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Introduction

While childhood obesity has gained national attention as one of the greatest public health challenges our country has faced, it disproportionately affects ethnic/racial minority groups and the poor and varies greatly between states.[1-4] Data from the NHANES 2007-2008 demonstrates that the prevalence of obesity is significantly higher among Mexican-American (26.8%) and Black (19.8%) boys than among non-Hispanic White boys (16.7%).[5] Additionally, non-Hispanic Black girls (29.2%) are significantly more likely to be obese compared with non-Hispanic White adolescent girls (14.5%).[5] In Texas, both Mexican American boys (31.1%) and girls (26.4%) have a substantially higher prevalence of obesity than their White counterparts (17.7% boys, 13.7% girls).[5] Black children in Texas have a similar prevalence of obesity as what has been observed nationally (21.6% boys, 30.8% girls).[5] While differences in health behaviors by race may contribute to these obesity disparities, the environments in which children live provides a platform for which resources are accessed that facilitate or prevent the risk of the condition.

Environment and Childhood Obesity

The relation between community environment and childhood obesity is multifaceted and manifests in many ways. Studies of the community environment context of obesity, poor diet, and low physical activity have typically focused on aspects of the built environment (access to parks, sideways, food environment), without careful consideration of the socioeconomic or cultural context of these environments. For example, although low accessibility to healthy foods, and high access to unhealthy foods are key determinates to obesity in adolescents,[6] food pricing may play an even more significant role in low-income areas where access to resources is generally low.[7] Still, socioeconomic environment, as it relates to racial/ethnic disparities of obesity, is often measured unidimensionally,[8-13] which overlooks multiple aspects of the environment and the complexity of interrelationships for both adults and children.[15]

Hispanic children in Texas (the majority of whom are Mexican American) are disproportionately represented among those living in poverty, and are more likely to live in communities that have poor access to healthy foods and low access to green space.[16] There is evidence to suggest that Hispanic ethnic concentration is a risk factor for obesity in these adults,[15] contrary to the protective effects observed for other health and mortality outcomes.[17-19] Similarly, Black children and adults who live in predominantly Black neighborhoods are more likely to be obese and have

comorbidities associated with obesity.[20,21] Still, it is not clear how the potentially beneficial effects of ethnic enclaves offset the negative effects of the socioeconomic conditions in which Hispanics and Blacks live.[22]

The effects of ethnic concentration on children may be compounded by economic hardship. Evidence suggests that Hispanic children may be most affected by socioeconomic status in their risk for obesity.[1] Watt et al[23] found evidence that among low-income Hispanic preschoolers, environmental stress and participation in the SNAP program were more important predictors of childhood obesity than the consumption of sugar or sweetened beverages by their mothers. In fact, the effect of ethnicity and race on obesity and its comorbidities may be due also in part to socioeconomic exposures and not ethnic composition in the neighborhood.[10,24,25] Do et al[15] found that because Mexican Americans and Blacks live in different types of socioeconomic and cultural environments, their exposure to risk factors also varies, creating differences in the putative mechanisms responsible for disparities in childhood obesity by race/ethnicity. However, the relationship between environment and obesity among school-aged children is not understood.

Previous research has not disentangled the complex relations among ethnic concentration, socioeconomic conditions, and obesity in children. The purpose of this study is to examine associations between county-level socioeconomic characteristics and weight status in fourth grade Texas school children by race/ethnicity. The analysis will explore to what extent county racial/ethnic composition (ie, percent Hispanic and percent Black) is associated with differences in body mass index by racial/ethnic group. We will also examine the extent to which socioeconomic environment is associated with differences in body mass index by racial/ethnic group. We believe that because Hispanic and Black children living in Texas are more likely to live in high-ethnically-concentrated and socioeconomically-disadvantaged environments, they will be at greater risk for being overweight or obese compared to non-Hispanic White children. However, since this relationship is complex, the associations between ethnicity and socioeconomic environment (measured at a county level) and obesity are likely to differ between non-Hispanic Black and Hispanic children.

Methods

Data Sources

School Physical Activity and Nutrition (SPAN) Project. The School Physical Activity and Nutrition (SPAN) Project is a multi-wave childhood obesity surveillance study of children in the fourth, eighth and eleventh grades in the Texas public school system.[26] It is conducted through the Michael & Susan Dell Center for Healthy Living, part of The University of Texas Health Science Center at Houston, in partnership with the Texas Department of State Health Services. Data were collected in 2000-2002, 2004-2005 and 2009-2011. This data source provides a unique opportunity to evaluate childhood obesity across racial and ethnic groups (Hispanic, non-Hispanic White and Black children).

Fourth grade children from the 2009-2011 wave of the SPAN were used in this study. In the SPAN, schools were randomly selected from eligible school districts. Exclusion criteria were: 1) Schools without special education populations, such as charter or magnet schools; 2) schools under construction; 3) schools without gender and ethnicity enrollment information; and 4) schools with fewer than 75 students at the selected grade levels. The 2009-2011 sampling frame was composed of 4,312 schools that represented 868,805 students in Texas, of which 286,903 were fourth grade students.

Random selection from the 2009-2011 sampling frame was made with probability proportional to size (PPS) using the following: (1) the list of school districts in Texas based on eligibility criteria for the first stage; (2) the list of schools within each school district for the second stage; and (3) the list of classrooms within each school for the third stage. Questionnaires were administered to students in the fourth grade and to their parents/guardians. The fourth grade sample (n= 4,401) is primarily Hispanic (2,479 Hispanic) and selected from 64 school districts (116 schools) in 41 counties across Texas.

Dependent Variable

Body Mass Index. A categorical variable was used as an outcome based on CDC Body Mass Index (BMI) percentile based on gender and age-specific CDC standards for underweight, normal/healthy weight, overweight and obese in children.[27] For this study we will use a three-category BMI variable: (1) underweight/normal/healthy weight, (2) overweight, and (3)obese.

Independent Variables

Human Security Index (HSI). We use variables used in the HSI to evaluate the socioeconomic factors at the county level. The (HSI) is an index of more than 30 economic, environmental and social indicators, and captures multiple dimensions of the socioeconomic context at different levels (ie, state, county, city).[28] The HSI is an index comprising of a network of three sub-components or "fabrics"; the Economic, Environmental, and Social Fabrics. The Social Fabric (component) is further subdivided into the (a) Education, (b) Health, (c) Crime & Punishment, and (d) Social Stress subcomponents (or sub-fabrics). Each of the three Fabrics (Economic, Environmental, and Social) characterizes a different aspect of quality of life, and provides an overall assessment of socioeconomic conditions. The HSI is modeled after the Human Development Index (HDI) as a way to characterize the multiple dimensions of social and economic inequality, and has been tested in the United States.[28]

Table 1 presents each individual variable name, how it was measured and the source of the data for each variable used. Sources of information included databases from the US Census Bureau, the Environmental Protection Agency (EPA), Centers for Disease Control (CDC), Environmental Protection Agency (EPA), United States Department of Agriculture (USDA), Bureau of Labor Statistics (BLS), and Federal Bureau of Investigation (FBI). These data were collected directly from each organization or agency website. The most recently available data, which in most cases was collected within the past 5 years, were used. In a few instances the most current data were collected within the previous decade, which is noted in Table 1. The HSI has been previously used as an index of the compiled variables from various sources to create the different fabrics and subcomponents. In order to provide a more detailed description of the association between the county socioeconomic environment and BMI in fourth grade students in the SPAN we have opted to use the variables without constructing the indices (see Table 2). All county-level socioeconomic variables were treated as continuous variables in all analyses for this paper.

Table 1. County Level Human Security Index (HSI) Variables, Sources and Means for SPAN 4th Grade Sample**.**

Variable	Source
Economic Fabric	
% Unemployment	Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics (LAUS) 2010
Median Household Income (dollars)	American Communities Survey - US Census Bureau 2008
% of Population on Food Stamps	USDA Economic Research Service 2007
Environmental Fabric	
Ozone Days > Environmental Protection Agency (EPA) Threshold (average per year)	Centers for Disease Control (CDC)-Environmental Protection Agency (EPA) Collaboration 2006
Social Fabric Index	
Education Subcomponent	
% Population 25 yrs or Older High School Graduate (incl. GED)	US Census 2010
% Population > 25 yrs Some College Incl. Associate Degree	US Census 2010
% Population > 25 yrs with Bachelors degree	US Census 2010
%Adult Literacy	National Center for Education Statistics (NCES), National Assessment of Adult Literacy 2003
% Not Proficient in English	American Communities Survey US Census Bureau 2008
Health Subcomponent	
Male &Female Life Expectancy at Birth	CDC- National Center for Health Statistics (NCHS) 2010
Years of Potential Life Lost Premature Death Rate	CDC National Center for Health Statistics (NCHS) 2005-07
% Adults Uninsured	CDC NCHS 2001-2007
Crime Subcomponent	
Violent Crimes (Per 100,000)	Uniform Crime Reporting (UCF), Federal Bureau of Investigation (FBI) 2010
Incarceration (% of Population)	US Census 2010
Social Stress subcomponent	
% Child Poverty	Small Area Income & Poverty Estimates (SAIPE) US Census Bureau 2009
Teen Birth Rate (per 1,000 15 to19 years)	NCHS 2001-2007
Grandparent performing parental Role %	US Census 2010
Commute Index(% Drive Alone*Commute Time)	American Communities Survey (ACS) 5 Year Estimates 2005-09
Creative share (% of population in occupations that require "thinking creatively").	U.S. Department of Agriculture (USDA) Economic Research Service 2003

Race/ethnic concentration was measured by county-level percent Hispanic and percent Black obtained from the 2010 US Census. Demographic Covariates used were self-reported age and gender.

Statistical Analysis.

The analysis for this study included a bivariate test using Chi-square for associations between BMI category and racial/ethnic group and gender. Frequencies and weighted percentages using population-based sampling weights are presented for the bivariate analysis. In addition, we conducted ANOVA tests to determine difference in means by racial/ethnic group for category and the socioeconomic variables using the HSI framework. Odds ratios were generated using multinomial logistic regression using jackknife variance estimate. Because the sampling design of the SPAN is at a school level and not the county level, we opted for using the jackknife method to adjust the p-values, even though students are clustered within counties. The jackknife method systematically re-samples subsets of the data to correct potential bias due to non-random distributions as is the case with clusters (e.g. schools, counties).[29] Multilevel models are used often when school level data is being analyzed to minimize the effect of covariation between students who attend the same school and to distinguish differences in schools.[30] By using jackknife variance estimate instead of a multilevel model we are assessing the effect of socioeconomic and cultural county environment at the individual level, and not the school level to predict the effect on students, not on groups of students. All analyses were conducted in STATA 12SE.[31]

Results

Distribution frequencies and percentages for race/ethnic group by BMI category (underweight/normal/healthy, overweight, obese) are presented in Table 2. Hispanic children were compared to non-Hispanic Whites. Hispanic children had the greatest proportion of those who were obese

Table 2. Frequencies and weight percentages for BMI category by Race/Ethnicity and Gender for 4th Grade SPAN Students. †

	Underweight/Healthy/Normal Weight	Overweight	Obese
Non-Hispanic White	904 (73.1)	202 (12.7)	220 (14.2)
Non-Hispanic Black	1,174 (55.5)	496 (19.6)	780 (24.9)***
Hispanic	359 (48.7)	111 (21.0)	155 (30.3)***
Gender			
Girl	1,507 (59.1)	443 (18.8)	594 (22.1)*
Boy	1,341 (54.1)	464 (18.1)	686 (27.8)

† frequencies with weighted percentages in parentheses; reference group is Non-Hispanic White.
*** p<.001,**p<.01, *p<.05

(30.3%) and overweight (21.0%) ($p<.001$). Non-Hispanic Black children also had a significantly higher percentage of those who were obese (24.9%) and overweight (19.6%) compared to non-Hispanic Whites ($p<.001$). There was a significant difference between boys (27.8%) and girls (22.1%) ($p<.05$) in proportion obese, but not overweight.

To provide a context of the places in which fourth grade children of the SPAN sample live, Table 3 presents county-level Human Security Index (HSI) Variables Means and Standard Deviations (S.D.) by Race/Ethnic group. In terms of the Economic Fabric variables there were significant differences from non-Hispanic Whites for both Black and Hispanic children for county-level % unemployment (Black - 8.7%, Hispanic 9.1%, White 7.7%) ($p<.001$). Hispanics were significantly different from non-Hispanic Whites in county-level median household income (Hispanic $41,125.22, White $45,876.82) ($p<.001$) and percent of the population on food stamps (Hispanic 15.7%, White 10.7%) for Hispanics only ($p<.001$).

Table 3. County Level Human Security Index (HSI) Variables Means (S.D.) by Race/Ethnic Group of SPAN 4th Grade Students.

Variable	White	Black	Hispanic	Total
Economic Fabric				
% Unemployment	7.7 (1.6)	8.7(1.4)***	9.1 (2.3)***	8.6 (2.1)
Median Household Income (dollars)	$45,876.82 ($8312.61)	$46,068.91 ($8,274.62)	$41,125.22 ($8,711.17)***	$43,258.92 ($8858.74)
% of Population on Food Stamps	10.7 (5.3)	11.1 (4.7)	15.7(7.5)***	13.5 (6.97)
Social Fabric Index				
Education Subcomponent				
% Population 25 yrs or Older High School Graduate (incl. GED)	76.6 (7.9)	75.2 (6.8)**	68.5(11.3)***	71.9 (10.6)
% Population > 25 yrs Some College Incl. Associate Degree	8.1 (1.3)	7.6 (1.1)***	7.2(1.4)***	7.54 (1.42)
% Population > 25 yrs with Bachelors degree	14.3 (5.5)	14.9 (4.4)**	12.4 (4.8)***	13.3 (5.06)
%Adult Literacy	82.9 (8.4)	73.4 (13.6)***	80.3 (7.7)***	77.4 (12.3)
% Not Proficient in English	10.8(7.9)	14.7(8.2)***	19.8 (10.8)***	16.4 (10.5)
Health Subcomponent				
Male &Female Life Expectancy at Birth	76.3 (1.7)	76.1 (1.4)*	77.3 (1.7)***	76.8 (1.76)
Years of Potential Life Lost Premature Death Rate	8070.8 (1577.1)	8003.3 (1456.1)	7349.0 (1324.2)***	7659.4 (1465.3)
% Adults Uninsured	29.5 (4.3)	31.1 (4.5)***	33.6 (6.4)***	32.0 (5.87)
Crime Subcomponent				
Violent Crimes (Per 100,000)	53.6 (20.4)	60.8 (17.6)***	51.3 (19.5)***	53.3 (19.8)
Incarceration (% of Population)	2.9 (.82)	2.9 (.72)	2.6 (.73)***	2.77 (.77)
Social Stress subcomponent				
% Child Poverty	22.0(6.7)	24.0 (6.2)***	28.6 (9.7)***	25.9 (8.95)
Teen Birth Rate (per 1,000 15 to19 years)	66.9 (20.1)	69.1 (16.0)*	75.7(17.1)***	72.1 (18.4)
Grandparent performing parental Role %	49.6 (8.8)	47.7 (7.2)***	44.9 (8.7)***	46.7 (8.76)
Commute Index(% Drive Alone*Commute Time)	78.6 (3.3)	78.9 (2.4)	78.0 (3.5)***	78.3 (3.3)
Creative share (% of population in occupations that require "thinking creatively").	22.2 (6.5)	23.6 (5.6)***	20.8 (5.8)***	21.6 (6.1)

* p<.05, ** p<.01, ***p <.001; White is the reference category.

There were substantial race/ethnic differences in county-level Social Fabric variables. Beginning with educational subcomponent variables, both Black and Hispanic differed significantly from White children in the percentage of adults in the county who had at least a high school degree (Black 75.2%, Hispanic 68.5%, White 76.6%) (p<.001), percentage with some college (Black 7.6%, Hispanic 7.2%, White 8.1%) (p<.001), percentage with a bachelors degree (Black 14.9%, Hispanic 12.4%, White 14.3%) (p<.001), adult literacy (Black 80.3%, Hispanic 73.4%, White 82.9%) (p<.001), and percentage of non proficient in English (Black 14.7%, Hispanic 19.8%, White 10.8) (p<.001). There were significant differences from Whites in the county-level Health Component for both Black and Hispanic children in life expectancy (Black 76.1 years (p<.05), Hispanics 77.3 years (p<.001), Whites 76.3 years), county-level total years of potential life lost in premature death (Hispanic 7349.0, White 8070.8) (p<.001), and percentage of adults uninsured (Black 31.1%, Hispanic 33.6%, White 29.5%) (p<.001). Averages for county-level crime subcomponent variables differed from White children for both Black and Hispanic children for violent crime rate per 100,000 (Black 60.8, Hispanic 51.3, White 53.6) (p<.001) and for Hispanics for percent incarcerated (Hispanic 2.6, White 2.9) (p<.001). Finally, significant differences for the Social Stress Subcomponent variables existed from Whites for both Black and Hispanic children for percent poverty (Black 24.0%, Hispanic 28.6%, White 22.0%) (p<.001), teenage birth rate (Black 69.1 (p<.05), Hispanic 75.7(p<.001), White 66.9), percentage of grandparents in parent role (Black 47.7%, Hispanic 44.9%, White 49.6%) (p<.001) and creative share (Black 23.6, Hispanic 20.8%, White 22.2%) (p<.001). Hispanic children differed significantly from White children in county-level commute index ratio (Hispanics 78.0, White 78.6) (p<.001).

Table 4 presents odds ratios from the logistic regression analysis with jackknife variance estimation using HSI variables for SPAN fourth grade students for obesity and overweight compared to underweight/healthy/normal weight. Odds ratios are presented for stratified analysis for Hispanic, Black and White students and the full sample. Beginning with the total sample in the final column of Table 4, Hispanic children have a significantly greater odds of being overweight (OR=1.87, p<.001) and obese (OR= 2.54, p<.001) than White children. Black children are significantly more likely to be obese (OR= 1.90, p<.001) than White children. For the total sample HSI factors significantly associated with overweight included percentage of Hispanic ethnic concentration (OR= 1.07, p=.007), percentage of adult literacy (.842, p=.034), percentage not proficient in English (OR=.888, p=.025), M&F life

expectancy at birth (OR=.621, p=.019), percentage of adults uninsured (OR= 1.07, p=.052) and teen birth rate (OR= .961, p=.022). For obesity in the total sample, percent of population with a bachelor's degree (OR=.848, p=.046), and percentage of adult literacy (OR= 1.08, p=.045) were significant and percent incarcerated (OR=.711, p=.018) was the only significant factor associated with overweight in the total sample.

Table 4. Odds Ratios from Logistic Regression Analysis with Jackknife Variance Estimation Using HSI Variables for SPAN Fourth Grade Students for Obesity and Overweight as Outcome.†

	Hispanic (n= 2,450)				White (n=1,326)				Black (n=625)				Total			
Student Race/Ethnicity (ref. White)	Overweight		Obese		Overweight		Obese		Overweight		Obese		Overweight		Obese	
	OR	p-value	OR	p-value	OR	p-value	OR	p-value	OR	p-value	OR	p-value	OR	p-value	OR	p-value
Hispanic													1.87	.000	2.54	.000
Black													1.33	.057	1.90	.000
Ethnic Concentration																
Hispanic	1.07	.007	1.03	.101	.974	.244	.999	.944	1.17	.311	1.01	.795	1.01	.531	.999	.974
Black	1.06	.126	1.06	.048	1.00	.941	.973	.501	1.30	.475	1.08	.464	1.02	.338	1.01	.487
Economic Fabric																
Unemployment	.843	.211	.899	.359	.861	.556	1.36	.227	.898	.863	1.14	.781	.968	.708	1.01	.900
Median Household Income	.999	.633	.999	.260	.999	.242	1.01	.022	.999	.340	1.00	.780	1.00	.966	1.00	.198
% of Population on Food Stamps	.921	.539	.885	.262	1.06	.711	1.08	.602	.307	.188	.844	.623	.950	.490	2.67	.786
Social Fabric																
Educational Subcomponent																
% Population 25 yrs or Older High School Graduate (incl. GED)	.999	.142	.999	.181	1.00	.678	1.00	.315	.999	.164	1.00	.714	.999	.416	1.00	.701
% Population > 25 yrs Some College Incl. Associate Degree	1.41	.153	1.16	.456	.884	.747	.788	.391	3.67	.565	.606	.536	.886	.375	.848	.178
% Population > 25 yrs with Bachelors degree	1.20	.304	.883	.407	.808	.380	.990	.964	.489	.346	.706	.490	.841	.073	.848	.046
%Adult Literacy (below BPLS)	.842	.034	2.62	.580	1.02	.903	1.06	.574	1.49	.336	1.31	.284	1.03	.486	1.08	.045
% Not Proficient in English	.888	.025	.986	.762	1.04	.796	.932	.567	2.48	.131	1.23	.422	1.01	.676	1.04	.160
Health Subcomponent																
Male & Female Life Expectancy at Birth	.621	.019	.708	.053	1.16	.550	1.25	.236	.204	.234	1.62	.388	.939	.588	.970	.770

Years of Potential Life Lost Premature Death Rate	1.00	.066	1.00	.723	1.00	.642	.999	.762	.999	.473	.999	.730	.999	.705	.999	.230
Adult Uninsured %	1.07	.052	1.01	.797	.969	.506	1.04	.405	.785	.387	.993	.953	1.03	.242	1.00	.963
Crime Subcomponent																
Violent Crimes	.987	.343	.999	.958	1.02	.195	.999	.887	.945	.650	1.03	.433	1.01	.387	1.00	.762
Incarceration	.789	.335	1.33	.159	.542	.078	.981	.935	2.82	.512	.786	.717	.711	.018	.816	.112
Social Stress Subcomponent																
% Child Poverty	1.04	.517	1.05	.240	.899	.406	1.00	.966	1.59	.324	.965	.844	.996	.903	1.03	.381
Teen Birth Rate	.961	.022	.964	.013	.988	.557	1.02	.334	.867	.401	1.04	.766	.996	.651	.990	.224
Grandparent performing parental Role %	.989	.534	.984	.269	.970	.288	1.01	.744	1.14	.393	1.05	.510	.994	.570	1.00	.933
Commute Index	1.04	.282	.986	.607	.936	.528	1.04	.549	1.93	.192	1.04	.851	1.02	.354	1.01	.686
Creative share	1.04	.665	1.12	.092	1.07	.564	.912	.414	2.15	.327	.947	.828	1.08	.140	1.01	.817
† reference category is underweight/healthy/normal weight.																

In the stratified analysis, there were no significant HSI factors associated with overweight or obesity in Black fourth grade students in the SPAN, however the only significant factor associated with obesity in White children was median income (OR= 1.01, p=.022). There were three factors associated with obesity in Hispanics: Black ethnic concentration (OR=1.06, p=.048), and teen birth rate (OR= .964, p= .013), although M&F life expectancy at birth was not significant.

Discussion

This study was intended to provide insight into the relationship between community environment and racial/ethnic obesity disparities. Focus in childhood health has been largely placed on home and school environments, and not on communities. Results from this study revealed that Hispanic and Black children were significantly more likely to be overweight and obese compared to non-Hispanic Whites both in the bivariate and regression analysis. When adjusting for county-level factors, gender and age in the logistic regression analysis, Hispanic and Black children were still significantly more likely to be obese than non-Hispanic White children, however only Hispanic children were more likely to be

overweight. The separate analyses for each racial/ethnic group suggest that cultural and socioeconomic county-level influences on overweight and obesity vary by racial/ethnic group. Moreover, county-level socioeconomic factors and ethnic concentration were most associated with overweight and obesity in Hispanic children, but had no significant association in the regression analysis for Black children.

While socioeconomic status and ethnic concentration are risk factors for obesity, the extent and magnitude of their effects may depend on the context of the community. Results of this study provide insight into the complex causal pathways that lead to obesity and it may be that communities where Hispanic children live may differ from other race/ethnic groups. Although poverty is often used as an overarching conceptual framework to understand and explain obesity disparities,[32] it is important to focus on specific mechanisms within communities and understand how pathways may differ depending on racial/ethnic group.

Hispanic and Black children are more likely to live in places that have lower average educational attainment; median income, lower access to green space and healthier foods.[16,33] Additionally, Hispanic communities are also plagued with lower health literacy and utilization of preventive health screenings.[33] However, none of the HSI factor variables were associated with being overweight or obese in the Black students. While Hispanic and Black children are more likely to live in poverty and be exposed to well-established risk factors for both acute and chronic diseases, the combined effects of social stress, resource scarcity, and obesogenic environments may require an analysis of cumulative burdens/impacts to understand causal mechanisms. It is also vital to understand the nuances by which racial/ethnic composition contributes to social determinants of childhood obesity so that we can design effective intervention and prevention strategies.

The salubriousness of Hispanic communities are debated in the literature and while higher Hispanic ethnic concentration has been associated with lower mortality and the incidence of certain cancers,[17-19] there is now also evidence that Hispanic ethnic concentration is associated with increased risk of obesity in Mexican American adults.[15,34] Similar obesity risk findings have been observed in predominantly Black communities,[20,21] but without the other health benefits observed in Hispanic communities. In this study of fourth grade SPAN students, there was an increase in odds of being overweight with increased Hispanic ethnic concentration for Hispanic children, but no significant relationship for obesity. However, increased Black ethnic concentration was associated with increased odds of obesity in Hispanic children, but not

Black children. The fact that greater ethnic diversity in counties is associated with higher childhood obesity prevalence of Hispanic fourth graders may be the result of stressors of living in communities that may be more socially and culturally challenging for integration of Hispanics. There is some evidence to suggest perceived acceptance or discrimination is associated with depression and other mental health outcomes.[35] This is among Mexican American children and their perceived body images.[36] Another possible explanation is that the food and built environment may vary in ethnically mixed counties, so that susceptibility to obesity in Hispanic children in these communities is due to access, rather than the actual racial or ethnic makeup of the communities in which these children live.[15,16,33]

Disparities in socioeconomic status are established determinants of differentials in health and mortality outcomes by race and ethnicity.[37] Although the socioeconomic impact on health is so well recognized, the paths through which socioeconomic environments lead to disease or obesity are not understood. Using the Human Security Index as a framework of variables, we began the process of disentanglement of socioeconomic characteristics of counties and risk of obesity by race/ethnicity. While economic and educational environments may be associated with a greater risk of obesity, they did not contribute or explain the disparities by race. In fact, it was only the Health subcomponent and Social Stress components of the Social Fabric that provided the greatest explanations for differentials in obesity risk by race in for Hispanic in the SPAN study. Though socioeconomic status and ethnic concentration are risk factors for obesity, it may depend on the context and may serve as risk factors for all, not just Blacks and Hispanics.

As in all studies, this study is not without limitations. Using one age group hampers our capacity to make inferences about children in other age groups. It is possible that older children may be more influenced by the county level environment than fourth graders. Also, there is always the issue of measurement when dealing with indices. Comparing other comprehensive instruments to assess multiple dimensions of the places we live is essential to building a model for social determinants of obesity that could be targeted for prevention and intervention efforts. Moreover, we chose county-level data due to its richness of information but we understand that it does not necessarily correspond directly to the neighborhoods in which children live. A potential weakness of this approach is the over aggregation of these variables that may inadvertently obscure potential relations at smaller local levels, such as census tracts, or contribute to mistakes related to the ecological fallacy.[38,39] An additional

limitation is that we did not include many individual-level controls that may have explained these relationships, such as behaviors or cultural tendencies. Finally, these data are cross sectional and we only detected associations and therefore causality cannot be inferred from these findings. Despite these limitations, the added information this study provides outweighs the potential methodological issues. Our results are a starting point for future investigations aimed at better understanding the influence of living environment on obesity risk in school-aged children.

References

1. Bethell C, Read D, Goodman E, et al. Consistently Inconsistent: A Snapshot of Across- and Within-State Disparities in the Prevalence of Childhood Overweight and Obesity. *Pediatrics.* 2009;123:S277.
2. Ogden C, Carroll M. Prevalence of obesity among children and adolescents: united states, trends 1963–1965 through 2007–2008 health e-stat.
http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm Accessed December 2, 2013.
3. Singh GK, Siahpush M, Hiatt RA, Timsina LR. Dramatic Increases in Obesity and Overweight Prevalence and Body Mass Index Among Ethnic-Immigrant and Social Class Groups in the United States, 1976–2008. *J Comm Health.* 2011;36:94–110.
4. Sisson SB, Church TS, Martin CK, Tudor-Locke C, Smith SR, Bouchard C, Earnest CP, Rankinen T, Newton RL, Katzmarzyk PT. Profiles of Sedentary Behavior in Children and Adolescents: The U.S. National Health and Nutrition Examination Survey, 2001–2006. *Int J Pediatr Obes.* 2009;4:353–359.
5. Centers for Disease Control. Obesity rates among all children in the United States. http://www.cdc.gov/obesity/childhood/data.html. Accessed May 5, 11.
6. Powell LM, Han E, Chaloupka FJ. Economic contextual factors, food consumption, and obesity among U.S. adolescents. *J Nutr.* 2010;140:1175-1180.
7. Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*. 2009;87:229-257.
8. Robert SA, Reither EN. A multilevel analysis of race, community disadvantage, and BMI. *Soc Sci Med*. 2004;59:2421-2434.
9. Ruel E, Reither EN, Robert SA, Lantz PM. Neighborhood effects on BMI trends: examining BMI trajectories for Black and White women. *Health Place.* 2010;16:191-198.
10. Dubowitz T, Heron M, Bird CE, et al. Neighborhood socioeconomic status and fruit and vegetable intake among whites, blacks, and Mexican Americans in the United States. *Am J Clin Nutr* 2008;87:1883–1891.
11. Zhang Q, Wang Y. Using concentration index to study changes in socio-economic inequality of overweight among US adolescents between 1971 and 2002. *Int J Epidemiol.* 2007;36(4):916–925.
12. Bodor JN, Rice JC, Farley TA, Swalm CM, Rose D. The association between obesity and urban food environments. *J Urban Health.* 2010;87(5):771-781.

13. Brown HS 3rd, Pérez A, Mirchandani GG, Hoelscher DM, Kelder SH. Crime rates and sedentary behavior among 4th grade Texas school children. *Int J Behav Nutr Phys Act.* 2008;14(5):28.
14. Zick CD, Smith KR, Fan JX, Brown BB, Yamada I, Kowaleski-Jones L. Running to the store? The relationship between neighborhood environments and the risk of obesity. *Soc Sci Med*. 2009;69(10):1493-1500.
15. Do DP, Dubowitz T, Bird CE, Lurie N, Escarce JJ, Finch BK. Neighborhood context and ethnicity differences in body mass index: A multilevel analysis using the NHANES III survey (1988–1994). *Econ Hum Biol*. 2007;5:179–203.
16. Lovasi GS, Hutson MA, Guerra M, Neckerman KM. Built environments and obesity in disadvantaged populations. *Epidemiol Rev.* 2009;31:7–20.
17. Eschbach K, Ostir GV, Patel KV, Markides KS, Goodwin JS. Neighborhood context and mortality among older Mexican Americans: is there a barrio advantage? *Am J Public Health*. 2004;94:1807-1812.
18. Mair C, Diez Roux AV, Osypuk TL, Rapp SR, Seeman T, Watson KE. Is neighborhood racial/ethnic composition associated with depressive symptoms? The multi-ethnic study of atherosclerosis. *Soc Sci Med*. 2010;71(3):541-550.
19. Sheffield KM, Peek MK. Neighborhood context and cognitive decline in older Mexican Americans: results from the Hispanic Established Populations for Epidemiologic Studies of the Elderly. *Am J Epidemiol.* 2009; 169: 1092-1101.
20. Kershaw KN, Albrecht SS, Carnethon MR. Racial and ethnic residential segregation, the neighborhood socioeconomic environment, and obesity among Blacks and Mexican Americans. *Am J Epidemiol*. 2013;177(4):299-309.
21. Landrine H, Corral I. Separate and unequal: residential segregation and black health disparities. *Ethn Dis*. 2009;19:179-184.
22. Larson NI, Story MT. Food insecurity and weight status among U.S. children and families: a review of the literature. *Am J Prev Med.* 2011;40:274-275.
23. Watt TT, Appel L, Roberts K, Flores B, Morris S. Sugar, stress, and the supplemental nutrition assistance program: early childhood obesity risks among a clinic-based sample of low-income Hispanics. *J Community Health*. 2013;38(3):513-520.
24. Laveist T, Pollack K, Thorpe R Jr, Fesahazion R, Gaskin D. Place, not race: disparities dissipate in southwest Baltimore when blacks and whites live under similar conditions. *Health Aff*. 2011;30:1880-1887.

25. Springer AE, Hoelscher DM, Castrucci B, Perez A, Kelder SH. Prevalence of physical activity and sedentary behaviors by metropolitan status in 4th-, 8th-, and 11th-grade students in Texas, 2004-2005. *Prev Chronic Dis.* 2009;6:A21.
26. Hoelscher DM, Barroso C, Springer A, Castrucci B, Kelder SH. Prevalence of self-reported activity and sedentary behaviors among 4th-, 8th-, and 11th-grade Texas public school children: the school physical activity and nutrition study. *J Phys Act Health.* 2009;6(5):535-547.
27. Centers for Disease Control. Overweight and Obesity. Data and Statistics. http://www.cdc.gov/obesity/childhood/data.html. Accessed May 11, 2012.
28. Hastings D. The human security index: potential roles for the environmental and earth observation communities. Earthzine: Fostering Earth Observation & Global Awareness. http://www.earthzine.org/2011/05/04/the-human-security-index-potential-roles-for-the-environmental-and-earth-observation-communities/. Accessed October 8, 2011.
29. Sawyer S. Resampling data: using a statistical jackknife. Working paper at Washington University. March 11, 2005. http://www.math.wustl.edu/~sawyer/handouts/Jackknife.pdf. Accessed November 8, 2013.
30. Raudenbush S, Bryk AS. *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2nd ed. Thousand Oaks, CA: Sage Publications, Inc.; 2002.
31. StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.
32. Shrewsbury V, Wardle J. Socioeconomic status and adiposity in childhood: a systematic review of cross-sectional studies 1990-2005. *Obesity*. 2008;16(2):275-284.
33. Liao Y, Bang D, Cosgrove S, et al. Surveillance of health status in minority communities - Racial and Ethnic Approaches to Community Health Across the U.S. (REACH U.S.) Risk Factor Survey, United States, 2009. *MMWR Surveill Summ*. 2011;60(6):1-44.
34. Salinas J, Abdelbary B, Rocha E, Gay J, Sexton K. Impact of Hispanic Ethnic Concentration and Socioeconomic Status on Obesity Prevalence in Texas Counties. *Int J Environ Res Public Health.* 2012;9(4):1201-1215.
35. Finch BK, Kolody B, Vega WA. Perceived discrimination and depression among Mexican-origin adults in California. *J Health Soc Behav*. 2000;41:295-313.
36. Edwards TC, Patrick DL, Skalicky AM, Huang Y, Hobby AD. Perceived body shape, standardized body-mass index, and weight-specific quality of

life of African-American, Caucasian, and Mexican-American adolescents. *Qual Life Res*. 2012;21(6):1101-1107.
37. Williams DR, Mohammed SA, Leavell J, Collins C. Race, socioeconomic status, and health: Complexities, ongoing challenges, and research opportunities. *Ann N Y Acad Sci.* 2010;1186: 69–101.
38. Cutter SL, Holm D, Clark L. The role of geographic scale in monitoring environmental justice. *Risk Anal*. 1996;16(4):517–526.
39. Most MT, Sengupta R, Burgener MA. Spatial scale and population assignment choices in environmental justice analyses. *Prof Geogr*. 2004; 56(4):574–58