude OR, CI) First generation: cOR: 1.23 CI: (0.83, 1.84) Second generation: cOR: 1.27 CI: (0.92, 1.74) Third generation: cOR:1.00

Measures of Acculturation and Relations to zBMI among Mexican-Origin Youth.	Loren et al.	2018	United States	102	To examine the cross-sectional relations between several measures of acculturation and child zBMI, as well as the 12-month longitudinal relations between these measures and child BMI	Acculturation Scales-P, adapted from the Brief Acculturation Rating Scale for Mexican Americans-II (ARSMA-II) Acculturation scales comprise the AOS (Anglo Orientation Subscale) and MOS (Mexican Orientation Subscale) of the ARSMA-II	Significant correlations between two acculturation variables, language preference, and Anglo Orientation, and zBMI were observed. No correlation was found between Mexican Orientation, number of immigrant parents, or parent time in the US and zBMI. Language preference was positively associated with BMI measurements over time, such that greater English preference was related to higher BMI. "zBMI (R2= .099, F (1, 90) = 9.928, p= 0.002) SE=0.36, p= 0.047 "
Body Image, Assimilation, and Weight of Immigrant Adolescents in the United States: A Person-Centered Analysis.	McCulloug h et al.	2019	United States	57	To investigate immigrant adolescents' assimilation to the United States (US) effect on weight, and body image dissatisfaction	Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA) measured adolescents' level of assimilation	Adolescents were categorized as having an overweight BMI and reported the lowest assimilation scores. "Underweight, high assimilation, satisfied (n=10) Underweight (100%) Mean assimilation score: 4.40 Overweight, low assimilation, dissatisfied (n=21) Overweight (100%) Mean assimilation score: 3.19 Normal weight, moderate assimilation, dissatisfied (n=26) Normal range (100%) Mean assimilation score: 3.44 "
Parent Perceptions of Child Weight Status in Mexican-Origin Immigrant Families: An Investigation of Acculturation, Stress, and Coping Factors	McLeod et al.	2018	United States	86	To examine acculturation, stress, coping, and involuntary responses to stress and their relation to the estimation of a child's weight status among Mexican-origin immigrant families	Brief Acculturation Rating Scale for Mexican Americans-II (ARSMA-II) The acculturation scales comprise the Anglo Orientation Subscale (AOS), and Mexican Orientation Subscale (MOS)	Children in the sample had an average BMI percentile ranking of 75.6% (SD=27.0%), indicating healthy weight status acculturative factors, even when measured by Multidimensional scale scores, may not significantly impact parent perception of child weight. "zBMI (OR) Step 1: 0.58 Step 2: 0.54 Step 3: 0.63 "

Investigating dietary acculturation and intake among US-born and Thailand/Laos-born Hmong American children aged 9-18 years.	Mulasi-Pokhriyal et al.	2011	United States	355	To investigate the dietary intake of Hmong children and whether acculturation and/or time lived in the USA influences dietary intake, BMI, and nutritional status	Assessed using ten questions asking about language use, social connections, and overall dietary habits	Children who were more acculturated to US norms including language use, social connections, and dietary habits had a higher BMI for age compared with their less acculturated counterparts. "Sample characteristics of Hmong children aged 9–18 years - BMI (mean) Males 9–13 years 5th to <85th percentile (healthy weight): 40 85th to <95th percentile (overweight): 12 95th percentile (obese): 31 Males14–18 years 5th to <85th percentile (healthy weight): 31 85th to <95th percentile (overweight): 10 95th percentile (obese): 26 Females 9–13 years 5th to <85th percentile (healthy weight): 51 85th to <95th percentile (overweight): 14 95th percentile (obese): 18 Females 14–18 years 5th to <85th percentile (healthy weight): 57 85th to <95th percentile (overweight): 18 95th percentile (obese): 27 "
Adolescent obesity increases significantly in second and third generation U.S. immigrants: the National Longitudinal Study of Adolescent Health.	Popkin et al.	1998	United States	16000	To help explain the underlying conditions of adolescent health and health behavior with special emphasis on the multiple contexts of adolescent life	Generational status	Body mass index >85th percentile (%) Hispanic American First generation: 24.5 Second generation: 32.1 Third generation: 31.7 Asian American First generation: 11.6 Second generation: 27.2 Third generation: 28.0
Food Insecurity among Hispanic/Latino youth: Who is at risk and what are the health correlates?	Potochnick et al.	2019	United States	1362	To examine the correlates and health implications of household food insecurity among Hispanic/Latino youth (ages 8-16), a high food insecurity-risk population	Parental nativity Parental language preference Parent and child acculturative stress	Found significantly higher mean BMI and CDI scores among Hispanic/Latino youth experiencing household and child food insecurity that may be explained by co-occurring acculturation, economic, and family stressors. "Child Acculturative Stress High Acculturative Stress: Food insecure/BMI b: −0.4 CI:(−1.5,0.8) Low Acculturative Stress: Food insecure/BMI b: −0.8 CI:(−1.9 ,0.3) "
Obesity Risk in Children: The Role of Acculturation in the Feeding Practices and Styles of Low-Income Hispanic Families.	Power et al.	2015	United States	169	To determine whether acculturation was associated with feeding in Hispanic populations	Bidimensional Acculturation Scale (BAS) was used to measure mothers' acculturation to the US culture - generational status	Child BMI categories (%) Normal (<85 percentile): 52.7 Overweight (85th to<95th percentile): 20.1 Obese (‡95th percentile): 27.2 Restriction for weight control: immigrant status (coded as 1=later generation; 2= first generation) Standard Beta: 0.14 Acculturation (higher scores reflect more English acculturation Standard Beta: -0.23

Acculturative stress and emotional eating in Latino adolescents.	Simmons et al.	2018	United States	446	To examine the associations between acculturative stress, emotional eating, and change in BMIz scored in Latino adolescents and compare Latino and non-Latino adolescents on measures of acculturative stress, emotional eating, and body mass index (BMI)	Social, Attitudinal, Familial, and environmental Acculturative Stress scale for Children (SAFE-C)	Latino Adolescents demonstrated significantly higher BMI scores than non-Latino adolescents and first-generation immigrant youth are at a higher risk for negative outcomes Bivariate correlations for Latino Sample SAFE-Acculturative 0.97, 0.85
Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status.	Singh et al.	2009	United States	46707	To examine the prevalence and socio-behavioral correlates of obesity and overweight among immigrant and US-born children and adolescents	Generational status and language spoken at home	Overall, first-generation immigrants, when controlled for all covariates, including race/ethnicity, had 26% lower odds (OR=0.74; 95% CI=0.56, 0.98) of obesity than native-born children. Obesity and overweight prevalence (%) "Hispanic: 1st Generation: 19.4 2nd Generation: 21.7 3rd Generation: 17.2 " " Non-Hispanic White: 1st Generation: 8.9 2nd Generation: 10.9 3rd Generation: 12.1 "" Non-Hispanic Black: 1st Generation: 16.5 2nd Generation: 15.1 3rd Generation: 24.0 "" Non-Hispanic Other: 1st Generation: 14.5 2nd Generation: 6.3 3rd Generation: 17.8 "
The influence of maternal acculturation on child body mass index at age 24 months.	Sussner et al.	2009	United States	108	To examine the influence of maternal acculturation on child body mass index (BMI) at age 24 and 36 months (about 3 years) among predominantly Latino, low-income mother-child pairs enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children	Nativity (born in the United States vs foreign-born), parents' nativity, years of US residence (<8 years vs>8 years), and exclusive use of native language vs nonexclusive use (mixed or English only)	Exclusive use of native language was associated with greater BMI in children as young as age 24 months (about 2 years) Language acculturation and Mothers nativity cross-referenced with child body mass index Language Acculturation - BMI z Score Exclusive use native: 1.08 Non-exclusive use: 1.12 Mother nativity Born in the United States: 1.04 Foreign born: 1.16

Big boys and little girls: gender, acculturation, and weight among young children of immigrants.	Van Hook et al.	2010	United States	20150	To examine how place of socialization hypothesis points to immigrant parents' lack of experience with the health risks in the U.S. environment in general, and with overweight among children, as contributing to children's weight gain	Place of socialization Level of social integration in the host society Generational status	The influence of acculturation by language is much stronger for boys than girls. All children of immigrants Kindergarten Percentile BMI: 65.822 Monthly Growth: .136 Children of the 1.0 generation Kindergarten Percentile BMI: 64.914 Monthly Growth: .149 Children of the 1.5 generation Kindergarten Percentile BMI: 71.758 Monthly Growth: .148
Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children.	Villa-Caballero et al.	2009	United States	812	The purpose of this study was to determine the association of family history of diabetes (FHM), BMI, and acculturation with children's BMI status.	The Acculturation Rating Scale for Mexican Americans (ARSMA-II)	Maternal acculturation level was marginally associated with children's BMI, FHD, and gestational diabetes, and BMI was associated with children's overweight status. "Acculturation level - Children's BMI Categorized by Normal Versus Overweight OR:0.87, CI:0.76-0.99, P-Value: .06 "
Growth status among low-income Mexican and Mexican American elementary school children.	Winham	2012	United States and Other country	484	The research purpose was to assess child growth status, including sitting height, in relation to acculturation among Mexican and Mexican American children	Bidimensional Acculturation Scale: language and birth country focused.	There was no significant difference in BMI categories observed by birth country alone. (%) US Born - BMI Percentile Underweight - 1.8 Normal - 56.4 Overweight - 14.5 Obese - 27.3 Mexico Born - BMI percentile Underweight - 0 Normal - 60.4 Overweight - 16.9 Obese - 22.7
Acculturation, Dietary Practices and Risk for Childhood Obesity in an Ethnically Heterogeneous Population of Latino School Children in the San Francisco Bay Area.	Wojcicki et al.	2012	United States	144	To evaluate the relationship between ethnicity and acculturation in determining risk for obesity in Latino children	Based on child and parent's place of birth, use of spoken Spanish versus English in the home or at school and watching TV in Spanish versus English.	Speaking Spanish at home [odds ratio (OR) 2.13, 95% CI 1.05–4.34] and having an obese parent (OR, 2.04, 95% CI 1.03–4.04) increased risk of obesity. Risk for obesity was not associated with Spanish language use (at home) when evaluating only the Mexican origin children (OR 1.76, 95% CI 0.51–6.10) Spanish language use (at home) was associated with increased risk in the Central/South American children (OR 12.62, 95% CI 1.38–115.55)

Chapter 4: Results

The association between acculturation and obesity varied in the 34 studies assessed in this systematic review. We found 4 main findings in this review that were relevant to specific ethnic and or racial groups. These findings focused on generational status, maternal nativity, race, and age and these findings were present across all racial groups. Findings are as follows: Generational status influences odds of obesity; Maternal nativity influences obesity outcomes; Ethnicity and race influence obesity outcomes; Age and gender were modifiers in the outcomes seen in the association between acculturation and obesity.

In 29 of the studies assessed in this systematic review including Latino and or Hispanic children 13 had a negative association between acculturation and obesity. Only 5 studies had a positive association between acculturation and obesity. The classification of no association or a neutral outcome that was not statistically significant was found in 11 of the studies. Findings related to age, gender, nativity, language use, and maternal influence.

Regarding age as a modifier, a study identified in this review by Barroso et al highlighted that age also had a varying impact in acculturative measures, and young children of Mexican descent had a lack of association between acculturation and weight status.[72] Age as a modifier was not extensively assessed in this study but was present in all variables assessed for acculturative influence. The impact of age as a modifier was also generalized in a study by Acciai et al that assessed parental nativity status on changes in their children's body mass index.[73] Although age as a modifier was supported in the study by Acciai et al, the modification was highlighted through generational status.[73]

In addition, second generation Latino children in the literature reviewed were found to have healthier BMI trends over time.[73] However, the finding of healthier BMI trends in second

generation children were contradicted in a study by Ji-Hong et al that assessed generation and acculturation status's impact on immigrant children's body weight.[74] These findings tell us that age and how it modifies the association between acculturation and obesity requires further insight.

Results of our study show that gender may influence the role of acculturation on obesity. A study by Popkin et al found that Latino and or Hispanic boys were the most affected by acculturation.[75] In a study in migrant Latino children by Winham et al, higher BMI was also seen in boys regardless of birth country.[76] Latino and or Hispanic girls however had a normal BMI regardless of birth country.[76]

Although there were contradictions, consistency was seen in studies assessing acculturation through Language preference. The preference for Spanish at home seemed to have the strongest impact. Increased obesity prevalence, and higher BMI in children with native language use at home was consistent across studies.[77-79] Baker et al found that obesity prevalence was statistically significantly negatively associated with for English proficiency.[79] Therefore low English use constituted higher obesity prevalence than high English use.[79] Considering that language preference may be influenced by children's parents and home life, maternal influence was also found to be associated with obesity. Villa-Caballero et al found a marginal association with children's BMI and maternal acculturation.[80]

Food security was a mediating factor in the relationship between acculturation and obesity.[81] Higher food insecurity was correlated with low acculturation and lower BMI, while less food insecurity was attributed to more acculturation and higher BMI in a study by Buscemi et al.[81]

In 11 of the studies including Asian children 5 found an inverse association between acculturation and obesity, 4 studies had a positive association and 1 of the 4 was found not to be statistically significant. 2 additional studies had no association or neutral outcomes that were not statistically significant. Specific measures of acculturation for Asian children were the Suinn-Lew Asian Self-Identity Acculturation Scale and the Acculturation level scale for Hmong.[82,83] Studies including Asian children focused on nativity, length of US residence, generational status, maternal influences, and language preference. Nativity was interconnected with length of US residence and generational status.

A study by Argueza et al found that the children of US born mothers had lower odds of obesity than the children of immigrant mothers .[84] This was contradicted in a study by Mulasi-Pokhriyal et al that found that US born Asian children had a higher BMI and were classified as obese compared to immigrant children from Thailand or Laos.[85] However, once the children lived in the US for 5 or more years and became more acculturated, they had a higher BMI than less acculturated peers.[85] Relatedly in a study by Jyu-Lin Chen maternal acculturation was a prominent factor in obesity outcomes in Asian children.[86] A high level of maternal acculturation was positively associated with low body mass index and low acculturation actually led to overweight children.[86] This was supported in two additional studies. One study by Chomitz et al on living behaviors in preschool aged children found that less acculturation was associated with higher BMI scores for Asian children, however this result was not statistically significant.[87] The study by Franzen-Castle et al on influences on BMI and acculturation found that more acculturation through use of English was associated with less obesity in second generation Hmong children.[88]

In 7 of the studies including Black and or African children, 2 found an inverse association between acculturation and obesity, while 3 studies found a positive association. No association or a neutral outcome that was not statistically significant was found in 2 studies. These studies were assessed as neutral or not statistically significant as they did not apply acculturation measures to this population. In studies including Black and or African children there were no race-based measures of acculturation. Studies including Black children focused on generational status. In a study by Singh et al obesity prevalence in Black children was found to increase with each generation.[89] Additionally the study including Somali immigrant children by Eisenberg et al.[90] found that acculturation scores were inversely associated with unhealthy weight control behaviors.[90] However, the study noted that acculturation measures in this study were proxies and could not provide greater insight to preferences related to weight status.[90]

Chapter 5: Discussion, Conclusions, and Recommendations

Discussion and Findings

This systematic review found trends in generational status, maternal nativity, ethnicity and race, and age as it relates to the association between acculturation and obesity in first- and second-generation immigrant children in the United States. Ethnicity and race were also a primary influence in the measures of acculturation used and the associations seen between acculturation and obesity. Although trends were seen in age, age was also a modifier in the association between acculturation and obesity in children. Overall, the association between acculturation and obesity varied in the 34 studies assessed in this systematic review. Assessment of associations between acculturation and obesity Latino and or Hispanic populations were included in 29 of the studies and 18 studies were solely focused on Hispanic and or Latino populations. Studies that included Latino and or Hispanic children were the largest and accounted for 85% of the studies assessed in this systematic review. Acculturative measures and scales utilized on Latino and or Hispanic children varied. Additionally, acculturation was measured in Latino and or Hispanic children by population specific acculturation scales. Asian populations were included in 11 of the studies and 5 studies were solely focused on Asian populations. Studies that included Asian children were the second largest and accounted for 32% of the studies assessed in this systematic review. Acculturative measures and scales utilized on Asian children also varied. Studies that included white populations were the third largest and accounted for 26% of the studies assessed. Studies including white children were used as a point of comparison for the ethnic and minority groups in the studies assessed in this systematic review. Black and or African populations were included in 7 of the studies and 0 studies were solely focused on Black and or African populations. Studies that included Black and or African

children accounted for 21% of the studies assessed in this systematic review. Acculturative measures utilized on Black and or African children varied and there were no specific scales tailored for this group. Some studies regardless of ethnicity and or race had multiple measures of acculturation. Modifiers such as age and race need further exploration in studies that will assess the association between acculturation and obesity in first- and second-generation immigrant children.

This review is in consensus with two previous systematic reviews assessing the association between acculturation and obesity in children. A 2016 systematic review by McLeod et al, that sought to understand the effects of becoming American and the role acculturation has on weight in Latino youth populations. The study reported that 25% of studies reviewed found a positive association between acculturation and child weight for preschool aged children in the United States, while 46% of studies exhibited an inverse association between acculturation and weight in elementary school-aged children.[91] In the adolescent age group, 50% of the studies found a positive relationship between acculturation and child weight. The variance found in age groups in this study was indicative that the association between acculturation and obesity may differ based on the age of the children studied.[91] Although findings were statistically insignificant, McLeod et al highlighted the possibility that age may modify the relationship between acculturation and weight in children.[91] This notion was present in 4 of the studies assessed in this systematic review. Modification by age was seen in the association between acculturation and obesity in first- and second-generation immigrant children in the United States. However, the association was not consistent across ethnic and racial groups. Three of the studies modified by age were on Asian children and had varying results in the association between acculturation and obesity in children. Only one study was on Latino and or Hispanic children.

The use of age is not exclusive to these 4 studies, and spans across all studies. However, these studies included this modifier as a notable point in the interpretation of their results.

Our findings are also similar to those from a systematic review by Zhang et al, that sought to assess the affect acculturation had on the dietary intakes and body weight status of Asian children of immigrants in the U.S and other developed countries.[92] The review found that measuring a acculturation in children is challenging and found no plausible relationship between acculturation and body weight status in Asian-Americans.[92] This was especially true if the child's parents were originally from Asia.[92] Additionally, Zhang et al, noted that acculturation was easier to measure for adults.[92] Five studies examined in the current systematic review were solely on Asian children. Influences present were maternal nativity and acculturation score. Age and gender were also identified as modifiers in three of the studies. Consensus varied in the association between acculturation and obesity in Asian children. The lack of consensus identifies that even if studies are solely on ethnicity or race, the variation in acculturative measures may impact the consensus regarding the impact acculturation has on obesity. The lack of a standardized measure to assess acculturation level is likely the culprit in this inconsistency. This review highlights the gaps in acculturative measurement and how the gaps are impacting existing literature on the association between acculturation and obesity.

Our study was similar to two other systematic reviews on the topic in that. hat the association between acculturation and obesity varied in populations. Modifiers were present for all ethnic and racial groups. In addition, the results of our review found that generational status influences odds of obesity, maternal nativity influences obesity outcomes, ethnicity and race influence obesity outcomes and age and gender were modifiers in the outcomes seen in the association between acculturation and obesity. The association between acculturation and obesity

also varies by race. The findings may be inconsistent given the varying measures used to assess the relationship between acculturation and obesity. Therefore, it may be useful to consider a standardized measure of acculturation to be used across ages, race/ethnic groups, and generations to better understand this association. A study by Vilar-Compte et al on disparities in obesity among US immigrants, labeled migration as a determinant of childhood obesity, and highlighted the guidance of the Community Energy Balance framework.[93] The study stated that in order to prevent obesity, researchers must understand sociocultural and ecological frameworks and utilize them.[93] The implications of this notion tie obesogenic behaviors to sociocultural influences which stem from an ecological perspective.[94] The CEB framework is an ecological approach that is suitable to aid in filling the gaps associated with the relationship between acculturation and obesity.[95] The framework helps public health practitioners and researchers recognize how environments impact minorities and their processes and how adaptation can be adverse or promoting for health.[95] In the same study they also assessed migrant Mexican households in the US and found that by using CEB's guidance in and studies were successful in tackling barriers to healthy choices in immigrants.[95] This was found through and assessment of overweight or obese Mexican children's households.[95] The success of CEB in Mexican children proves promising as associations in first and second generation immigrant children vary and modifiers and obesogenic behaviors from sociocultural influence are present.[94,95] In another study by Marsiglia et al, the success of an ecological perspective was attributed to the interrelatedness of environments in minority families and the way the environmental perspective takes a multidimensional approach.[96] Therefore, one recommendation is that CEB is utilized to tackle barriers to healthy behaviors present in more vs. less acculturated children. In order for researchers to better understand the association between acculturation and obesity in children

there should be further exploration of the rhetoric of the CEB framework as it tackles the socio cultural and ecological aspects that influence the obesogenic behaviors present in the acculturative process. Understanding this framework will aid in understanding the association between acculturation and obesity. Additionally, through the CEB framework a standardized acculturative measure can be developed and applied to all ethnic or racial groups. It is possible that through this added acculturative measure, studies can garner a consensus on the association between acculturation and obesity in first- and second-generation immigrant children in the United States.

Strengths and Limitations

Several strengths were present in this systematic review. One being the adherence to PRISMA guidelines and methodology to ensure uniformity in search and extraction of the literature.[97] The review also had clearly defined inclusion and exclusion criteria, population, and measures and associations assessed. The characteristics of each study found were also clearly and uniformly defined. Additionally, strategies utilized in the quality assessment of literature adhered to a peer reviewed quality assessment tool curated by the National Institutes of Health.[98] This was done to assess for bias in the studies reviewed. Lastly there were no conflicts of interest regarding this systematic review.

Furthermore, limitations were present in this systematic review. One being that the search, data extraction, and validation were done by a single reviewer and there was no secondary reviewer or investigator. Additionally, the data search and extraction process had a short duration, and a small amount of search engines were used to conduct the search. This short duration and small number of databases may impact the results of this systematic review because

some studies that are relevant may have been missed in the screening process by the one reviewer.

Conclusions

In conclusion, future research should utilize the community energy balance framework to understand the socio cultural and ecological contexts surrounding obesogenic behaviors and obesity prevalence in immigrants.[99,100] Through this framework a standardized measure of acculturation can be curated and applied in research that seeks to assess the association between acculturation and obesity in first- and second-generation immigrant children.

References

1. Immigrant Medicine. (2007). *Acculturation Definition*. Science Direct. Retrieved March 6, 2023, from https://www-sciencedirect-com.proxy.library.emory.edu/topics/neuroscience/acculturation

2. McLeod, D. L., Buscemi, J., & Bohnert, A. M. (2016). Becoming American, becoming obese A systematic review of acculturation and weight among Latino youth. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, *17*(11), 1040–1049. https://doi.org/10.1111/obr.12447

3. Kaushal, N. (2009), Adversities of acculturation? Prevalence of obesity among immigrants. Health Econ., 18: 291-303. https://doi-org.proxy.library.emory.edu/10.1002/hec.1368

4. Prisma. (n.d.). Retrieved March 9, 2023, from http://www.prisma-statement.org/PRISMAStatement/FlowDiagram

5. *The State of America's children 2021 - Immigrant Children*. Children's Defense Fund. (2021, March 28). Retrieved March 6, 2023, from https://www.childrensdefense.org/state-of-americas-children/soac-2021-immigrant-children/#:~:text=CHILDREN%20IN%20THE%20U.S.%E2%80%94%20APPROXIMATELY,workplaces%2C%20and%20houses%20of%20worship

6. *Ages 10-17*. State of Childhood Obesity. (2022, November 11). Retrieved March 6, 2023, from https://stateofchildhoodobesity.org/demographic-data/ages-10-17/#:~:text=Roughly%20one%20in%20six%20youth,to%20the%20COVID%2D19%20pandemic.

7. Rosenberg, S. (2020, August 20). *Facts on U.S. immigrants, 2017*. Pew Research Center's Hispanic Trends Project. Retrieved March 7, 2023, from https://www.pewresearch.org/hispanic/2019/06/03/facts-on-u-s-immigrants-2017-data/

8. Centers for Disease Control and Prevention. (2022, May 17). *Childhood obesity facts*. Centers for Disease Control and Prevention. Retrieved March 6, 2023, from https://www.cdc.gov/obesity/data/childhood.html

9. Radford, J., & Noe-Bustamante. (2019). Facts on US immigrants, 2017: Statistical portrait of the foreign-born population in the United States.

10. Immigrant Medicine. (2007). *Acculturation Definition*. Science Direct. Retrieved March 6, 2023, from https://www-sciencedirect-com.proxy.library.emory.edu/topics/neuroscience/acculturation

11. McLeod, D. L., Buscemi, J., & Bohnert, A. M. (2016). Becoming American, becoming obese A systematic review of acculturation and weight among Latino youth. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, *17*(11), 1040–1049. https://doi.org/10.1111/obr.12447

12. Perreira, K. M., & Ornelas, I. J. (2011). The physical and psychological well-being of immigrant children. *The Future of children*, *21*(1), 195–218. https://doi.org/10.1353/foc.2011.0002

13. McLeod, D. L., Buscemi, J., & Bohnert, A. M. (2016). Becoming American, becoming obese A systematic review of acculturation and weight among Latino youth. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, *17*(11), 1040–1049. https://doi.org/10.1111/obr.12447

14. Mendoza F. S. (2009). Health disparities and children in immigrant families: a research agenda. *Pediatrics*, *124 Suppl 3*, S187–S195. https://doi.org/10.1542/peds.2009-1100F

15. Delavari, M., Sønderlund, A.L., Swinburn, B. et al. Acculturation and obesity among migrant populations in high income countries – a systematic review. BMC Public Health 13, 458 (2013). https://doi.org/10.1186/1471-2458-13-458

16. Kaushal, N. (2009), Adversities of acculturation? Prevalence of obesity among immigrants. Health Econ., 18: 291-303. https://doi-org.proxy.library.emory.edu/10.1002/hec.1368

17. Fruh S. M. (2017). Obesity: Risk factors, complications, and strategies for sustainable long-term weight management. Journal of the American Association of Nurse Practitioners, 29(S1), S3–S14. https://doi.org/10.1002/2327-6924.12510

18. Pulgarón E. R. (2013). Childhood obesity: a review of increased risk for physical and psychological comorbidities. Clinical therapeutics, 35(1), A18–A32. https://doi.org/10.1016/j.clinthera.2012.12.014

19. Fruh S. M. (2017). Obesity: Risk factors, complications, and strategies for sustainable long-term weight management. Journal of the American Association of Nurse Practitioners, 29(S1), S3–S14. https://doi.org/10.1002/2327-6924.12510

20. Pulgarón E. R. (2013). Childhood obesity: a review of increased risk for physical and psychological comorbidities. Clinical therapeutics, 35(1), A18–A32. https://doi.org/10.1016/j.clinthera.2012.12.014

21. Delavari, M., Sønderlund, A.L., Swinburn, B. et al. Acculturation and obesity among migrant populations in high income countries – a systematic review. BMC Public Health 13, 458 (2013). https://doi.org/10.1186/1471-2458-13-458

22. McLeod, D. L., Buscemi, J., & Bohnert, A. M. (2016). Becoming American, becoming obese? A systematic review of acculturation and weight among Latino youth. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, *17*(11), 1040–1049. https://doi.org/10.1111/obr.12447

23. U.S. Department of Health and Human Services. (2023). *Study Quality Assessment Tools*. National Heart Lung and Blood Institute. Retrieved March 9, 2023, from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

24. Acciai F, Yellow Horse AJ, & Ohri-Vachaspati P. (2020). Individual-, family-, and contextual-level variables do not explain the protective effect of parental nativity status on changes in 3–15-year-oldchildren's BMI. *SSM Popul Health*, *12*. https://doi.org/10.1016/j.ssmph.2020.100652

25. Arandia G, Sotres-Alvarez D, Siega-Riz AM, Arredondo EM, Carnethon MR, Delamater AM, Gallo LC, Isasi CR, Marchante AN, Pritchard D, Van Horn L, & Perreira KM. (2018). Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study. *Appetite*, *129*, 25–36. https://doi.org/10.1016/j.appet.2018.06.017

26. Argueza, B. R., Sokal-Gutierrez, K., & Madsen, K. A. (2020). Obesity and Obesogenic Behaviors in Asian American Children with Immigrant and US-Born Mothers. *International Journal of Environmental Research & Public Health*, *17*(5), 1786.

27. Ariza AJ, Chen EH, Binns HJ, & Christoffel KK. (2004). Risk factors for overweight in five- to six-year-old Hispanic-American children: A pilot study. *J Urban Health*, *81*(1), 150–161. https://doi.org/10.1093/jurban/jth091

28. Baker, E., Rendall, M., & Weden, M. (2015). Epidemiological Paradox or Immigrant Vulnerability? Obesity Among Young Children of Immigrants. *Demography (Springer Nature)*, *52*(4), 1295–1320.

29. Baker EH & Altman CE. (2015). Maternal ratings of child health and child obesity, variations by mother's race/ethnicity and nativity. *Matern Child Health J*, *19*(5), 1000–1009. https://doi.org/10.1007/s10995-014-1597-6

30. Barroso CS, Roncancio A, Hinojosa MB, & Reifsnider E. (2012). The Association between Early Childhood Overweight and Maternal Factors. *Child Obes*, *8*(5), 449–454. https://doi.org/10.1089/chi.2011.0094

31. Buscemi J, Beech BM, & Relyea G. (2011). Predictors of obesity in Latino children: Acculturation as a moderator of the relationship between food insecurity and body mass index percentile. *J Immigr Minor Health*, *13*(1), 149–154. https://doi.org/10.1007/s10903-009-9263-6

32. Buttenheim AM, Pebley AR, Hsih K, Chung CY, & Goldman N. (2013). The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California. *Soc Sci Med*, *78*, 1–8. https://doi.org/10.1016/j.socscimed.2012.10.023

33. Chang, Y., & Halgunseth, L. (2015a). Early Adolescents' Psychosocial Adjustment and Weight Status Change: The Moderating Roles of Gender, Ethnicity, and Acculturation. *Journal of Youth & Adolescence*, *44*(4), 870–886.

34. Chang, Y., & Halgunseth, L. (2015b). The Association Between Family Meals and Early-Adolescents' Weight Status Change in the Context of Parental Discipline Practices: The Moderating Roles of Ethnicity and Acculturation. *Journal of Immigrant & Minority Health*, *17*(2), 450–458.

35. Chomitz, V. R., Lee, V., Must, A., Chui, K. K. H., & Brown, A. (2018). Healthy Living Behaviors Among Chinese-American Preschool-Aged Children: Results of a Parent Survey. *Journal of Immigrant & Minority Health*, *20*(4), 926–935.

36. Eisenberg ME, Puhl R, Areba EM, & Neumark-Sztainer D. (2019). Family weight teasing, ethnicity and acculturation: Associations with well-being among Latinx, Hmong, and Somali Adolescents. *J Psychosom Res*, *122*, 88–93. https://doi.org/10.1016/j.jpsychores.2019.04.007

37. Fialkowski MK, Ettienne R, Shvetsov YB, Rivera RL, Van Loan MD, Savaiano DA, & Boushey CJ. (2015). Ethnicity and acculturation: Do they predict weight status in a longitudinal study among Asian, Hispanic, and non-Hispanic White early adolescent females? *Adolesc Health Med Ther*, *6*, 1–7. https://doi.org/10.2147/AHMT.S67511

38. Franzen-Castle, L., & Smith, C. (2014). Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second Generation Hmong Children. *Maternal & Child Health Journal*, *18*(1), 73–89.

39. Ishizawa, H., & Jones, A. (2016). IMMIGRANT NEIGHBORHOOD CONCENTRATION, ACCULTURATION AND OBESITY AMONG YOUNG ADULTS. *Journal of Urban Affairs*, *38*(2), 298–311.

40. Ji-Hong Liu, Chu, Y. H., Frongillo, E. A., & Probst, J. C. (2012). Generation and Acculturation Status Are Associated with Dietary Intake and Body Weight in Mexican American Adolescents. *Journal of Nutrition*, *142*(2), 298–305.

41. Jyu-Lin Chen. (2009). Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese-American Children and Mothers. *Journal of Immigrant & Minority Health*, *11*(3), 198–204.

42. LeCroy, M. N., Strizich, G. M., Gallo, L. C., Perreira, K. P., Ayala, G. X., Carnethon, M. R., Delamater, A. M., Gonzalez, J. S., Arredondo, E. M., Pulgaron, E. R., & Isasi, C. R. (2021). The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth). *Annals of Behavioral Medicine*, *55*(8), 734–745.

43. Liu J, Probst JC, Harun N, Bennett KJ, & Torres ME. (2009). Acculturation, physical activity, and obesity among Hispanic adolescents. *Ethn Health*, *14*(5), 509–525. https://doi.org/10.1080/13557850902890209

44. Loren, D. M., Bohnert, A., & Santiago, C. D. (2019). Measures of Acculturation and Relations to zBMI among Mexican-Origin Youth. *Journal of Racial & Ethnic Health Disparities*, *6*(2), 364–370.

45. McCullough, M. B., Pieloch, K. A., & Marks, A. K. (2020). Body Image, Assimilation, and Weight of Immigrant Adolescents in the United States: A Person-Centered Analysis. *Journal of Immigrant & Minority Health*, *22*(2), 249–254.

46. McLeod, D. L., Bates, C. R., Heard, A. M., Bohnert, A. M., & Santiago, C. D. (2018). Parent Perceptions of Child Weight Status in Mexican-Origin Immigrant Families: An Investigation of Acculturation, Stress, and Coping Factors. *Journal of Immigrant and Minority Health*, *20*(2), 441–447. https://doi.org/10.1007/s10903-017-0569-5

47. Mulasi-Pokhriyal U, Smith C, & Franzen-Castle L. (2012). Investigating dietary acculturation and intake among US-born and Thailand/Laos-born Hmong-American children aged 9-18 years. *Public Health Nutr*, *15*(1), 176–185. https://doi.org/10.1017/S1368980011001649

48. Popkin BM & Udry JR. (1998). Adolescent obesity increases significantly in second and third generation U.S. immigrants: The National Longitudinal Study of Adolescent Health. *J Nutr*, *128*(4), 701–706. https://doi.org/10.1093/jn/128.4.701

49. Potochnick S, Perreira KM, Bravin JI, Castañeda SF, Daviglus ML, Gallo LC, & Isasi CR. (2019). Food Insecurity among Hispanic/Latino youth: Who is at risk and what are thehealth correlates? *J Adolesc Health*, *64*(5), 631–639. https://doi.org/10.1016/j.jadohealth.2018.10.302

50. Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Hughes, S. O. (2015). Obesity Risk in Children: The Role of Acculturation in the Feeding Practices and Styles of Low-Income Hispanic Families. *Childhood Obesity*, *11*(6), 715–721.

51. Simmons, S., & Limbers, C. A. (2019). Acculturative stress and emotional eating in Latino adolescents. *Eating & Weight Disorders*, *24*(5), 905–914.

52. Singh, G. K., Kogan, M. D., & Yu, S. M. (2009). Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status. *Journal of Community Health*, *34*(4), 271–281.

53. Sussner KM, Lindsay AC, & Peterson KE. (2009). The influence of maternal acculturation on child body mass index at age 24 months. *J Am Diet Assoc*, *109*(2), 218–225. https://doi.org/10.1016/j.jada.2008.10.056. Van Hook, J., & Baker, E. (2010). Big boys and little girls: Gender, acculturation, and weight among young children of immigrants. *Journal of Health & Social Behavior*, *51*(2), 200–214.

54. Villa-Caballero, L., Arredondo, E. M., Campbell, N., & Elder, J. P. (2009). Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children. *Diabetes Educator*, *35*(6), 959–965.

55. Winham, D. M. (2012). Growth status among low-income Mexican and Mexican-American elementary school children. *American Journal of Human Biology*, *24*(5), 690–695.

56. Wojcicki, J., Schwartz, N., Jiménez-Cruz, A., Bacardi-Gascon, M., & Heyman, M. (2012). Acculturation, Dietary Practices and Risk for Childhood Obesity in an Ethnically Heterogeneous Population of Latino School Children in the San Francisco Bay Area. *Journal of Immigrant & Minority Health*, *14*(4), 533–539.

57. Prisma. (n.d.). Retrieved March 9, 2023, from http://www.prisma-statement.org/PRISMAStatement/FlowDiagram

58. Winham, D. M. (2012). Growth status among low-income Mexican and Mexican-American elementary school children. *American Journal of Human Biology*, *24*(5), 690–695.

59. Popkin BM & Udry JR. (1998). Adolescent obesity increases significantly in second and third generation U.S. immigrants: The National Longitudinal Study of Adolescent Health. *J Nutr*, *128*(4), 701–706. https://doi.org/10.1093/jn/128.4.701

60. LeCroy, M. N., Strizich, G. M., Gallo, L. C., Perreira, K. P., Ayala, G. X., Carnethon, M. R., Delamater, A. M., Gonzalez, J. S., Arredondo, E. M., Pulgaron, E. R., & Isasi, C. R. (2021). The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth). *Annals of Behavioral Medicine*, *55*(8), 734–745.

61. Jyu-Lin Chen. (2009). Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese-American Children and Mothers. *Journal of Immigrant & Minority Health*, *11*(3), 198–204.

62. Barroso CS, Roncancio A, Hinojosa MB, & Reifsnider E. (2012). The Association between Early Childhood Overweight and Maternal Factors. *Child Obes*, *8*(5), 449–454. https://doi.org/10.1089/chi.2011.0094

63. McLeod, D. L., Bates, C. R., Heard, A. M., Bohnert, A. M., & Santiago, C. D. (2018). Parent Perceptions of Child Weight Status in Mexican-Origin Immigrant Families: An Investigation of Acculturation, Stress, and Coping Factors. *Journal of Immigrant and Minority Health*, *20*(2), 441–447. https://doi.org/10.1007/s10903-017-0569-5

64. Loren, D. M., Bohnert, A., & Santiago, C. D. (2019). Measures of Acculturation and Relations to zBMI among Mexican-Origin Youth. *Journal of Racial & Ethnic Health Disparities*, *6*(2), 364–370.

65. Villa-Caballero, L., Arredondo, E. M., Campbell, N., & Elder, J. P. (2009). Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children. *Diabetes Educator*, *35*(6), 959–965.

66. LeCroy, M. N., Strizich, G. M., Gallo, L. C., Perreira, K. P., Ayala, G. X., Carnethon, M. R., Delamater, A. M., Gonzalez, J. S., Arredondo, E. M., Pulgaron, E. R., & Isasi, C. R. (2021). The Association of the Parent-Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth). *Annals of Behavioral Medicine*, *55*(8), 734–745.

67. Buscemi J, Beech BM, & Relyea G. (2011). Predictors of obesity in Latino children: Acculturation as a moderator of the relationship between food insecurity and body mass index percentile. *J Immigr Minor Health*, *13*(1), 149–154. https://doi.org/10.1007/s10903-009-9263-6

68. Simmons, S., & Limbers, C. A. (2019). Acculturative stress and emotional eating in Latino adolescents. *Eating & Weight Disorders*, *24*(5), 905–914.

69. Arandia G, Sotres-Alvarez D, Siega-Riz AM, Arredondo EM, Carnethon MR, Delamater AM, Gallo LC, Isasi CR, Marchante AN, Pritchard D, Van Horn L, & Perreira KM. (2018). Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study. *Appetite*, *129*, 25–36. https://doi.org/10.1016/j.appet.2018.06.017

70. McCullough, M. B., Pieloch, K. A., & Marks, A. K. (2020). Body Image, Assimilation, and Weight of Immigrant Adolescents in the United States: A Person-Centered Analysis. *Journal of Immigrant & Minority Health*, *22*(2), 249–254.

71. Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Hughes, S. O. (2015). Obesity Risk in Children: The Role of Acculturation in the Feeding Practices and Styles of Low-Income Hispanic Families. *Childhood Obesity*, *11*(6), 715–721.

72. Barroso CS, Roncancio A, Hinojosa MB, & Reifsnider E. (2012). The Association between Early Childhood Overweight and Maternal Factors. *Child Obes*, *8*(5), 449–454. https://doi.org/10.1089/chi.2011.0094

73. Acciai F, Yellow Horse AJ, & Ohri-Vachaspati P. (2020). Individual-, family-, and contextual-level variables do not explain the protective effect of parental nativity status on changes in 3–15-year-oldchildren's BMI. *SSM Popul Health*, *12*. https://doi.org/10.1016/j.ssmph.2020.100652

74. Ji-Hong Liu, Chu, Y. H., Frongillo, E. A., & Probst, J. C. (2012). Generation and Acculturation Status Are Associated with Dietary Intake and Body Weight in Mexican American Adolescents. *Journal of Nutrition*, *142*(2), 298–305.

75. Popkin BM & Udry JR. (1998). Adolescent obesity increases significantly in second and third generation U.S. immigrants: The National Longitudinal Study of Adolescent Health. *J Nutr*, *128*(4), 701–706. https://doi.org/10.1093/jn/128.4.701

76. Winham, D. M. (2012). Growth status among low-income Mexican and Mexican-American elementary school children. *American Journal of Human Biology*, *24*(5), 690–695.

77. Liu J, Probst JC, Harun N, Bennett KJ, & Torres ME. (2009). Acculturation, physical activity, and obesity among Hispanic adolescents. *Ethn Health*, *14*(5), 509–525. https://doi.org/10.1080/13557850902890209

78. Sussner KM, Lindsay AC, & Peterson KE. (2009). The influence of maternal acculturation on child body mass index at age 24 months. *J Am Diet Assoc*, *109*(2), 218–225. https://doi.org/10.1016/j.jada.2008.10.056

79. Baker, E., Rendall, M., & Weden, M. (2015). Epidemiological Paradox or Immigrant Vulnerability? Obesity Among Young Children of Immigrants. *Demography (Springer Nature)*, *52*(4), 1295–1320.

80. Villa-Caballero, L., Arredondo, E. M., Campbell, N., & Elder, J. P. (2009). Family History of Diabetes, Parental Body Mass Index Predict Obesity in Latino Children. *Diabetes Educator*, *35*(6), 959–965.

81. Buscemi J, Beech BM, & Relyea G. (2011). Predictors of obesity in Latino children: Acculturation as a moderator of the relationship between food insecurity and body mass index percentile. *J Immigr Minor Health*, *13*(1), 149–154. https://doi.org/10.1007/s10903-009-9263-6

82. Jyu-Lin Chen. (2009). Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese-American Children and Mothers. *Journal of Immigrant & Minority Health*, *11*(3), 198–204.

83. Franzen-Castle, L., & Smith, C. (2014). Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second Generation Hmong Children. *Maternal & Child Health Journal*, *18*(1), 73–89.

84. Argueza, B. R., Sokal-Gutierrez, K., & Madsen, K. A. (2020). Obesity and Obesogenic Behaviors in Asian American Children with Immigrant and US-Born Mothers. *International Journal of Environmental Research & Public Health*, *17*(5), 1786.

85. Mulasi-Pokhriyal U, Smith C, & Franzen-Castle L. (2012). Investigating dietary acculturation and intake among US-born and Thailand/Laos-born Hmong-American children aged 9-18 years. *Public Health Nutr*, *15*(1), 176–185. https://doi.org/10.1017/S1368980011001649

86. Jyu-Lin Chen. (2009). Household Income, Maternal Acculturation, Maternal Education Level and Health Behaviors of Chinese-American Children and Mothers. *Journal of Immigrant & Minority Health*, *11*(3), 198–204.

87. Chomitz, V. R., Lee, V., Must, A., Chui, K. K. H., & Brown, A. (2018). Healthy Living Behaviors Among Chinese-American Preschool-Aged Children: Results of a Parent Survey. *Journal of Immigrant & Minority Health*, *20*(4), 926–935.

88. Franzen-Castle, L., & Smith, C. (2014). Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second Generation Hmong Children. *Maternal & Child Health Journal*, *18*(1), 73–89.

89. Singh, G. K., Kogan, M. D., & Yu, S. M. (2009). Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status. *Journal of Community Health*, *34*(4), 271–281.

90. Eisenberg ME, Puhl R, Areba EM, & Neumark-Sztainer D. (2019). Family weight teasing, ethnicity, and acculturation: Associations with well-being among Latinx, Hmong, and Somali Adolescents. *J Psychosom Res*, *122*, 88–93. https://doi.org/10.1016/j.jpsychores.2019.04.007

91. McLeod, D. L., Buscemi, J., & Bohnert, A. M. (2016). Becoming American, becoming obese A systematic review of acculturation and weight among Latino youth. *Obesity reviews: an official journal of the International Association for the Study of Obesity*, *17*(11), 1040–1049. https://doi.org/10.1111/obr.12447

92. Zhang, Q., Liu, R., Diggs, L. A., Wang, Y., & Ling, L. (2019). Does acculturation affect the dietary intakes and body weight status of children of immigrants in the U.S. and other developed countries? A systematic review. *Ethnicity & health*, *24*(1), 73–93. https://doi.org/10.1080/13557858.2017.1315365

93. Vilar-Compte, M., Bustamante, A. V., López-Olmedo, N., Gaitán-Rossi, P., Torres, J., Peterson, K. E., Teruel, G., & Pérez-Escamilla, R. (2021). Migration as a determinant of childhood obesity in the United States and Latin America. *Obesity Reviews*, *22*(S3). https://doi.org/10.1111/obr.13240

94. Delavari, M., Sønderlund, A.L., Swinburn, B. et al. Acculturation and obesity among migrant populations in high income countries – a systematic review. BMC Public Health 13, 458 (2013). https://doi.org/10.1186/1471-2458-13-458

95. Vilar-Compte, M., Bustamante, A. V., López-Olmedo, N., Gaitán-Rossi, P., Torres, J., Peterson, K. E., Teruel, G., & Pérez-Escamilla, R. (2021). Migration as a determinant of childhood obesity in the United States and Latin America. *Obesity Reviews*, *22*(S3). https://doi.org/10.1111/obr.13240

96. Marsiglia, F. F., Kulis, S., FitzHarris, B., & Becerra, D. (2009). Acculturation Gaps and Problem Behaviors among U.S. Southwestern Mexican Youth. *Social Work Forum (New York, N.Y.)*, *42–43*, 6–26.

97. Prisma. (n.d.). Retrieved March 9, 2023, from http://www.prisma-statement.org/PRISMAStatement/FlowDiagram

98. U.S. Department of Health and Human Services. (2023). *Study Quality Assessment Tools*. National Heart Lung and Blood Institute. Retrieved March 9, 2023, from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

99. Delavari, M., Sønderlund, A.L., Swinburn, B. et al. Acculturation and obesity among migrant populations in high income countries – a systematic review. BMC Public Health 13, 458 (2013). https://doi.org/10.1186/1471-2458-13-458

100. Vilar-Compte, M., Bustamante, A. V., López-Olmedo, N., Gaitán-Rossi, P., Torres, J., Peterson, K. E., Teruel, G., & Pérez-Escamilla, R. (2021). Migration as a determinant of childhood obesity in the United States and Latin America. *Obesity Reviews*, *22*(S3). https://doi.org/10.1111/obr.13240