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Examining Family and Neighborhood Level Predictors of Sleep Duration in Urban Youth

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Abstract

Introduction: Shortened sleep duration in adolescence has been found to be associated with adverse health outcomes. While several studies have explored individual predictors, few have examined the role of neighborhood-level factors, family and peer contexts as predictors of sleep among adolescents.

Methods: We examined contextual factors of sleep duration in a sample of 1,614 urban, public high school students from the 2008 Boston Youth Survey. Neighborhood data came from the 2008 Boston Neighborhood Survey of 1,710 adult Boston residents, the 2009 American Community Survey Census (ACS), and Boston Police.

Results: Using multi-level linear regression, adjusting for neighborhood and school clustering, age, race and sex, we found concentrated neighborhood poverty to be positively associated with sleep duration ($\beta=0.09$, $p=0.03$). Family context was significantly associated with longer sleep duration: >1–3 hours of homework per night reported longer sleep compared to students reporting 1 hour per night ($\beta=0.20$, $p=0.005$). Students reporting lower levels of positive parenting influence had shorter sleep duration (0–25th percentile: $\beta=-0.25$, $p=0.01$; 26th–50th $\beta=-0.24$, $p=0.03$), compared to students in the highest percentile. Students who never ate dinner with family had shorter sleep duration as compared to those having dinner with family five or more times per week ($\beta=-0.22$, $p=0.05$).

Discussion: Our findings focusing on neighborhood and family context represent potentially modifiable practices. These findings are important for public health advocates and health care providers as they seek to curb the epidemic of sleep deprivation in youth.

Keywords

Sleep; Youth; Context; Neighborhoods; Family

INTRODUCTION

Optimal sleep takes up a third of a person's day, and is known to be an important component of good health (Roberts, Roberts, & Duong, 2009). The National Sleep Foundation recommends adolescents get 9 hours of sleep per night (Hirshkowitz et al., 2015); however, sleep deprivation amongst U.S. youth is highly prevalent. The Youth Risk Behavior Surveillance System (YRBSS) indicates that ~73% of teenagers nationwide report insufficient nighttime sleep, defined as 7 hours or less of sleep per night (Kann, 2016). Shortened sleep duration in adolescence increases risk for adverse health outcomes including overweight and mood disorders (Berkey CS, 2008; Carskadon, 2004; Dinges et al., 1997; Gordon-Larsen, Adair, Nelson, & Popkin, 2003), decreases attention and focus (Fallone, Acebo, Arnedt, Seifer, & Carskadon, 2001), and increases risk for accidents (Brown, Finn, DeSautel, & Mezzanotte, 1996).

Recent research has focused on identification of risk factors for sleep deprivation. Studies find that shorter sleep duration is associated with individual level characteristics including older age (Hitze et al., 2009), minority ethnicity, obesity/overweight status (Knutson, 2005; Nixon et al., 2008), and male sex (Eaton et al., 2010; Moore et al., 2011; Spilsbury et al., 2004). Additionally, bedtimes and sleep routines are found to affect sleep quality and duration in youth (Lund, Reider, Whiting, & Prichard, 2010; Mindell, 2009; Nixon et al., 2008; Spilsbury et al., 2004). Limited studies have examined the role of broader contextual factors such as family and neighborhood conditions predicting sleep (McHale, Kim, Kan, & Updegraff, 2011; Spilsbury et al., 2005; Spilsbury et al., 2006).

Social-ecological theory outlines the multiple levels affecting individual behavior, illustrating the need to investigate individual, interpersonal (peer), family, and neighborhood factors as influences of sleep characteristics (Bronfenbrenner, 1986) and served as the theoretical framework for our study.

Neighborhood factors, including poverty, crime, collective efficacy, physical and social disorder, have been linked to children's health and well-being (Browning, Burrington, Leventhal, & Brooks-Gunn, 2008; Browning, Leventhal, & Brooks-Gunn, 2004; Dupere, Leventhal, Crosnoe, & Dion, 2010). Few studies have explored the association between neighborhood level characteristics and sleep duration in youth. Neighborhood disadvantage (including area-level socioeconomic and built environment) has been associated with higher rates of sleep apnea (Spilsbury et al., 2006), shorter sleep duration (Moore et al., 2011), and higher odds of serious sleep problems (Singh & Kenney, 2013). Neighborhood characteristics including high crime rates (McHale et al., 2011) and greater social fragmentation (Pabayo, Molnar, Street, & Kawachi, 2014) have been associated with

inadequate sleep and shorter sleep duration. Additionally, timing and consistency of sleep were associated with demographic, behavioral (e.g., number of household members, sleep hygiene behaviors), and neighborhood (e.g., type of housing, quality of public space) factors (Marco, Wolfson, Sparling, & Azuaje, 2011).

Family characteristics have been associated with children's health and well-being in a limited number of studies. Positive parenting and family meals have predicted improved health outcomes in youth, most notably overweight/obese (Gordon-Larsen, Adair, Nelson, & Popkin, 2004; Gordon-Larsen, Adair, & Popkin, 2003; Ritchie, Welk, Styne, Gerstein, & Crawford, 2005) and mental health (Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004; Gillman, 2000; Sallis & Nader, 1988). A few studies support the impact of family environment on sleep characteristics. Positive characteristics of home environments were found to be significantly associated with increased sleep time for African American children (Spilsbury et al., 2005). A study of young children found a positive family environment to be significantly associated with fewer sleep problems (Lumeng et al., 2007). Studies find increased marital conflict (El-Sheikh, Buckhalt, Mize, & Acebo, 2006), absent fathers, and distant or high-conflict mother-child relationships (Bell & Belsky, 2008) were associated with disruptions in quantity and quality of children's sleep.

Peers represent a proximal influence for high school students, as they spend a majority of waking hours with classmates and friends (Elkington, Bauermeister, & Zimmerman, 2004). Peer influence in adolescence is linked to health behaviors (Buhi & Goodson, 2007; Rai et al., 2003) and subjective well-being (Morgan et al., 2009), with positive peer influence specifically being associated with positive affect and healthy behaviors (Buhi & Goodson, 2007).

Recognizing that sleep is important to health and growing evidence that health is linked to neighborhood context, we explored whether neighborhood level characteristics predicted variation in duration of sleep amongst a sample of urban adolescent students. We hypothesized that students residing in neighborhoods with higher poverty rates, more social and physical disorder, and higher reports of violent crime would report less sleep.

Further, we explored whether family factors and peer influences predicted variation in sleep duration. We hypothesized that students with one or more family and peer supports would report more sleep.

METHODS

Sample

Data for this analysis came from multiple sources. The adolescent data came from the 2008 administration of the Boston Youth Survey (BYS), a biennial paper survey of Boston Public High School students (grades 9–12) (Dunn, Johnson, & Green, 2012). The survey included demographic characteristics, neighborhood resources, and household factors, emphasizing violence perpetration, witnessing and victimization (Pabayo et al., 2014). Of the 2,725 students from 22 participating schools selected to participate, 68.9% completed the survey (n=1878; non-completers included those who chose not to take the survey (n=99, 3.6%),

those without parent/caregiver permission to take the survey ($n=24$, $<1\%$), and those absent for survey administration ($n=724$, 27%). The BYS was administered in 2008 by trained Harvard School of Public Health staff. A statement requesting assent from students was read prior to survey administration; students could decline participation.

The neighborhood level data came from 2009 American Community Survey Census (ACS) data, crime reports from Boston Police, and the Boston Neighborhood Survey (BNS), a telephone survey of 1,710 adults (age 18+). Key informants from Boston identified 38 neighborhoods, each comprising multiple contiguous census blocks. Stratified sampling of neighborhoods was proportional to neighborhood population size. The BNS survey was administered in 2008 in English and Spanish by trained staff from Fact Finders, Inc., a professional research firm. Of individuals who spoke with an interviewer, 31% completed the survey.

The data sets were merged based on data obtained by the BYS, including neighborhood where student lives, street of residence, nearest cross street and zip-codes.

The Office of Human Research Administration at the Harvard School of Public Health approved data collection procedures.

Measures

Sleep Duration.—Hours of sleep per school night were assessed in the BYS using a two-question format. Students reported the closest hour and minutes for 1) their typical bedtime on a school night, and 2) their typical wake up on a school morning. Average school-night sleep duration was calculated from these two questions, taken from the Sleep Timing Questionnaire, with established reliability ($\alpha=0.80$) and validity ($r=0.7-0.8$ to two-week sleep diary) (Monk et al., 2003).

Neighborhood-level Concentrated Poverty.—Poverty level in each neighborhood was represented by an index value combining three measures. ACS data were used to calculate 1) percent of persons living below the federal poverty line, 2) percent of residents 16 years or older unemployed, and 3) percent of households on public assistance. We conducted a principle component analysis of these three variables and created the index of concentrated neighborhood poverty (Molnar, 2004; Sampson, Raudenbush, & Earls, 1997).

Neighborhood Violent Crime Rate.—For each neighborhood, count data on robberies, aggravated assaults, and homicides in 2008 was provided by the Boston Police Department.

Neighborhood Disorder.—Information on neighborhood-level disorder was drawn from the BNS. Six items were used from physical and social disorder scales from previously published surveys: Project of Human Development in Chicago Neighborhoods (Molnar, 2004) and *Measuring violence related attitudes, behaviors and influences among youths* (Dahlberg, Toal, Swahn, & Behrens, 2005). Items included aspects of physical or social disorder in one's neighborhood (response options: not a problem, kind of a problem, a big problem). The mean score of these six items was calculated ($\alpha=0.84$).

Collective Efficacy: Social Cohesion and Control.—Collective efficacy, a measure of neighborhood cohesion and informal social control, was assessed in the BNS using a 10-item scale with established reliability and validity with adults (Sampson et al., 1997). Individual responses were used to calculate neighborhood-specific mean scores. Higher scores reflect higher reports of neighborhood cohesion and control ($\alpha=0.87$).

Hours of Homework.—A question on the BYS asked students to report on average number of hours spent on homework daily (1 hour, >1–3 hours, >3 hours).

Positive Peer Influence.—Peer influence was measured using three questions from the BYS capturing positive influences (i.e., my friends stay out of trouble, follow parent rules, and do well in school) ($\alpha=0.85$), presented as percentiles ranging from low to high scores from the Likert scale responses.

Positive Parent/Guardian Influence.—Three questions (i.e., an adult in my household tries to understand my point of view, tells me that he/she loves me and/or wants good things for me, and is available for me to talk with about my problems) from the BYS were combined to assess positive parent/guardian influence. Four response options (ranging from strongly disagree to strongly agree) were summed for a 12-point range. This variable is presented in percentiles, where higher scores reflected a high level of parent/guardian influence ($\alpha=0.79$).

Frequency of Family Dinner.—The BYS asked students how frequently they sat down for dinner with their family per week (none, 1–2 times, 3–4 times, 5).

Statistical Analysis

We conducted univariate descriptive analyses of sleep time, social/ physical disorder score, percent poverty, collective efficacy and violent crime reports by neighborhood ($n=38$) and calculated Spearman correlation coefficients between neighborhood level factors. We fit multi-level random intercept models (also known as mixed effects models) to estimate the relationship between individual and neighborhood level independent variables and sleep duration. These multi-level models allow for assessment of multiple levels within a single model and account for the clustered structure of the data where students are situated within neighborhoods and schools.

We fit four models to analyze variation in sleep duration by individual, family, and neighborhood factors. The first model adjusted for age, sex, and race/ethnicity. The second model additionally included hours of homework and peer influence, and the third model additionally included positive parental influence and frequency of family dinners. The final model further adjusted for concentrated poverty. All analyses were conducted using SAS version 9.3 (SAS, 2011) with PROC MIXED for multi-level models, accounting for neighborhood and school clusters using random intercepts.

Missing Data and Sample Size

Sleep duration information was missing for 304 students. Sensitivity analysis revealed significant differences in missing sleep duration data by race/ethnicity and age. Therefore, we imputed values for sleep duration based on predictors including age, sex, and grade level using the Iweware program (n=1878) (Raghunathan & Elliott, 2011). We had useable residential information for geocoding from 88% of students, resulting in a final sample of 1,614 students.

RESULTS

Characteristics of Youth Sample

Of the sample of 1,614 youth residing in 38 Boston neighborhoods, 46% percent were male, 42.8% identified themselves as Black non-Hispanic and 33% Hispanic. The sample age ranged from 14 to 19 years (mean=16.7). The mean sleep time of the youth on a weeknight was 6.8 hours (range: 2.25–11.75 hours; Table 1).

Neighborhood Characteristics

The percent of families living below poverty within the neighborhoods ranged from 5% to 54% across the 38 neighborhoods (mean=21%). Neighborhood percent unemployment ranged from 3% to 22%. Neighborhood collective efficacy values ranged from 3.20 to 4.11 (mean=3.7). Violent crime in 2008 ranged from 45 to 386 events (mean=192) (Table 2). The index of neighborhood concentrated poverty ranged from 1.7 to 2.7.

Sleep Duration by Neighborhood

Multi-level regression analyses revealed a statistically significant increase in sleep duration by concentrated poverty, adjusted for demographic characteristics ($\beta=0.09$, $p=0.03$). Neighborhood collective efficacy, physical/social disorder and violent crime incidents were not significantly associated with sleep duration in adjusted models (Table 3).

Sleep Duration by Individual and Family Factors

In bivariate analyses examining individual characteristics (Table 1), Whites reported a longer average duration of sleep (7.16 hours), relative to Black non-Hispanic (6.75 hours), Hispanic (6.82 hours) and bi- or multi-racial students (6.53 hours). Sleep duration was inversely associated with age; oldest students reported shortest average sleep duration (6.6 hours). There was no significant difference in sleep duration between boys and girls. Students in lower quartiles of positive parent influence reported less sleep (0–25th percentile: 6.68 hours; 26–50th percentile: 6.76 hours) compared to those in the highest quartile (76–100th: 7.01 hours). Students in the 51–75 percentile of positive peer influence reported more sleep time as compared to those in the highest percentile (6.97 hours versus 6.75 hours). Further, students who reported never having family dinners had significantly less sleep as compared to those who reported five or more family dinners each week (6.6 hours versus 6.9 hours). All p-values were <0.05.

In analyses controlling for school level clustering and gender, age and race/ethnicity were significant predictors of sleep duration (Model 1), as were family contextual factors (Table

4). Students who reported >1–3 hours spent on homework daily had significantly longer sleep duration compared to those who spent 1 (β=0.20, p=0.005); students reporting >3 hours spent on homework had shorter sleep duration than those who spent 1 (β=-0.34, p=0.004; Model 2). The effect of hours of homework on sleep duration remained significant when adjusting for positive parental influence and frequency of family dinner (Model 3). Students reporting lower positive parent influence had less sleep than those in the highest percentile (0–25th percentile: β=-0.25, p=0.01; 26th-50th β=-0.24, p=0.03). Frequency of family dinners significantly predicted sleep duration, with those never eating family dinner reporting less sleep than those who reported five or more family dinners each week (β=-0.22, p=0.05). In Model 4, which included both individual and family predictors, neighborhood concentrated poverty was significantly associated with sleep duration, with those living in higher concentrated poverty having longer sleep duration (β=0.10, p=0.009). Hours of homework, positive parenting influence and frequency of family dinner remained statistically significant when adjusting for neighborhood concentrated poverty.

DISCUSSION

In this representative sample of Boston public high school students, higher neighborhood concentrated poverty was associated with longer sleep duration, controlling for age, race and sex. Three family contextual factors (hours of homework, positive parental influence, and participating in family dinner) were significant predictors of sleep duration, even after adjusting for age, race, sex and concentrated poverty. Among individual-level characteristics, increasing age was associated with shorter sleep duration. White students reported significantly longer sleep durations compared to all other racial groups; bi- and multi-racial students report the shortest sleep duration.

Concentrated neighborhood poverty was associated with sleep duration in our analyses in the reverse direction to our hypothesis. Students living in neighborhoods with higher concentration of poverty slept longer than those from neighborhoods with lower concentrations. Our findings lead us to speculate that children from higher socioeconomic neighborhoods may have greater access to electronic devices (e.g., laptops and smart phones) and may be up later at night using devices. These children may also be engaged in organized afterschool and evening activities, leading to later bedtimes.

Our hypothesis, that higher levels of neighborhood collective efficacy would predict longer sleep duration, was not supported in this analysis. Higher collective efficacy is thought to support community members through enhanced communication and greater community engagement (Kawachi & Berkman, 2000). Our neighborhood findings differ from previous research that suggests neighborhood social control and safety are linked to increases in healthy behaviors among youth (Cradock, Kawachi, Colditz, Gortmaker, & Buka, 2009; Molnar, 2004). Further, neighborhood physical and social disorder and violent crime were not associated with sleep duration in our adjusted analyses. This finding is in keeping with prior work with urban youth (Moore et al., 2011) yet differs from a study of Mexican-American youth that reports a marginal association between neighborhood crime and shorter sleep duration (McHale et al., 2011).

Our neighborhood-level assessment utilized is not exhaustive of the multiple influences of youth health behaviors. The association between neighborhood environments and sleep is likely complex and may relate to cultural and other factors we did not include. Future research should include additional neighborhood-level factors that may be targets for intervention for improving sleep, including environmental noise levels (traffic, sirens, etc.). Additional consideration of measuring quality of sleep amongst youth may address sleep hygiene. Sleep duration represents a component of sleep hygiene, while quality of sleep and other sleep distracting factors may be important considerations in analyses of contextual-level factors on adolescents' sleep.

We recognize that sleep is a behavior occurring within the home and may be primarily driven by family context, or the proximal household environment, rather than neighborhood environment. In this study, family context most consistently predicted sleep duration, where 1–3 hours of homework per night, positive parenting influence, and frequency of family dinners were all significant predictors of longer sleep duration. These findings are consistent with findings noting the role of family in promoting healthy behaviors, including proper nutrition and sleep hygiene (Ritchie et al., 2005; Sallis & Nader, 1988; Spilsbury et al., 2005), and set the stage for parent education by health professionals and educators.

Regarding individual characteristics, older age was associated with less sleep, consistent with a large body of evidence (Crowley, Acebo, & Carskadon, 2007; McHale et al., 2011; Moore et al., 2011; Smaldone, Honig, & Byrne, 2007). Older children may have less parental oversight than younger children, thus have more control over their bedtime. Furthermore, research on physiological changes in circadian rhythms across adolescence suggests biological process may contribute to this pattern, in addition to the social patterning of later bedtimes (Carskadon, 1999, 2005; Crowley et al., 2007). Racial differences in sleep duration documented in this study are consistent with other studies and may reflect a variety of environmental conditions that require further investigation (Moore et al., 2011; Smaldone et al., 2007).

Our study has several limitations. Data comes from a sample of urban youth residing in a densely populated, segregated city. Our sample of students attending public high schools in Boston, a school system of mainly low-income students, truncated our sample's socioeconomic range. Notably, those absent from school were not represented. Even though data used in this analysis came from Boston adolescents in 2008–09, it is likely that the impact of family context remains a strong predictor of sleep duration now, approximately ten years later, although more recent data would be needed to formally investigate this. Further, a causal relationship between neighborhood-level and family contextual variables with sleep duration cannot be established as data were cross-sectional. We relied on students' self-report of sleep duration and family context. Finally, we lack data on students' family socioeconomic status and were unable to adjust for this factor.

Despite these limitations, a major strength is the large, multi-level design permitting examination the joint effects of neighborhood, individual and family predictors of sleep. We incorporated data from multiple sources, including Census data and Police reports. Neighborhood characteristic variables were derived from adults, providing independent

reports of collective efficacy and disorder. Information on sleep duration and family context was obtained from adolescents, which strengthens our work (compared with parental reports). Furthermore, we imputed missing data in the youth survey to attenuate risk for potential bias related to survey completion.

Our findings focusing on family context represent potentially modifiable practices, most notably family dinners at least one or two times per week as well as expressions of parental support, such as being understanding, being available to talk about problems, and telling youth they are loved. Primary care providers and nurses may want to incorporate these findings into their health education and counselling of families with young children. Further, these findings are important for educators and public health advocates working to lower sleep deprivation in youth and can easily translate into a campaign for improved youth health.

To our knowledge, this is one of few studies examining the joint effects of neighborhood level and family factors on sleep duration in youth. We encourage research in this area to understand the association of contextual characteristics and sleep duration among adolescents. Longitudinal studies are needed to investigate the causal relationship between neighborhood and family characteristics with sleep. More socioeconomically diverse samples may afford researchers the opportunity to explore these associations further.

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Appendix Table.: Description of study measures

Measure	Description	Scale or Items	Source
Sleep Duration	Hours of sleep per school night	Derived hours based on closest hour and minutes for typical bedtime on a school night and typical wake up time on a school morning; Sleep Timing Questionnaire	BYS
Neighborhood-level Concentrated Poverty	Combined neighborhood poverty level index score	Percent of persons living below the federal poverty line, Percent of residents 516 years or older unemployed, and 3) percent of households on public assistance; Principle component analysis used to create index score	ACS

Measure	Description	Scale or Items	Source
Neighborhood Violent Crime Rate	Neighborhood count of crimes	Count data for 2008 of robberies, aggravated assaults, and homicides	Boston Police Dept.
Neighborhood Disorder	Neighborhood physical and social disorder	6-items reporting about aspects of physical or social disorder; response options included not a problem, kind of a problem, a big problem; neighborhood-specific mean scores derived	BNS
Collective Efficacy: Social Cohesion and Control	Neighborhood cohesion and informal social control	10-item scale of collective efficacy (Sampson et al., 1997); neighborhood-specific mean scores derived	BNS
Hours of Homework	Daily average hours of homework	Average number of hours spent on homework per day (1 hour, >1–3 hours, >3 hours)	BYS
Positive Peer Influence	Presence of positive peer influences	Reported agreement for the following items: my friends stay out of trouble, my friends follow parent rules, and my friends do well in school; derived percentiles based on responses	BYS
Positive Parent/Guardian Influence	Presence of positive parent/guardian influences	Reported agreement for the following items: an adult in my household tries to understand my point of view, tells me that he/she loves me and/or wants good things for me, and is available for me to talk with about my problems; derived percentiles based on responses	BYS
Frequency of Family Dinner	Weekly average family dinner	Frequency of dinner with family per week (none, 1–2 times, 3–4 times, 5+ times)	BYS

BYS = Boston Youth Survey; ACS = American Community Survey Census; BNS = Boston Neighborhood Survey

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Table 1.

Sleep Duration by Individual and Family Contextual Factors Predictors, Boston Youth Survey, 2008
(N=1614)^a

	n (%)	Sleep time (hours) Mean (SE)	p-value
Full Sample	1614(100)	6.79 (1.30)	
Sex			
Male	739 (45.8)	6.78 (0.07)	0.83
Female	875 (54.2)	6.80 (0.07)	Ref
Age			
15	135 (8.4)	7.16 (0.14)	<0.001
>15 and <=16	315 (19.5)	6.83 (0.12)	0.05
>16 and <=17	436 (27.0)	6.89 (0.11)	0.01
>17 and <= 18	425 (26.3)	6.71 (0.10)	0.30
18	303 (18.8)	6.60 (0.09)	Ref
Race/Ethnicity			
White, non-Hispanic	144 (8.9)	7.16 (0.13)	Ref
Black, non-Hispanic	691 (42.8)	6.75 (0.14)	0.004
Hispanic	535 (33.1)	6.82 (0.14)	0.01
Asian	130 (8.1)	6.75 (0.17)	0.07
Other	114 (7.1)	6.53 (0.19)	0.001
Time spent on homework daily			
1 hour	745 (46.2)	6.74 (0.07)	Ref
>1–3 hours	690 (42.8)	6.96 (0.07)	0.001
>3 hours	179 (11.1)	6.41 (0.11)	0.01
Positive parent influence (percentile)			
0–25 th	526 (32.6)	6.68 (0.09)	0.0003
26–50 th	468 (29.0)	6.76 (0.10)	0.02
51–75 th	295 (18.3)	6.84 (0.11)	0.13
76–100 th	325 (20.1)	7.01 (0.09)	Ref
Positive peer influence (percentile)			
0–25 th	478 (29.6)	6.67 (0.09)	0.44
26–50 th	306 (19.0)	6.79 (0.13)	0.70
51–75 th	475 (29.4)	6.97 (0.10)	0.02
76–100 th	355 (22.0)	6.75 (0.09)	Ref
Frequency of Family Dinners			
None	590 (36.6)	6.61 (0.96)	0.001
1–2	451 (27.9)	6.85 (0.11)	0.50
3–4	211 (13.1)	7.02 (0.12)	0.43
5+	362 (22.4)	6.92 (0.90)	Ref

^a Data was imputed using IVEware. Bivariate analysis adjusted for school level clusters using SAS 9.3, ProcMixed. SE=standard error. Ref=reference.

Table 2.

Neighborhood Cluster-level Characteristics, Boston Neighborhood Survey (BNS), 2008 (N=38)

	N	Mean	Median	Min	Max	SD
Physical and social disorder	38	2.86	2.83	2.06	3.98	0.47
Social cohesion and control	38	3.70	3.66	3.20	4.11	0.23
% below poverty line	38	20.70	21.16	5.12	54.66	9.85
% employed ^a	38	88.54	89.93	77.95	97.02	4.69
% of households on public assistance	38	6.45	5.34	0.17	18.61	4.25
Violent crime (count, 2008 data)	38	191.77	145.00	45.00	386.00	107.68

^aReflects employment among individuals ages 16 and older.

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Table 3.

Multi-level Multivariable Parameter Estimates (SE) between Neighborhood Factors (controlling for individual factors) and Sleep Duration in Boston Youth Survey/Boston Neighborhood Survey, 2008 (n=1614)^a

Neighborhood Predictors	Model 1	Model 2	Model 3	Model 4
Concentrated Poverty	0.09 (0.04)	0.10 (0.07)	0.07 (0.04)	0.06 (0.04)
Collective Efficacy		0.07 (0.30)		
Social and Physical Disorder			0.08 (0.09)	
Violent Crime (percentile)				
0–25 th				–0.11 (0.12)
26–50 th				–0.01 (0.12)
51–75 th				0.05 (0.12)
76–100 th				Ref

^a Separate models were created for neighborhood factors, adjusted for neighborhood level concentrated poverty and age, race and ethnicity.

Collective efficacy was highly correlated with concentrated poverty; therefore we tested it without concentrated poverty in a separate model not shown (parameter estimate –0.26 (SE=0.18, p>.05).

Statistically significant differences (p<.05) are in **bold**. All models were adjusted for neighborhood and school level clustering using SAS 9.3, Proc Mixed. Ref=reference.

Table 4.

Multi-level Parameter Estimates (SE) of Sleep Duration (hours) by Demographics, Peers, Hours of Homework and Family Context in Boston Neighborhood Survey / Boston Youth Survey, 2008 (n=1614)

	Model 1	Model 2	Model 3	Model 4
Sex				
Male	-0.04(0.07)	-0.05(0.07)	-0.06(0.07)	-0.05(0.06)
Female	Ref	Ref	Ref	Ref
Age				
15	0.53(0.14)	0.53(0.14)	0.50(0.14)	0.51(0.13)
>15 and <=16	0.21(0.12)	0.23(0.12)	0.20(0.12)	0.20 (0.11)
>16 and<=17	0.28(0.11)	0.29(0.12)	0.28(0.12)	0.29(0.11)
>17 and <= 18	0.08(0.10)	0.09(0.10)	0.07(0.10)	0.07(0.10)
18	Ref	Ref	Ref	Ref
Race/Ethnicity				
White, non-Hispanic	Ref	Ref	Ref	Ref
Black, non-Hispanic	-0.39(0.13)	-0.37(0.13)	-0.31(0.13)	-0.40(0.13)
Hispanic	-0.35(0.14)	-0.32(0.13)	-0.28(0.13)	-0.34(0.13)
Asian	-0.35(0.17)	-0.28(0.18)	-0.21(0.17)	-0.23(0.17)
Other	-0.65(0.19)	-0.61(0.19)	-0.54(0.19)	-0.61(0.19)
Time on homework daily				
1 hour		Ref	Ref	Ref
>1-3 hours		0.20 (0.07)	0.17(0.07)	0.17(0.07)
>3 hours		-0.34 (0.12)	-0.37(0.12)	-0.36(0.12)
Positive peer influence				
0-25 th percentile		-0.13(0.10)		
26-50 th percentile		-0.01(0.13)		
51-75 th percentile		0.18(0.10)		
76-100 th percentile		Ref		
Positive parental influence				
0-25 th percentile			-0.25(0.09)	-0.26(0.09)
26-50 th percentile			-0.24(0.11)	-0.24(0.11)
51-75 th percentile			-0.17(0.11)	-0.17(0.11)
76-100 th percentile			Ref	Ref
Freq. of Family Dinners				
None			-0.22(0.11)	-0.22(0.11)
1-2			-0.02(0.12)	-0.02(0.12)
3-4			0.09(0.12)	0.09(0.12)
5+			Ref	Ref
Neighborhood Concentrated Poverty^a				0.10(0.04)

Data was imputed using IVEware.

^aNeighborhood concentrated poverty index ranged from 2.7 to -1.7. **Bold** indicates significant p<0.05. Ref=reference.