ORIGINAL ARTICLE

Social Determinants of Overweight and Obesity Among Children in the United States

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ABSTRACT

Background: Childhood obesity is one of the foremost threats to population health in the United States (U.S.) leading to the emergence of co-morbidities and increased healthcare cost. We explore the influence of selected social determinants of health (SDOH) on overweight and obesity among U.S. children.

Methods: We utilized the National Survey of Children's Health (NSCH) 2016-17 dataset for this analysis. Overweight was defined as Body Mass Index (BMI) ≥ 85th to <95th, while obesity was defined as BMI ≥95th percentile for age and sex. Based on the literature and pathway plausibility, we examined several SDOH variables as predictors of childhood overweight or obesity in the US. Survey log-binomial regression models were built to generate prevalence ratio (PR) estimates to capture the associations between SDOH and overweight or obesity.

Results: About 30.6 million children were surveyed of which 9.5 million (31.0%) were either overweight or obese. The likelihood of obesity was elevated among non-Hispanic Black and Hispanic children (PR = 1.53; 95% CI = 1.01-2.31) and (PR = 1.50; 95% CI = 1.18-1.90) respectively. Overweight was more frequent in younger children, children of single parents, and children who lived in a neighborhood with no amenities. Parental attainment of college education, health insurance coverage, female gender, and language spoken in home other than Spanish were protective against overweight or obesity.

Conclusions and Global Health Implications: SDOH represent markers of overweight or obesity in children. We recommend the development of innovative interventions using SDOH risk and protective pathways as guide to address the current epidemic of childhood overweight and obesity.

Key words: Social determinants • Obesity • Overweight • SDOH • Children • United States

1. Introduction

1.1. Background

Childhood obesity is one of the foremost threats to population health in the United States (U.S.).[1,2] Childhood obesity refers to a body mass index (BMI) at or greater than 95th percentile for age and sex, while childhood overweight is BMI at or greater than 85th to less than 95th percentile for age and sex.[3] Globally, the mean standardized BMI increased by 0.32kg/m² per decade between 1975 and 2016.[4] In the U.S. and over the last three decades, the prevalence of childhood obesity has increased by more than four-folds.[5] Mean obesity prevalence in children 6-11 years of age increased from 4% to 18.4%; and in children 12-19 years from 6.1% to 20.6% between 1971 to 1974,[5,6] and between 2015 to 2016,[7] respectively. The rising prevalence of childhood overweight and obesity is associated with the emergence of comorbidities such as obstructive sleep apnea, type 2 diabetes mellitus, dyslipidemia, hypertension, and non-alcoholic fatty liver disease.[3] These comorbidities are positively correlated with the severity of obesity[3] and do influence adult life morbidity and mortality.[1] Additionally, psychosocial problems such as lowered self-esteem, depression, and peer discrimination are experienced by overweight and obese children.[8] Furthermore, there are significant societal and economic burdens associated with the rising prevalence of childhood obesity and related comorbidities.[9] The dire consequences associated with childhood obesity which progress into adulthood include poor academic and lower skill achievements, inferior outcomes in the labor market, rising healthcare costs, and increasing decline in productivity.[9]

Several studies have assessed the independent relationships between sociodemographic and economic factors on childhood obesity in the U.S. particularly, the influence of age, gender, race/ethnicity and socioeconomic status on childhood obesity.[10-15] There are, however, fewer studies examining the association of selected social determinants such as socioeconomic, behavioral, and environmental factors on childhood overweight and obesity in the U.S.[5]

1.2. Objective

The aim of this study was to explore the association of selected social determinants of health (SDOH) comprising socioeconomic, behavioral, and environmental factors on overweight and obesity among children in the U.S. using nationally representative data.

2. Methods

2.1. Study Population/variables

This study utilized survey data from the National Survey of Children's Health (NSCH) 2016-17.[16] The NSCH is sponsored and directed by the Health Resources and Services Administration (HRSA) Maternal and Child Health Bureau (MCHB).[16] Beginning 2016, NSCH started integrating two surveys, the previous NSCH and the National Survey of Children with Special Health Care Needs (NS-CSHCN), which were administered via web and mail (paper) instruments. The majority of the questions in the NSCH were the same in both the 2016 and 2017 surveys. Only items that were the same across both data sets were included in the combined dataset for this analysis. From 2016 onward, the NSCH is being conducted annually by the U.S. Census Bureau, and the 2017 survey was the second administration of the redesigned NSCH. The survey provides rich data on multiple factors of health and well-being (physical, emotional, and mental), access to quality health care, neighborhood, school, and social context of non-institutionalized children 0-17 years of age living in the US.

2.1.1. Sampling strategy

Households with one or more children under 18 years old were randomly sampled and contacted by mail, and one child from each household was randomly selected to be the subject of the survey. Then an adult (usually a parent or guardian) in the household who was most familiar with the child's health and health care was invited to complete a short screener questionnaire and a more detailed age-specific topical questionnaire online or by paper. Children with special health care needs and children 0-5 years of age were oversampled in the survey. A total of 71,811 surveys were completed for 2016

and 2017 combined comprising 50,212 surveys in 2016 and 21,599 in 2017. Survey data were weighted and adjusted for the combined dataset to represent the population of noninstitutionalized children aged 0-17 years living in housing units nationally and in each state. The overall weighted response rate was 40.7% for 2016 and 37.4% for 2017. The survey data was weighted to allow for generalizations to state and national pediatric populations (Screener and Topical file), and households with children (Screener file). The final weight for selected children, household, and child screener weights were assigned to all households and children with completed screeners. [16]

2.1.2. Exposure and outcome variables

Our exposures of interest were selected social determinants of health (SDOH) comprising demographic, socioeconomic, behavioral, and environmental characteristics. Demographic factors included sex categorized as male and female, age sub-grouped into 10 – 12 years, 13 – 15 years, and 16 – 17 years; and race/ethnicity categorized into non-Hispanic White, non-Hispanic Black, Hispanic and Other. Socioeconomic factors included parents' nativity categorized into parent(s) born in the US, any parent born outside the US, other (child born in the US, parents not listed); primary household language categorized into Hispanic children with non-English primary household language, Hispanic children with English as primary household language and non-Hispanic children; family structure categorized as two parents currently married, two parents who are not currently married, single parent, other family member with no parent reported; poverty level had 4 sub-groups based on Federal Poverty Level (FPL) which were 0 – 99% FPL, 100 – 199% FPL, 200 – 399% FPL and 400% FPL and above; highest education attained by the adults in the household categorized as less than high school, high school degree or GED, some college or technical school and college degree or higher; insurance type classified as public only, private only, public and private insurance and currently uninsured. Behavioral characteristic was measured by how well the parents were able to cope with day to day demands of raising children categorized as "very well", "somewhat well" and "not very well

or not very well at all". Environmental characteristic was measured as the number of neighborhood amenities such as: (1) sidewalks or walking paths; (2) park or playground area;(3) recreation center, community center or Boys'/Girls' Club; (4) library or bookmobile the child had access to. The response options were no amenities, 1 amenity, 2 amenities, 3 amenities and 4 amenities.

The outcomes of interest were overweight and obesity in children 10 to 17 years. As reported in previous studies that parents typically overestimate height and underestimate weight of children younger than 10 years of age,[28] the BMI for children under the age of 10 years was therefore, not reported in the survey.

2.2. Statistical Analysis

We conducted weighted bivariate analysis using Pearson's Chi-squared test to determine the association between various exposure variables and overweight or obesity. To adjust for confounders, we ran weighted survey log binomial logistic regression which generated prevalence ratio (PR) estimates for the association between our exposure and outcome variables. We constructed three models separately for (1) overweight only; (2) obese only; and (3) overweight or obese. All tests of hypotheses were two-tailed with a type 1 error fixed at 5%.

2.3. Ethical Approval

This study was approved as exempt by the Institutional Review Board of Baylor College of Medicine.

3. Results

A total of 30.6 million children aged 0-17 years were surveyed. Of these, 9.5 million children aged 10-17 years were either overweight or obese (31.0%). The prevalence of children classified as overweight only, and obese only was 15.19% and 15.77% respectively.

3.1. Sociodemographic Characteristics

Table 1 shows overall distribution and prevalence of demographic, socioeconomic, and environmental characteristics comparing children that were

Table 1. Socio-demographic characteristics of U.S. children 10-17 years according to non-overweight and overweight or obesity status

Characteristics	Non-over weight (BMI <85th) n=21159491	Proportion %=69.0	Overweight or obesity (BMI 85th to ≥95th) n=9485994	Proportion %=31.0	p-value	Prevalence#
Demographic characteristics						
Sex					<0.0001	
Male	10556223	49.9%	5107233	53.8%		32.6%
Female	10603268	50.1%	4378761	46.2%		29.2%
Age					<0.0001	
10-12 years	7377725	34.9%	3832750	40.4%		34.2%
13-15 years	8198336	38.7%	3502254	36.9%		29.9%
16-17 years	5583430	26.4%	2150990	22.7%		27.8%
Race/ethnicity					<0.0001	
NH-White	11926308	56.4%	4109161	43.3%		25.6%
NH-Black	2516748	11.9%	1681717	17.7%		40.1%
Hispanic	4558876	21.5%	2863638	30.2%		38.6%
Others	2157559	10.2%	831478	8.8%		27.8%
Socioeconomic characteristics						
Parents' nativity					<0.0001	
Parent (s) born in US (at least one parent)	14435674	68.2%	5968120	62.9%		29.3%
Any parent born outside US (at least one parent)	5372948	25.4%	2579730	27.2%		32.4%
Other (child born in U.S, parents not listed)	1137829	5.4%	802192	8.5%		41.3%
Primary household language (PHHL)					<0.0001	
Hispanic children, non-English PHHL	1811395	8.6%	1171059	12.3%		39.3%
Hispanic children, English PHHL	2656967	12.6%	1613537	17.0%		37.8%
Non-Hispanic child	16520820	78.1%	6568862	69.2%		28.4%
Family structure					<0.0001	
Two parents currently married	14702781	69.5%	5466241	57.6%		27.1%
Two parents, not currently married	1408492	6.7%	755553	8.0%		34.9%
Single parent (mother or father)	3061135	14.5%	1991738	21.0%		39.4%
Other family type, no parent reported	1720667	8.1%	1094497	11.5%		38.9%
Poverty level					<0.0001	
0-99% FPL	3636078	17.2%	2331532	24.6%		39.1%
100%-199% FPL	4117300	19.5%	2263631	23.9%		35.5%
200%-399% FPL	5709372	27.0%	2629827	27.7%		31.5%
400% FPL or above	7696741	36.4%	2261004	23.8%		22.7%
Highest education of household adult					<0.0001	
Less than high school	1763797	8.3%	1321308	13.9%		42.8%

(Contd...)

Table 1. *(Continued)*

Characteristics	Non-over weight (BMI <85th) n=21159491	Proportion %=69.0	Overweight or obesity (BMI 85th to ≥95th) n=9485994	Proportion %=31.0	p-value	Prevalence#
High school degree or GED	3732854	17.6%	2394485	25.2%		39.1%
Some college or technical school	4623420	21.9%	2512813	26.5%		35.2%
College degree or higher	10897275	51.5%	3186337	33.6%		22.6%
Insurance type					<0.0001	
Public only	5007232	23.7%	3460596	36.5%		40.9%
Private only	13543873	64.0%	4520148	47.7%		25.0%
Currently uninsured	1305664	6.2%	710410	7.5%		35.2%
Public and private insurance	888280	4.2%	572593	6.0%		39.2%
Behavioral characteristic						
Parents' coping with day to day demands of raising children					<0.0001	
Very well	13821997	65.3%	6267432	66.1%		31.2%
Somewhat well	6833958	32.3%	2979310	31.4%		30.4%
Not very well or not very well at all	298814	1.4%	122042	1.3%		29.0%
Environmental characteristic						
Neighborhood amenities*					<0.0001	
Neighborhood does not contain any amenities	2250267	10.6%	1155408	12.2%		33.9%
Neighborhood contains 1 amenity	2075021	9.8%	1122736	11.8%		35.1%
Neighborhood contains 2 amenities	3300468	15.6%	1362376	14.4%		29.2%
Neighborhood contains 3 amenities	4675674	22.1%	2127837	22.4%		31.3%
Neighborhood contains all 4 amenities	8134344	38.4%	3343060	35.2%		29.1%

Total of some variables not 100% because missing values were excluded.

* Neighborhood amenities are 1) sidewalks or walking paths, 2) park or playground area, 3) recreation center, community center or Boys'/Girls' Club, 4) library or bookmobile

Prevalence of overweight/obesity

overweight or obese versus those that were non-overweight. Chi-square test revealed statistically significant differences (p < 0.0001) across all selected variables. Children that were overweight or obese were more likely to be boys (53.8%), in the 10-12 years age group (40.4%), Hispanic (30.2%), living with a single parent and more likely to be living with an adult with high school degree or GED (25.2%) compared to their non-overweight counterparts. There was a dose- response relationship observed between obesity and poverty level with rising prevalence of obesity/overweight with incremental poverty levels (P < 0.0001).

Table 2 presents the characteristics of children who were overweight only or obese only.

Compared to those who were overweight, obese children were more likely to be Hispanic (22.5%), to speak a language other than English at home (23.8%), to live with a single parent (21.6%), and to come from a poorer household (22.9%). Obese children were also more likely to have a parent with less than high school educational attainment (25.0 % versus17.8%).

3.2. Prevalence of Overweight and Obesity

Table 3 provides the estimates for the association between SDOH and overweight or obesity, overweight only, and obesity only. The probability of overweight or obesity was higher in children 10-12 years 34% (95% CI = 16%-56%) and 13-15 years 12% (95% CI

Table 2. Weighted prevalence (%) of overweight or obesity among U.S. children aged 10-17 years

Characteristics	Overweight only	Overweight prevalence (15.2%)	p-value	Obesity only	Obesity prevalence (15.8%)	p-value
Demographic characteristics						
Sex			<0.0001			<0.0001
Male	49.1%	14.6%		58.4%	18.0%	
Female	50.9%	15.8%		41.6%	13.4%	
Age			<0.0001			<0.0001
10-12 years	40.1%	16.6%		40.7%	17.5%	
13-15 years	39.6%	15.8%		34.3%	14.2%	
16-17 years	20.3%	12.2%		25.0%	15.6%	
Race/ethnicity			<0.0001			<0.0001
NH-White	28.6%	17.9%		31.7%	20.6%	
NH-Black	45.3%	13.2%		41.4%	12.5%	
Hispanics	15.9%	17.6%		19.5%	22.5%	
Others	10.2%	15.9%		7.4%	11.9%	
Socioeconomic characteristics						
Parents' nativity			<0.0001			<0.0001
Parent (s) born in US	63.7%	14.5%		62.2%	14.7%	
Any parent born outside US	27.2%	15.9%		27.1%	16.5%	
Other (child born in U.S, parents not listed)	7.7%	18.5%		9.2%	22.9%	
Primary household language (PHHL)			<0.0001			<0.0001
Hispanic children, non-English PHHL	9.9%	15.4%		14.7%	23.8%	
Hispanic children, English PHHL	17.8%	19.4%		16.3%	18.4%	
Non-Hispanic child	70.9%	14.3%		67.7%	14.2%	
Family structure			<0.0001			<0.0001
Two parents, currently married	60.0%	13.8%		55.4%	13.3%	
Two parents, not currently married	8.0%	17.2%		7.9%	17.7%	
Single parent (mother or father)	19.3%	17.8%		22.6%	21.6%	
Other family type, no parent reported	11.2%	18.6%		11.8%	20.3%	
Poverty level			<0.0001			<0.0001
0-99% FPL	20.7%	16.2%		28.3%	22.9%	
100%-199% FPL	22.4%	16.3%		25.3%	19.1%	
200%-399% FPL	28.1%	15.7%		27.3%	15.8%	
400% FPL or above	28.7%	13.4%		19.1%	9.3%	

(Contd...)

Table 2: *(Continued)*

Characteristics	Overweight only	Overweight prevalence (15.2%)	p-value	Obesity only	Obesity prevalence (15.8%)	p-value
Highest education of household adult			<0.0001			<0.0001
Less than high school	11.8%	17.8%		16.0%	25.0%	
High school degree or GED	22.5%	17.1%		27.9%	22.0%	
Some college or technical school	25.7%	16.8%		27.3%	18.5%	
College degree or higher	39.3%	13.0%		28.1%	9.6%	
Insurance type			<0.0001			<0.0001
Public only	32.8%	18.0%		40.0%	22.8%	
Private only	53.8%	13.9%		41.7%	11.2%	
Public and private insurance	3.4%	10.8%		8.6%	28.4%	
Currently uninsured	7.7%	17.7%		7.3%	17.5%	
Behavioral characteristic						
Parents' coping with day to day demands of raising children			<0.0001			<0.0001
Very well	64.0%	14.8%		68.1%	16.4%	
Somewhat well	33.5%	15.9%		29.4%	14.5%	
Not very well or not very well at all	1.2%	13.0%		1.4%	16.0%	
Environmental characteristic						
Neighborhood amenities*			<0.0001			<0.0001
Neighborhood does not contain any amenities	12.7%	17.4%		11.6%	16.5%	
Neighborhood contains 1 amenity	11.3%	16.5%		12.3%	18.6%	
Neighborhood contains 2 amenities	14.6%	14.6%		14.1%	14.6%	
Neighborhood contains 3 amenities	22.0%	15.0%		22.9%	16.2%	
Neighborhood contains all 4 amenities	34.7%	14.1%		35.7%	15.0%	

Total of some variables not 100% because missing values were excluded.

* Neighborhood amenities are 1) sidewalks or walking paths, 2) park or playground area, 3) recreation center, community center or Boys'/Girls' Club, 4) library or bookmobile

= 96%-29%)] respectively, using children 16-17 years as referent category. Children who lived with a single parent had a greater probability of being overweight or obese 32% (95% CI = 12%-55%) compared to those having two parents who were currently married. Similarly, compared to children who lived in neighborhoods containing all 4 amenities, those who lived in neighborhoods having one or less amenity, were 27% (95% CI = 2%-58%) more likely to be overweight or obese. Conversely, factors protective of being overweight or obese included; children who lived with an adult with more than 12 years of education (PR= 0.57; 95% CI= 0.42-0.79) and having private health insurance (PR=0.71; 95% CI= 0.59-0.87) (Table 3).

Prevalence of overweight only

In the adjusted model for overweight only, compared to children 16-17 years, children 10-12 years and those 13-15 years had a 45% (95% CI=20%-74%) and 35% (95% CI= 11%-64%) higher probability of

Table 3. Adjusted prevalence ratio model for social determinants of health in overweight or obesity, overweight only and obesity only among U.S. children aged 10-17 years

Characteristics	Overweight or obese adjusted PR	p-value	Overweight only adjusted PR	p-value	Obese only	Adjusted PR P value
Demographic characteristics						
Sex						
Male	Reference					
Female	0.88 (0.78-0.99)	0.15	1.10 (0.94-1.27)	0.23	0.74 (0.63-0.87)	<0.0001
Age						
16-17 years	Reference					
10-12 years	1.34 (1.16-1.56)	<0.0001	1.45 (1.20-1.74)	<0.0001	1.12 (0.92-1.36)	0.26
13-15 years	1.12 (0.96-1.29)	<0.0001	1.35 (1.11-1.64)	<0.0001	0.89 (0.73-1.08)	0.25
Race/ethnicity						
NH-White	Reference					
NH-Black	1.41 (1.01-1.98)	0.03	1.12 (0.72-1.74)	0.61	1.53 (1.01-2.31)	0.04
Hispanic	1.52 (1.25-1.85)	0.04	1.29 (1.00-1.65)	0.05	1.50 (1.18-1.90)	<0.0001
Multiracial/NH-other	1.11 (0.92-1.34)	<0.0001	1.29 (1.03-1.62)	0.03	0.89 (0.69-1.14)	0.34
Socioeconomic characteristics						
Parents' nativity						
Parent (s) born in US	Reference					
Any parent born outside US	0.90 (0.74-1.09)	0.27	1.02 (0.81-1.29)	0.88	0.83 (0.63-1.08)	0.17
Other (child born in U.S, parents are not listed)	1.08 (0.71-1.65)	0.29	0.80 (0.46-1.41)	0.45	1.43 (0.87-2.36)	0.16
Primary household language (PHHL)						
Hispanic children, non-English PHHL	Reference					
Hispanic children, English PHHL	1.09 (0.75-1.57)	0.72	1.32 (0.82-2.11)	0.25	0.88 (0.56-1.37)	0.57
Non-Hispanic child	0.56 (0.51-0.63)	0.45	0.88 (0.61-1.26)	0.49	0.53 (0.38-0.74)	<0.0001
Family structure						
Two parents currently married	Reference					
Two parents not currently married	1.05 (0.80-1.37)	0.74	1.06 (0.76-1.48)	0.73	1.02 (0.74-1.40)	0.92
Single parent (mother or father)	1.32 (1.12-1.55)	<0.0001	1.26 (1.03-1.54)	0.03	1.22 (0.99-1.50)	0.06
Other family type, no parent	1.11 (0.81-1.52)	0.52	1.45 (0.93-2.25)	0.1	0.78 (0.54-1.13)	0.19
Poverty level						
0-99% FPL	Reference					
100%-199% FPL	1.06 (0.85-1.31)	0.62	1.09 (0.84-1.41)	0.52	1.01 (0.78-1.31)	0.93
200%-399% FPL	1.22 (0.97-1.53)	0.09	1.20 (0.88-1.64)	0.25	1.15 (0.86-1.55)	0.34
400% FPL or above	1.02 (0.81-1.27)	0.89	1.15 (0.86-1.55)	0.34	0.85 (0.64-1.13)	0.27
Highest education of household adult						
Less than high school	Reference					
High school degree or GED	0.98 (0.71-1.36)	0.91	0.99 (0.63-1.54)	0.96	0.99 (0.69-1.43)	0.97
Some college or technical school	0.86 (0.62-1.19)	0.36	0.95 (0.61-1.48)	0.81	0.86 (0.60-1.23)	0.40
College degree or higher	0.57 (0.42-0.79)	<0.0001	0.77 (0.50-1.20)	0.25	0.52 (0.37-0.75)	<0.0001

(Contd...)

Table 3: *(Continued)*

Characteristics	Overweight or obese adjusted PR	p-value	Overweight only adjusted PR	p-value	Obese only	Adjusted PR P value
Insurance type						
Public only (government assistance)	Reference					
Private only	0.71 (0.59-0.87)	<0.0001	0.91 (0.72-1.17)	0.47	0.65 (0.50-0.84)	<0.0001
Public and private insurance	0.95 (0.68-1.33)	0.75	0.59 (0.41-0.85)	<0.0001	1.31 (0.87-1.98)	0.20
Currently uninsured	0.78 (0.57-1.08)	0.14	1.02 (0.68-1.55)	0.91	0.68 (0.46-1.01)	0.06
Behavioral characteristic						
Parents' coping with day to day demands of raising children						
Very well	Reference					
Somewhat well	0.96 (0.85-1.08)	0.48	1.07 (0.91-1.26)	0.4	0.87 (0.75-1.02)	0.08
Not very well or not very well at all	0.85 (0.56-1.27)	0.42	0.98 (0.63-1.52)	0.92	0.79 (0.49-1.26)	0.32
Environmental characteristic						
Neighborhood amenities*						
Neighborhood contains all 4 amenities	Reference					
Neighborhood does not contain any amenities	1.20 (1.00-1.45)	0.05	1.32 (1.03-1.69)	0.03	1.02 (0.80-1.28)	0.89
Neighborhood contains 1 amenity	1.27 (1.02-1.58)	0.03	1.22 (0.91-1.65)	0.18	1.20 (0.90-1.59)	0.21
Neighborhood contains 2 amenities	1.00 (0.84-1.19)	0.97	1.06 (0.87-1.30)	0.57	0.95 (0.75-1.21)	0.69
Neighborhood contains 3 amenities	1.08 (0.92-1.26)	0.36	1.12 (0.92-1.35)	0.26	1.01 (0.81-1.25)	0.94

Total of some variables not 100% because missing values were excluded.

* Neighborhood amenities are 1) sidewalks or walking paths, 2) park or playground area, 3) recreation center, community center or Boys'/Girls' Club, 4) library or bookmobile

being overweight respectively. Likewise, compared to non-Hispanic Whites, the probability of overweight in Hispanic and multiracial children were 29% (95% CI=0%-65%) and 29% (95% CI= 3%-62%) greater, respectively. Additionally, children who lived with a single parent (PR=1.26; 95% CI= 1.03-1.54) compared to those who lived with two married parents, as well as children who lived in a neighborhood with no amenities (PR= 1.32; 95% CI= 1.03-1.69) compared to children who lived in a neighborhood with all four amenities were also more likely to be overweight. Inversely, having private and public insurance coverage protected children from being overweight (PR = 0.59; 95% CI = 0.41-0.85) compared to children who had public insurance/government assistance only (Table 3).

Prevalence of obesity only

The likelihood of obesity was 53% and 50% greater among non-Hispanic Black and Hispanic children compared to their White counterparts. The strongest protective factors against childhood obesity include female gender (PR = 0.74; 95% CI = 0.63-0.87), non-Hispanic speaking primary household language (PR = 0.53; 95% CI = 0.38-0.74) compared to non-English speaking Hispanic child, parental attainment of college education or higher (PR = 0.52; 95% CI = 0.37-0.75) compared to having less than high school education, and having private insurance coverage only (PR = 0.65; 95% CI = 0.5-0.84) as compared to having public insurance only (Table 3).

4. Discussion

The aim of this study was to understand and detail the potential influence of SDOH on childhood and adolescent overweight and obesity using a nationally representative sample in the United States. Our study showed that 31% of children in our study population were either overweight or obese; this finding is in consonance with previous studies which reported that the prevalence of overweight or obesity was between 30.9 - 34.0%.[17,19] More specifically, the prevalence of overweight in our

study was 15.2 %, depicting similar findings with previous studies.[6,19,20] However, other studies[18,21,22] showed that the prevalence of overweight was between 28.8-33.4%. Furthermore, we established that the prevalence of obesity was 15.8%, similar to previous findings[5,17-23] indicating a leveling of obesity since 2007. It is worth to note that the prevalence of overweight and obesity varied between studies as a result of geographic variation,[24] methodology,[25] and differences in types of unit of analysis used (individual vs. state vs. national level).[19]

Our study found that selected sociodemographic and environmental factors were associated with a higher probability of being overweight or obese. Concerning demographic factors, we observed that being a female child predicted less likelihood of obesity; a finding consistent with some studies conducted prior to 2016.[5-7,23,25] However, contrary to our results, some other studies either reported no difference in obesity prevalence between the sexes[17,23] or found females to be at increased risk for childhood obesity.[14] In addition, in relation to age, our adjusted model showed that younger children (age groups 10-12 and 13-15 years) were significantly more likely to be overweight. However, it was interesting that we did not observe any association between obesity and age, in contrast to the findings of Skinner et al.[18] and Ogden[14] who reported that obesity significantly increased with age. Our observations of a strong association between overweight and age are concordant with findings reported in previous studies.[5,7,8]

The findings in this study showed that the SDOH that could possibly protect a child from being overweight or obese were consistent with those of previous studies specifically, language spoken in the home other than Spanish (obesity only),[5,26] parental attainment of college degree or higher (overweight or obese),[5,14,20,25] and the possession of private or public insurance coverage.[25,26] These protective socioeconomic determinants may provide children from these families the resources and opportunity of attaining and maintaining healthier physical and mental life styles. An interesting finding was that we, however, did not find poverty level to be an associated determinant of overweight or obesity. This finding was contrary to earlier studies showing

that high income was less predictive of overweight or obesity.[1,5,22,26] To our knowledge, this is the first study to examine parent's nativity as well as a parent's ability to cope with day-to-day demands of raising children in association with the social determinants of overweight or obesity. However, our analysis did not portray these two SDOH factors to be statistically significant predictors. Our results in relation to environmental characteristics confirm previous studies that children living in neighborhoods with no access to sidewalks or walking paths were more predisposed to obesity or overweight.[1,22,25]

Limitations

An important limitation in our study is that the data collected by NSCH was cross-sectional in nature, and that limited our ability to establish a temporal relationship between our exposures and outcomes. Nonetheless, the findings provide important information regarding the role of SDOH on childhood obesity.

Recommendation for Further Studies

Further research to clarify the relationship between overweight/obesity and SDOH in children is needed. Since overweight and obesity are multi-factorial in origin, in order to impact and bring about a reduction in their prevalence, it is crucial to develop effective preventive strategies aimed at addressing the relevant SDOH. We recommend the development of innovative multilevel individualized- as well as community-customized interventions using SDOH risk and protective pathways as guide to address the current childhood overweight and obesity epidemic.

5. Conclusion and Global Health Implications

The results of our study evidently illustrate that demographic, socioeconomic, and environmental characteristics represent important determinants of overweight and obesity in U.S. children. Our study showed that due to possible effective changes at the individual level, initiatives by schools and other communities, at the state, national, and global levels, the prevalence of obesity and overweight in the U.S appeared to have plateaued in 2016 and

2017.[17,27,28] More work needs to be done as the social determinants of overweight and obesity in children have significant national and global implications relating to racial/ethnic disparities, population-based policy development, funding allocation, and prevention of overweight and obesity in childhood and subsequently in adulthood.

Compliance with Ethical Standards

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