

9-24-2019

# Does Place Matter? Food Insecurity, Perceptions of Neighborhood Walkability, and Acculturation as Predictors of Treatment Outcome in an Early Childhood Obesity Prevention Study

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## Recommended Citation

Marfo, Nana Yaa, "Does Place Matter? Food Insecurity, Perceptions of Neighborhood Walkability, and Acculturation as Predictors of Treatment Outcome in an Early Childhood Obesity Prevention Study" (2019). *Master's Theses*. 1441.  
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Does Place Matter? Food Insecurity, Perceptions of Neighborhood Walkability, and  
Acculturation as Predictors of Treatment Outcome in an Early Childhood Obesity Prevention  
Study

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University of Pittsburgh, B. Phil, 2012

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

at the

University of Connecticut

2019

APPROVAL PAGE

A Master of Science Thesis

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## Abstract

**BACKGROUND:** Though cross-sectional studies have established a relationship between environmental factors and weight status, few have looked at how these environmental factors influence response to obesity intervention in adults or children. This study explored the impact food insecurity, neighborhood walkability, and acculturation may have had on the outcomes of an obesity prevention study for low-income, Black and Latinx preschool-aged children.

**METHODS:** Prior to the start of the primary care-based intervention program (Cloutier et al., 2015), caregivers (n=203) completed measures assessing their household's food insecurity, their perceptions of their neighborhoods' walkability, and for Latinx participants, levels of acculturation. Baseline responses were analyzed as potential predictors of their 2- to 4-year old children's BMI percentile change during a 12-month obesity prevention intervention.

**RESULTS:** There was little variability in food insecurity and neighborhood walkability scores in the sample, and scores did not predict BMI change from study start to 12-month follow-up. Among Latinx participants, acculturation significantly predicted BMI change ( $\beta = -0.29$ ,  $t = -3.32$ ,  $p = 0.001$ ). Degree of identification with mainstream U.S. culture appeared to drive this effect ( $\beta = -0.25$ ,  $t = -2.30$ ,  $p < 0.05$ ).

**CONCLUSION:** Contrary to the "Latino health paradox," caregiver identification with mainstream U.S. culture predicted better child participant response to treatment in the form of a decrease or no change in BMI percentile. Lack of variability in food insecurity and neighborhood walkability scores limits conclusions that can be drawn about these factors. More research with a more economically and geographically diverse sample is needed to understand these unexpected findings.

## **Introduction**

In the past six decades, obesity rates have more than tripled in both U.S. adults and youth. Between 1960 and 2016, obesity rates in adults aged 20 and older rose from approximately 13% to nearly 40% (Baron, Steege, Marsh, Menéndez, & Myers, 2013; Hales, Carroll, Fryar, & Ogden, 2017). Within the same time frame, obesity rates in youth 2 to 19 years of age increased from 5% to 18.5% (Baron et al., 2013; Hales et al., 2017). This marked increase gives cause for great concern given the evidence linking obesity to increased risk for a variety of health complications including hypertension, type II diabetes, heart disease, and even death (Kopelman, 2007). While obesity and many of its associated health complications are treatable, these conditions and the existing appropriate treatments come at a cost. In addition to the financial and quality of life costs it imposes on affected individuals, the pervasiveness of obesity also poses significant costs to society in the form of high medical costs, productivity costs, mortality costs, and more (Hammond & Levine, 2010; U.S. Department of Health and Human Services, 2001). Because of these consequences and how difficult it is to reverse obesity once it has been established, prevention has become a key component of efforts to lower rates of overweight and obesity nationwide.

Closer examination of patterns of obesity in the U.S. reveals that the disease has a disparate impact on different racial and ethnic groups. Results from the most recent National Health and Nutrition Examination Survey indicate that obesity has a significantly greater impact on Hispanic (47%) and non-Hispanic Black (46.8%) adults compared to their non-Hispanic White (37.9%) and non-Hispanic Asian (12.7%) counterparts (Hales et al., 2017). The survey detected a similar trend amongst youths, with obesity affecting larger proportions of Hispanic and non-Hispanic Black youth (25.8% and 22%, respectively) than of non-Hispanic White and

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non-Hispanic Asian youth (14.1% and 11%, respectively; Hales et al., 2017). With growing evidence suggesting that obesity in childhood predicts obesity and obesity-related health problems in adulthood, researchers have shifted their attention toward the etiology, treatment, and prevention of overweight and obesity in childhood (Baidal & Taveras, 2012; Baird et al., 2005; Bennett & Looker, 2010; Cloutier et al., 2015; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008). In doing so, investigators have identified the early childhood years (i.e. ages 2-5) as a critical period for targeted intervention (Brotman et al., 2012; Ogden et al., 1997; Salsberry, 2005; Wofford, 2008). Not only can intervention at this point reduce the likelihood of a child remaining obese through adulthood, but it can also stop obesity before it starts. In the last few decades, researchers have significantly expanded the literature base regarding the etiology and correlates (e.g. parent responsiveness, control, and feeding styles; child behavior problems; and characteristics of the built environment) of overweight and obesity in pre-school aged children; however, the pool of evidence-based obesity prevention and intervention programs for preschool-aged children remains relatively small (Brotman et al., 2012; Grafova, 2008; Haire-Joshu et al., 2008; R. P. Schwartz et al., 2014; Sosa, Parra-Medina, He, Trummer, & Yin, 2016; Stark et al., 2011; Yin et al., 2012). Even fewer programs are incorporated into existing primary care pediatrician visits (R. P. Schwartz et al., 2014). The Steps to Growing Up Healthy (Steps) pediatric weight management program was designed and tested to help bridge this gap (Cloutier et al., 2015; Gorin et al., 2014).

Steps is a brief (i.e. 3- to 5-minute) pediatric obesity intervention tool developed for easy implementation during annual pediatric primary care visits. Grounded in motivational interviewing (MI), this tool aims to create partnerships between families and primary care medical staff, to minimize the burdens associated with treating pediatric obesity, and to target at

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least one of four key obesogenic behaviors – the consumption of sugar-sweetened beverages, milk consumption, screen time, and physical activity. The efficacy of Steps for use with low-income families of color was tested by Cloutier and colleagues (2015) between 2010 and 2012 in a pediatric primary care center that serves the Greater Hartford, CT area. Participants receiving the intervention were Black and/or Latinx 2- to 4-year-old children and their primary caregivers. At their baseline annual pediatric care visits, children had their height and weight recorded by their primary care providers. Providers then used the Steps tool and MI framework to collaborate with primary caregivers, select at least one obesogenic behavior to target, and develop a plan to target that behavior. Research assistants followed up with the primary caregivers shortly after these visits to address any challenges with implementing their plans and assess the quality of their visits. During any sick or well visits with intervention dyads over the next 12 months, primary care providers used the Steps tool and MI framework to reinforce behavior change or assist caregivers in selecting more appropriate goals. At 12 months, child heights and weights were recorded. Baseline and 12-month BMI percentiles were calculated and compared against those of a group of historical controls who had annual visits with the study providers within the two-years of the study's start. Statistical analyses comparing the control and intervention groups showed a significant effect of intervention on BMI percentile change and study group (Cloutier et al., 2015).

When developing programs to treat or prevent obesity, identifying predictors of treatment response beyond primary obesogenic targets is crucial. Awareness of these predictors makes it possible to adapt interventions to meet the unique needs of various populations. As they investigate potential predictors of weight loss outcomes, obesity and weight management researchers tend to hone in on individual level predictors like biological, psychosocial, and

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behavioral factors (e.g., physical limitations, negative thoughts/mood, motivation; Burgess, Hassmén, & Pumpa, 2017; Lazzeretti, 2017; Saelens et al., 2018; Stubbs et al., 2011; Texeira, Going, Sardinha, & Lohman, 2005). Investigators have long since identified correlations between adult weight status and various key contextual factors (e.g. healthy food access, proximity to services, built environment, etc.); however, few have investigated how these known correlates might predict an individual adult or child's response to treatment. These factors appear especially important considering that low income, Black and Latinx populations are most vulnerable to overweight and obesity in the U.S (Baidal & Taveras, 2012; Barlow, 2007; Cloutier et al., 2015; Hales et al., 2017; Ogden, Carroll, Kit, & Flegal, 2014). These populations may not have the same ease of access to resources necessary to participate in more rigorous, well-researched weight loss programs as those with greater access. Moreover, it is possible that those who do have greater access may not utilize or respond to these treatment programs in the same way as the typically less diverse, more middle-class test populations.

Food insecurity, perceived neighborhood walkability, and acculturation are some of the key contextual factors that researchers have either directly or indirectly correlated with individual weight status (Adams et al., 2011; Larson & Story, 2011; Sussner, Lindsay, Greaney, & Peterson, 2008). In the health disparities literature, the “hunger-obesity paradox” as well as “Latino health paradox” were both coined in response to findings associating food insecurity and greater acculturation toward the dominant U.S. culture in Latinx individuals with obesity (and other poorer health outcomes as far as the Latino paradox; Abraído-Lanza, Chao, & Flórez, 2005; Abraído-Lanza, Echeverría, & Flórez, 2016; Dinour, Bergen, & Yeh, 2007). Though substantial support has been established for both paradoxes, it is important to note that research has produced mixed findings (i.e. positive, negative, and null) regarding the respective

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relationships obesity has with food insecurity and acculturation (Eisenmann, Gundersen, Lohman, Garasky, & Stewart, 2011; Teruya & Bazargan-Hejazi, 2013). Findings regarding the correlation between perceived neighborhood walkability and obesity have been more consistent with researchers detecting an inverse relationship between greater perceived walkability and obesity (Adams et al., 2011; Cerin, Saelens, Sallis, & Frank, 2006; Duncan, Johnson, Molnar, & Azrael, 2009; Grafova, 2008; Güngör, Fleischmann, & Phalet, 2011; Ohri-Vachaspati et al., 2015).

In the Steps efficacy study, the intervention group showed greater BMI percentile maintenance from baseline to 12 months than their control group counterpart. However, as is seen in most weight management programs, individual response to the intervention was quite varied – there was a wide range of BMI percentile increases and decreases with most children showing little to no change in their BMI percentiles. The aim of the current experiment, a sub-study of the Steps efficacy trial, was to understand the extent to which the home and neighborhood environmental factors of food insecurity, perceived neighborhood walkability, and acculturation predicted variation in the intervention arm's response to treatment (i.e. increase, decrease, or no change in BMI percentile). Considering findings in the established literature, it was hypothesized that 1) higher ratings of household food insecurity will predict less response to treatment (i.e. increase in BMI percentile), 2) higher ratings of neighborhood walkability will predict more response to treatment (i.e. decrease or no change in BMI percentile), and 3) higher ratings of acculturation toward Latinx heritage will predict more response to treatment (i.e. decrease or no change in BMI percentile).

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### **Method**

The present experiment is a sub-study of the Steps to Growing Up Healthy randomized control trial which tested the efficacy of a brief, early childhood obesity prevention tool within a primary care setting. A detailed description of the procedure for the primary study has been previously published (Cloutier et al., 2015). In brief, a total of thirty-two primary care physicians and nurses received training in motivational interviewing to administer the intervention to caregiver-child dyads. Medical staff collaborated with caregivers to choose one out of four target obesogenic behaviors (i.e., high amounts of screen time, low levels of physical activity, and high consumption of sugar-sweetened beverage consumption or whole milk) to change over the course of the study. Caregivers received tools and education to support behavior modification, and they worked closely with their clinicians to develop child-specific action plans and behavioral contracts. Within one week of each clinic visit, research assistants followed up with caregivers via telephone to review their appointments and initial behavior change implementation. Each caregiver-child dyad received a range of 1 to 7 doses of the intervention over the course of the study. Anthropometric measures were recorded by medical staff at baseline and 12 months. The measures assessing food security, acculturation, and neighborhood walkability were administered by research assistants at baseline. These measures were offered in English and Spanish and read aloud to participants in the waiting room just before their initial clinic visits.

### Participants

Participants were recruited in the waiting room of the Primary Care Clinic (PCC) at Connecticut Children's Medical Center between October 2010 and November 2012. The PCC serves predominantly low income, Black, and Latinx families in the city of Hartford, CT.

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Caregiver-child dyads were deemed eligible for the study if they were Latinx and/or Black (self-report), if the caregiver was greater than 18-years-old, if the child was between two and four years of age, and if the family received services from the Women, Infants and Children (WIC) program. Dyads who lived outside of Hartford or planned to move away from Hartford in the next year were excluded from the study. Children with special needs that might interfere with the implementation of the intervention (e.g. Type I diabetes; cystic fibrosis; dietary, physical or emotional needs, etc.) or with a body mass index (BMI) < 5<sup>th</sup> percentile were also ineligible for the study. Of the 232 caregiver-child dyads enrolled in the trial, 203 met the baseline BMI criterion and provided measurements of height and weight at baseline and 12 months.

### Measures

#### *Anthropometric Measures*

Child height was measured in centimeters to the nearest 0.5 cm using a wall-mounted stadiometer. Children stood barefoot and completely erect during height measurement. Child weight was measured in kilograms to the nearest 100 g. Children wore light clothing during weigh-ins. Child BMI ( $\text{kg}/\text{m}^2$ ) was calculated at baseline and at 12 months, and BMI percentile was calculated based on the Centers for Disease Control and Prevention's growth charts (Kuczmarski et al., 2000). Children with a BMI between the 5<sup>th</sup> and 85<sup>th</sup> percentile were categorized as normal weight, children with a BMI from the 85<sup>th</sup> to the 95<sup>th</sup> percentile were classified as overweight, and those with a BMI in the 95<sup>th</sup> percentile or higher were classified as obese.

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### *The Food Security Core Module Questionnaire*

Food insecurity was measured using The Food Security Core-Module Questionnaire (see Appendix A) from the United States Department of Agriculture (USDA) *Guide to Measuring Household Food Security* (Bickel, G. Nord, M. Price, C. Hamilton, W. & Cook, 2000). This 15-item measure was designed to assess and classify the severity of food insecurity and hunger within a respondent's household in the previous 12 months. Items were read aloud in English or Spanish based on the caregiver's preferred language. For six of the items, caregivers were asked to indicate whether statements were "often true," "sometimes true," "never true," or that they "didn't know or refused." Of the remaining nine items, three had two parts – a yes or no question followed by the question "How often did this happen?" If caregivers replied "yes" to Part I of these questions, they were asked to indicate whether conditions described in Part I occurred "almost every month," "some months but not every month," "only 1 or 2 months" or "don't know." If caregivers responded "no" to Part I, Part II of the question was skipped. The remaining six items were yes or no questions with the additional option of "don't know." Food insecurity scores were calculated following the guidelines detailed in the *Guide to Measuring Household Food Security* (Bickel, G. Nord, M. Price, C. Hamilton, W. & Cook, 2000). Negative responses were coded as 0 while affirmative responses were coded as 1. Questions answered with a "don't know" or refusal response were coded missing. Missing responses were imputed following the instructions outlined in Chapter 3 of the *Guide to Measuring Household Food Security* (Bickel, G. Nord, M. Price, C. Hamilton, W. & Cook, 2000). Total scores on this measure can range anywhere from 0 to 18 with lower scores indicating less food insecurity and higher scores indicating greater food insecurity. This measure is the most widely used measure of food insecurity and its psychometric properties have been well established (Buscemi, Ae, Beech, &

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Relyea, 2009; Derrickson, Fisher, & Anderson, 2000; Marques, Reichenheim, De Moraes, Antunes, & Salles-Costa, 2015).

### *Neighborhood Environment Walkability Scale- Abbreviated (NEWS-A) Subscale C*

Caregivers' perceptions of their respective neighborhood environments were measured using a modified version of the Neighborhood Environment Walkability Scale (NEWS; Cerin et al., 2006; Saelens, Sallis, Black, & Chen, 2003). Using findings from the fields of urban planning and transportation, Saelens and colleagues (2003) designed the NEWS to capture how key aspects of a neighborhood's built environment might contribute to the physical activity levels and weight statuses of its residents. Following the recommendations of Saelens and colleagues (2018), the three items that comprise subscale C (Access to services) of the abbreviated NEWS (NEWS-A) were used as a proxy for overall neighborhood walkability perceptions in the current study (see Appendix B). According to the authors, perceived neighborhood land use mix (i.e. access to services) tends to have a positive relationship with higher rates of walking behavior in adults and with other facets of neighborhood walkability (e.g. higher residential density and greater street connectivity; Saelens et al., 2018). Survey items were read aloud to participants in their preferred language, and their responses were recorded. Item response options were presented on a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). Scores were obtained by calculating the means of responses. As such, scores can range anywhere from 1 to 4. Means were included in analyses only if participants answered all three questions. The measure has been reported to have adequate reliability and validity (Cerin et al., 2006; Saelens et al., 2003).

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### *The Brief Acculturation Rating Scale for Mexican Americans-II (ARMSA-II)*

Acculturation was measured at baseline using the Brief ARMSA-II (see Appendix C), a short form of the revised ARMSA-II, the gold standard measure of acculturation in Mexican Americans (Cuellar, Arnold, & Maldonado, 1995). The instrument measures acculturation along three primary factors – language, ethnic identity, and ethnic interaction. Though the ARMSA-II was originally designed for use with Mexican Americans, it has been used to measure acculturation in other Latin-American populations including Puerto Ricans (Jimenez, Gray, Cucciare, Kumbhani, & Gallagher-Thompson, 2010). Designed by Hernández-Valero et al. (2007), the Brief ARMSA-II is a 12-item questionnaire composed of six items from the Anglo Oriented Scale (AOS) and six items from the Mexican Oriented Scale (MOS) of the full ARMSA-II. Questions are presented in both English and Spanish, with responses on a five-point Likert scale from 1 (not at all) to 5 (almost always/extremely often). In the present study, survey questions were read aloud to Latinx caregivers (n=178) in their preferred language, and their responses were recorded. Scoring procedures followed those detailed in Wiley et al. (2014) which resulted from an exploratory factor analysis of the measure using responses from all the Puerto Rican mothers in the current study. While completing the Brief ARMSA-II, Puerto Rican mothers – who made up approximately 60% of the study’s caregiver sample – had difficulty answering the two questions about relationships with “Anglos.” As a result, a factor analysis was performed, and it produced two new factors – the U.S. Mainland Orientation Scale (USMOS) and Hispanic Orientation Scale (HOS). Each factor consists of six and four of the original Brief ARMSA-II questions, respectively. For the sake of uniformity, all participant responses were scored in accordance with these new scales. Mean scores on each scale were calculated, and HOS means were subtracted from USMOS means to give an overall acculturation score for each

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participant. USMOS and HOS means as well as acculturation scores were included in analyses so long as participants responded to 80% of the questions (i.e.  $\geq 8$  questions). Acculturation scores as well as their component HOS and USMOS means were entered into analyses to assess the relationship between acculturation and BMI percentile change at 12 months. Bauman (2005) reported alpha coefficients of .84 on the MOS and .75 on the AOS with a sample of 112 Mexican American children in grades 3 through 5. The measure displayed strong validity via the high linear and orthogonal correlation between acculturation scores and language choice in the sample ( $r = -.49, p < .01$  and  $r = -.29, p < .01$ , respectively).

### Data Analytic Plan

Statistical analyses were performed using SPSS Statistics 25 (SPSS, Inc., 2017, Chicago, IL). Descriptive statistics were calculated to examine the distribution of scores on each of the survey measures. A series of three hierarchical linear regressions were used to test whether neighborhood walkability, food insecurity, and/or acculturation measures predicted BMI percentile change (i.e. 12-month BMI percentile – baseline BMI percentile) in response to the intervention. Initial child BMI percentile, race/ethnicity, sex, and age at the start of the study were entered as covariates in the first step of all three regressions. Food insecurity score was entered into the second step of the regressions. Neighborhood walkability score was entered into the third step of the regressions. Because the Brief ARMSA-II was administered to Latinx caregivers only, a second hierarchical linear regression was run adding in the overall acculturation scores (i.e. USMOS means – HOS means) into the fourth step. A third regression was run replacing the overall acculturation score with the separate USMOS and HOS means into the fourth step. T tests and beta coefficients were used to determine the significance and the

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extent of prediction for each predictor. Predictor variables were assessed for multicollinearity via the calculation of Pearson's correlation coefficients.

### **Results**

#### Descriptive Statistics

Descriptive data are presented in Table 1. The average child participant age at baseline was  $35.61 \pm 8.72$  months, and the ratio of female to male child participants was approximately one-to-one (47.8% and 52.2%, respectively). In terms of race and ethnicity, most primary caregivers self-identified as Hispanic (89.6%). The remaining primary caregivers self-identified as Black (9.9%) or Multiracial (0.5%). Average BMI percentile at baseline was  $75.56 \pm 24.83\%$ . Approximately half of child participants fell in the normal BMI range (51.3%) and the other half were either overweight (17.4%) or obese (31.3%). Average BMI percentile change from baseline to 12 months was  $-0.11 \pm 20.11\%$  with change scores ranging from -65.30% to 68.70%.

Table 2 shows the means, standard deviations, and ranges of scores on all the baseline measures in the present study. On the measure of food insecurity, total scores ranged from 0 to 12. The average score on this measure was  $1.80 \pm 2.77$  suggesting that most study participants were food secure or experiencing minimal food insecurity based on their reports. On the NEWS Subscale C, scores ranged from 1.67 to 4. The average walkability score was  $3.67 \pm 0.59$  suggesting that primary caregivers largely considered their neighborhoods walkable. In terms of acculturation, overall acculturation scores (i.e. USMOS-HOS) ranged from -4 to 4. Mean acculturation scores were  $-0.76 \pm 2.10$  suggesting that caregivers' identification with the Spanish language/their Latinx heritages was slightly greater than their identification with the English language/mainstream U.S. culture. On both the USMOS and HOS subscales of the adapted Brief ARMSA-II, mean scores ranged from 1 to 5. On the USMOS, the average score was  $3.51 \pm 1.43$

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suggesting that identification with the English language/mainstream U.S. culture was relatively moderate across the sample. On the HOS, the average score was  $4.26 \pm 0.91$  suggesting that most Latinx participants strongly identify with the Spanish language/their Latinx heritage. Taken together, these average subscale scores suggest that the caregiver sample was relatively bicultural with slightly stronger identification with the Spanish language/Latinx heritage than with the English language/mainstream U.S. culture.

### Regression Analyses

Pearson's correlations were used to detect multicollinearity between the predictor variables (Table 3). Food insecurity was not significantly correlated with walkability. There was a significant negative correlation between acculturation and walkability ( $r = -.15, p < 0.05$ ). At closer inspection, the USMOS appeared to drive the significance of this correlation ( $r = -.15, p < 0.05$ ). There was no significant correlation between the HOS and walkability.

#### *Regression 1: Effects of Food Insecurity and Walkability on BMI Percentile Change*

Regression 1 assessed whether baseline food insecurity and neighborhood walkability scores predicted BMI percentile change over the course of the study. The results of this regression are presented in Table 4. BMI percentile change was significantly predicted by step 1 of the model,  $F(4, 190) = 8.67, p < 0.001, R^2 = 0.15$ . More specifically, both age ( $\beta = -0.16, t = -2.35, p < 0.05$ ) and initial BMI percentile ( $\beta = -0.32, t = -4.73, p < 0.001$ ) had significant negative relationships with BMI percentile change. In other words, older child participants and those with higher BMI percentiles at baseline experienced greater 12-month BMI percentile maintenance or decreases than younger child participants and those with lower BMI percentiles at baseline, respectively. Neither sex nor ethnicity significantly predicted child participant BMI

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percentile change. Furthermore, adding food insecurity in step 2 and walkability in step 3 did not account for any additional variance.

### *Regressions 2 and 3: Effects of Food Insecurity, Walkability, and Acculturation on BMI*

#### *Percentile Change*

Regression 2 assessed whether food insecurity, neighborhood walkability, and caregiver acculturation scores predicted BMI percentile change in the study's Latinx child participants. The results of this regression are presented in Table 5. As was seen in Regression 1, BMI percentile change was significantly predicted by step 1 of the model,  $F(4, 168) = 6.79$ ,  $p < 0.001$ ,  $R^2 = 0.14$ . Unique to Regression 2, initial BMI percentile alone had a significant negative relationship with BMI percentile change ( $\beta = -0.32$ ,  $t = -4.35$ ,  $p < 0.001$ ). Age, sex, and ethnicity showed no significant effects. Adding food insecurity and walkability in the second and third step did not account for any additional variance. Once acculturation was added in step 4, the regression model did significantly predict child BMI percentile change,  $F(7, 165) = 5.75$ ,  $p < 0.001$ ,  $R^2 = 0.20$ . In this model, age ( $\beta = -0.17$ ,  $t = -2.39$ ,  $p < 0.05$ ), initial BMI percentile ( $\beta = -0.32$ ,  $t = -4.45$ ,  $p < 0.001$ ), and acculturation score ( $\beta = -0.29$ ,  $t = -3.32$ ,  $p = 0.001$ ) were all significant negative predictors of BMI percentile change in Latinx child participants. In other words, older Latinx children, those with higher initial BMI percentiles, and those whose primary caregivers had more positive acculturation scores showed greater BMI percentile maintenance or decreases at 12 months.

Regression 3 followed the same procedure as Regression 2 but with USMOS and HOS scores entered in place of overall acculturation score in the fourth step. The results are shown in Table 6. As with Regression 2, BMI percentile change was significantly predicted by step 1 of the model,  $F(4, 168) = 6.79$ ,  $p < 0.001$ ,  $R^2 = 0.14$  and initial BMI percentile was the only

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significant predictor in this step ( $\beta = -0.32, t = -4.35, p < 0.001$ ). Age, sex, and ethnicity showed no significant effects, and adding food insecurity and walkability in the second and third step did not account for any additional variance. When USMOS and HOS scores were added in the fourth step, the model became significant,  $F(8, 164) = 5.05, p < 0.001, R^2 = 0.20$ . In addition to age ( $\beta = -0.18, t = -2.44, p < 0.05$ ) and initial BMI percentile ( $\beta = -0.31, t = -4.36, p < 0.001$ ), USMOS scores significantly negatively predicted BMI percentile change in Latinx child participants ( $\beta = -0.25, t = -2.30, p < 0.05$ ). In other words, older Latinx children, those with higher initial BMI percentiles at baseline, and those whose parents reported higher scores on the USMOS showed greater response to treatment in the form of BMI percentile maintenance or decrease from baseline to 12 months. HOS scores did not account for any additional variance in BMI percentile change.

## Discussion

The purpose of the current study was to gain a better understanding of the impact home and neighborhood environmental factors may have had on the outcomes of a 12-month, pediatric obesity prevention study. More specifically, this study sought to determine the extent to which food insecurity, acculturation, and neighborhood walkability explained the variance in BMI percentile change for 200 preschool-aged children in response to a brief obesity prevention intervention.

Prior to conducting analyses, it was hypothesized that a pattern supporting the “hunger-obesity paradox” would emerge. In other words, it was hypothesized that greater food insecurity would predict poorer response to intervention in the form of an increase in BMI percentile from baseline to 12 months. This hypothesis was not supported by the results. This apparent lack of an association between food insecurity and obesity in this sample could be due to the lack of

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reported food insecurity within this study sample. On average, caregiver ratings of household food insecurity were very low. Out of the maximum of 18 food insecurity indicators participants could select, approximately 84% of participants reported 1-4 indicators. This high percentage of low ratings suggest that the sample was predominantly food secure (73% of the sample) or food insecure without hunger (11% of the sample) (Marques et al., 2015).

It was also hypothesized that greater perceived neighborhood walkability would predict greater response to intervention in the form of a decrease or no change in BMI percentile from baseline to 12 months. This hypothesis was also not supported. Similar to their response patterns on the food insecurity measure, most caregivers had highly favorable perceptions of their neighborhoods' walkability. Approximately 90% of the caregiver sample had NEWS Subscale C means ranging from 3 to 4 when means can range from a minimum of 1 to a maximum of 4. These high scores indicate that the bulk of the sample either agreed or strongly agreed that their neighborhood was walkable in that they can walk from their homes to stores, transit stops, and many other places in 1- to 15 minutes (Cerin et al., 2006). Again, this rather uniform pattern of responding suggests that there may not have been enough variability in responses to detect any predictors of treatment response.

Lastly, it was hypothesized that stronger identification with Latinx heritage would predict greater response to intervention in support of the "Latino paradox" that links less acculturation toward mainstream U.S. culture with better health outcomes in Latinx American populations (Abraído-Lanza et al., 2005; Fuller et al., 2009). This hypothesis was not supported by the results. In fact, upon closer inspection, it became apparent that most of the caregivers in the study sample reported a strong identification with their Latinx heritage. Approximately 74% of caregivers had an average score of 4 or higher on the Hispanic Orientation Scale (HOS). That is,

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almost 3 out of 4 caregivers reported “very often” or “almost “always” speaking, reading, thinking, and watching TV and movies in Spanish (Cuellar et al., 1995). Contrary to what was hypothesized, child participants whose caregivers indicated stronger identification with mainstream U.S. culture (i.e. often thinking, reading, speaking, and watching TV and movies in English) showed a significantly greater response to intervention than those who identified less with mainstream U.S. culture. Though these findings conflict with the “Latino paradox,” they are consistent with findings in a relatively small number of studies correlating maternal Spanish-English bilingualism with healthier child weight status (Lee, 2015; Sussner, Lindsay, & Peterson, 2009). It is also possible that language barriers contributed to this outcome. Although all the study measures were available in Spanish and Spanish-speaking research assistants administered the baseline measures to non-English-speaking participants, only small number of the primary care providers spoke Spanish. Those who did not speak Spanish had to rely on the help of translators who may not have been as skilled in delivering the intervention as the primary care providers. Consequently, it is possible that participants who were primarily Spanish speakers working with non-Spanish-speaking medical staff may not have received the treatment with the same fidelity as those who were fluent in English or paired with Spanish-speaking staff. Future iterations of this study could match participants with medical staff by primary language to rule out this possible confound.

There were several limitations to the present study. First and foremost, the study sample displayed a high level of uniformity in their responses on the food insecurity measure, the NEWS Subscale C, and the HOS of the Brief ARMSA-II. Given the low levels of variability in responses yet high levels of variability in BMI percentile change, one might presume that these home and neighborhood environmental factors may not be relevant in predicting a preschool-

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aged child's response to an obesity prevention intervention. However, the general lack of variability in responses makes it difficult to draw conclusions about how the factors associated with these scales (i.e. food insecurity, walkability, and identification Latinx heritage) may have influenced changes in BMI percentile over the course of the study. Without greater distribution of data points on these different scales, it is difficult to extrapolate what patterns may or may not have emerged if there were more variation in scores. This lack of variability could stem from the reality that all participants in this study resided in different neighborhoods of Hartford. Though none of the neighborhoods of Hartford are identical, it is possible that the ones these participants come from have similarities that may have extended to the environmental factors measured in the study. For instance, perhaps participants tended to live in the parts of Hartford that have better access to food, more concentrated communities of Spanish-speakers, and built environments that are more walkable than other parts of Hartford. Future studies would benefit from gathering data from neighborhoods in different cities and regions of the nation. Studies comparing neighborhoods across different cities might help illuminate the potential relationship between disparate neighborhood conditions and treatment outcomes.

It is also possible that some of the tools used to measure different environmental factors in this study were not sensitive enough to detect certain environmental differences amongst study participants. Though the NEWS Subscale C is deemed a valid proxy for neighborhood walkability, it is possible that the limited scope of its three questions missed some important distinctions between different Hartford neighborhoods. For instance, some of the other subscales contained within the NEWS-A assess factors like crime rates and traffic safety, factors that could change participant ratings of overall neighborhood walkability. It's also possible that though the NEWS and NEWS-A have been well-integrated into the adult weight status literature, they may

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not hold the same relevance for preschool-aged children. For instance, parents may be more likely to walk to stores, transit stops, and other places; however, they may also be likely to place their children in strollers for practical purposes. A version of the NEWS has been validated for use with youths aged 11 and older, however, no such measure exists for younger children. Assessing the relevance of any versions of the NEWS for use with young children constitutes a crucial first step in being able to assess how the built environment may relate to weight status and response to obesity prevention interventions in young children.

On a similar note, though the Brief-ARMSA has been validated in different Latinx populations and language use has been determined a decent proxy for acculturation, all the items on the acculturation measure were about use of the English or Spanish language. Furthermore, the measure treats acculturation as a linear construct. More recent research evaluating the construct of acculturation has scrutinized the lack of agreement amongst researchers regarding how to both define and measure acculturation (Schwartz, Unger, Zamboanga, & Szapocznik, 2010). In general, many acculturation researchers have come to the agreement that acculturation consists of various elements beyond language including ethnic identity, cultural practices, and more (Goforth, Oka, Leong, & Denis, 2014; Schwartz et al., 2010; Viruell-Fuentes, Miranda, & Abdulrahim, 2012). These same researchers also continue to grapple with whether acculturation should be measured categorically, on a continuum, or across multiple dimensions (Schwartz et al., 2010). The use of an acculturation measure that can capture more of the nuance in the construct could help detect more of the subtle, nuanced differences in acculturation across participants.

A final limitation to the study is related to the administration of the measures at baseline. The items for food insecurity, neighborhood walkability, and acculturation were all read aloud to

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participants in the waiting room of a busy medical clinic. Research assistants were instructed to find a quiet spot in the waiting room to assess caregivers, but this was not always possible. Additionally, because participants completed these measures upon first meeting research assistants in the waiting room, there was not much time or room for building rapport. As a result, it is possible that social desirability bias may have influenced how caregivers answered questions on different measures. Providing personal information regarding whether one can provide enough food for their family or raise their children in a safe environment to practical strangers in a public space could easily influence anyone to provide answers that may be less likely to elicit judgment from others. Future iterations of this study could include a private space for participants to answer these sensitive questions with the option of completing them alone or alongside a research assistant.

Though this study had various limitations, it also possessed a variety of strengths. First and foremost, the study directly benefitted low-income, Latinx and Black preschool-aged children. Research and census data have shown that the populations targeted in this study are at greatest risk for developing overweight and obesity that could continue into adulthood and lead to a variety of potentially life-threatening health complications (Baidal & Taveras, 2012). Given that this risk is especially pronounced for children of Latinx heritage and nearly 90% of the study sample was Latinx, this study makes an important contribution to both the health disparities literature and public health efforts to combat early childhood obesity in the U.S. (Liu, Hannon, Qi, Downs, & Marrero, 2015). In addition to targeting those disproportionately affected by the obesity epidemic, this study was also implemented in a busy primary care setting rather than a specialty clinic or an academic research center. Testing the intervention with a community sample within a community setting can give researchers, primary care medical staff, and the

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public a better sense of how the intervention might work in real world settings. This study also had a reasonably large sample size which helped improve the generalizability its results. It also had a follow-up period of one year which is on the longer end of follow-up studies.

Despite its limitations, this study and its findings add valuable information to the existing body of literature on obesity prevention in low income, non-White preschool-aged children. Though no firm conclusions could be drawn regarding the role food insecurity, neighborhood walkability, and acculturation may play in the effectiveness of a treatment program like Steps, it is a step in the right direction toward understanding how known correlates of adult weight status 1) may or may not be relevant for use with young children and 2) whether they may influence response to weight loss or weight maintenance treatment programs in children. This study lays the groundwork for future studies to investigate these factors and inevitably enable intervention researchers to adapt existing programs or create new ones to meet the unique needs of different underserved populations. Doing so could not only address the U.S. obesity epidemic, but it could also help close a wide range of health disparities stemming from complications from overweight and obesity.

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## **APPENDICES**

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Table 1. *Sample Demographics – Child Participants (n=203)*

Participant Characteristic	<u>±SD</u>
Sex (%)	
Female	47.8
Male	52.2
Race/Ethnicity (%)	
Latinx, Puerto Rican	58.6
Latinx, Other	31.0
Black/African American	9.9
Multiracial	0.5
Age (months)	35.61 ± 8.72
Baseline BMI %ile	75.56 ± 24.83

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Table 2. *Means, Standard Deviations, and Ranges of Scores on Baseline Measures*

Name of Measure	Mean ( $\pm$ SD)	Range
Food Insecurity	1.80 $\pm$ 2.77	0 – 12
NEWS Subscale C	3.67 $\pm$ 0.59	1.67 – 4
Brief ARMSA-II	-0.75 $\pm$ 2.10	-4 – 4
USMOS	3.50 $\pm$ 1.40	1 – 5
HOS	4.30 $\pm$ 0.90	1 – 5

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Table 3. *Pearson Correlation Matrix among Predictor Variables*

	NEWS Subscale C	Brief ARMSA-II	USMOS	HOS
Food Insecurity	-.05	.006	-.03	-.06
NEWS Subscale C		-.15*	-.15*	.11
Brief ARMSA-II			-.94**	-.84**
USMOS				-0.61**

\*p<0.05

\*\*p<0.01

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Table 4. *Regression 1: Effects of Food Insecurity and Walkability on BMI Percentile Change*

Variable	Model 1 (Covariates)			Model 2			Model 3		
	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$
Age (months)	-0.37	(0.16)	-0.16*	-0.37	(0.16)	-0.16*	-0.36	(0.16)	-0.16*
Sex	2.02	(2.69)	0.05	2.22	(2.70)	0.06	2.38	(2.72)	0.06
Race/Ethnicity	0.48	(0.79)	0.04	0.40	(0.80)	0.03	0.37	(0.81)	0.03
Baseline BMI %	-0.26	(0.06)	-0.32**	-0.26	(0.06)	-0.32**	-0.26	(0.06)	-0.32**
Food Insecurity	--	--	--	0.34	(0.49)	0.05	0.36	(0.49)	0.05
NEWS Subscale C	--	--	--	--	--	--	1.38	(2.29)	0.04
$R^2$		0.15			0.16			0.16	
$F$ for change in $R^2$		8.67**			7.01			5.88	

\* $p < 0.05$ \*\* $p \leq 0.001$

DOES PLACE MATTER?

Table 5. *Regression 2: Effects of Food Insecurity, Walkability, and Acculturation on BMI Percentile Change*

Variable	Model 1 (Covariates)			Model 2			Model 3			Model 4		
	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$
Age (months)	-0.30	(0.17)	-0.13	-0.30	(0.17)	-0.13	-0.29	(0.17)	-0.13	-0.40	(0.17)	-0.17*
Sex	2.90	(2.91)	0.07	2.97	(2.93)	0.07	3.12	(2.94)	0.08	3.01	(2.86)	0.08
Race/Ethnicity	0.57	(0.89)	0.05	0.54	(0.89)	0.04	0.53	(0.90)	0.04	-1.46	(1.06)	-0.12
Baseline BMI %	-0.26	(0.06)	-0.32**	-0.25	(0.06)	-0.32**	-0.26	(0.06)	-0.32**	-0.26	(0.06)	-0.32**
Food Insecurity	--	--	--	0.18	(0.53)	0.03	0.19	(0.53)	0.03	0.22	(0.51)	0.03
NEWS Subscale C	--	--	--	--	--	--	1.84	(2.55)	0.05	0.34	(2.52)	0.01
Brief ARMSA-II	--	--	--	--	--	--	--	--	--	-2.84	(0.86)	-0.29**
$R^2$		0.14			0.14			0.14			0.20	
$F$ for change in $R^2$		6.79**			5.43			4.60			5.75**	

\* $p < 0.05$

\*\* $p \leq 0.001$

DOES PLACE MATTER?

Table 6. *Regression 3: Effects of Food Insecurity, Walkability, and HOS and USMOS on BMI Percentile Change*

Variable	Model 1 (Covariates)			Model 2			Model 3			Model 4		
	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$
Age (months)	-0.30	(0.17)	-0.13	-0.30	(0.17)	-0.13	-0.29	(0.17)	-0.13	-0.41	(0.17)	-0.18*
Sex	2.90	(2.91)	0.07	2.97	(2.93)	0.07	3.12	(2.94)	0.08	3.19	(2.87)	0.08
Race/Ethnicity	0.57	(0.89)	0.05	0.54	(0.89)	0.04	0.53	(0.90)	0.04	-1.64	(1.11)	-0.13
Baseline BMI %	-0.26	(0.06)	-0.32**	-0.25	(0.06)	-0.32**	-0.26	(0.06)	-0.32**	-0.25	(0.06)	-0.31**
Food Insecurity	--	--	--	0.18	(0.53)	0.03	0.19	(0.53)	0.03	0.20	(0.51)	0.03
NEWS Subscale C	--	--	--	--	--	--	1.84	(2.55)	0.05	0.25	(2.53)	0.01
HOS	--	--	--	--	--	--	--	--	--	1.88	(1.96)	-0.08
USMOS	--	--	--	--	--	--	--	--	--	-3.53	1.53	-0.25*
$R^2$		0.14			0.14			0.14			0.20	
$F$ for change in $R^2$		6.79**			5.43			4.60			5.05*	

Hispanic Orientation Scale (HOS)

U.S.-Mexican Orientation Scale (USMOS)

\* $p < 0.05$

\*\* $p \leq 0.001$

Appendix A



ID#   -

Interviewer's Initials:

Today's Date:   /   /    
(Month) (Day) (Year)

## Helping Children to Grow Up Healthy: The Pediatrician's Role in Preventing Childhood Obesity

### U.S. Household Food Security Instrument, English Version

I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for you or your household in the last 12 months.

1. I worry whether my food would run out before I get money to buy more.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
2. The food that I bought just didn't last, and I didn't have money to get more.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
3. I couldn't afford to eat balanced meals.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
4. I relied on only a few kinds of low-cost food to feed my child because I was running out of money to buy food.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
5. I couldn't feed my child a balanced meal, because I couldn't afford it.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
6. My child was not eating enough because I just couldn't afford enough food.  
a. Often true      b. Sometimes true      c. Never true      d. Don't Know or Refused
7. In the last 12 months, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?  
a. Yes (GO TO 7A)      b. No (SKIP TO 8)      c. Don't Know (SKIP TO 8)
- 7a. How often did this happen?  
a. Almost every month      b. Some months but not every month      c. Only 1 or 2 months      d. Don't Know
8. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?  
a. Yes      b. No      c. Don't Know

Appendix B



ID#   -

Today's Date:   /   /    
(Month) (Day) (Year)

## Helping Children to Grow Up Healthy: The Pediatrician's Role in Preventing Childhood Obesity

### Neighborhood Environmental Walkability Scale (NEWS) – Abbreviated

We would like to find out more information about the way that you perceive or think about your neighborhood. Please answer the following questions about your neighborhood and yourself.

#### A. Type of residences in your neighborhood.

Please circle the answer that best applies to you and your neighborhood.

1. How many different types of residences are there in your immediate neighborhood?

a. detached single-family residences

1	2	3	4	5
None	A few	Some	Most	All

b. duplexes (2 family residences)

1	2	3	4	5
None	A few	Some	Most	All

c. apartment buildings

1	2	3	4	5
None	A few	Some	Most	All

#### C. Access to Services

Please circle the answer that best applies to you and your neighborhood. Both local and within walking distance mean within a 10-15 minute walk from your home.

1. Stores are within easy walking distance of my home.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

2. Parking is difficult in local shopping areas.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

## DOES PLACE MATTER?

3. There are many places to go within easy walking distance of my home.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

4. It is easy to walk to a transit stop (bus, train) from my home.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

5. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

6. There are major barriers to walking in my local area that makes it hard to get from place to place (for example, freeways, railway lines, rivers).

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

7. Do you own a car or have easy access to a car?

Yes                  No

### E. Places for walking and cycling

Please circle the answer that best applies to you and your neighborhood.

1. There are sidewalks on most of the streets in my neighborhood.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

### F. Neighborhood surroundings

Please circle the answer that best applies to you and your neighborhood.

1. There are trees along the streets in my neighborhood.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

4. There are attractive buildings/homes in my neighborhood.

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

Appendix C



ID# <input style="width: 20px; height: 20px;" type="text"/> <input style="width: 20px; height: 20px;" type="text"/> - <input style="width: 20px; height: 20px;" type="text"/>
Today's Date: <input style="width: 20px; height: 20px;" type="text"/> <input style="width: 20px; height: 20px;" type="text"/> / <input style="width: 20px; height: 20px;" type="text"/> <input style="width: 20px; height: 20px;" type="text"/> / <input style="width: 20px; height: 20px;" type="text"/> <input style="width: 20px; height: 20px;" type="text"/>
(Month) (Day) (Year)

## Helping Children to Grow Up Healthy: The Pediatrician's Role in Preventing Childhood Obesity

### A Brief Acculturation Rating Scale for Hispanics

Can you tell us something about how you read and write and use Spanish at home? For each question, put an "X" in the box that best describes how you use, write or read Spanish.

	Not At All	Very Little	Moderately	Very Often	Almost Always
1. I speak Spanish					
2. I speak English.					
3. I enjoy speaking Spanish.					
4. I associate with Anglos.					
5. I enjoy English language movies.					
6. I enjoy Spanish language TV.					
7. I enjoy Spanish language movies.					
8. I enjoy reading books in Spanish.					
9. I write letters in English.					
10. My thinking is done in the English language.					
11. My thinking is done in the Spanish language.					
12. My friends are of Anglo origin.					

Note: Used by permission from Dr. Israel Cuéllar, former director of the Julian Samora Research Institute at Michigan State University.