Moderating Effects of Components of Resilience on Obesity Across Income Strata in the National Survey of Children's Health

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Abstract

Objective: This study examined whether components of resilience at the family or child level are associated with a decreased risk of obesity in children after accounting for community-, family-, and individual-level stressors associated with an increased risk of obesity.

Methods: Data are from the 2016 National Survey of Children's Health, using the subset of children 10 to 17 years of age with weight data. We examined whether or not components of family- or child-level resilience were associated with weight status. Community-, family-, and individual-level risk factors for obesity were examined within each income stratum. We used multinomial logistic regression to evaluate if components of resilience are associated with lower overweight or obesity.

Results: The sample included 24,405 10- to 17-year-old children. Child-level but not family-level resilience components were associated with a decreased risk of child obesity across income strata. Food security and adverse childhood experiences (ACEs) were only associated with obesity within higher income strata; bullying was consistently associated across strata. Physical activity was strongly associated with increased emotional resilience. The association between higher emotional resilience and lower obesity remained after adjusting for community-level factors (parks), family-level factors (ACEs), and individual-level factors (bullying). Better maternal health was associated with increased emotional resilience and lower risk of obesity.

Conclusions: Resilience, specifically emotional resilience, may be a protective factor against obesity in children regardless of income stratum. Physical activity of the child is associated with greater emotional resilience, and better maternal health may mediate the association between this component of resilience and weight.

Keywords: adverse childhood experiences; income; obesity; physical activity; resilience

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What's New

A component of child resilience is associated with lower obesity within multiple income levels using nationally representative data. This association may be mediated by child physical activity and maternal physical health.

Resilience can be defined as the capacity to respond or adapt in the context of a stressor.[1] Resilience develops via interactions among genetics, environmental stressors, and social and structural support systems.[1,2] Although resilience constitutes a process, core traits of resilient individuals have been recognized across cultures and include emotional stability, self-awareness, and self-efficacy.[3] Additional contributors to resilience are relational, particularly parental and familial relationships.[3,4] Most research on resilience in childhood has focused on response and adaptation to the risk of adverse childhood experiences (ACEs)[5,6]; however, a similar dynamic occurs with stressors that influence obesity.[4]

For obesity, resilience at the family-unit level may be protective if the family is able to use its strengths to overcome an obesogenic environment, collaborate more effectively on identifying healthy habits, or support each other in making changes. A longitudinal study of low-income families identified traits of resilient parenting as being associated with lower soda consumption and adiposity.[7] Another study on family-level resilience found a significant association with health behaviors in the home but not adiposity.[8] Individual child resilience operates similarly to enable the child to be successful despite environmental stressors. Data supporting this hypothesis include a recent clinical study among homes with low socioeconomic status which reported that children using strategies described as resilient had lower adiposity,[9] as well as an interventional study aimed at building resilience that reduced adiposity.[10] A well-recognized contributor to psychological resilience in adults is physical activity.[11] Evidence specific to children is

more inconsistent,[12] although a recent trial of physical activity demonstrated increased subsequent psychological resilience in adolescents.[13]

The 2016 National Survey of Children's Health (NSCH) provides the opportunity to examine the relationship between certain components of family-level and child-level resilience with weight status. Our hypothesis was that higher family-level resilience and child-level resilience, specifically emotional stability, would be associated with a lower risk of obesity, with physical activity and physical health moderating that association. Obesity disparities across income strata are well established, with higher income being associated with lower obesity.[14] We examined the relationship between components of resilience and obesity within income strata, as there are likely distinct experiences within groups.[15] We used a socioecologic framework to describe the community-, family-, and individual-level stressors.

METHODS

The overall hypothesis was that higher resilience, either family resilience or child emotional resilience, is associated with a lower prevalence of obesity among 10- to 17-year-old children. In this model, the physical activity of the child or health status of the parents drives either individual child- or family-level resilience. Children or families with high resilience would be resilient to stressors at the community level (eg, neighborhood without parks), family level (eg, low food security), and individual level (eg, bullying), and they would have a lower prevalence of obesity.

DATA SOURCE

We used data from the 2016 NSCH to generate estimates. The NSCH is the only national-level survey completed on the health of children ages 0 to 17 years in the United States. The full methodology regarding the sampling frame and data generation can be found at https://www.census.gov/programs-surveys/nsch.html. The 2016 iteration differs from prior versions of the survey by using physical addresses as the sampling frame, given changes in telephone usage. Participants completed the survey as either a web or mailed survey. Of the 139,923 households screened for eligibility, 50,212 completed the detailed questionnaires, with 80% using the web survey. Participants reported data for 1 child in the family, regardless of family size. Adjusted sample weights account for nonresponses and oversampling of certain populations; using these sample weights allows for estimates to be representative of the noninstitutionalized child population in the United States.

DEPENDENT VARIABLE: WEIGHT STATUS

Weight status, classified as body mass index (BMI) percentiles for age and sex, was available for children 10 to 17 years of age. BMI percentiles are calculated using parent-reported height and weight with Centers for Disease Control and Prevention standards.[16] We excluded children who were underweight and used 3 groups for the outcome: normal weight ($\geq$5th to <85th percentile), overweight ($\geq$85th to <95th percentile), and obese ($\geq$95th percentile).

STRATA VARIABLE: INCOME

Income is available as <100% of the federal poverty level (FPL), 100% to 199% of the FPL, 200% to 399% of the FPL, and $\geq$400% of the FPL. Income is household level and is adjusted for household size and based on the FPL in 2016, which was $24,300 for a family of 4. We examined the variation in demographic characteristics such as race/ethnicity, education, and insurance status across these strata and found them to be different enough to keep separate. We examined associations within income strata to define the distinct experiences of these groups.[17]

INDEPENDENT VARIABLES

DEMOGRAPHIC VARIABLES

We examined parental education as an ordinal variable; in the NSCH dataset, this is the highest education of any caregiver identified in the survey, not the mother's education. We treated insurance as a categorical variable (private, public, or uninsured), child sex as binomial, and child age in years as continuous. We grouped race/ethnicity into categories of white, non-Hispanic/Latino; black, non-Hispanic/Latino; Hispanic/Latino; and all others.

RESILIENCE

For family resilience, the query read as follows: "When your family faces problems, how likely are you to do each of the following? Talk together about what to do. Work together to solve our problems. Know we have strengths to draw on. Stay hopeful even in difficult times." Given the distribution of the data, we operationalized components of family resilience as the mean response to the 4 variables; we then categorized the mean response into a dichotomous variable of "most of the time" or higher and less than "most of the time." For individual child resilience, the query read as follows: "How well do each of the following phrases describe this child? This child shows interest and curiosity in learning new things. This child works to finish tasks that he or she starts. This child stays calm and in control when faced with a challenge." An expert technical panel consisting of 14 members designed these questions with public input and subsequent testing by the NCHS Questionnaire Design Research Laboratory for validity.[18] These questions were used in the 2011−12 and 2016 NSCH. We used the last indicator as the primary variable of the component of child resilience —emotional stability—consistent with prior analyses.[6,19] In addition, the first 2 variables had mostly positive responses and did not differentiate the population.

PHYSICAL HEALTH AND ACTIVITY

We examined the physical health status of the parents as a proxy measure of parental physical activity with groups of very good/excellent, good, and fair/poor. The variable querying how many days a child does physical

activity for at least 60 minutes was dichotomized into 0 to 3 days per week and 4 to 7 days per week.

SOCIOECOLOGIC MODEL OF STRESSORS

COMMUNITY LEVEL

We generated a composite variable for neighborhood safety and cohesion using affirmative responses to 4 variables; statements regarding the safety of the child in the neighborhood and the safety of the child at school required "definitely agree" or "somewhat agree" responses to be affirmative. A composite variable was used for neighborhood supportiveness, categorized as a binomial variable of supportive or not. Neighborhood amenities queried were the presence of sidewalks, parks or playgrounds, recreation or community centers, and libraries. These were treated as binomial variables.

FAMILY LEVEL

The 2 primary family-level stressors examined were ACEs and food security. ACEs are a significant source of stress and have been shown previously to be associated with weight status.[19] The NSCH queried 9 items: violence, drug use, jail time, alcohol or drug problems, experience of racial prejudice, mental illness, parental death, income stressors, and parental separation; we grouped these into an ordinal variable of 0, 1, 2−3, or ≥4 ACEs for each child. The prevalence of ACEs in NSCH data increases with child age; therefore, these data reflect a higher prevalence given the restricted age range. Food security questions provided the following options: 1) family could always afford to eat good, nutritious meals; 2) family could always afford enough to eat but not always the kinds of food they know they should eat; 3) family sometimes could not afford enough to eat; and 4) family often could not afford enough to eat. We used a binomial variable of child living in a food-secure household if their parent indicated the first response and insecure for any other response.

INDIVIDUAL LEVEL

The primary stressor examined at the child level was bullying, reported by the parent as a degree of agreement that it happened to their child. A response of "definitely" or "somewhat true" was considered positive that bullying was occurring. Bullying was treated as a binomial variable.

DATA ANALYSIS

Data were analyzed using SPSS version 24.0 (IBM, Armonk, NY) with Taylor series adjustment for accurate estimation of variance given the complex sampling strategy. Sample weights were applied to allow for national-level estimates. We first examined the association between the components of resilience and weight status (Table 1), and then we examined the association among community-, family-, and individual-level stressors and weight status, as well as potential mediators (Table 2). The potentially moderating role for these components of resilience in mitigating the effect of stressors on the association with weight was examined using multivariable regression models as detailed in the following (Table 3).

Multinomial regression was used to examine the role of child and family components of resilience within income strata with the dependent outcome of overweight or obesity. We did not use multilevel modeling for analysis, given that the structure of the dataset lacked identifiers linking individual, family, and community variables. We chose to use multiple steps in building the models to understand the relative contributions of the variables to the overall association. In the first model, we adjusted for demographic variables only. In the second set of models, we adjusted for both child physical activity and any environmental stressors at the community, family, or individual levels if those stressors were significantly associated with weight in the bivariate analysis. Finally, parental health status was included to examine if there was any persistent association after accounting for parental health and child physical activity. We tested for interaction effects among the resilience variables, the stressors, child physical activity, and parental health at each stage of the modeling to examine whether only under certain conditions or stressors would the components of resilience have an association. We ran models using the individual demographic and environmental stressor variables and a propensity score−matched regression with no difference in the outcomes.

RESULTS

INCOME AND WEIGHT STATUS

There were 24,405 children 10 to 17 years of age in the final sample. Obesity was significantly associated with lower income, as 22.9% of children had obesity in families at <100% of the FPL, 21.2% at 100% to 199% of the FPL, 15.8% at 200% to 399% of the FPL, and 9.2% in families at ≥400% of the FPL ($P < .001$). Further analyses were completed within income strata to understand the potential drivers of these differences.

COMPONENTS OF RESILIENCE AND WEIGHT STATUS

Family-level components of resilience were not associated with the child's weight status in any income stratum (Table 1). The child-level component of resilience, emotional stability, was significantly associated with weight status in 3 of the 4 income strata (Table 1). Given the lack of an association with the measure of family resilience, we further examined only the relationship among child-level emotional resilience, stressors, and weight status. Race/ethnicity was only associated with weight status in the highest income group (Table 1).

COMMUNITY-, FAMILY-, AND INDIVIDUAL-LEVEL STRESSORS ASSOCIATED WITH WEIGHT

There was not a strong association between a safe, supportive neighborhood and weight within income strata (Table 2). However, children in families at ≥400% of the

Table 1. Demographic Characteristics and Resilience Measures Stratified by Family-Level Income as a Percentage of the FPL in the 2016 National Survey of Children's Health

	<100% FPL				100%–199% FPL				200%–399% FPL				≥400% FPL			
	NW	OW	OB	*P*	NW	OW	OB	*P*	NW	OW	OB	*P*	NW	OW	OB	*P*
Resilience																
Family resilience, % high	75.4	76.5	75.9	.97	77.9	77.3	68.0	.07	80.9	81.9	78.1	.57	81.6	80.7	83.5	.64
Child emotional resilience, % high	46.7	51.2	33.2	.03	52.4	49.5	47.8	.62	57.2	47.7	46.0	.001	60.0	53.7	45.3	<.001
Demographics																
Age in years, mean	13.7	13.1	13.3	.08	13.8	13.1	13.5	.002	13.7	13.1	13.5	.001	13.6	13.4	13.6	.05
Gender, % female	53.2	60.2	37.1	.001	51.7	60.2	39.5	.003	51.9	44.9	46.5	.08	51.1	44.1	33.3	<.001
Race/ethnicity				.15				.06				.09				<.001
White, non-Hispanic	35.2	32.5	27.5		44.9	33.3	34.5		61.3	54.7	53.6		72.1	61.5	65.4	
Hispanic	36.1	39.3	46.6		32.0	37.4	38.2		18.0	18.7	25.3		10.8	20.7	17.6	
Black, non-Hispanic	19.6	17.4	21.6		14.0	19.3	21.4		11.8	14.0	13.1		5.5	7.2	11.0	
All others	9.1	10.8	4.3		9.1	10.1	5.9		8.9	12.7	7.9		11.5	10.6	6.0	
Insurance				.80				.001				<.001				.001
Public	71.4	68.0	74.7		53.4	64.2	66.1		18.3	19.8	31.3		5.4	9.9	14.2	
Private	15.0	14.0	12.4		39.5	32.3	22.9		76.9	76.7	61.6		92.5	88.1	83.0	
Uninsured	13.6	18.1	12.9		7.1	3.5	11.0		4.8	3.6	7.1		2.1	1.9	2.8	
Highest education level				.06				.02				.005				.006
Less than high school	21.2	23.9	34.2		13.5	13.0	17.1		4.4	2.7	6.5		1.2	3.5	2.9	
High school	37.1	31.0	31.4		27.3	40.7	39.0		17.4	20.8	27.9		5.5	7.7	8.9	
Some college	24.5	28.0	25.7		33.2	26.3	29.6		25.6	32.9	28.6		12.4	15.6	25.2	
College or more	17.3	17.1	8.7		26.0	20.0	14.3		52.6	43.6	37.0		80.8	73.3	63.1	

NW indicates normal weight; OW, overweight; OB, obese; and FPL, federal poverty level.

Table 2. Community-, Family-, and Individual-Level Stressors Associated With Overweight and Obesity and Potential Mediators of Resilience Stratified by Family-Level Income as a Percentage of the FPL in the 2016 National Survey of Children's Health

	<100% FPL				100%–199% FPL				200%–399% FPL				≥400% FPL			
	NW	OW	OB	*P*	NW	OW	OB	*P*	NW	OW	OB	*P*	NW	OW	OB	*P*
Community																
Safe, supportive neighborhood	30.9	23.6	35.6	.20	37.3	32.6	30.2	.25	48.6	46.4	43.4	.31	61.9	58.7	53.6	.05
Resources																
Sidewalks	75.8	74.6	74.7	.29	70.6	66.7	69.6	.71	71.6	72.5	67.1	.23	77.5	77.4	76.1	.85
Parks or playgrounds	73.5	66.9	73.2	.42	72.5	70.7	66.2	.35	74.8	69.5	68.7	.08	80.6	77.1	72.8	.02
Community centers	47.8	39.0	51.6	.22	49.1	42.5	50.8	.38	51.9	45.8	40.7	.003	56.0	52.7	51.2	.25
Libraries	63.2	67.4	69.9	.36	68.9	63.3	70.5	.36	70.1	70.5	58.5	.001	72.0	74.0	71.6	.76
Family level																
Food security, % insecure	59.2	55.0	62.9	.56	51.3	55.0	57.0	.48	27.6	38.8	45.7	<.001	8.0	11.5	20.1	<.001
ACEs				.63				.58				.001				<.001
None	27.0	19.1	29.8		36.3	31.2	30.1		50.5	44.1	34.6		66.5	65.5	53.5	
1	24.8	29.5	25.1		26.8	29.7	27.5		26.1	28.1	31.2		20.7	22.2	22.3	
2–3	33.1	33.0	28.0		23.7	29.1	26.2		17.3	20.5	24.7		9.8	10.0	16.4	
≥4	15.1	18.4	17.1		13.1	10.0	16.2		6.1	7.3	9.5		2.9	2.3	7.8	
Child level																
Bullied, % yes	23.4	27.0	36.7	.03	19.8	29.6	34.7	<.001	19.0	21.0	35.7	<.001	15.9	18.2	32.0	<.001
Resilience-mediating																
Physical activity, ≥60 min				.008				<.001				<.001				<.001
0–3 d/wk	48.1	46.0	64.4		49.5	54.9	70.2		47.1	56.3	68.5		45.2	50.5	59.4	
4–7 d/wk	51.9	54.0	35.6		50.5	45.1	29.8		52.9	43.7	31.5		54.8	49.5	40.6	
Mother's health, % very good/excellent	53.3	45.7	32.7	.003	61.7	52.0	50.3	.05	72.7	62.9	58.1	<.001	82.0	74.0	67.5	<.001
Father's health, % very good/excellent	57.1	49.1	46.0	.39	65.8	65.8	64.4	.96	71.9	66.5	54.8	<.001	80.1	71.8	69.7	<.001

NW indicates normal weight; OW, overweight; OB, obese; FPL, federal poverty level; and ACEs, adverse childhood experiences.

P values represent chi-square tests within income strata and across weight groups.

Table 3. Multivariable Models of the Association Between Individual Child Emotional Resilience and Overweight or Obesity

Child-Level Resilience	<100% FPL Adjusted Odds Ratio (95% CI)		100%–199% FPL Adjusted Odds Ratio (95% CI)		200%–399% FPL Adjusted Odds Ratio (95% CI)		≥400% FPL Adjusted Odds Ratio (95% CI)	
Model 1	Overweight	Obese	Overweight	Obese	Overweight	Obese	Overweight	Obese
Low resilience	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High resilience	1.16 (0.71–1.90)	0.51 (0.32–0.83)	0.96 (0.65–1.41)	0.91 (0.60–1.37)	0.73 (0.55–0.97)	0.73 (0.55–0.95)	0.88 (0.71–1.10)	0.59 (0.46–0.77)
Model 2	Overweight*	Obese*	Overweight*	Obese*	Overweight†	Obese†	Overweight‡	Obese‡
Low resilience	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High resilience	1.17 (0.73–1.89)	0.58 (0.35–0.97)	1.08 (0.73–1.60)	1.12 (0.74–1.71)	0.78 (0.59–1.04)	0.98 (0.74–1.30)	0.90 (0.71–1.13)	0.74 (0.55–0.98)
Low PA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High PA	0.95 (0.57–1.58)	0.48 (0.30–0.77)	0.81 (0.55–1.20)	0.43 (0.28–0.68)	0.66 (0.51–0.86)	0.46 (0.34–0.62)	0.83 (0.66–1.04)	0.60 (0.45–0.81)
Model 3	Overweight*	Obese*	Overweight*	Obese*	Overweight§	Obese§	Overweight‖	Obese‖
Low resilience	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High resilience	1.14 (0.69–1.89)	0.63 (0.36–1.11)	1.00 (0.65–1.52)	1.01 (0.64–1.59)	0.79 (0.57–1.10)	1.07 (0.79–1.44)	0.97 (0.76–1.24)	0.76 (0.56–1.05)
Low PA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High PA	0.91 (0.52–1.58)	0.46 (0.27–0.77)	0.83 (0.55–1.27)	0.46 (0.29–0.75)	0.69 (0.51–0.92)	0.45 (0.33–0.63)	0.81 (0.63–1.04)	0.59 (0.44–0.79)
Poor maternal health	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Very good/excellent maternal health	0.66 (0.40–1.11)	0.50 (0.29–0.85)	0.72 (0.48–1.08)	0.80 (0.50–1.29)	0.69 (0.50–0.96)	0.70 (0.50–0.98)	0.74 (0.53–1.02)	0.72 (0.53–0.99)

FPL indicates federal poverty level; CI, confidence interval; PA, physical activity; and ACEs, adverse childhood experiences.

Model 1 accounts for child age, gender, race/ethnicity, insurance status, and highest parental education only. Model 2 accounts for environmental stressors and child physical activity. Model 3 additionally accounts for parental physical health.

*Adjusted for bullied status.

†Adjusted for libraries, bullied, food security, and ACEs.

‡Adjusted for bullied, food security, and ACEs.

§Adjusted for libraries, bullied, food security, and father physical health.

‖Adjusted for bullied, food security, ACEs, and father physical health.

FPL were about twice as likely to meet the criteria of living in a safe, supportive neighborhood without any detrimental factors as children in families at <100% of the FPL (Table 2). There also was no consistent association between amenities such as presence of parks or playgrounds and weight status within income strata (Table 2). Food insecurity was only associated with obesity in the highest 2 income strata (Table 2). The prevalence of ACEs followed a similar pattern, with only a significant gradient by weight status in higher income families and higher overall levels in lower-income families (Table 2). Finally, at the child level, bullying was strongly associated with weight status within all income strata (Table 2).

COMMUNITY-, FAMILY-, AND INDIVIDUAL-LEVEL STRESSORS ASSOCIATED WITH EMOTIONAL RESILIENCE

Child-level emotional resilience did not vary by race/ethnicity in any income stratum; however, the composite variable of a safe, supportive neighborhood showed a strong association with child-level emotional resilience (Supplementary Table 1). We observed a significant bivariate association between bullying and emotional resilience, with twice the prevalence of reported bullying in the low emotional resilience group across income strata (Supplementary Table 1). We also examined the association among parental health, physical activity, and child emotional resilience within each income stratum (Supplementary Table 1). We observed an association between physical activity and this component of child resilience within each stratum. Both maternal and paternal health were associated with child emotional resilience in most income strata, and we observed a gradient across income.

MULTIVARIABLE MODELS OF STRESSORS AND OBESITY, ADJUSTING FOR CHILD RESILIENCE

Child-level emotional resilience had a significant negative association with obesity for 3 of the 4 income strata in multivariable models adjusting for the demographic characteristics (Table 3). In model 2, accounting for child physical activity and environmental stressors, emotional resilience was associated with decreased odds of obesity in only the upper and lower strata of income, and child physical activity was associated with weight status across all strata. In model 3, adjusted for maternal and paternal physical health status in addition to child physical activity, emotional resilience was no longer associated with weight status (Table 3). In this multivariable model, we did not find a significant interaction between child emotional resilience and maternal or paternal health.

DISCUSSION

Contrary to our hypothesis, family resilience was not associated with lower prevalence of overweight or obesity among children 10 to 17 years of age; however, higher levels of 1 component of child resilience—emotional stability—showed a significant association with lower obesity in children across income strata. This is the first analysis at a national level to demonstrate a significant association between child emotional resilience and weight status. This association remained significant after adjusting for the strong associated covariates of food insecurity and bullying.

Physical activity of the child was strongly associated with both child emotional resilience and weight status, and physical activity levels were remarkably similar across income groups. Our measure of resilience examined 1 component of the complex process that is resilience—a core trait of the individual; others have also reported an association between the core traits associated with resilience (emotional stability, self-esteem) and physical activity in children.[20,21] Studies examining the effect of physical activity on emotional stability have consistently shown a significant stabilizing effect, although this has only been experimentally studied in the short term.[22]

The association between emotional resilience and weight status was no longer significant after adjusting for maternal health status in a multivariable model, and both maternal and paternal health status were strongly associated with this component of resilience and weight status. This suggests an influence of the family potentially serving as a proxy measure for family wellness. The family resilience measure used in the NSCH was not significantly associated with weight status. The explanation for this lack of an association could be either that there truly is no underlying association between family resilience and obesity or that the measure used does not accurately measure the association. The queries used in the NSCH map well conceptually to the core components of family resilience—namely, communication, routines, and dealing with challenges. Alternatively, it may be that, although families are resilient in general, that may not translate in a natural setting to resilience against risks for obesity, particularly if families do not view weight status as a priority. One of the proposed specific processes linking family resilience to weight status is eating family meals together;[4] in our preliminary analysis (data not shown) we examined this measure of family resilience and also found no association with child weight status within income strata. Family resilience shows a range over income strata, and our analysis within each stratum may also partially explain the lack of an association. Family-based strategies that incorporate parenting skills or family functioning have demonstrated success in addressing weight[23] in a field where many interventions fail. These contradictory findings require further work to understand how family resilience specific to childhood obesity can be understood and addressed.

One explanation for maternal health accounting for the association with child emotional resilience and obesity could be the weight status of the mother, with the same drivers of obesity for the mother (eg, diet) being associated with the child's weight status. This explanation probably does not completely account for the association, as more than two thirds of adults in the United States are overweight or obese, and we observed a wider distribution of maternal health status in this sample. Maternal physical

activity is associated with child physical activity,[24] and accounting for maternal physical health may have approximated that contribution to the weight status of the child.

Other studies have shown a consistent association between higher obesity and lower income, 1 theory being that low-income families have fewer resources in an obesogenic environment and are thus more susceptible to developing obesity.[25,26] Although we identified differences in community-level resources between the highest and lowest income strata, we did not find a significant association between community-level resources and weight status within the lower 2 income strata. National-level studies examining the built environment (using measures like street connectivity or parks) have consistently found an association with obesity—these studies have adjusted for income rather than stratifying by income level.[27,28] A study from Massachusetts showed a much stronger reduction in the association with childhood obesity when adjusting for socioeconomic status compared with adjusting for the built environment characteristics.[29] Although income plays a role in the development of obesity, our data suggest that community resources may not be the primary driver. The assessment in the NSCH queries presence and not quality of resources, and, notably, the perception of a safe, supportive neighborhood across income strata varied twofold. This approach of stratifying by income illustrates the value of examining associations within socioeconomic strata rather than across.

Although food security and income were strongly associated overall, only the upper 2 income strata demonstrated a significant association between weight status and food security. Prior studies examining food security and weight status among low-income families are mixed. One cross-sectional study found no association[30]; another longitudinal study found an association but only among mothers with overweight or obesity.[31] A study among low-income Latino families in California showed an association of food insecurity with obesity for women but not men.[32] One study that examined food insecurity in higher income households found co-morbid chronic disease and addiction in higher income households with food insecurity.[33]

Similar to studies using 2012 NSCH data,[17,19] we found a consistent relationship between ACEs and weight status only in the top strata of income. In our study, ACEs were not associated with weight status after accounting for emotional resilience in the multivariable models, providing support for the argument that individual child resilience may be protective in the pathway between ACEs and chronic disease. These data are specific to 10 to 17 year olds, with younger age groups having a lower prevalence.

The measures for the components of resilience at the child level for this study have been used in the NSCH since 2012. It was developed by an expert panel and tested by the National Center for Health Statistics, although the cognitive results of that testing have not been published. The measure of emotional stability has not been examined in direct comparison with other measures of resilience. There is no current gold standard for measuring resilience; other scales encompass more of the contextual factors that facilitate resilience as a multidimensional process. Arguably, the NSCH measure examines primarily 1 of the core individual traits—emotional stability—associated with resilience.[1] Other measures that have better published psychometric properties include the Child and Youth Resilience Measure[3] and the Resiliency Attitudes and Skills Profile.[34] These are relatively lengthy measures that prevent their deployment in the NSCH.

Limitations include the cross-sectional nature of the data collection, which precludes any inferences of causality. One could reasonably hypothesize that children who are overweight or obese may become less emotionally resilient over time because of their experience due to their weight status rather than the other way around. Longitudinal data measuring resilience and weight status would be able to distinguish these possibilities. Prior research would suggest that the causal pathway is that physical activity can lead to greater resilience. Ideally, an approach using multilevel modeling examining how individual, family, and community factors interact would be used to analyze the data; the public NSCH dataset does not provide these variables.

CONCLUSIONS

The 2016 NSCH data provide the opportunity to examine associations in a sample representative of the US child population 10 to 17 years of age. Populations in different income strata experienced different stressors associated with an increased risk of obesity. Individual child emotional resilience was associated with lower odds of obesity across most income strata, suggesting that interventions designed to increase resilience may have potential in addressing obesity.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at https://doi:10.1016/j.acap.2018.08.012.

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