NATIVE CULTURE AND LANGUAGE EXPERIENCES: SUPPORTING THE HEALTH OF AMERICAN INDIAN/ALASKA NATIVE CHILDREN

By

Jessica Sandra Saucedo

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ABSTRACT

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Native culture and language practice have been identified as core supports that have allowed American Indian/Alaska Native (AI/AN) communities to persevere despite adversity. Native culture and language may be important protective factors against obesity; however, this relationship is understudied in the current literature. High obesity rates among AI/AN young children continue to persist despite Native culture and language practice. Food insecurity is an understudied correlate of obesity and its associated health conditions. This study addresses gaps in the existing literature by examining the association between childhood obesity and food insecurity among 2- to 4-year-old AI/AN children, and by examining whether Native culture and language may support resilience. Food insecurity was used to predict obesity, defined as high body mass index, within a sample from the AI/AN Family and Children Experiences Survey 2015 of 476 children who identify as AI/AN alone or in combination with another race. A Native culture practice index and a Native language use scale were used to moderate the relationship between food insecurity and obesity. Ordinary least square regression was used to explore if boys had higher obesity rates than girls; if food insecurity was positively associated with obesity; and if Native culture and language moderated the relationship between food insecurity and obesity. However, these relationships were not statistically significant. Potential reasons for these findings and directions for future exploration are provided.

This thesis is dedicated to all Native children.
You are the future.

ACKNOWLEDGEMENTS

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I am deeply grateful for my mom for always reminding me that I can do anything I set my mind to. To my partner-in-life, Alan, thank you for always cheering me on and supporting me through the ups and downs. I have so much gratitude for my many friends for always grounding me— (including but definitely not limited to) Clarissa, Sergio, Kristine, Jasmine, Rosaura, Jaleah, Ereisa, Kristina, Tatiana, Anna, and Alex.

To those I've lost throughout this process, Uncle Luis and Jesse, I wish we could have celebrated this accomplishment together; even though you're not physically here anymore, I continue to feel your encouragement and joy.

This accomplishment was definitely a community effort, and I am forever grateful to everyone, both mentioned here and not, for helping me reach this goal.

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INTRODUCTION

Obesity affects nearly 13 million children ages 2- to 5-year-olds in the United States (Fryar et al., 2020). Childhood obesity, defined as "body mass index at or above the 95th percentile for children and teens of the same age and sex" (Centers for Disease Control and Prevention [CDC], 2018, para. 1), has become a major health concern in the United States. Children who are considered obese are more likely to be categorized as obese in adulthood, which is associated with increased risk for a variety of chronic and potentially fatal health conditions, such as diabetes, hypertension, and kidney failure (Gordon-Larsen et al., 2010; Kelsey et al., 2014). Childhood obesity rates increased every year from 1988 to 2013 in the U.S. (Ogden et al., 2016). Notably, American Indian/Alaska Native (AI/AN)[1] children and adolescents 2 to 19 years of age are currently being affected by obesity at high rates (Bullock et al., 2017; Schell & Gallo, 2012). Although national data on overweight and obese AI/AN children is missing (Office of Minority Health, 2020), data from older sources display that obesity and negative health consequences due to obesity have systematically affected AI/AN children (Eisenmann et al., 2000; Story et al., 1999; Story et al., 2003; Zephier et al., 1999). Additionally, past research has indicated sex differences in childhood obesity rates, as boys who were identified as AI/AN display slightly increased rates of obesity rates over AI/AN girls of the same age (Zephier et al., 1999). These trends indicated how critical it is to examine possible systemic correlates and protective factors of childhood obesity among AI/AN communities.

Food insecurity is an understudied correlate of obesity, diabetes and hypertension, which are associated health conditions among young AI/AN children (Jernigan et al., 2017). Food

[1] The terms "American Indian/Alaska Native (AI/AN)," "Native American," "Native," and "Indigenous" are used interchangeably and are inclusive of those who identify as Native, Native American, American Indian, Alaska Native, or Indigenous in the United States context.

insecurity is often defined as having difficulty paying for or having insufficient resources for food or having restricted or unreliable access to sufficient and nutritious healthy food (Mohammad et al., 2016; USDA, 2019). Food insecurity rates have increase for all racial and ethnic groups in the United States since 2000 but have increased significantly for AI/AN communities (Jernigan et al., 2017). AI/AN children and families who experience food insecurity may find it challenging to access healthy, nutritious food where rural and urban AI/AN communities report insufficient food and inadequate food quality. Due to the increased risk of obesity affecting AI/AN children and the impact food insecurity has on decreased access to healthy food, it is important to study the possible relationship between food insecurity and obesity among young AI/AN children (Jernigan et al., 2017; Tomayko et al., 2017).

Although food insecurity and obesity may affect AI/AN children more than other displaced racial and ethnic groups, there may be important protective factors to examine. Native culture and language use have been identified as core positive supports that have allowed AI/AN communities to persevere despite adversity (Lowe & Struther, 2004; Weaver et al., 1999). Exposure to cultural practices, such as participating in ceremonial dance, traditional songs, or gathering traditional foods, may act as a buffer against negative health outcomes among AI/AN youth (Barnes-Najor et al., 2019). Further, language exposure may protect against chronic disease (Coe et al., 2004) and decrease negative physical health indicators, such as alcohol and drug abuse, obesity, psycho-social issues (Hodge & Nandy, 2011). Given these findings, Native culture and language may be important protective factors against obesity; however, this relationship is understudied in the current literature.

The current study addresses gaps in the existing literature by examining the association between childhood obesity and food insecurity among AI/AN children ages 2- to 4-years old. I

hypothesize that AI/AN boys will have higher rates of obesity than AI/AN girls. Further, I hypothesize that Native culture and language use will be protective against obesity, such that the relationship between food insecurity and obesity will be lessened for children who are exposed to their Native culture and language compared to children without these cultural and language ties.

LITERATURE REVIEW

Obesity Rates among AI/AN Children

AI/AN children and adolescents 2 to 19 years of age experience obesity at much higher rates than their racial and ethnic counterparts in the United States (Bullock et al., 2017; Schell & Gallo, 2012; Zamora-Kapoor et al., 2019). Health diseases, such as coronary heart disease, hypertension, and type 2 diabetes, have affected AI/AN children in adulthood at increased rates as compared to non-AI/AN children in the United States due to childhood obesity (Espey et al., 2014; Indian Health Service, 2019; Story et al., 2003; Turner Goins & Pilkerton, 2010). One study found obesity rates have increased for preschool-aged AI/AN children since 2003 (Sharma et al., 2009). Skinner et al. (2018) concluded that there was an increase in obesity rate among early childhood in the 2015-2016 school year. Studies that included 2- to 5-year-old AI/AN children in their investigation found increased obesity rates in 2005 compared to children of other racial/ethnic groups (Anderson & Whitaker, 2009) and to AI/AN children of different ages (Adams et al., 2005). The trend differences of obesity rates among 2- to 5-year-old AI/AN children must be examined further for various reasons. First, data used to investigate obesity trends are outdated. Second, early childhood is a critical developmental window for the prevention of obesity in adulthood (Giles et al., 2013; Guyer et al., 2009; Lindsay et al., 2002) and cardiovascular disease (Groner et al., 2006). Lastly, poor diet (Jernigan et al., 2017) and diet habits (Harvey-Berino et al., 2000) due to food insecurity have been found to be correlates of obesity. Food insecurity can affect what how much is eaten (Seligman & Schillinger, 2010); therefore, food insecurity should be investigated further among 2- to 5-year-old AI/AN children.

Body Mass Index and its Criticisms

Body mass index (BMI) is used by the CDC and the WHO to determine obesity. To calculate BMI, weight (in kilograms) is divided by height (in meters) squared. BMI is categorized into four categories: underweight (less than the 5th percentile), normal weight (5th to less than the 85th percentile), overweight (85th to less than the 95th percentile), and obese (95th percentile or greater; CDC, 2018). Given the way BMI is calculated, it cannot measure body fat directly, yet it continues to be a common indicator of health. Although the use of BMI can be useful for determining general weight status at a population level, it has been criticized as being a poor indicator of body fat because it does not differentiate between lean body mass and body fat mass. Additionally, it does not consider ethnicity as an influencing factor (Deurenberg et al, 1998; Hsu et al., 2012; Rothman, 2008), despite evidence that there are ethnic differences in body weight and height, which affect BMI calculations (Heymsfield et al., 2016). The use of BMI as a health indicator can lead to incorrect assertions that individuals in certain categories are unhealthy without taking other factors—body mass, body fat, and factors such as nutritional intake and physical activity—into consideration. Despite these concerns, obesity can be a proxy for life-threatening conditions such as cardiovascular disease, hypertension, and diabetes (Jernigan et al., 2017). Further, BMI is widely used in health assessments because it is easy to assess and is standardized by gender and age.

Sex Differences in Childhood Obesity

Males and females may differ in childhood obesity rates. Although, females have more fat at birth than do males (Dunger et al., 2007), male children have a higher prevalence of obesity across all age groups (Ogden et al., 2012). For example, Mexican American boys and men tend to have higher rates of obesity in comparison to Mexican American girls and women (Frisco et

al., 2016; Kaiser et al, 2004; Ogden et al., 2008; Smith et al., 2016). Individuals who identify as Mexican American often have Native American ancestry, and past research has found Native American ancestry to be associated with increased risk for diabetes among overweight and obese Mexican American individuals (Hu et al., 2015). In 1999, it was found that obesity rates for AI/AN male children and adolescents living in the Great Plains area (i.e., North Dakota, South Dakota, Nebraska, and Iowa) were higher than AI/AN females of the same age group (Zephier, et al., 1999). Furthermore, AI/AN males were found to be more obese than AI/AN females in 5 Indian Health Service regions (Cobb et al, 2014). In 2015, one study found that AI/AN male children ages 2- to 5-years old that were analyzed had a higher prevalence of being obese as compared to AI/AN female children of the same age in the same study; the girls had a higher prevalence of being overweight rather than obese (Bullock et al., 2017). These results imply that there are sex differences in childhood obesity within ethnic groups and should be further investigated in AI/AN children.

Food Insecurity and Childhood Obesity

Food insecurity is commonly defined as having difficulty gathering enough food to meet the needs of all household members due to insufficient money (USDA, 2019) or having restricted or unreliable access to sufficient and nutritious healthy food (Mohammad et al., 2016). Food insecurity may be assessed at a personal level and a child level. Personal food insecurity applies to individual children within a food insecure household, whereas child-level food insecurity applies to all children within a food insecure household (Kaur et al., 2015).

Children who are raised in a food insecure household have a higher risk for developing negative health and academic outcomes such as increased risk of infectious diseases, decreased immune response, decreased academic performance, and increased socio-emotional difficulties

(Cook & Frank, 2008; Fiese et al., 2011). Higher levels of food insecurity also led to lower levels of physical activity, restriction of healthy dietary options, and higher levels of unhealthy eating behaviors such as reduced caloric intake, skipped meals during food shortages, avoidance of food waste, and systematic overconsumption during times when food was adequate (Seligman & Schillinger, 2010).

Food insecurity may contribute to increased rates of obesity, especially among marginalized groups (Adams et al., 2003; Hernandez et al., 2017; Jernigan et al., 2017; Kaiser et al., 2004; Smith et al., 2016). Studies have found a non-significant association between food insecurity and obesity (e.g., Gundersen et al., 2008; Gundersen et al., 2009; Laraia et al., 2004; Lyons et al., 2008); however, these studies were conducted over a decade ago and did not include 2- to 5-year-old AI/AN children in their analyses. Recent studies have found a significant association between food insecurity and obesity specifically among AI/AN, Black, and Hispanic adults (Hernandez et al., 2017; Jernigan et al., 2013; Jernigan et al., 2017). These mixed findings support the need for further exploration of the association between food insecurity and obesity among 2- to 5-year-old AI/AN children.

Underrepresentation of AI/AN Children & Families

Few studies have examined food insecurity and obesity among AI/AN children and households with children between 2- and 5-years-old (Jernigan et al., 2017; Tomayako et al., 2017). This is surprising as significant findings reported insufficient food and low-quality foods were associated with obesity, diabetes, and hypertension; and AI/AN peoples living in rural locations report having insufficient food and inadequate food quality (Jernigan et al., 2017). It may be difficult to study food insecurity and obesity among AI/AN children and families for various reasons. One reason may be that USDA does not typically include AI/AN populations in

their Food Security Data Analysis and Reporting (Jernigan et al., 2017). Additionally, studies on AI/AN communities use data from the Indian Health Service which does not provide age-specific obesity prevalence rates (Story et al., 2003), and the remaining studies (Gundersen et al., 2009; Swindle et al., 2018) use the National Health and Nutrition Examination Survey, which does not include AI/AN communities living on reservations. This omission overlooks approximately 22% of the AI/AN population in the United States (Office of Minority Health, 2018).

The underrepresentation of AI/AN children and families in studies on the association between food security and obesity is shocking given the fact that AI/AN children and adults experience poverty, food insecurity, and obesity at alarmingly high rates (Jernigan et al., 2016; Gordon & Oddo, 2012). Approximately 64% of AI/AN adults live below the poverty level (U.S. Census Bureau, 2017); and high poverty, increased unemployment, and insufficient education may contribute to the risk of food insecurity, particularly for AI/AN families (Gordon & Oddo, 2012). Consistent with this, AI/AN adults are twice as likely to be food insecure compared to their White counterparts (Jernigan et al., 2016), and AI/AN children experience approximately twice the rates of food insecurity than non-AI/AN children (Gordon & Oddo, 2012). Moreover, it is important to explore protective factors for obesity in this population, such as culture and language practice, as they may protect against Western practices that have harmed the communities in the past and in the present. Additionally, it is important to disaggregate results by sex given that the current literature on food insecurity and obesity among AI/AN youth does not discuss possible differences between males and females. Together, this body of research is clear that research on food insecurity and obesity among AI/AN children is needed. Further, protective

factors such as Native language and culture should be examined as moderators of the association between food insecurity and obesity.

Protective Factors of Obesity and Related Health Outcomes for AI/AN Children

Protective factors are characteristics at a biological, psychological, family, community, or cultural level associated with a decreased probability of developing negative outcomes and increase resilience (Substance Abuse and Mental Health Services Administration, 2019). Resilience may be defined as an adaptation process when facing significant sources of stress, trauma, or adversity (American Psychological Association, 2020), and may be considered a protective mechanism that may help an individual's response during critical points in life (LaFromboise et al., 2006). There are three models of resilience—compensatory, protective, and challenge—where the protective model of resiliency moderates or reduces the effects of a risk on a negative outcome (Fleming & Ledogar, 2008). Resilience is important to discuss as AI/AN tribes have faced immense hardships throughout history, such as genocide, forced removal off their lands, and forced relocation onto reservations. Native culture and language may be important protective factors that contribute to resilience against obesity for AI/AN children.

Native Culture

Recent research on the factors influencing childhood obesity among non-AI/AN populations tend to not consider culture as an influencing factor (Ang et al., 2013; Cook & Frank, 2008; Fiese et al., 2011; Seligman & Schillinger, 2010), yet culture was found to act as a protective factor for AI/AN youth. Interviews conducted with American Indian (AI) elders described culture as "teachings and values centered on knowing one's tribal roots and history, understanding intergenerational relationships, and engaging in cultural activities" (Kahn et al., 2016). Of note, AI elders mentioned that teaching culture and cultural values may become a

resilience strategy for creating personal strength and positive character traits among youth (Kahn et al., 2016). Having a strong, cultural identity has been theorized as a core component of well-being for AI/AN individuals (Lowe & Struther, 2004; Weaver et al., 1999). Having a strong, positive cultural identity can develop supportive attributes for health beyond resilience (Fleming & Ledogar, 2008), such as increased self-efficacy and overall well-being among children and teens (Henson et al., 2017; Lacourt et al., 2005; LaFromboise et al., 2006; Pu et al., 2013; Wexler, 2014). LaFromboise et al. (1990) discuss the importance of addressing protective factors, such as resilience, among youth instead of addressing deficits. Additionally, having pride in one's culture has been found to be protective for well-being (Lacourt et al., 2005; LaFromboise et al., 2006). Parents who have children participating in Region XI Head Start Programs find it important for their children to participate in cultural practices as it can create a positive racial identity, strength and resiliency against Western practices and policies that have hurt the community in the past (Barnes-Najor et al., 2019). AI/AN teen parents who have strong cultural bonds are more likely to have positive parenting styles and lower odds of engaging in substance use (Barlow et al., 2010). For Alaska Native adults who identified being bi-cultural, their Native culture acted as protection against blood pressure, cholesterol, and obesity (Philip et al., 2017). With evidence of cultural ties being protective of children's well-being, Native culture should be examined as a protective factor of obesity.

Native Language

Native language can also support children's health in positive ways. Research has described the practice of Indigenous languages among AI/AN and Canadian First Nations groups as having supportive effects in three areas. Positive mental health outcomes increase with increased Native language practice (Hallett et al., 2007). Secondly, engaging in tribal language,

tribal culture, and living on reservations supports children's health (Coe et al., 2004). Lastly, there is support for decreased negative physical health indicators, such as alcohol and drug abuse, obesity, psycho-social issues (Hodge & Nandy, 2011), suicidal ideation, and diabetes (Oster et al., 2014) through the practice of Native language. Therefore, it is imperative to understand how protective factors, such as culture and language, may impact the possible relationship between food insecurity and obesity.

Conceptual Framework

The conceptual framework guiding this work is an extension of three lines of research. Work done with adults has shown that food insecurity plays an important role in the cycle of socioeconomic disparities in chronic disease (Seligman & Schillinger, 2010). As exhibited in Figure 1, according to Seligman and Schillinger (2010), food insecurity complicates chronic disease management by decreasing dietary quality and increasing unhealthy eating behaviors. The resulting chronic diseases—obesity, hypertension, and diabetes—create an increase in psychological stress and a decrease in financial resources which in turn leads to greater food insecurity. This work, when coupled with work conducted to understand the modifiable factors of childhood obesity (e.g., socioeconomic status, physical activity, diet; Ang et al., 2013), highlights the role of food insecurity as a modifiable factor. However, culture and language participation are not considered factors in either of the aforementioned conceptual frameworks. Based on prior research, Native culture and language have been associated with increased self-efficacy (Henson et al., 2017; Pu et al., 2013) and resilience (LaFromboise et al., 2006; Wexler, 2014); decreased blood pressure, diabetes, and cholesterol (Oster et al., 2014; Philip et al., 2017); and reduced substance use and psychological issues (Hodge & Nandy, 2011). The conceptual framework developed from combining Seligman and Schillinger (2010), Ang et al. (2013), and

research on Native culture and language participation, as presented in Figure 2, displays a modified model of the multi-factorial influences of childhood obesity as it highlights the role of food insecurity as a risk factor and AI/AN culture and language as possible moderating factors. In this model, the influence of socioeconomic status occurs through food insecurity. As indicated in Seligman & Schillinger (2010), higher levels of food insecurity led to lower levels of physical activity, restriction of healthy dietary options, and higher levels of unhealthy eating behaviors such as reduced caloric intake, skipped meals during food shortages, avoidance of food waste, and systematic overconsumption during food adequacy. In contrast to food insecurity as a risk factor, participation in AI/AN language and culture is conceptualized as protective factors, leading to an increase in physical activity (engaging in cultural customs such as dances, drumming, harvesting), healthy dietary options (through traditional foods), and healthy eating behaviors (focus on balance). The reduced conceptual model for this study (figure 3) focuses on examining the influence of food insecurity on obesity, and the influence of participating in Native culture and language on both food insecurity and obesity. Physical activity, dietary options, and eating behaviors, which can be seen in figure 2, are not being examined in this study.

Figure 1. *Modified Cycle of Food Insecurity & Chronic Disease (Seligman & Schillinger, 2010)*

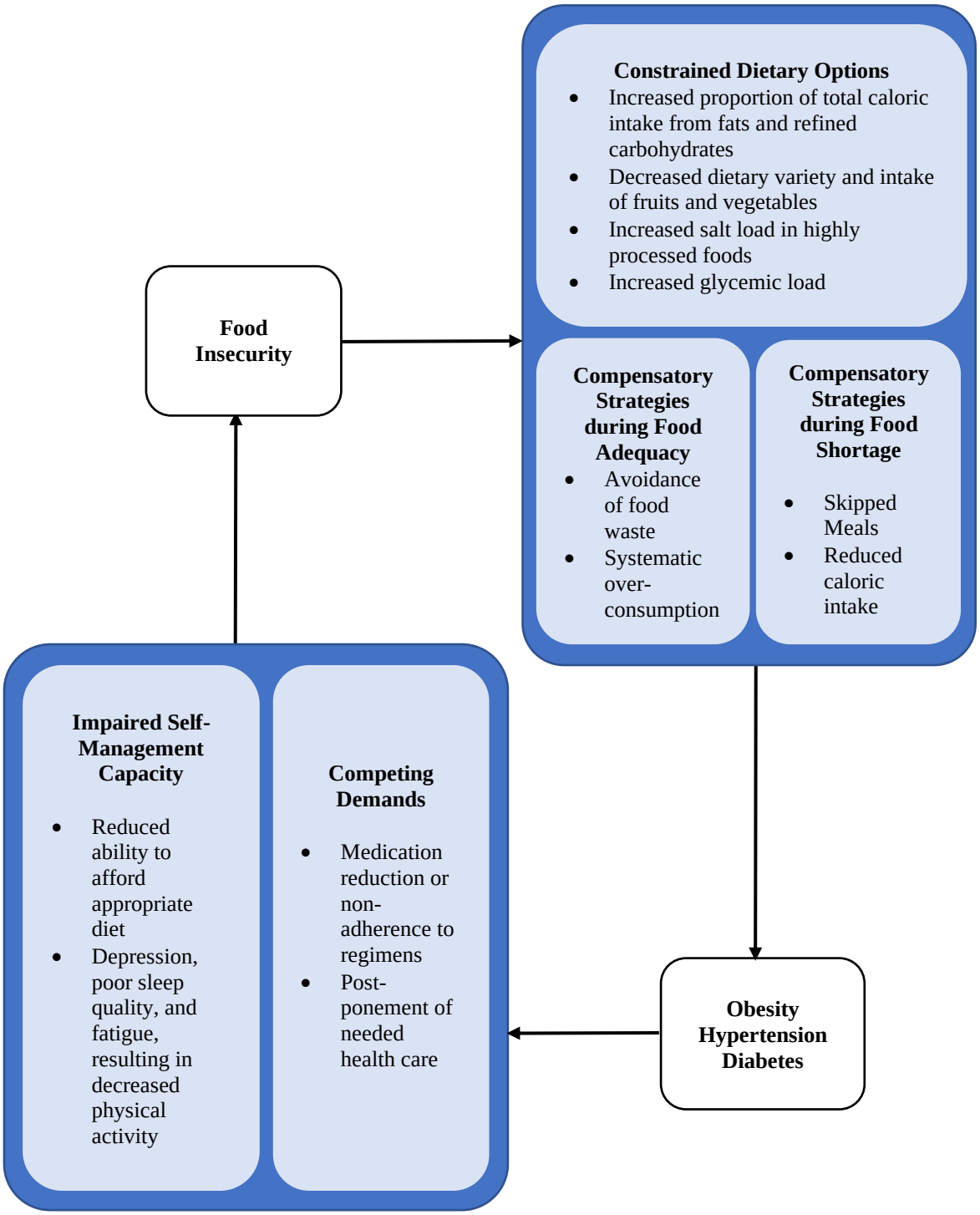


Figure 2. *Conceptual model combining Seligman & Schillinger's (2010) Cycle of Food Insecurity & Chronic Disease, Ang et al.'s (2013) modifiable factors of childhood obesity, and the moderating effects of participating in Native culture and language*

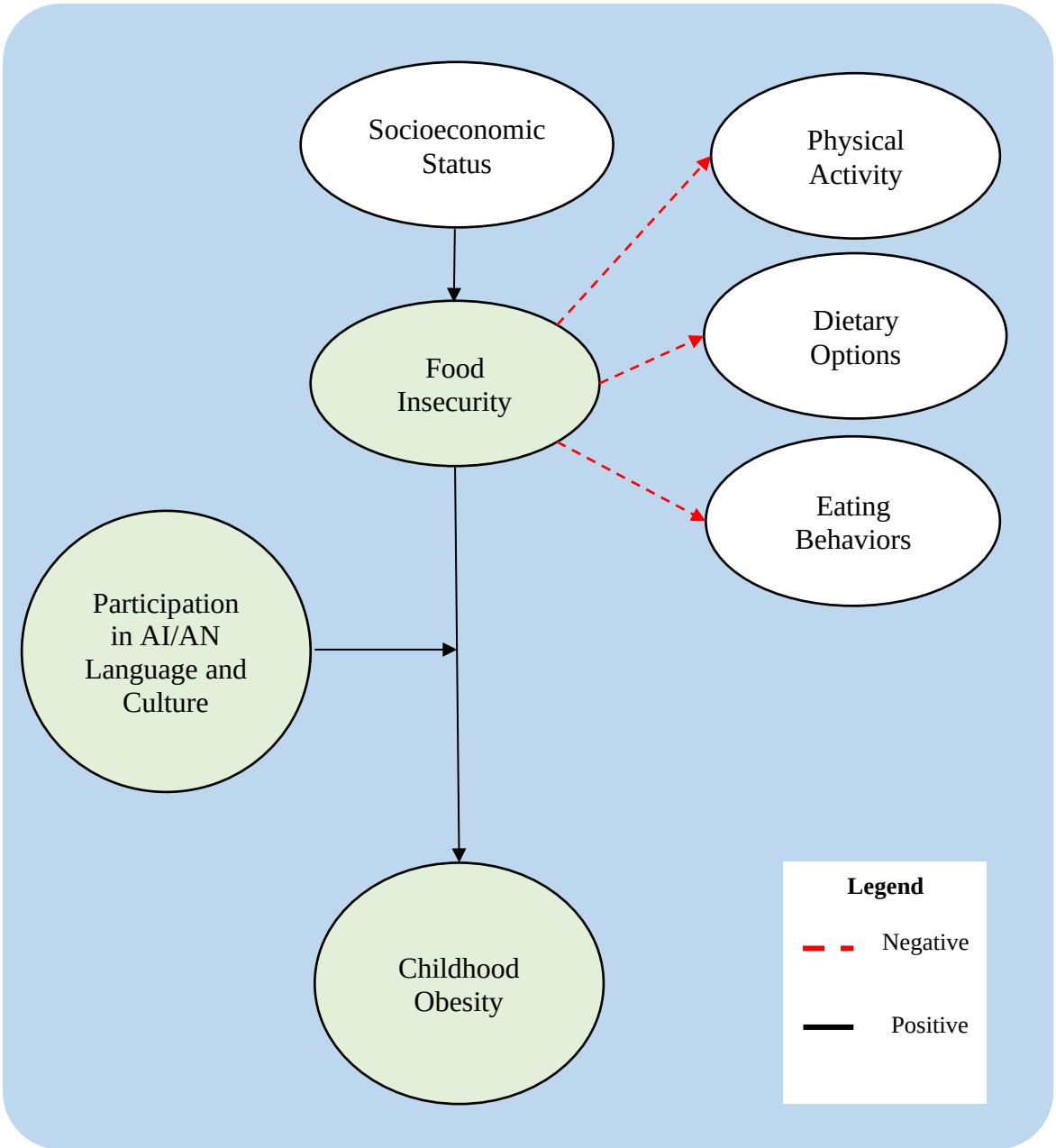
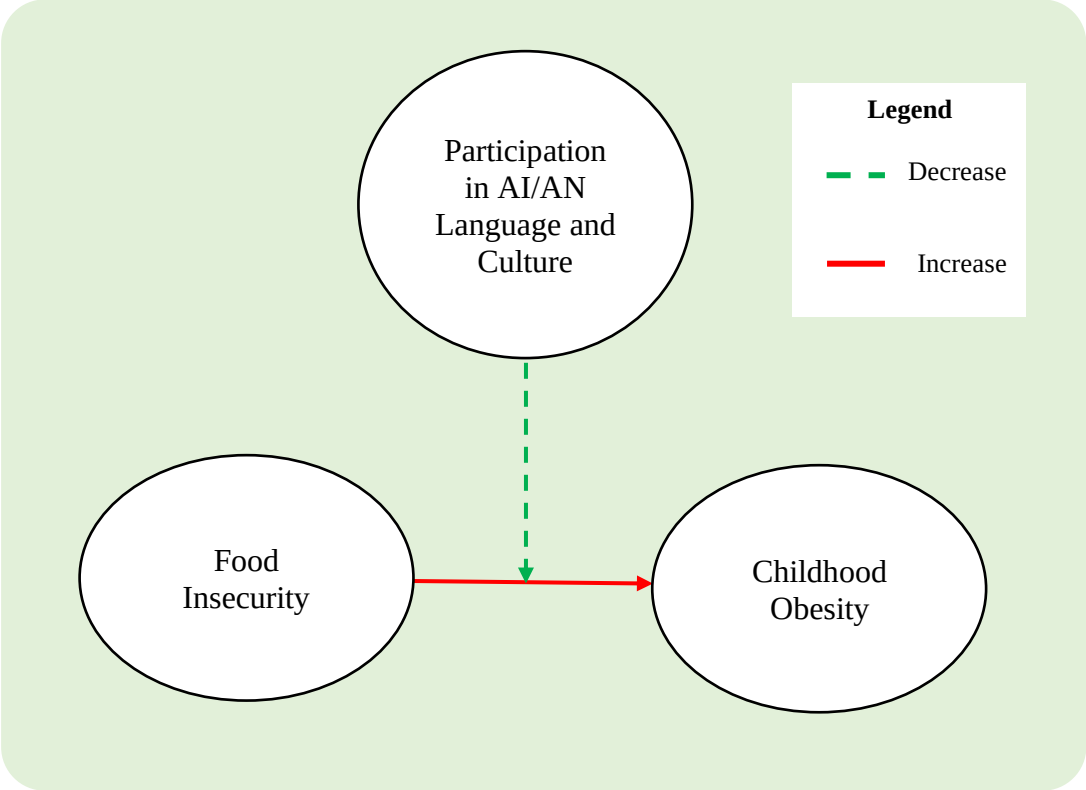


Figure 3. *Reduced conceptual model*



Present Study

The present study examined the relationships between obesity, sex, food insecurity, and Native culture and language among AI/AN children, ages 2- to 4-years old[2] using secondary data from the "AI/AN Head Start Family and Children Experiences Survey (AI/AN FACES 2015)." The present study was guided by the following hypotheses:

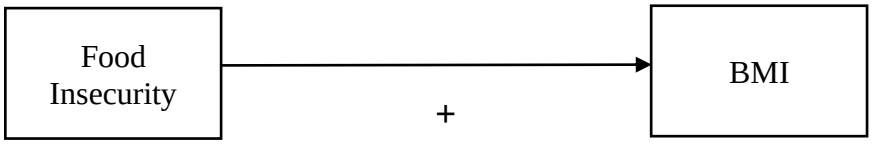
Hypothesis One

AI/AN Head Start boys will have higher obesity rates (defined as high BMI) than AI/AN Head Start girls.

Hypothesis Two

Food insecurity will be positively associated with obesity (defined as high BMI) in 2- to 4-year-old AI/AN Head Start children.

Figure 4. *The Relationship between Food Insecurity and Obesity*

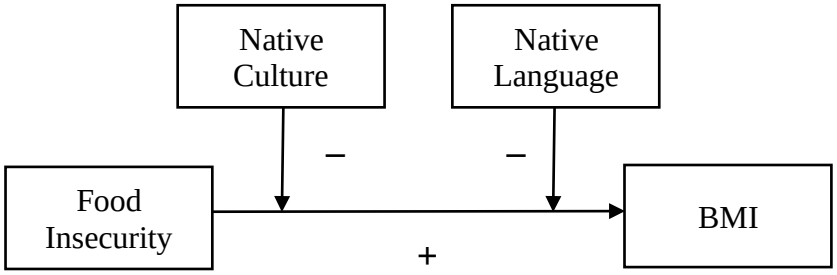


Hypothesis Three

Native culture and language will moderate the relationship between food insecurity and obesity (defined as high BMI) such that higher levels of either Native culture or language will attenuate the relationship between food insecurity and obesity.

[2] Due to small sample size, two cases of 5-year-old children were omitted from the present study.

Figure 5. *The Relationship between Food Insecurity and Obesity Moderated by Native Culture and Language (tested model)*



METHOD

Survey Information

The American Indian and Alaska Native (AI/AN) Head Start Family and Children Experiences Survey (FACES), referred to as the AI/AN FACES 2015, is the first national study of Region XI Head Start children, families, and programs. Head Start programs provide federally funded center- and home-based early childhood education services to low-income children and families throughout the United States. There are twelve regions of Head Start programs; ten regions are defined geographically, and two regions are nationwide and defined by population type. Region XI serves children and families operated by federally recognized AI/AN tribes in the United States. The AI/AN FACES 2015 gathers information to understand the cultural and language experiences of Native children and families in Region XI Head Start programs and is comprised of a nationally representative sample of Region XI Head Start programs, classrooms, and children. FACES, a survey launched by the Office of Planning, Research & Evaluation prior to the AI/AN FACES 2015, has been a source of nationally representative data on Head Start programs, families, and children, but did not include data on Region XI until the 2015-2016 program year. As a large descriptive study, there are multiple components to the AI/AN FACES 2015, including surveys administered to parents, teachers, and Head Start directors, as well as child assessments and classroom observations. For the present study, data was derived from the child assessments and surveys administered to parents (Barnes-Najor et al., 2019; Bernstein et al., 2018).

Region XI Head Start program administrators, researchers, and federal staff involved with the collection of data for the FACES gathered prior to 2015 to plan the data collection. Planning and data collection were informed by principles of participatory action research with

AI/AN communities (e.g., Fisher & Ball, 2003; Jernigan et al., 2014; Lavallée & Howard, 2011) and by receiving advice from a workgroup composed of Region XI Head Start administrators, researchers, and federal government officials. The workgroup was created to discuss the design, implementation, and dissemination of the AI/AN FACES 2015, and to assure that AI/AN community voice was prioritized throughout the project (Barnes-Najor et al., 2019; Bernstein et al., 2018). Workgroup partners have been working together for three years to understand how Native culture and language support children's health and development. The partners have prioritized understanding how children's weight status is influenced by food insecurity and Native culture and language experiences. Currently, the workgroup is conducting analyses from the AI/AN FACES 2015 data to understand the role that Native language and culture experiences play in the development of cognitive skills for children in Region XI Head Start programs. The present study expanded the workgroup's focus to include the analysis, interpretation, and dissemination of findings regarding children's obesity.

Procedure

Data were collected across fall 2015 and spring 2016. Child assessments and parent surveys were conducted during both time periods. Parental consent was obtained for all children who participated in the study.

Parent Survey

Parents were asked to complete a survey which asked about their income and food security status, and their child's Native culture and language experiences at home and in the community, age, and sex. Parents had the option of completing the survey online or through computer-assisted telephone interviewing (CATI) with the guidance of an employee from Mathematica, a research firm contracted by the Office of Planning, Research & Evaluation.

Child Assessments

Child physical outcomes (i.e., height and weight), along with other assessment data not related to the current study, were collected by the AI/AN FACES 2015 staff at the child's Region XI Head Start programs. These were untimed assessments. Table 1 displays the mode, location, and time it took to collect the parent surveys and child assessment across fall 2015 and spring 2016.

Table 1. *Data Collection Components and Characteristics by Time*

Data Collection Component	*Administration Characteristics*	*Fall 2015*	*Spring 2016*
Parent survey	Mode	Online and CATI	Online and CATI
	Location	Online via parent's home, Region XI Head Start program, or other location; CATI by Mathematica employee at a survey center	Online via parent's home, Region XI Head Start program, or other location; CATI by Mathematica employee at a survey center
	Time	30 minutes	30 minutes
Child assessment (specifically when collecting height and weight)	Mode	One-on-one with AI/AN FACES 2015 staff member	One-on-one with AI/AN FACES 2015 staff member
	Location	Region XI Head Start program	Region XI Head Start program
	Time	Untimed	Untimed

Sample

The AI/AN FACES 2015 sample (N = 1,049) includes both AI/AN and non-AI/AN children. To be included in this analysis, the children had to be identified as AI/AN by their

parents and have documented BMI data (n = 766). Due to listwise deletion, the final analytic sample was reduced (n = 476).

A series of t-test and chi-square analyses were conducted to test for significant differences between my final analytic sample and dropped cases. The results are provided in table 2. There were no statistical differences for the two samples for age or sex, but the samples did differ on income. The average income for the analytic sample was between $25,001 to $30,000 ($M$ = 5.33, SD = 3.22), whereas the average income for the non-analytic sample was between $20,001 to $25,000 ($M$ = 4.94, SD = 3.38).

Table 2. *T-test and Chi-square Test Results*

Variable	**Test used**	**Finding**
Age	independent-samples t-test	(t = 1.86, p = .06), *ns*
Sex	chi-square analysis	(X^2 = .29, p = .59), *ns*
Income	chi-square analysis	(X^2 = 28.12, p < .001), *sig*

Participants

Only children who were identified to be American Indian or Alaska Native alone or with another race/ethnicity were included in the analysis. The average age of children included in the analysis was 48 months, or just under 4 years old. However, over 50% of children in the analysis were 4 years old (56.7%). The sample include more males (53%) and females (47%). About 60% of households included in the analysis made up to $30,000 annually. Table 3 provides a summary of participant characteristics.

Table 3. *Sample Characteristics*

	n	*%*
Age (in months)		
2 years old (24 – 35 months)	10	2.1
3 years old (36 – 47 months)	196	41.2
4 years old (48 – 59 months)	270	56.7
Sex		
Female	235	46.8
Male	241	53.2
Household income		
$0 - $5,000	44	6.7
$5,001 - $10,000	49	9.1
$10,001 - $15,000	61	11.2
$15,001 - $20,000	60	11.8
$20,001 - $25,000	55	10.7
$25,001 - $30,000	51	10.3
$30,001 - $35,000	34	8.3
$35,001 - $40,000	24	5.9
$40,001 - $50,000	0	0.0
$50,001 - $75,000	50	13.1
$75,001 - HIGH	48	12.8

Measures

Body mass index (outcome)

BMI, a continuous variable, was calculated using the CDC SAS program based on the CDC Growth Charts (CDC, 2019a). The CDC SAS program requires the height and weight values in metric units (i.e., centimeters and kilograms, respectively). Composite scores for height and weight were created by averaging two metric measurement values for each, which were found in the same instance. To change the values to an imperial scale, the height composite was divided by 0.3937009 and the weight composite was divided by 2.20462262. BMI data for this study were collected in spring 2016.

Sex (control)

Data on a child's sex was derived from the answer recorded in the study's survey management system, which was provided by the parent consent form. If sex was not available in the management system, sex was based on fall 2015 parent survey data and in some instances spring 2016 parent survey data. The options for sex included 0 (female) and 1 (male).

Age (control)

A child's age, in months, was obtained by the parent through the parent survey during fall 2015.

Household income (control)

Parents had 11 income categories to choose from. Categories ranged from $0 to more than $75,000 (see Table 2 for category ranges). Parents' household income was obtained through the parent survey during fall 2015.

Food insecurity (predictor)

Food insecurity data was collected in fall 2015 through the parent survey. Parents described their food security status by answering short form of the 12-month Food Security Scale (Blumberg, et al., 1999), these six items were found to have high specificity and sensitivity for identifying food insecurity and represent the strongest subset of items for measuring food insecurity in households with or without children (Bickel et al., 2000). As recommended (Bickel et al., 2000), responses were dichotomized, reverse coded when appropriate, and summed to create a food security scale score where high scores indicate greater food insecurity. If participants were missing two or more items, their food security scale score was coded as missing. If a single item was missing, its score was imputed by multiplying the respondent's average of the other five items by six. The food insecurity measure ranged from zero (food secure) to six (food insecure with hunger; Malone et al., 2018), and had high internal consistency with this study sample ($\alpha = 0.83$).

Native culture (moderator)

Across fall 2015 and spring 2016, parents answered whether or not their household engaged in six cultural practices, such as teaching children traditional or ceremonial songs, involving children in traditional or ceremonial practices, or including children in visits to the tribal center through the parent survey. Each item was coded as "Yes" (1), "No" (0), or "missing" if they did not know or did not answer the question.

The AI/AN FACES 2015 collected data related to activities about AI/AN culture and traditional ways through six items. For the present study, an exploratory factor analysis (EFA) was conducted through R statistical package to create a single measure for Native culture experiences—an index. The EFA indicated that six items held together as single factor (see

Appendix D for the scree plot). Table 4 displays eigenvalues that were found. Table 6 displays the factor loadings for the items included in the Native culture experiences index. The Native culture experiences index was thus created by summing across the six dichotomous items, ranged from 0 (no exposure to culture experiences) to 6 (high exposure to culture experiences), and demonstrated acceptable internal consistency ($\alpha = 0.69$).

Table 4. *Eigenvalues for Native Culture*

Factors	*Eigenvalues*		
	Total	*% of Variance*	*Cumulative %*
Factor 1	1.53	0.26	0.26
Factor 2	1.09	0.18	0.44

Native language (moderator)

Throughout fall 2015 and spring 2016, parents were asked to provide information regarding frequency of exposure of Native language at home, and whether Native language was usually spoken to the child through the parent survey. Answer options "refused" and "don't know" were excluded from the data by being recoded as "missing."

Similar to Native culture, the AI/AN FACES 2015 collected data on whether a tribal language was spoken at home, as well as how often through six items. For the present study, an EFA was conducted through R statistical package to create a single measure of Native language experiences—a scale (see Appendix D for the scree plot). The EFA indicated that six items held together as single factor. However, one item was omitted because this item had a smaller loading (0.61) compared to the other five items (see table 6) and resulted in a decrement of model fit (*RMSEA* = 0.10, $p < .01$, 90% CI [0.07, 0.13] with the item and (*RMSEA* = 0.04, $p = .63$, 90% CI [0.00, 0.08] without the item). Table 5 displays the factor eigenvalues for Native language. The

scale included five variables initially ranged from “very often (1)” to “never (5).” A mean scale score was created by calculating the mean across the five items (M = 3.33). The resulting scale ranged from 1 to 5, 1 being never having exposure to Native language and 5 being always having exposure to Native language. The internal consistency of the language scale indicated high internal consistency ($\alpha = 0.92$).

Table 5. *Eigenvalues for Native Language*

Factors	*Eigenvalues*		
	Total	*% of Variance*	*Cumulative %*
Factor 1	3.13	0.52	0.52
Factor 2	1.37	0.23	0.75

Table 6. *Exploratory Factor Analysis*

Construct/Items	*M*	*SD*	Loadings	α
Native Culture Index	**0.37**			**0.69**
1. In the past month, has [child] listened to Elders tell stories with someone in your community (outside of your family)?	0.49	0.50	0.41	
2. In the past month, has [child] participated in traditional ways with someone in your community (outside of your family)?	0.49	0.50	0.50	
3. In the past month, has [child] danced/sang/drummed/other cultural activity with someone in your community (outside of your family)?	0.44	0.50	0.66	
4. In the past month, has [child] worked on traditional arts and crafts, such as beading, blanket weaving, or making jewelry, a basket, a painting, or pow-wow regalia with someone in your community (outside of your family)?	0.31	0.46	0.47	

Note. M = mean; SD = standard deviation.

Table 6 (cont'd)

5. In the past month, has [child] participated in traditional ceremonies with someone in your community (outside of your family)?	0.34	0.47	0.64	
6. In the past month, has [child] played American Indian or Alaska Native games with someone in your community (outside of your family)?	0.22	0.42	0.51	
Native Language Scale	**3.33**			**0.92**
1. I spoke our tribal language with my [child/children].	3.36	1.32	0.86	
2. I made sure my [child/children] heard our tribal language spoken by others.	2.86	1.36	0.74	
3. I used our tribal language in prayers or songs with my [child/children].	3.56	1.39	0.77	
4. I used our tribal language in everyday life with my [child/children].	3.38	1.41	0.90	
5. I spoke our tribal language with other adults when my [child was/children were] around.	3.60	1.41	0.86	
Item dropped from scale				
6. I encouraged my [child/children] to learn our tribal language (for example, take classes in school).	2.69	1.44	0.61	

Note. *M* = mean; *SD* = standard deviation.

Analysis

Analysis Weight

The analysis required the application of analysis weights to account for unequal sample selection probabilities and nonrespondents. Mathematica, the policy research firm that led the AI/AN FACES 2015, created analysis weights for all levels of sampling (e.g., child level). Malone et al. (2018) provides detailed information on how the analysis weights for the AI/AN FACES 2015 were created and how they should be used. The analysis weight for the present

study, a spring 2016 cross-sectional weight, specified appropriate use for analyzing parent survey data in fall 2015 or spring 2016 in combination with child assessment data in spring 2016. This analysis weight was deemed appropriate for the present study because the outcome variable, BMI was collected in spring 2016 through the child assessment. The remaining variables of interest for this study were collected across fall 2015 and spring 2016 through parent surveys.

Complex Samples

SPSS Complex Samples allows for analysis weights to be added to an analysis by computing "statistics and standard errors from complex sample designs by incorporating the designs into survey analysis" (IBM, n.d.). Through stratified sampling a representative sample of AI/AN FACES 2015 was analyzed, as Complex Samples selects a sample within subgroups of the survey population (IBM, 2012). Therefore, inferences from the results are more statistically valid due to incorporating the complex sampling design in the analysis.

RESULTS

Data was analyzed using general linear models (GLMs) through Complex Samples in SPSS to examine if food insecurity predicted obesity (defined as high BMI), and if the relationship between food insecurity and obesity was moderated by Native culture and Native language. After conducting listwise deletion of missing data through Complex Samples, a total of 476 cases were included in the analysis. The first general linear model (GLM) included age, sex, and household income. The second model included the prior variables in addition to food insecurity. Model three, added Native culture and the interaction term (i.e., food insecurity by Native culture). The final model included age, sex, household income, food insecurity, Native language, and the interaction term (i.e., food insecurity by Native language). Table 7 provides the regression equations used to guide the analysis.

Table 7. *Obesity predicted by food insecurity, Native culture, and Native language, controlling for sex, age, and income*

Model	*Regression Equation*
1	$\hat{Y}_{obesity} = \alpha + \beta_{sex} x_{sex} + \beta_{age} x_{age} + \beta_{income} x_{income} + \varepsilon$
2	$\hat{Y}_{obesity} = \alpha + \beta_{sex} x_{sex} + \beta_{age} x_{age} + \beta_{income} x_{income} + \beta_{food\ insecurity} X_{food\ insecurity} + \varepsilon$
3	$\hat{Y}_{obesity} = \alpha + \beta_{sex} x_{sex} + \beta_{age} x_{age} + \beta_{income} x_{income} + \beta_{food\ insecurity} X_{food\ insecurity} + \beta_{Native\ culture} X_{Native\ culture} + \beta_{food\ insecurity\ x\ Native\ culture} X_{food\ insecurity\ x\ Native\ culture} + \varepsilon$
4	$\hat{Y}_{obesity} = \alpha + \beta_{sex} x_{sex} + \beta_{age} x_{age} + \beta_{income} x_{income} + \beta_{food\ insecurity} X_{food\ insecurity} + \beta_{Native\ language} X_{Native\ language} + \beta_{food\ insecurity\ x\ Native\ language} X_{food\ insecurity\ x\ Native\ language} + \varepsilon$

In addition to the GLMs, descriptive statistics were examined across all variables. The correlation matrix (table 8) displays the correlations, means, and standard deviations of the control, predictor, and outcome variables. It is noteworthy to highlight that the Native language scale was not reverse coded (i.e., 1 = very often and 5 = never); therefore, the significant negative correlation indicates a positive association between Native culture and Native language, as expected (r = -.51, p < .001). Interestingly, with more income, less Native language was spoken or used (r = .27, p < .001).

Table 8. *Means, Standard Deviations, and Correlations of the Control, Predictor, and Outcome Variables*

Variable	*M*	*SD*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
(1) Age	48.03	6.76	—						
(2) Sex	.51	.50	.07	—					
(3) Income	5.47	3.15	.05	-.16**	—				
(4) Body mass index	16.75	1.99	-.05	.02	-.00	—			
(5) Food insecurity status	1.12	1.67	-.06	.05	-.17**	-.02	—		
(6) Native culture index	2.23	1.77	-.07	.13**	-.05	.04	-.05	—	
(7) Native language scale	3.33	1.21	-.03	-.16**	.27**	-.01	-.05	-.51**	—

Note. n = 476; **p < .001

Model One

Income was entered into this model as a control variable because food insecurity is often dependent on household income and one past study examining food insecurity among AI/AN families and early childhood also examined income (Jernigan et al., 2017). Age was also

included into this model as a control variable because there are wide developmental differences between 2-, 3-, and 4-year-old children (CDC, 2021). Sex differences in BMI were examined before the remaining predictor variables were added to the GLMs; sex acted as a control variable for models two, three, and four as there are sex differences in BMI among Native youth (Bullock et al., 2017). Sex, age, and income did not explain a significant proportion of the variance in BMI [R^2 = .003, Wald F (1, 15) = 0.79, p = .39], and sex differences were not significant[3] (B = -.04, p = 0.85; see Table 9).

Table 9. *Unstandardized coefficients and standard errors for general linear model one examining differences in sex*

	Model 1						
	n = 476						
Variable	*B*	*SE*	*95% CI*		*t*	*p*	*Design Effect*
			LL	*UL*			
Age	.01	.02	-.02	.04	.76	.46	1.20
Sex	-.04	.20	-.45	.38	-.19	.85	1.13
Income	-.02	.04	-.11	.07	-.45	.66	2.06
R^2	.003						

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit

[3]Originally, there were 576 eligible cases prior to listwise deletion. Due to listwise deletion, the final analytic sample was reduced to 476. Analyses were run using the larger sample [R^2 = .002, Wald F (1, 15) = 0.79, p = .39] and yielded similar results to the final analytic sample.

Model Two

Model two did not explain a significantly greater proportion of variance in BMI than model one (ΔF (1, 471) = .00, p = .05; see Table 10). With the addition of food insecurity, the second model still explained a relatively low proportion of the variance in BMI [R^2 = .003, Wald F (1, 15) = 0.81, p = .39]. Food insecurity positively predicted BMI, although it was not significant (B = .02, p = .67). Controlling for all other predictors, individuals who reported more food insecurity also had higher BMIs, such that for each 1 unit increase in food insecurity, BMI increased by .02 units.

Table 10. *Unstandardized coefficients and standard errors for general linear model two predicting obesity (defined as high body mass index) due to food insecurity*

	Model 2						
	n = 476						
Variable	*B*	*SE*	*95% CI*		*t*	*p*	*Design Effect*
			LL	*UL*			
Age	.01	.02	-.02	.04	.75	.47	1.21
Sex	-.04	.19	-.44	.38	-.18	.86	1.08
Income	-.02	.04	-.11	.08	-.37	.72	2.19
Food insecurity	.02	.05	-.09	.13	.44	.67	.79
R^2	.003						
ΔR^2	.00						
ΔF	.00						

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit

Model Three

Model three did not explain a significantly greater proportion of variance in BMI than model two (ΔF (2, 469) = .002, p = .05; see Table 11). The addition of variables in the third model did not lead to a significant increase in the r-squared value [R^2 = .008, Wald F (1, 15) = 0.81, p = .39], which suggests that Native culture may not be playing a role in preventing high BMI. There was not a significant main effect of Native culture on BMI (B = .07, p = .53). There was also not a significant interaction effect (i.e., food insecurity*Native culture; B = .01, p = .82). Native culture did not significantly attenuate the relationship between food insecurity and BMI, as hypothesized.

Table 11. *Unstandardized coefficients and standard errors for general linear model three moderating the relationship between food insecurity and obesity (defined as high body mass index)*

	Model 3						
	n = 476						
Variable	*B*	*SE*	*95% CI*		*t*	*p*	*Design Effect*
			LL	*UL*			
Age	.01	.01	-.02	.04	.58	.57	.93
Sex	-.01	.19	-.42	.40	-.06	.95	1.13
Income	-.01	.04	-.10	.07	-.34	.74	1.93
Food insecurity	.01	.10	-.20	.21	.07	.95	1.28
Native culture scale	.07	.11	-.16	.30	.64	.53	2.58
Food insecurity*Native culture	.01	.04	-.07	.09	.24	.82	1.63

Table 11 (cont'd)

	Model 3						
	n = 476						
Variable	*B*	*SE*	*95% CI*		*t*	*p*	*Design Effect*
			LL	*UL*			
R^2	.008						
ΔR^2	.005						
ΔF	.002						

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit

Model four did not explain a significantly greater proportion of variance in BMI than model two (ΔF (2, 469) = .002, p = .05; see Table 12). The addition of variables in the fourth model did not lead to a significant increase in the r-squared value [R^2 = .004, Wald F (1, 15) = 0.09, p = .77], which suggests that Native language also may not be playing a role in preventing high BMI. Like model three, there was not a significant main effect of Native language on BMI (B = .04, p = .77). There was also not a significant interaction effect (i.e., food insecurity*Native language; B = -.04, p = .50). Native language also did not significantly attenuate the relationship between food insecurity and BMI, as hypothesized.

Table 12. *Unstandardized coefficients and standard errors for general linear model four moderating the relationship between food insecurity and obesity (defined as high body mass index)*

	Model 4						
	n = 476						
Variable	*B*	*SE*	*95% CI*		*t*	*p*	*Design Effect*
			LL	*UL*			
Age	.01	.01	-.02	.04	.76	.46	1.00
Sex	-.03	.20	-.45	.38	-.16	.87	1.14
Income	-.02	.04	-.09	.06	-.48	.64	1.34
Food insecurity	.17	.23	-.33	.65	.72	.48	1.17
Native language index	.04	.14	-.25	.33	.30	.77	1.81
Food insecurity* Native language	-.04	.06	-.18	.09	-.69	.50	1.30
R^2	.004						

Note. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit

DISCUSSION

This study aimed to investigate differences in obesity rates between AI/AN young male and female children; the relationship between food insecurity on increased obesity rates among 2- to 4-year-old AI/AN children; and the impact of Native culture and language practice on the relationship between food insecurity and obesity rates. Past studies on obesity trends and its correlates have omitted AI/AN individuals from their investigations, and when AI/AN individuals are included, rarely is early childhood the focus. This is shocking given the fact that AI/AN communities tend to have increased rates of obesity, high blood sugar, and diabetes among adults (Jernigan et al., 2017). Further, early childhood is a critical developmental window for the prevention of chronic disease in adulthood (Guyer et al., 2009).

In this study, the relationship between food insecurity and obesity was examined, in addition to examining sex differences in obesity rates. Lastly, Native culture and language was used to test a moderation model for the relation between food insecurity and obesity. None of the hypotheses were supported; there were no significant differences in obesity rates between AI/AN boys and girls; food insecurity was not significantly associated with obesity in 2- to 4-year-old AI/AN Head Start children; and Native culture and language did not significantly moderate the relationship between food insecurity and obesity. In this section, various reasons for the findings will be explored. The expected relationships will be described in relation to the findings and how these findings have been interpreted within the community partnership. Interpretations and explanations of findings include a discussion of the challenges with creating expected hypotheses based on research other populations (not AI/AN communities and not young children). Challenges with measurement in AI/AN FACES will also be explored. Finally, community reflections on the importance and meaning of the findings will be described.

Hypothesis One

It was expected that males in the sample would have higher obesity rates than females; this hypothesis was not supported. This finding that males and females did not have statistically significantly different obesity rates does not align with past research findings. In studies of AI/AN adults (Cobb et al., 2014) and children and teens, ages 5- to 17-years-old (Zephier et al., 1999), AI/AN males often have a higher BMI compared to AI/AN females of the same age. As of 2015, 2- to 5-year-old Native male children had the highest prevalence of being in the obese category, while Native female children of the same age had a higher prevalence of being in the overweight category (Bullock et al., 2017). Although the finding for hypothesis one was unexpected, early childhood is an ever-changing developmental stage, as most children are consistently growing. Given this, there may be issues with the fluctuating nature of height and weight of very young children (e.g., before growth spurts, children are more likely to be shorter and have higher weight). In addition to the variable state of children's height and weight status, there may be an issue with the unestablished patterns of obesity in early childhood. Research suggests that this may be the case for early childhood of all races (i.e., 2- to 5-years old (Child Trends, 2018)). For example, in 2011-2012, males were more obese as compared to females, at 9.5 and 7.2 percent, respectively. In 2013-2014, as males were less obese than females, at 8.8 and 10 percent, respectively. In 2015-2016, males were more obese than females again, at 14.3 and 13.5 percent, respectively. These trends display the fluctuating sex differences every two years and the increase of obesity among 2- to 5-year-old children.

Hypothesis Two

Food insecurity was hypothesized to increase obesity rates among 2- to 4-year-old AI/AN children. Similar to hypothesis one, this was not supported. This is both similar and contradictory

to past research examining the relationship between food insecurity and obesity. Past studies that also found a non-significant association between food insecurity and obesity did not examine AI/AN children (e.g., Gundersen et al., 2008; Gundersen et al., 2009; Laraia et al., 2004; Lyons et al., 2008). However, other research has found a significant association between food insecurity and obesity, especially among marginalized ethnic groups in the United States. It was expected that the relationship would be similar to those found among AI/AN children and adults (Adams et al., 2019; Jernigan et al., 2017) and other marginalized ethnic groups in the United States (Adams et al., 2003; Hernandez et al., 2017; Kaiser et al., 2004; Smith et al., 2016), but this was not the case. As indicated in Adams et al. (2019), there is a lack of research on obesity among 2- to- 5-year-old Native children. To the author's knowledge, the current study was one of the first to examine the relationship between food insecurity and obesity in the context of AI/AN 2- to 4-year-old children. Adams et al. (2019) explored possible predictors of obesity among young Native children and their parents. They found food insecurity to be a statistically insignificant predictor of child and adult BMI, and food insecurity had a negative association to obesity in childhood (Adams et al., 2019) found in the current study. Based on the reduced conceptual model (figure 3), food insecurity and childhood obesity may not be associated, or there may be other concepts that were not included in the reduced conceptual model. For instance, the current study did not expect the young age of the children to be an impacting factor on the results. Early childhood (i.e., 2- to- 5-years-old) may be too young of an age to find significant results on the association between food insecurity and obesity. Therefore, the results indicate the need to continue examining the impact of food insecurity on the health and well-being of Native American young children; further, the impact of food insecurity across the lifespan should also be considered.

Hypothesis Three

Lastly, the impact of Native culture and language practice on the relationship between food insecurity and obesity rates was examined. Results from conducting general linear models indicated that Native culture and language practice did not decrease the relationship of food insecurity on obesity. These results do not support prior research, as Native culture and language have been found to support Native children's health and well-being (Coe et al., 2004; Fleming & Ledogar, 2008; Hallett et al., 2007; Henson et al., 2017; Hodge & Nandy, 2011; Lacourt et al., 2005; LaFromboise et al., 2006; Lowe & Struther, 2004; Oster et al., 2014; Pu et al., 2013; Weaver et al., 1999; Wexler, 2014). Food insecurity is a large, systemic issue that can lead to individual-level factors of obesity (i.e., less physical activity, fewer dietary options, and negative eating behaviors, see figure 2). In other words, the reasons for food insecurity among Native communities (i.e., settler colonialism, the "Western" diet; McCoy, 2012) may have a more direct impact on the individual level factors of obesity. Although, settler colonialism, the dietary options, physical activity, and negative eating behaviors were not examined in this study. The reduced conceptual model (figure 3) did not take the factors on food insecurity and the individual-level factors of obesity into consideration. Examining food insecurity and its impact on obesity may require considering not only individual-level reasons, but historical and structural reasons as well.

Additionally, conceptualizing Native culture into a scale with six items and Native language into an index with five items may not have taken all aspects of Native culture and language into consideration, as this is not possible. The AI/AN FACES 2015 included questions on culture and language practice that focused on broad buckets of how Native language and culture are expressed, as well as how families include their children in their Native culture and

language practice. There is immense variation across tribal communities in the United States, and culture and the use of Native language are complex; therefore, it is difficult to capture a picture of Native culture and language into a few items. Moreover, settler colonialism has negatively impacted Native communities for years and has made it difficult for Native communities to practice their culture and to pass it to other family members. Although the literature indicates that culture and language support child physical and mental health, the AI/AN FACES 2015 data was limited. The items included in this study that ask about Native culture and language practice are not necessarily related to health outcomes. The items used for the Native culture scale and Native language index are capturing different concepts that may not be associated with food insecurity and BMI; however, these items were chosen for this study based on the findings reported in Barnes-Najor et al. (2019).

The insignificant results of this study may have highlighted the possibility that obesity is not directly related to food insecurity, particularly among this age group. Because obesity is a more distant outcome of food insecurity, these relationships may be more reliably associated and assessed for older children and adolescents. Further, eating choices are usually not made by young children, but by those who take care of them (Savage et al., 2007). This was also the case when children do have the agency to choose their food, specifically while at early childcare centers, as the educator continues to influence what children can eat (Harte et al., 2019). The children examined in the current study may be too young in age for the proposed relationships to hold.

Strengths, Limitations, and Future Research

As with all research studies, this study had its strengths and limitations; and there are opportunities to improve future research. The main strength of the current study was the novelty

of the data used. The AI/AN FACES 2015 is the first survey to gather information on tribal Head Start program children and families, and it is nationally representative. However, this indicates a limitation of the study, as past research on other populations and age groups have been used to hypothesize outcomes for the Native early childhood population. Second, this study adopted a strengths-based lens to study obesity rates among Native children, specifically by examining the impact of Native language and culture as protective factors against a chronic disease that settler colonialism imposed on tribal communities across the United States and North America.

The study's main limitation was examining the relationship between food insecurity and obesity and the moderating effects of Native culture and language among a young age group cross-sectionally. Longitudinal research should be considered when examining the impact of Native culture and language on children's health, as it may be too early to detect the positive impact of culture and language in early childhood. The relationship to a child's culture and language may be more meaningful for teens.

An additional limitation to the study was the use of a specific BMI variable as the outcome. BMI was collected in spring 2016, while the predictor variables—food insecurity, Native culture and Native language, age, sex, household income—were collected in fall 2015. Theoretically, this was the most appropriate decision for analyses as all predictors should be collected prior or concurrent to the outcome variable. Analytically, this decision may not have been the most appropriate choice, as there is a wide time gap (i.e., at least 3 months) between when the predictor variables were collected and when spring BMI was collected. With a wide time gap between the outcome and the predictors, establishing a statistically significant relationship between variables became difficult. Further, these relationships may be too far apart to study.

Future research should examine more direct relations between culture and language, and food insecurity and obesity. Settler colonialism, the dietary options, physical activity, and negative eating behaviors should be more closely examined, as food insecurity and increased obesity rates may be influenced by historical and structural factors. Additionally, similar research should be conducted but with a different health indicator. BMI is a commonly used indicator of health, although it has been criticized for being a poor indicator of body fat due to its inability to differentiate between lean body mass and body fat mass. This differentiation is important as body mass composition can vary across ethnic groups, resulting in inequities in how BMI is applied. Further, nutritional intake, dietary options, and physical activity are not taken into consideration when calculating BMI. Nutritional intake, dietary options, and physical activity are important to consider as, studies have found these to be influential factors on health (Ang et al., 2013). The AI/AN FACES 2015 data do not include information on children's physical activity, dietary options, and nutritional intake; therefore, these factors were not investigated in this study. Furthermore, a different, more appropriate indicator of health that aligns best with Native American culture should be used in future research. Moreover, it is possible that tribal communities across North America define health in a number of ways, as there is no pan-Native experience. Given this, the author of this paper is currently working with Michigan tribal community partners to research and redefine health in Michigan tribal communities. My community partners and I are collaborating to identify a more appropriate measure of health, rather than using BMI. Lastly, future studies should consider and examine children's eating behaviors, dietary options, and physical activity. Although the AI/AN FACES 2015 did not examine these factors collect data on these factors, the Center for American Indian Health at Johns Hopkins Bloomberg School of Public Health is currently conducting the Preventing Early

Childhood Obesity study, which evaluates the impact of a home visiting lesson that promotes healthy infant feeding and growth (Center for American Indian Health, n.d.).

CONCLUSION

Native culture and language provide a strengths-based framework for examining AI/AN child and adult health and well-being (Coe et al., 2004; Fleming & Ledogar, 2008; Hallett et al., 2007; Henson et al., 2017; Hodge & Nandy, 2011; Lacourt et al., 2005; LaFromboise et al., 2006; Lowe & Struther, 2004; Oster et al., 2014; Pu et al., 2013; Weaver et al., 1999; Wexler, 2014). Combating childhood obesity and systemic issues, such as food insecurity, has begun with the revitalization of Native culture and language exposure and practice in early childhood. This study is a valuable addition to the literature on the impact culture and language have on young children. Additionally, this study has highlighted what health may not represent in Native communities (i.e., BMI is not an appropriate health indicator, especially for ethnic groups such as AI/ANs. Ultimately, the findings from this study indicate the need to continue researching the short-term, and possibly long-term, impact of Native culture and language on the health of AI/AN youth.

APPENDICES

APPENDIX A:

Survey Questions on Child Demographic Information

A. ABOUT YOUR CHILD

A1. Is [CHILD] a boy or a girl?

- ❍ Girl
- ❍ Boy

A2. What is [CHILD]'s birth date?

☐

MM/DD/YYYY

A3. Is [CHILD] of Spanish, Hispanic, or Latino origin?

- ❍ Yes
- ❍ No

A4. What is [CHILD]'s race? You may enter more than one if you like.

Select all that apply

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian, or other Pacific Islander
- ☐ Another race

Please specify other race. ☐

A5. Is [CHILD] currently enrolled in an American Indian or Alaska Native tribe?

Select one only

- ❍ Yes, enrolled

Specify ☐

- ❍ No, but have applied and awaiting approval
- ❍ No, not enrolled

A6. Please enter the country [CHILD] was born in.

Select one only

- ❍ USA
- ❍ Canada

- ❍ Mexico
- ❍ Another country

Specify ☐

A7. Did [CHILD] participate in Early Head Start?

Early Head Start is a program designed to provide services to enhance development of children from birth to three years of age.

- ❍ Yes
- ❍ No

APPENDIX B:

Survey Questions on Children's Native Culture and Language Exposure

C. ACTIVITIES WITH YOUR CHILD

C1. The next questions are about you and [CHILD] at home.

How many times have you or someone in your family read to [CHILD] in the past week?

Note: By family, we mean the people living together in your household.

Would you say… (select only one)

- ❍ not at all
- ❍ once or twice
- ❍ three or more times, but not every day
- ❍ every day

C2. In the past week, have you or someone in your family done the following things with [CHILD]?

The following activities can be done in your native language or in English.

Select one per row

	Yes	No
a. Told [him/her/him or her] a story?	❍	❍
b. Taught [him/her/him or her] letters, words, or numbers?	❍	❍
c. Taught [him/her/him or her] songs or music, including traditional or ceremonial songs?	❍	❍
d. Worked on arts and crafts (such as painting or jewelry making) with [him/her/him or her]?	❍	❍
e. Played with toys or games indoors?	❍	❍
f. Danced, played a game, sport, or exercised together?	❍	❍
g. Took [him/her/him or her] along while doing errands like going to the post office, store, tribal center or office, doctor, or to check on elderly family members?	❍	❍
h. Involved [him/her/him or her] in household chores like cooking, cleaning or picking up after him/herself, setting the table, caring for animals such as pets or livestock, or helping with planting or chopping wood?	❍	❍
i. Talked about what happened in Head Start?	❍	❍
j. Talked about TV programs or videos?	❍	❍
k. Played counting games like singing songs with numbers or reading books with numbers with [him/her/him or her]?	❍	❍

l.	Played a board game or a card game with [him/her/him or her]?	❍	❍
m.	Played with blocks with [him/her/him or her]?	❍	❍
n.	Counted different things with [him/her/him or her], like twigs, stones, grapes, or stars?	❍	❍

C3. How many times have you or someone in your family told stories to [CHILD] in the past <u>week</u>? Would you say…

- ❍ once or twice
- ❍ three or more times, but not every day
- ❍ every day

C4. About how many children's books does [CHILD] have in your home now, including library books? Please only include books that are for children. *(Your best estimate is fine.)*

C5. <u>In the past month</u>, has [CHILD] done the following with someone in your community (outside of your family)?

		Select one per row	
		Yes	No
a.	Listened to Elders tell stories?	❍	❍
b.	Participated in traditional ways, including carving, harvesting, collecting, hunting, and fishing?	❍	❍
c.	Danced, sang, or drummed at a pow-wow or other community cultural activity?	❍	❍
d.	Worked on traditional arts and crafts, such as beading, blanket weaving, or making jewelry, a basket, a painting, or pow-wow regalia?	❍	❍
e.	Participated in traditional ceremonies?	❍	❍
f.	Played American Indian or Alaska Native games?	❍	❍

C6. Is any language other than English spoken in your home?

- ❍ Yes
- ❍ No

C7. What other languages are spoken in your home?

Select all that apply

☐ Your tribal language

Specify ____

☐ Languages of other tribes

Specify ____

☐ French

☐ Spanish

☐ Another language

Specify ____

C8. What language do you usually speak to [CHILD] at home?

Select one only

❍ English

❍ Your tribal language

❍ Languages of other tribes

❍ French

❍ Spanish

❍ Another language

Specify ____

C9. Please indicate how often you did each of the things below in the <u>past month</u>.

	SELECT ONE PER ROW				
	VERY OFTEN	OFTEN	SOME-TIMES	RARELY	NEVER
a. I spoke our tribal language with my [child/children].	❍	❍	❍	❍	❍
b. I made sure my [child/children] heard our tribal language spoken by others.	❍	❍	❍	❍	❍
c. I encouraged my [child/children] to learn our tribal language (for example, take classes in school).	❍	❍	❍	❍	❍
d. I used our tribal language in prayers or songs with my [child/children].	❍	❍	❍	❍	❍
e. I used our tribal language in everyday life with my [child/children].	❍	❍	❍	❍	❍
f. I spoke our tribal language with other adults when my [child was/children were] around.	❍	❍	❍	❍	❍

C10. How important is it for you that your [child learns/children learn] your tribal language?

Select one only

- ❍ Very important
- ❍ Somewhat important
- ❍ Not at all important

C11. What languages are spoken at your child's Head Start center?

Select all that apply

- ☐ English
- ☐ Your tribal language
- ☐ Languages of other tribes
- ☐ French
- ☐ Spanish
- ☐ Another language

Specify [ ]

C12. How often is there someone in [CHILD]'s Head Start classroom available to talk to [him/her/him or her] in the language you usually use at home? Would you say it is…

Select one only

- ❍ always
- ❍ sometimes
- ❍ never

APPENDIX C:

Survey Questions on Income and Food Insecurity

I. INCOME AND HOUSING

I1. In the <u>past six months</u>, did you or anyone in your household receive any income or support from the following sources...

Select one per row

	Yes	No
a. [FILL WITH STATE WELFARE NAME] or welfare?	❍	❍
b. Unemployment insurance?	❍	❍
c. Food Stamps or SNAP benefits?	❍	❍
d. WIC - Special Supplemental Food Program for Women, Infants, and Children?	❍	❍
e. Child support?	❍	❍
f. SSI or Social Security Retirement, Disability, or Survivor's benefits?	❍	❍
g. Payments for providing foster care, guardianship subsidies, or adoption assistance?	❍	❍
h. Energy assistance?	❍	❍

BOX M1a

STATE WELFARE AGENCIES

Alabama	FA (Family Assistance Program)	**Nebraska**	Employment First
Alaska	ATAP (Alaska Temporary Assistance Program)	**Nevada**	TANF
Arizona	EMPOWER (Employing and Moving People Off Welfare and Encouraging Responsibility)	**New Hampshire**	FAP (Family Assistance Program), financial aid for work exempt families

			NHEP (New Hampshire Employment Program), financial aid for work-mandated families
Arkansas	TEA (Transitional Employment Assistance)	**New Jersey**	WFNJ (Work First New Jersey)
California	CALWORKS (California Work Opportunity and Responsibility for Kids)	**New Mexico**	NM Works
Colorado	Colorado Works	**New York**	FA (Family Assistance Program), SNA (Safety Net Assistance)
Connecticut	JOBS FIRST	**North Carolina**	Work First
Delaware	ABC (A Better Chance)	**North Dakota**	TEEM (Training, Employment, Education Management)
District of Columbia	TANF	**Ohio**	OWF (Ohio Works First)
Florida	Welfare Transition Program	**Oklahoma**	TANF
Georgia	TANF	**Oregon**	JOBS (Job Opportunities and Basic Skills)
Hawaii	TANF	**Pennsylvania**	Pennsylvania TANF
Idaho	Temporary Assistance For Families in Idaho	**Rhode Island**	FIP (Family Independence Program)
Illinois	TANF	**South Carolina**	Family Independence
Indiana	TANF, cash assistance, IMPACT (Indiana Manpower Placement and Comprehensive Training, TANF work program	**South Dakota**	TANF
Iowa	FIP (Family Investment Program)	**Tennessee**	Families First
Kansas	Kansas Works	**Texas**	Texas Works (Department of Human Services), cash assistance Choices (Texas Workforce Commission, TANF work program
Kentucky	K-TAP (Kentucky Transitional Assistance Program)	**Utah**	FEP (Family Employment Program)

Louisiana	FITAP (Family Independence Temporary Assistance Program) cash assistance STEP (Strategies to Empower People)	**Vermont**	ANFC (Aid to Families with Needy Children), cash assistance Reach Up, TANF work program
Massachusetts	TAFDC (Transitional Aid to Families with Dependent Children), cash assistance ESP (Employment Services Program), TANF work program	**Virginia**	VIEW (Virginia Initiative for Employment, Not Welfare)
Michigan	FIP (Family Independence Program)	**Washington**	WorkFirst
Minnesota	MFIP (Minnesota Family Investment Program)	**West Virginia**	West Virginia Works
Mississippi	TANF	**Wisconsin**	W-2 (Wisconsin Works)
Missouri	Beyond Welfare	**Wyoming**	POWER (Personal Opportunities With Employment Responsibility)
Montana	FAIM (Families Achieving Independence in Montana)		

I2. In the last 12 months, what was the total income of all members of your household from all sources before taxes and other deductions? Please include your own income and the income of everyone living with you. Please include money from jobs and public assistance programs, as well as any other sources, such as rental income, interest, dividends, and tribal subsidies or per capita distributions.

I3. Is that income per hour, per day, per week, every two weeks, for a month, or for a year?

Select one only

- ❍ Per hour
- ❍ Per day
- ❍ Per week
- ❍ Every two weeks
- ❍ Month
- ❍ Year
- ❍ Other

Specify

I4. Was it…

- ❍ $25,000 or less
- ❍ more than $25,000

I5. Was it…

Select one only

- ❍ $5,000 or less
- ❍ $5,001 to $10,000
- ❍ $10,001 to $15,000
- ❍ $15,001 to $20,000
- ❍ $20,001 to $25,000

I6. Was it…

Select one only

- ❍ $25,001 to $30,000
- ❍ $30,001 to $35,000
- ❍ $35,001 to $40,000
- ❍ $40,001 to $50,000
- ❍ $50,001 to $75,000
- ❍ more than $75,000

I7. Do you currently own your home or apartment, pay rent, or live in public or subsidized housing?

Select one only

- ❍ Own or buying home or apartment
- ❍ Rent (without public assistance)
- ❍ Public or subsidized housing
- ❍ Live with someone else (whether you pay rent or not)
- ❍ Some other arrangement

Specify ☐

I8. How often are these statements true about your housing?
Our housing is…

SELECT ONE PER ROW

	NEVER TRUE	SOMETIMES TRUE	OFTEN TRUE	ALWAYS TRUE
a. Just the right size	❍	❍	❍	❍

b. Crowded	❍	❍	❍	❍
c. Needs major repairs	❍	❍	❍	❍
d. Old and aged	❍	❍	❍	❍
e. Kept in good condition	❍	❍	❍	❍

I9. Does your home have adequate…

SELECT ONE PER ROW

	YES	NO	DOES NOT APPLY – I DON'T HAVE THIS
a. Plumbing?	❍	❍	❍
b. Heating?	❍	❍	❍
c. Insulation?	❍	❍	❍
d. Water?	❍	❍	❍

I10. People do different things when they are running out of money for food to make their food or food money go further. For each statement below, tell me if it was often true, sometimes true, or never true for [you/your household]. In the last 12 months…

SELECT ONE PER ROW

	OFTEN TRUE	SOMETIMES TRUE	NEVER TRUE
a. The food that [I/we] bought just didn't last, and [I/we] didn't have money to get more	❍	❍	❍
b. [I/We] couldn't afford to eat balanced meals	❍	❍	❍

I11. In the last 12 months, did [you/you or other adults in your household] ever cut the size of your meals or skip meals because there wasn't enough money for food?

❍ Yes

❍ No

I12. How often did this happen? Would you say…

Select one only

- ❍ almost every month
- ❍ some months, but not every month
- ❍ in only 1 or 2 months

I13. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?

- ❍ Yes
- ❍ No

I14. In the last 12 months, were you ever hungry but didn't eat because you couldn't afford enough food?

- ❍ Yes
- ❍ No

I15. Please think about how you feel about your family's economic situation. For each statement, indicate how much you agree or disagree.

	SELECT ONE PER ROW				
	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
a. My family has enough money to afford the kind of home we need.	❍	❍	❍	❍	❍
b. We have enough money to afford the kind of clothing we need.	❍	❍	❍	❍	❍
c. We have enough money to afford the kind of food we need.	❍	❍	❍	❍	❍
d. We have enough money to afford the kind of medical care we need.	❍	❍	❍	❍	❍

I16. Think back over the past year. How much difficulty did you have with paying your bills each month? Would you say you had. . .

Select one only

- ❍ a great deal of difficulty
- ❍ quite a bit of difficulty
- ❍ some difficulty
- ❍ a little difficulty
- ❍ no difficulty at all

I17. Think again over the past 12 months. Generally, at the end of each month do you end up with...

Select one only

- ❍ not enough to make ends meet
- ❍ almost enough to make ends meet
- ❍ just enough to make ends meet
- ❍ some money left over
- ❍ more than enough money left over

APPENDIX D:

Scree Plots for Native Culture Index and Native Language Scale

Figure 6. *Native Culture Index*

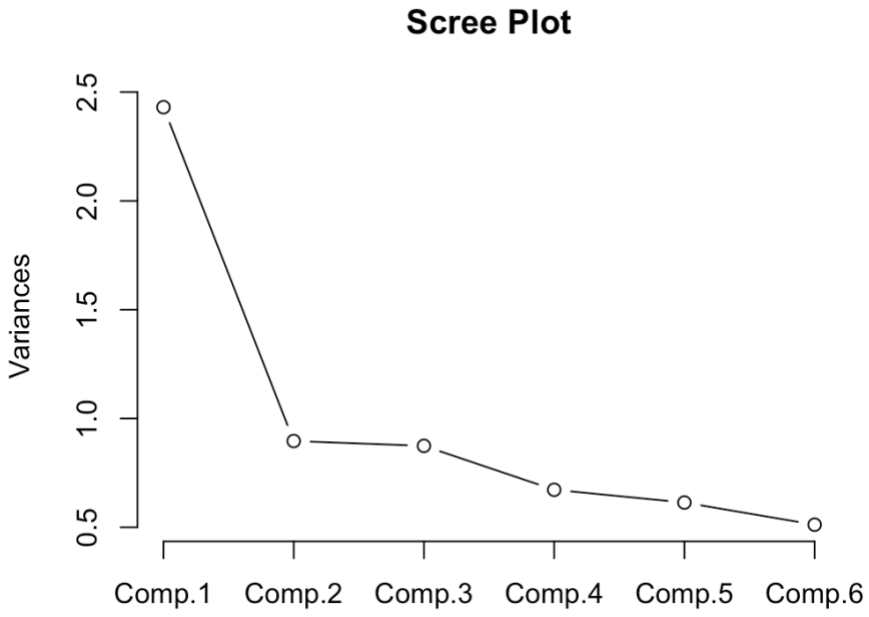
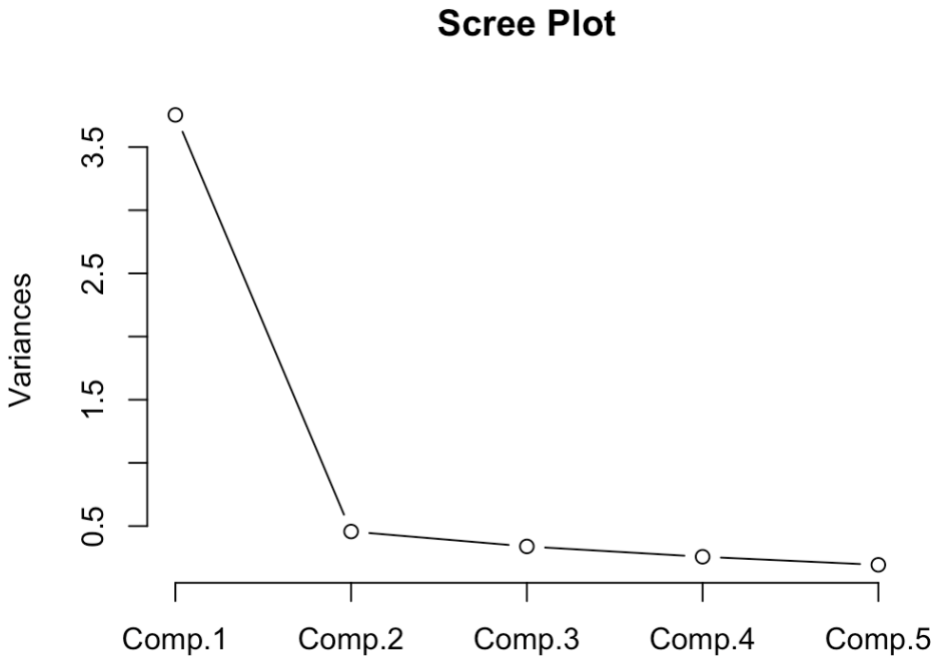


Figure 7. *Native Language Scale*



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