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Impact of Neighborhood Social Conditions and Household Socioeconomic Status on Behavioral Problems Among US Children

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Abstract We examine the impact of neighborhood social conditions and household socioeconomic status (SES) on the prevalence of parent-reported behavioral problems among US children aged 6–17 years. The 2007 National Survey of Children's Health was used to develop a factor analytic index and a dichotomous measure of serious behavioral problems (SBP) in children. The outcome measures were derived from 11 items capturing parents' ratings of their children on a set of behaviors, e.g., arguing, bullying, and feelings of worthlessness, depression, and detachment. Dichotomous measures of perceived safety, presence of garbage/litter, poor/dilapidated housing, and vandalism were used to assess neighborhood social conditions. Household SES was measured using parental education and household poverty status. Logistic and least squares regression models were used to analyze neighborhood and household socioeconomic effects on the continuous and binary outcome measures after controlling for sociodemographic and psychosocial factors, including behavioral risk factors, family cohesion, social participation, and geographic mobility. Higher levels of behavioral problems were associated with socially disadvantaged neighborhoods and lower household SES. Adjusted logistic models showed that children in the most disadvantaged neighborhoods (those characterized by safety concerns, poor housing, garbage/litter in streets, and vandalism) had 1.9 times higher odds, children in poverty had 3.7 times higher odds, and children of parents with less than high school education had 1.9 times higher odds of SBP than their more advantaged counterparts. Improvements in neighborhood conditions and household SES may both help to reduce childhood behavioral problems.

Keywords Neighborhood conditions · Household socioeconomic status · Behavioral Problems Index · Social participation · Sleep deprivation · Physical inactivity

Introduction

Behavioral and emotional problems in children have important implications for their health and well-being [1–3]. Children with emotional/behavioral conditions are more likely to have poor academic performance, to repeat a grade in school, face school suspension or expulsion, develop behavioral problems in adulthood, and are less likely to engage in social activities outside of school [1–3].

A number of studies have shown significant neighborhood and household socioeconomic influences on child health and behavioral outcomes, including physical inactivity, obesity, school achievement, perceived health status, mental health, youth violence, and behavioral problems [3–10]. More importantly, the effects of adverse neighborhood conditions, particularly neighborhood deprivation, on health and behavioral outcomes have been shown to persist even after controlling for parental socioeconomic status (SES) [3–5, 7–10]. Previous research relating neighborhood factors to children's mental health has been limited to

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Human Subjects Review: No IRB approval was required for this study, which is based on the secondary analysis of a public-use federal database.

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specific types of mental health conditions [3, 8] or age groups of children [3, 7–10]. To our knowledge, this relationship has not yet been examined using a broad measure of behavioral problems in a nationally-representative sample of school-aged children.

Analyzing the effects of neighborhood environment is important because neighborhood conditions reflect the broader social and community contexts within which variations in individual health and social behaviors occur [4–6, 11]. Many aspects of neighborhood environment that are thought to influence children's health, such as socioeconomic deprivation, poor housing, crime, and lack of social amenities are potentially modifiable through social policies [4–6, 12]. Additionally, neighborhood conditions have been linked to a variety of health and behavioral outcomes, including obesity and physical activity, infant mortality, low birthweight, smoking, self-rated health, violence, and mortality [4–6, 11]. As such, improvements in neighborhood environment hold the potential to positively impact a wide range of childhood health inequalities, including those in emotional/behavioral health.

Low household SES has also been linked to behavioral problems in children [1–3, 5, 9, 10, 13]. Research has shown household SES to be strongly associated with children's behavioral health in analytic models both with and without neighborhood effects [3, 5, 9, 10]. As such, it is important to identify behavioral health disparities among children of diverse socioeconomic backgrounds; moreover, assessing household SES effects may highlight opportunities to reduce such disparities. Emphasis on both the neighborhood environment and household socioeconomic factors is also consistent with the Healthy People 2020 objectives [14].

The 2007 National Survey of Children's Health (NSCH) allows us to further explore the complex associations between neighborhood conditions and household socioeconomic characteristics and childhood behavioral problems [15, 16]. In this study, we (1) estimate the prevalence of behavioral problems by a variety of neighborhood, household, and child-level characteristics (2) assess whether neighborhoods effects on behavioral problems persist after adjusting for household SES and sociodemographic characteristics, (3) examine the potential intervening mechanisms through which neighborhood conditions and household SES may influence behavioral problems, and (4) examine the extent to which behavioral effects of neighborhood environment and household SES vary by child's age, gender, and race/ethnicity.

Methods

The data for this study came from the 2007 NSCH, a nationally representative telephone survey of 91,642 children aged <18 years [15, 16]. These analyses were limited to children aged 6–17 years. Substantive and methodological details of the survey are described elsewhere [16–18].

The dependent variable was measured by a composite Behavioral Problems Index (BPI). Behavioral problems scales have been used previously and have been validated against emotional/behavioral and school outcomes among children [19–21]. In our study, the BPI was constructed using principal components analysis of 11 items capturing parents' ratings of their children on a set of behaviors, including arguing, bullying, disrespect, not getting along with others, disobedience, irritability, lacking empathy and conflict resolution strategies, and feelings of worthlessness, depression, and detachment (Table 1). The factor loadings for the BPI varied from a low of 0.51 for "detachment" to a high of 0.63 for "irritability." The BPI had a high reliability coefficient (alpha = 0.80). BPI was standardized with a mean of 100 and a standard deviation of 20; higher scores on the BPI indicate higher levels of behavioral problems.

A composite binary variable of serious behavioral problems (SBP) was also defined if the child scored "usually" or "always" on each of the 11 behavioral items in Table 1. To test the concurrent validity of the BPI, we estimated the magnitude of the association (the gamma statistic) between the dichotomous SBP variable with parent-reported diagnoses of depression (0.92), anxiety (0.87), oppositional defiant disorder/conduct disorder (0.95), and ADD/ADHD (0.82). The quartile distribution of the BPI was also highly correlated with the degree/severity of depression ($\gamma = 0.82$), anxiety (0.71), conduct disorder (0.89), and ADD/ADHD (0.54). To evaluate the predictive validity, we estimated the association between the dichotomous measure of SBP with parental-reported child health status ($\gamma = 0.74$) and school absence ($\gamma = 0.64$).

Neighborhood social conditions and household SES were the primary covariates of interest. Neighborhood conditions included dichotomous measures of perceived neighborhood safety, presence of garbage/litter in the neighborhood, poor/dilapidated housing, and vandalism such as broken windows or graffiti. Additionally, we used a previously developed factor-based index of neighborhood social environment that combined the four neighborhood indicators (4). Higher scores on the neighborhood index (alpha = 0.57) represent more favorable conditions. Household SES was measured by parental education and household poverty status (defined as a ratio of family income to the poverty threshold).

We used a social determinants of health framework to model links between neighborhood conditions, household socioeconomic characteristics, and childhood behavioral problems [4, 6, 22, 23]. Within this framework, neighborhood and household socioeconomic characteristics are

Table 1 Factor loadings and factor score coefficients for 11 variables comprising the Behavioral Problems Index, US children aged 6–17 years: The 2007 National Survey of Children's Health ($N = 62{,}804$)

Variable[a]	Factor loadings	Factor score coefficients
Child argues too much	0.61	0.16
Child bullies or is cruel or mean to others	0.61	0.16
Child does not show respect for teachers and neighbors	0.52	0.14
Child does not get along with other children	0.60	0.16
Child is disobedient	0.61	0.16
Child is stubborn, sullen, or irritable	0.63	0.17
Child does not try to understand other people's feelings	0.59	0.16
Child doesn't try to resolve conflicts with classmates/family/friends	0.52	0.14
Child feels worthless or inferior	0.57	0.15
Child is unhappy, sad, or depressed	0.61	0.16
Child is withdrawn, and does not get involved with others	0.51	0.14
Proportion of total variance explained by factor	0.34	
Cronbach's alpha (reliability coefficient)	0.80	

Derived from a principal components analysis

[a] Each variable is a 5-category item with response codes 1 (never), 2 (rarely), 3 (sometimes), 4 (usually), and 5 (always)

considered underlying determinants [4–6, 22, 23], which may influence behavioral problems directly by creating conditions that lead to problem behaviors. They are also hypothesized to affect behavioral problems indirectly through their effects on intervening psychosocial and behavioral factors such as familial stress, social interaction, and behavioral risk factors [5–7, 22].

Using this framework and past research as a guide, we considered eleven covariates of childhood behavioral problems, in addition to neighborhood conditions and household SES. These included sociodemographic variables (child's age, gender, race/ethnicity, household composition, and parental immigrant status) and six potentially intervening variables (family cohesion, child's social participation, geographic mobility, sleep duration, television viewing, and physical activity) [1, 2, 5, 19, 21, 24–28]. These covariates were measured as shown in Table 2. The detailed race/ethnicity variable was obtained from NCHS.

Fewer than 2 % of the observations had missing data on one or more of the behavioral items comprising the BPI, which was constructed for 62,804 children aged 6–17. For 9 % of the observations, household income was imputed [17]. For all other covariates, there were few missing cases, which were excluded from multivariable models, yielding an effective sample size of 59,531 for the fully-adjusted covariate models.

The χ^2 statistic was used to test the overall association between each covariate and behavioral problems. To estimate differentials in risks of SBP and mean BPI scores, we fitted three sets of logistic and least squares regression models keeping in mind the causal sequencing of neighborhood environment and socioeconomic covariates with behavioral problems [4, 5, 7]. The first set of models present unadjusted odds of behavioral problems associated with each covariate. The second set of sociodemographic models yield the adjusted effects of neighborhood conditions and household SES after controlling for age, gender, race/ethnicity, nativity status, and household composition. The third set of models consists of fully-adjusted models that provide the net effects of neighborhood and household SES after accounting for differences in sociodemographic, behavioral, and psychosocial characteristics.

A series of interaction models of neighborhood environment and household SES with age, gender, and race/ethnicity were also estimated. To account for the complex sample design of the NSCH, SUDAAN software was used to conduct logistic and least squares analyses and to estimate means, prevalence estimates, and corresponding standard errors [29].

Results

In 2007, 2.8 % of US children aged 6–17 were estimated to have SBP (Table 2). About 6 % of children in neighborhoods with the least favorable social conditions experienced SBP, compared with 2.0 % of children in the most favorable neighborhoods. Moreover, less favorable neighborhood conditions were associated with higher BPI scores; a mean BPI difference of 8.6 was observed between the least and most favorable neighborhood conditions (107.5 vs. 98.9).

Children in neighborhoods with the least favorable social conditions had 3.1 times higher unadjusted odds of SBP than children in neighborhoods with the most favorable conditions (Table 2); children in neighborhoods with perceived safety concerns, garbage/litter in streets/sidewalks, poor/dilapidated housing, and vandalism had 1.9, 2.4, 2.6, and 2.0 times higher unadjusted odds of SBP than children in neighborhoods without these unfavorable social conditions, respectively (Table 3).

Higher risks of behavioral problems associated with unfavorable neighborhood conditions persisted even after the adjustment for household socioeconomic and demographic characteristics (Tables 3, 4). The adjusted differential in the mean BPI scores between the least and most favorable neighborhoods was 7.1. After controlling for

Table 2 Behavioral Problems Index and serious behavioral problems according to neighborhood, household socioeconomic, demographic, and behavioral characteristics, US children aged 6–17 years: The 2007 National Survey of Children's Health ($N = 62,804$)

Covariate	Weighted percent in sample	Behavioral Problems Index (continuous variable)[a]			Serious behavioral problem (dichotomous variable)[b]			
		Mean	SE	*P* value	Weighted prevalence (%)[c]	SE	Unadjusted OR	95 % CI
United States	100.00	100.0	0.22		2.78	0.18		
Sociodemographic characteristics								
Age, years								
6–9	32.47	100.4	0.36	0.27	2.26	0.28	0.71	0.50–1.02
10–11	16.26	100.5	0.57	0.46	2.51	0.48	0.80	0.50–1.27
12–14	25.94	101.4	0.43	0.59	3.26	0.37	1.04	0.73–1.48
15–17	25.34	101.1	0.47	Ref	3.13	0.40	1.00	Ref
Gender								
Male	51.15	102.0	0.31	<0.001	3.24	0.27	1.43	1.08–1.88
Female	48.85	99.6	0.32	Ref	2.30	0.25	1.00	Ref
Race/ethnicity								
Non-Hispanic White	56.98	100.8	0.23	0.960	2.39	0.21	0.88	0.56–1.37
Non-Hispanic Black	14.84	102.2	0.65	0.151	4.52	0.58	1.70	1.04–2.76
Hispanic	18.58	100.8	0.71	Ref	2.72	0.55	1.00	Ref
American Indian/Alaska Native	0.82	102.7	1.45	0.227	4.84	1.63	1.82	0.81–4.08
Asian	3.14	93.8	1.05	<0.001	0.68	0.42	0.25	0.07–0.88
Hawaiian/Pacific Islander	0.31	99.4	3.02	0.655	1.39	1.38	0.50	0.07–3.78
Non-Hispanic mixed race	3.78	102.7	1.06	0.139	3.55	0.79	1.32	0.72–2.43
Other	1.54	102.2	1.81	0.462	2.85	1.28	1.05	0.39–2.84
Household composition								
Two-parent biological	62.41	98.4	0.26	Ref	1.64	0.20	1.00	Ref
Two-parent stepfamily	10.17	105.3	0.74	<0.001	4.83	0.78	3.05	2.02–4.61
Single mother	19.94	105.3	0.54	<0.001	4.84	0.50	3.06	2.21–4.23
Other family type	7.48	103.3	0.79	<0.001	4.06	0.59	2.55	1.73–3.74
Parental nativity/immigrant status								
Immigrant	18.44	98.1	0.62	Ref	1.96	0.41	1.00	Ref
US-born	81.56	101.5	0.23	<0.001	2.97	0.21	1.53	0.98–2.37
Index of neighborhood social conditions (mean index score = 100; SD = 20)								
20.78–67.09 (least favorable)	8.85	107.5	0.90	<0.001	5.87	0.85	3.06	2.13–4.40
67.10–88.32	7.32	105.9	0.92	<0.001	4.14	0.83	2.12	1.34–3.36
88.33–104.99	17.53	102.9	0.55	<0.001	3.52	0.47	1.79	1.28–2.51
105.00–111.40 (most favorable)	66.30	98.9	0.26	Ref	2.00	0.21	1.00	Ref
Household poverty status (ratio of family income to poverty threshold)								
<100 %	16.86	105.7	0.68	<0.001	6.51	0.68	6.67	4.48–9.94
100–199 %	20.36	102.2	0.59	<0.001	3.42	0.50	3.40	2.17–5.32
200–399 %	32.31	100.3	0.38	<0.001	2.08	0.28	2.04	1.33–3.13
≥400 %	30.48	97.9	0.29	Ref	1.03	0.17	1.00	Ref
Highest household or parental education level, years								
<12	8.27	105.9	1.05	<0.001	5.34	0.95	4.51	2.82–7.23
12	23.24	102.7	0.57	<0.001	4.78	0.55	4.01	2.76–5.85
13–15	27.06	101.3	0.41	<0.001	2.58	0.30	2.12	1.46–3.08
≥16	41.43	98.6	0.27	Ref	1.23	0.18	1.00	Ref

Table 2 continued

Covariate	Weighted percent in sample	Behavioral Problems Index (continuous variable)[a]			Serious behavioral problem (dichotomous variable)[b]			
		Mean	SE	*P* value	Weighted prevalence (%)[c]	SE	Unadjusted OR	95 % CI
Psychosocial and behavioral characteristics								
Family cohesion (no. of days/week family members eating meal together)								
≤1	8.06	107.3	0.82	<0.001	6.09	0.90	2.48	1.71–3.58
2	7.30	103.8	0.72	<0.001	2.93	0.56	1.15	0.75–1.79
3	10.27	103.0	0.66	<0.001	2.49	0.45	0.98	0.64–1.48
4	12.18	101.3	0.66	<0.001	2.48	0.65	0.97	0.55–1.71
5	16.03	100.9	0.46	<0.001	1.95	0.39	0.76	0.49–1.19
≥6	46.15	98.6	0.33	Ref	2.55	0.26	1.00	Ref
Social participation (participation in clubs, organization, or sports teams)								
Yes	57.53	98.9	0.24	Ref	1.62	0.18	2.77	2.10–3.65
No	42.47	103.5	0.40	<0.001	4.36	0.36	1.00	Ref
Geographic mobility (no. of times child moving to a new address during lifetime)								
0	23.71	98.7	0.39	Ref	1.84	0.31	1.00	Ref
1	22.60	99.1	0.39	0.43	1.56	0.29	0.85	0.52–1.39
2	18.47	99.7	0.51	0.11	2.23	0.38	1.22	0.76–1.96
3	15.73	102.4	0.69	<0.001	3.50	0.65	1.93	1.17–3.20
≥4	19.49	105.2	0.57	<0.001	5.17	0.50	2.91	1.97–4.28
Sleep behavior (no. of nights child getting adequate sleep during past week)								
0	2.28	112.0	1.56	<0.001	9.20	1.69	5.18	3.36–7.99
1–4	11.18	109.8	0.83	<0.001	7.19	1.04	3.96	2.78–5.64
5–6	22.53	102.8	0.39	<0.001	2.38	0.36	1.24	0.88–1.77
7	64.02	98.1	0.26	Ref	1.92	0.17	1.00	Ref
Television watching (number of hours per day)								
<1	20.63	97.7	0.42	Ref	1.36	0.29	1.00	Ref
1	29.15	99.4	0.42	0.004	2.25	0.38	1.67	0.97–2.88
2	28.40	101.3	0.38	<0.001	2.63	0.33	1.96	1.20–3.21
>2	21.81	105.1	0.55	<0.001	4.97	0.45	3.80	2.39–6.03
Physical activity (number of days of vigorous exercise for at least 20 min during past week)								
0	10.12	107.8	0.94	<0.001	6.81	0.80	3.33	2.39–4.65
1–2	12.19	103.9	0.72	<0.001	3.68	0.63	1.74	1.15–2.63
3–4	23.91	100.7	0.39	<0.001	2.07	0.32	0.96	0.66–1.41
≥5	53.79	98.8	0.28	Ref	2.15	0.24	1.00	Ref

[a] Higher scores on the Index indicate higher levels of behavioral problems

[b] This binary outcome variable was defined if the child scored "usually" or "always" on each of the 11 behavioral items in Table 1

[c] The χ^2 test for the overall association between each covariate (except age) and the prevalence of serious behavioral problem was statistically significant at $P < .05$

household socioeconomic and demographic factors, children in neighborhoods with the least favorable social conditions had 1.9 times higher odds of SBP than children living in the most favorable conditions. After adjusting for household SES, children in neighborhoods with garbage/litter, poor/dilapidated housing, and vandalism had 1.7, 1.8, and 1.4 times higher odds of SBP than children in neighborhoods without these unfavorable conditions, respectively.

The impact of household SES on children's behavioral problems was substantial (Table 4). Children living below the poverty line had 3.7 times higher odds of SBP than children whose family income exceeded 400 % of the poverty threshold. Children with parents having less than a high school education had 1.9 times higher odds of SBP than children whose parents had a college degree. Net of the neighborhood effects, the household income and education gradients in the BPI were marked.

Table 3 Relationship between specific neighborhood social conditions and behavioral problems among US children aged 6–17 years: The 2007 National Survey of Children's Health ($N = 62,804$)

	Behavioral Problems Index (continuous variable)								Serious behavioral problem (dichotomous variable)							
	Sociodemographic model					Fully-adjusted model							Sociodemographic Model		Fully-adjusted model	
Variable	Obs. Mean[a]	SE	β[b]	SE	*P* value	β[c]	SE	*P* value	Obs. Prev. (%)[d]	SE	Unadj. OR	95 % CI	Adj. OR[b]	95 % CI	Adj. OR[c]	95 % CI
Perceived neighborhood safety																
Unsafe	106.1	0.72	4.91	0.78	<0.001	3.88	0.78	<0.001	4.66	0.55	1.93	1.44–2.58	1.26	0.92–1.74	1.12	0.8–1.6
Safe	100.0	0.23	Ref			Ref			2.47	0.20	1.00	Ref	1.00	Ref	1.00	Ref
Presence of garbage/litter in neighborhood																
Yes	106.1	0.63	5.04	0.66	<0.001	4.37	0.64	<0.001	5.35	0.65	2.42	1.80–3.27	1.72	1.28–2.33	1.61	1.20–2.2
No	99.8	0.23	Ref			Ref			2.28	0.18	1.00	Ref	1.00	Ref	1.00	Ref
Poorly kept or dilapidated/rundown housing in neighborhood																
Yes	106.6	0.67	5.33	0.69	<0.001	5.03	0.65	<0.001	5.68	0.66	2.57	1.92–3.44	1.82	1.34–2.46	1.68	1.25–2.28
No	99.9	0.23	Ref			Ref			2.29	0.19	1.00	Ref	1.00	Ref	1.00	Ref
Vandalism such as broken windows or graffiti in neighborhood																
Yes	105.8	0.75	4.38	0.78	<0.001	3.98	0.76	<0.001	4.82	0.68	1.96	1.41–2.72	1.42	1.01–2.01	1.26	0.88–1.80
No	100.2	0.23	Ref			Ref			2.52	0.19	1.00	Ref	1.00	Ref	1.00	Ref

[a] The *t* test for the difference in observed mean index values between categories of each neighborhood condition was statistically significant at $P < .001$

[b] Adjusted by weighted least squares or logistic regression for age, gender, race/ethnicity, household composition, nativity status, and household education and poverty levels

[c] Adjusted by weighted least squares or logistic regression for age, gender, race/ethnicity, household composition, nativity status, household poverty and education levels, family cohesion, social participation, geographic mobility, sleep behavior, television viewing, and physical activity

[d] The χ^2 test for the overall association between each neighborhood condition and the observed prevalence of serious behavioral problem was statistically significant at $P < .01$

Table 4 Multiple regression models of the impact of neighborhood and household socioeconomic factors and other demographic characteristics on behavioral problems among US children aged 6–17 years: The 2007 National Survey of Children's Health ($N = 59{,}531$)

Covariate	Behavioral Problems Index[a]						Serious behavioral problem[b]			
	Sociodemographic model[c]			Fully adjusted model[d]			Sociodemographic model[c]		Fully adjusted model[d]	
	β[e]	SE	*P* value	β[e]	SE	*P* value	Adj OR	95 % CI	Adj OR	95 % CI
Sociodemographic characteristics										
Age, year										
6–9	−0.12	0.60	0.838	3.81	0.61	<0.001	0.72	0.48–1.07	1.15	0.71–1.86
10–11	0.29	0.73	0.694	3.68	0.72	<0.001	0.90	0.55–1.47	1.39	0.81–2.40
12–14	0.91	0.64	0.155	2.66	0.63	<0.001	1.13	0.78–1.65	1.41	0.93–2.12
15–17	Ref			Ref			1.00	Ref	1.00	Ref
Gender										
Male	2.36	0.43	<0.001	2.70	0.43	<0.001	1.43	1.07–1.90	1.47	1.09–1.99
Female	Ref			Ref			1.00	Ref	1.00	Ref
Race/ethnicity										
Non-Hispanic White	2.01	0.91	0.027	2.61	0.91	0.004	1.40	0.73–2.70	1.59	0.78–3.25
Non-Hispanic Black	−0.48	1.04	0.643	−0.72	1.04	0.490	1.34	0.72–2.48	1.48	0.76–2.90
Hispanic	Ref			Ref			1.00	Ref	1.00	Ref
American Indian/Alaska Native	0.33	1.68	0.844	1.87	1.69	0.267	1.55	0.63–3.86	1.85	0.67–5.15
Asian	−2.59	1.36	0.058	−0.89	1.39	0.521	0.74	0.20–2.74	0.83	0.18–3.71
Hawaiian/Pacific Islander	0.29	2.79	0.917	1.16	2.65	0.662	0.72	0.09–5.54	0.78	0.11–5.66
Non-Hispanic mixed race	2.27	1.26	0.072	2.64	1.27	0.037	1.47	0.72–3.03	1.75	0.79–3.84
Other	3.24	3.58	0.366	4.00	2.90	0.168	0.57	0.15–2.19	1.03	0.27–3.92
Household composition										
Two-parent biological	Ref			Ref			1.00	Ref	1.00	Ref
Two-parent stepfamily	5.97	0.83	<0.001	4.26	0.80	<0.001	2.26	1.41–3.63	1.80	1.10–2.92
Single mother	4.47	0.71	<0.001	3.13	0.69	<0.001	1.54	0.99–2.40	1.28	0.81–2.01
Other family type	3.42	0.92	<0.001	2.72	0.93	0.003	1.47	0.90–2.42	1.33	0.80–2.22
Parental nativity/immigrant status										
Immigrant	Ref			Ref			1.00	Ref	1.00	Ref
US-born	2.09	0.82	0.011	2.35	0.82	0.004	1.31	0.65–2.66	1.44	0.67–3.10
Index of neighborhood social conditions										
20.78–67.09 (least favorable)	7.07	0.92	<0.001	6.27	0.90	<0.001	1.86	1.26–2.74	1.60	1.07–2.37
67.10–88.32	6.28	0.94	<0.001	5.59	0.92	<0.001	1.57	0.96–2.55	1.33	0.80–2.21
88.33–104.99	3.18	0.60	<0.001	2.53	0.60	<0.001	1.33	0.95–1.86	1.19	0.84–1.68
105.00–111.40 (most favorable)	Ref			Ref			1.00	Ref	1.00	Ref
Household poverty status (ratio of family income to poverty threshold)										
<100 %	4.16	0.87	<0.001	3.82	0.85	<0.001	3.70	2.17–6.29	3.22	1.79–5.80

Table 4 continued

Covariate	Behavioral Problems Index[a]						Serious behavioral problem[b]			
	Sociodemographic model[c]			Fully adjusted model[d]			Sociodemographic model[c]		Fully adjusted model[d]	
	β[e]	SE	*P* value	β[e]	SE	*P* value	Adj OR	95 % CI	Adj OR	95 % CI
100–199 %	2.21	0.73	0.002	1.73	0.71	0.016	2.19	1.24–3.85	1.96	1.08–3.55
200–399 %	1.20	0.51	0.018	0.83	0.49	0.090	1.60	0.97–2.63	1.48	0.87–2.51
≥400 %	Ref			Ref			1.00	Ref	1.00	Ref
Highest household or parental education level, years										
<12	3.38	1.14	0.003	0.71	1.15	0.539	1.94	1.15–3.27	1.38	0.81–2.37
12	0.28	0.65	0.670	−0.88	0.64	0.168	1.83	1.18–2.84	1.45	0.91–2.33
13–15	−0.03	0.52	0.957	−0.86	0.51	0.091	1.23	0.79–1.91	1.01	0.63–1.62
≥16	Ref			Ref			1.00	Ref	1.00	Ref
Psychosocial and behavioral characteristics										
Family cohesion (no. of days/week family members eating meal together)										
≤1				5.47	0.86	<0.001			1.53	0.98–2.37
2				3.67	0.75	<0.001			1.03	0.67–1.60
3				3.24	0.75	<0.001			0.88	0.54–1.42
4				2.31	0.72	<0.001			1.07	0.60–1.90
5				2.43	0.57	0.001			0.79	0.48–1.31
≥6				Ref					1.00	Ref
Social participation (participation in clubs, organization, or sports teams)										
Yes				Ref					1.00	Ref
No				2.38	0.47	<0.001			1.66	1.21–2.28
Geographic mobility (no. of times child moving to a new address during lifetime)										
0				Ref					1.00	Ref
1				0.58	0.53	0.272			0.78	0.47–1.28
2				0.55	0.65	0.398			0.89	0.55–1.46
3				2.34	0.77	0.002			1.37	0.80–2.34
≥4				3.97	0.67	<0.001			1.69	1.13–2.53
Sleep behavior (no. of nights child getting adequate sleep during past week)										
0				11.10	1.52	<0.001			4.03	2.51–6.46
1–4				10.41	0.91	<0.001			3.82	2.60–5.61
5–6				4.41	0.46	<0.001			1.38	0.94–2.01
7				Ref					1.00	Ref
Television watching (number of hours per day)										
<1				Ref					1.00	Ref
1				1.14	0.56	0.043			1.54	0.91–2.62

Table 4 continued

Covariate	Behavioral Problems Index[a]						Serious behavioral problem[b]			
	Sociodemographic model[c]			Fully adjusted model[d]			Sociodemographic model[c]		Fully adjusted model[d]	
	β^e	SE	*P* value	β^e	SE	*P* value	Adj OR	95 % CI	Adj OR	95 % CI
2				2.14	0.55	<0.001			1.60	1.00–2.57
>2				4.09	0.67	<0.001			1.89	1.21–2.96
Physical activity (number of days of vigorous exercise for at least 20 min during past week)										
0				7.50	1.00	<0.001			2.23	1.44–3.46
1–2				3.91	0.75	<0.001			1.22	0.76–1.94
3–4				2.08	0.49	<0.001			1.01	0.67–1.54
≥5				Ref					1.00	Ref

[a] Continuous dependent variable modeled by weighted least squares regression

[b] Dichotomous dependent variable modeled by logistic regression

[c] The model includes age, gender, race/ethnicity, household composition, parental nativity status, neighborhood social conditions index, and household poverty and education levels

[d] The full model includes all covariates in the sociodemographic model plus family cohesion, social participation, geographic mobility, sleep behavior, television viewing, and physical activity

[e] Unstandardized regression coefficient or the expected mean difference in the index scores

The neighborhood and household socioeconomic effects were reduced but remained highly significant after adjusting for potentially intervening variables in the full models (Table 4). Children in neighborhoods with the least favorable social conditions had 1.6 times higher adjusted odds of SBP than children in the most favorable neighborhoods, whereas children below the poverty line had 3.2 times higher adjusted odds of SBP than their most affluent counterparts. Children who moved ≥4 times during their lifetime had 1.7 times higher adjusted odds of SBP and significantly higher BPI scores than children who had never moved. Sleep duration was strongly and inversely associated with behavioral problems in children. Children experiencing inadequate sleep during the entire week and those experiencing adequate sleep only 1–4 nights of the week had, respectively, 4.0 and 3.8 times higher odds of SBP than children who did not experience any sleep problems during the week. The adjusted mean BPI scores among children increased consistently in relation to the frequency of sleep problems.

Children with no physical activity had 2.2 times higher odds of SBP than children who exercised at least 5 days/week, with mean BPI scores increasing in relation to lower physical activity levels. Children who watched television >2 h/day had 1.9 times higher odds of SBP than those who watched television <1 h/day, with higher BPI scores associated with higher levels of television viewing. Children who did not participate in social activities outside of school had 1.7 times higher odds of SBP than children who did. Family cohesion or support was significantly associated with reduced BPI levels. The sociodemographic model explained 5.3 % of the variance in the BPI, whereas the full model accounted for 12.3 % of the variance in the BPI.

Interactions of neighborhood conditions and household SES with age and gender were not statistically significant. However, the impacts of neighborhood conditions and household SES varied significantly by race/ethnicity and were generally greater and more consistent for non-Hispanic White children than for Black and Hispanic children. For example, the unadjusted odds of SBP were approximately four times higher for both non-Hispanic White and Black children living in disadvantaged neighborhoods, compared to their counterparts from the most favorable neighborhoods. The unadjusted odds of SBP among children living in poverty were 11 times higher for white children and 5 times higher for Black and Hispanic children compared to their most affluent counterparts. However, after adjusting for sociodemographic factors, neighborhood social conditions and household income were only related to the risk of SBP in white children (data available upon request).

Discussion

Using data from a large, nationally representative survey, we found that children and adolescents living in more disadvantaged neighborhoods or in neighborhoods characterized by poor housing, garbage/litter, and vandalism have significantly higher levels of behavioral problems and a higher likelihood of experiencing serious behavioral problems. The effects of adverse neighborhood conditions on children's behavioral problems remained significant, albeit somewhat reduced, after controlling for household socioeconomic and demographic characteristics.

Besides the significant neighborhood effects, the powerful impacts of household socioeconomic factors on children's behavioral problems are worth noting. Regardless of neighborhood conditions, household structure, and race/ethnicity, children from low-education and low-income households experienced 1.9–3.7 times higher odds of experiencing SBP than children from the most advantaged households. Our finding of much stronger household SES effects relative to neighborhood effects is consistent with the findings of previous studies [4, 5, 7]. However, caution should be exercised when interpreting neighborhood health effects as neighborhood conditions themselves have an important influence on household SES, household composition, and family dynamics [5, 7, 8, 11]. Controlling for these household and individual-level characteristics may lead to an underestimation of neighborhood effects.

Although both neighborhood social conditions and household SES were associated with the outcomes of interest, the effects differed for the continuous Behavioral Problems Index and the dichotomous serious behavioral problems measure affecting <3 % of the study population. Even after adjustment, neighborhood conditions appear to have a stronger impact on behavioral problems when assessed using the continuous BPI. Conversely, when considering variations in the dichotomous SBP measure, the magnitude of effect was particularly strong for household poverty status. A closer look at the association between both measures of behavioral problems and specific neighborhood conditions reveals that while all four neighborhood conditions were significantly associated with mean BPI scores, only the presence of garbage/litter and poor/dilapidated housing significantly increased the odds of SBP.

We examined possible mechanisms through which neighborhood and household socioeconomic factors might influence the risk for behavior problems. Our finding of an increased risk of behavioral problems associated with multiple residential moves, physical inactivity, and greater screen time is consistent with past research [21, 27, 28]. The stress of moving, loss of old friends and familiar environments, and increased family conflicts associated with frequent moving have been suggested as underlying factors for children's behavioral problems [21]. We found a powerful effect of sleep disruption on children's behavioral problems, which has received little attention in past research [25, 26]. In our study, inadequate sleep was associated with at least a fourfold increase in the risk of SBP—a substantially stronger association than observed previously [26].

We also found greater influences of neighborhood environment and household SES on problem behaviors among non-Hispanic White children than among Black and Hispanic children. Although each of the adverse neighborhood conditions considered was related to behavioral problems among children in most racial/ethnic groups, the neighborhood influences appeared to be greater and more consistent for white children than for Black and Hispanic children. Three likely explanations may be offered for these patterns: (1) the neighborhood conditions and household SES measures considered here do not adequately capture these constructs as well for Blacks and Hispanics as for whites; (2) individuals in disadvantaged neighborhoods may be more optimistic about their neighborhood situation and, consequently, may downgrade the severity of problems facing their neighborhood surroundings, a phenomenon called "psychological adjustment" [11, 30]; (3) other community- and household-level characteristics and cultural factors may be more important in determining behavioral health of Black and Hispanic children.

Neighborhood effects on children's behavioral outcomes may be further explained in terms of other neighborhood or social processes, such as availability of institutional resources, e.g., public libraries and recreation/community centers; social organization and interaction; neighborhood social capital; and labor markets [3, 5, 7, 31]. Neighborhood social capital, measured in part by social cohesion, has been examined in relation to childhood obesity, physical activity, and mental health [23, 32–35]. Children in more cohesive neighborhoods have been found to have lower physical inactivity and obesity risks and better mental health than those in less cohesive neighborhoods [23, 32–35]. The effects of "built environments" such as parks, playgrounds and green spaces on child outcomes, including mental health, have been examined previously [4, 5, 36]. However, a previous analysis of the NSCH data has shown built environmental variables to be mostly independent of the neighborhood social conditions considered in our study (4); as such they are not likely to account for the neighborhood effects reported here.

A major strength of our study includes estimating the effects of a variety of neighborhood conditions and a composite index of neighborhood environment on children's behavioral problems. The development of a highly

valid and reliable BPI and of a binary variable capturing serious behavioral problems is an important contribution to the literature on children's mental health. The other strengths of our study include the large sample size, the generalizability of our findings, and examination of whether behavioral health effects of neighborhood conditions and household SES vary by age, gender, and race/ethnicity.

This study has some limitations. Behavioral problems in our study were based on parental reports and might not accurately reflect the true prevalence, particularly among older adolescents or among those primarily experiencing internalizing symptoms. Second, same-source bias is a possible limitation since neighborhood conditions and behavioral problems were reported by the same respondents [30]. The effects of neighborhood conditions on behavioral problems could have been underestimated if disadvantaged individuals provided a more positive assessment of neighborhood environment resulting from psychological adjustment, as mentioned above [11, 30]. Alternatively, if parents of children with behavioral problems rated their neighborhoods more unfavorably as an explanation for these problems, that would lead to overestimation. Third, because of the cross-sectional nature of the NSCH, causal inferences about the relationships between neighborhood environment, household SES, and childhood behavioral problems cannot be drawn.

The evidence presented here suggests that favorable neighborhood conditions and household socioeconomic circumstances are significantly associated with reduced risk of behavioral problems in children, which, in turn, may support reductions in overall child health inequalities. While a number of household- and individual-level factors such as increased social interaction and physical activity, improved sleep patterns, and reduced familial stress can be beneficial in promoting children's emotional/behavioral health, social policy measures aimed at improving the broader social and physical environments can be vital to improving overall child health in general and their psychological well-being in particular.

Conflict of interest None.

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