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Objective and Subjective Socioeconomic Gradients Exist for Sleep in Children and Adolescents

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Abstract

Objective—Socioeconomic position (SEP) is inversely associated with many health outcomes, yielding a socioeconomic gradient in health. In adults, low SEP is associated with short sleep duration, poorer sleep quality, and difficulty initiating and maintaining sleep. Relatively little is known about this relation in youth. The aim of the present study was to examine whether socioeconomic gradients exist for various sleep indices among a healthy sample of children and adolescents.

Method—Participants took part in the larger Healthy Heart Project and included 239 youth (69.6% Caucasian; 45.6% female), aged 8–17 years (M =12.6, SD =1.9). Parental income and education were used to measure objective SEP. The Subjective Social Status Scale-Youth Version was used to measure subjective SEP. Sleep duration, sleep quality, daytime sleepiness, and sleep disturbances were assessed through self- and parent-report.

Results—In children, objective SEP was related with sleep duration (β =.35, p <.01), although subjective SEP was related with daytime sleepiness (β_{avg} =.33, p <.01) and parent-reported sleep duration (β =.23, p <.05). In adolescents, subjective SEPwas related with sleep quality (β =.28, p <.01) and parent-reported sleep duration (β = −.18, p <.05), even after controlling for objective SEP.

Conclusions—Socioeconomic gradients were observed for multiple sleep measures in youth. Objective parental SEP was related with sleep complaints (e.g., sleep disturbances), and subjective SEP was related with sleep quality and daytime sleepiness. Findings suggest sleep may be one pathway underlying the socioeconomic gradient in health. Future research should aim to elucidate how distinct sleep constructs may explain how socioeconomic status “gets under the skin” to affect health.

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Keywords

socioeconomic position; sleep duration; sleep quality; daytime sleepiness; sleep disturbances

A relation between socioeconomic position (SEP) and health outcomes has been repeatedly observed. Socioeconomic inequalities exist for physical and mental health conditions in adults and youth, even after controlling for behavioral risk factors (Adler, Epel, Castellazzo, & Ickovics, 2000; Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007). Extant literature suggests the graded, inverse relation between SEP and health can be found across all SEP levels (Adler et al., 2000), yet the mechanisms underlying this relation are not fully elucidated. Sleep has been posited as a mediator to explain how SEP may "get under the skin" to affect health, as sleep adversely influences key physiological processes (e.g., insulin; Van Cauter & Spiegel, 1999).

Most studies examining the relation between sleep and SEP use objective indices of SEP, which assess tangible aspects of social status (e.g., material resources). Evidence indicates a link between inadequate sleep and low objective SEP (assessed by income, education, or occupation). Individuals of lower SEP report shorter sleep duration, poorer sleep quality, longer sleep latency, more daytime sleepiness, and weekend oversleep (Jarrin, McGrath, Silverstein, & Drake, 2013). Previous research suggests that *subjective* perception of status within the social hierarchy is independently related to overall health (Singh-Manoux, Marmot, & Adler, 2005). Subjective SEP reflects one's relative (vs. absolute) position in the social hierarchy, which affects health through psychological, physiological, and behavioral mechanisms. Subjective SEP may more fully and accurately reflect one's social status due to its multidimensional nature and nuanced synthesis of multiple tangible resources and future prospects (Singh-Manoux et al., 2005).

Low subjective SEP is linked with multiple physical and mental health outcomes (Adler et al., 2000; Goodman et al., 2001). In adults, low subjective SEP has been linked with nonoptimal sleep duration, poor sleep quality, daytime sleepiness, and irregular sleep habits, after adjusting for objective SEP (Goodin, McGruire, & Smith, 2010; Jarrin et al., 2013). In youth, subjective SEP is related to physical and mental health (Goodman et al., 2001; Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007).

Objective indices of parental SEP are linked with sleep in pediatric samples. Shorter and poorer sleep, measured by self- or parent-report, actigraphy, or polysomnography, are linked with lower household income and parent education in children and adolescents (Kelly & El-Sheikh, 2011; Moore et al., 2011). Youth with lower parental SEP report more sleep disturbances (e.g., nocturnal awakenings) and daytime sleepiness (Kelly & El-Sheikh, 2011). Despite evidence of a socioeconomic gradient between objective SEP and poor pediatric sleep, to date no studies have considered the effects of *subjective* SEP on sleep in youth (Quon & McGrath, in press).

Given that pathophysiological trajectories begin early in life (Hanson & Chen, 2010) and because sleep is one putative pathway by which SEP "gets under the skin," the aim of the present study was to identify whether a subjective socioeconomic gradient exists for

pediatric sleep. Given that childhood is typified by parental SEP dependency and adolescence is typified as a phase into independency (Chen, Matthews, & Boyce, 2002), it was posited that subjective SEP would be more related to sleep than objective SEP in adolescents, and objective SEP would be more related to sleep in children. The relation between subjective SEP and sleep was explored in children.

Method

Participants and Measures

Youth recruited from schools and neighborhoods agreed to participate in the larger Healthy Heart Project at Concordia University, Montréal, Québec. Exclusion criteria included use of medications with cardiovascular effects or serious psychopathology. Parents and youth provided informed consent and assent, and were compensated for their time (Ethics approval #UH2005–077).

Sleep—*Sleep Quality:* Youth rated their overall sleep quality on a 10-point scale. This question measures perception about feeling rested upon awakening, even in children as young as 8 years (Guerin et al., 1993). *Daytime Sleepiness*: The Pediatric Daytime Sleepiness Scale (Drake et al., 2003) is an 8-item self-report scale on the frequency of feeling sleepy during the day (e.g., “while doing homework”). This scale has been used in youth as young as 8 years and has good internal consistency (Cronbach’s alpha =.81; Present study: children α =.74; adolescents α =.77). *Sleep Disturbances:* Parents completed the Children’s Sleep Habits Questionnaire, rating the frequency of 43 common child sleep problems over the past week (e.g., “wakes more than once per night”; Owens, Spirito, & McGuinn, 2000). The scale has been previously used in youth aged 4 to 16 years, with demonstrated psychometric properties (Present study: children α =.77, adolescents α =.72). *Sleep Duration:* Youth and parents reported bed- and wake-time on school nights over the past month. Sleep duration was the difference between bed- and wake-time. Subjective reports have been used in youth as young as 7 years and have moderate validity with actigraphy (r =.53; Wolfson & Carskadon, 1998).

Socioeconomic position (SEP)—*Objective SEP:* Parents reported household income (17 categories: ≤*$10,000* to ≥*$200,000*) and highest education (nine categories: *No formal schooling* to *Doctorate*). Years of schooling were derived for each education category. The median value for each category was used ordinally (Diez Roux et al., 2001). *Subjective SEP:* The Subjective Social Status Scale-Youth Version (Goodman et al., 2001) consists of two 10-rung ladders: school and society. For the each ladder, youth placed an X on the rung best representing their rank relative to the reference group (society adapted for “Canada”). Originally designed for youth aged ≥12, the scale has been validated in pre-adolescent children aged 8 to 12 years (Quon & McGrath, 2013).

Covariates—*Body Mass Index (BMI):* Anthropometrics were measured by research assistants following standard procedures. Age-and sex-specific BMI Z-scores were determined using CDC growth charts (Ogden et al., 2002). *Pubertal Status:* Youth selected sex-specific illustrations corresponding to Tanner stages on the validated Growing and

Changing Questionnaire (Golding, Pembrey, & Jones, 2001). These illustrations are reliable and valid with physician examination (r =.77; Morris & Udry, 1980). *Anxiety/Depression:* Anxious/depressed and withdrawn/depressed subscales of the Child Behavior Checklist (Achenbach & Rescorla, 2001) were used to screen youth for anxiety and depression. These subscales show moderate to good construct validity, test–retest reliability, and internal consistency (r_{avg} =.57, r_{avg} =.85, α_{avg} = .82, respectively; Achenbach & Rescorla, 2001).

Statistical Analysis

Data were analyzed with SPSS Version 20 (Chicago, IL). To account for developmental milestones and school transitions (e.g., school start time), analyses were stratified by school-level (Primary Grade 3–6, "children"; Secondary Grade 7–11, "adolescents"). Collinearity diagnostics indicated potential for multicollinearity for subjective SEP indices; thus, they were analyzed separately.

Results

Participants (N =239) aged 8–17 years included children (n =92; M_{age}=10.6 years, range 8–13 years, SD =0.9; 38.0% female) and adolescents (n =147; M_{age} =13.9 years, range 11–17 years, SD =1.3; 50.3% female). The sample was mostly Cauca-sian (69.6%, Black 10.5%, Asian 8.4%, Latino 5.1%, Other/mixed 6.3%) and normal body mass ($M_{BMI\%ile}$ = 63.1%ile, SD =26.8). Adolescents had advanced pubertal development (p <.001), shorter sleep duration by self- (p <.001) and parent-report (p <.001), and poorer sleep quality (p <.001) than children. Children and adolescents did not differ on daytime sleepiness or sleep disturbances. Similar anxiety (5.9% clinical) and depression (2.9% clinical) symptoms and obesity (9.2%) and overweight (19%) rates were observed. Parents were mostly mothers (84.1%), aged 45 years (SD =6.27), who were married (66.8%), university educated (15.7 years, SD =3.0), and reported income of $79.2k CAN ($SD$ =52.8). Subjective SEP ratings were normally distributed for both ladders. Children and adolescents' subjective SEP rankings were similarly correlated across the two ladders (r =.51, .39, respectively) and with the society (education r =.15, .13; income r =.13, .27) and the school ladder (education r =.08, .07; income r =.11, .03).

To test the hypothesis that objective and subjective SEP would be inversely related to sleep, univariate regression analyses were conducted (see Table 1). In children, both subjective ladders were related to daytime sleepiness (R^2_{avg}=.12) and school ladder was related with parent-reported sleep duration (R^2 =.06); income was related to self- and parent-reported sleep duration (R^2 =.09, .05); education was related to sleep quality and parent-reported sleep duration (R^2 =.05, .07). In adolescents, school ladder was related to sleep quality (R^2 =.07); income was related to sleep disturbances (R^2 =.04).

Separate multivariate regression analyses were tested for each ladder while controlling for age, sex, ethnicity, BMI, puberty, anxiety, depression, and both objective SEP measures. In children, both SEP ladders were related to daytime sleepiness (R^2_{avg}=.24) and society ladder was related with parent-reported sleep duration (R^2 =.24); income was related to self-report sleep duration (R^2_{avg}=.26). In adolescents, school ladder was related to sleep quality

(R^2 =.26) and with parent-reported sleep duration (R^2 =.10); income was related to sleep disturbances ($R^2_{\text{avg}}=0.16$).

Discussion

The present study examined subjective and objective socioeconomic gradients for sleep in youth. Our hypothesis that subjective SEP would be more strongly related with sleep than objective SEP in adolescents was partly supported for certain sleep indices. Specifically, the school SEP ladder was more closely related to sleep quality and parent-reported sleep duration, and objective SEP was strongly related with parent-reported sleep disturbances. Our hypothesis that objective SEP would predict sleep better in children than in adolescents was also partly supported. In children, objective SEP was related to self-report sleep duration and subjective SEP was related with daytime sleepiness and parent-reported sleep duration, adjusting for objective SEP.

To the best of our knowledge, this is the first study to assess the association between subjective SEP with sleep in youth. Adult literature demonstrates that low subjective SEP is related with sleep duration, latency, quality, and daytime sleepiness (Adler et al., 2000; Goodin et al., 2010; Jarrin et al., 2013). Present findings coincide with adult findings for subjective SEP gradients for sleep quality, daytime sleepiness, and sleep duration. Further, objective SEP was related with sleep disturbances and sleep duration, which is also consistent with past research (Kelly & El-Sheikh, 2011; Moore et al., 2011).

There are several possible mechanisms by which SEP may influence sleep. Low objective SEP households are often characterized as chaotic (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005), with fewer resources (e.g., child-care) and inadequate knowledge about sleep-promoting practices (e.g., sleep hygiene). Overcrowding and noise exposure may also impede optimal sleep in low SEP environments. Further, low subjective SEP may exacerbate the impact of other stressors that may increase presleep cognitions that prevent restful sleep (Harvey, 2011).

Changes in the relation between SEP and sleep measures in youth were observed. In children, objective SEP was linked with self-reported sleep duration and subjective SEP was related with daytime sleepiness and parent-reported sleep duration. In adolescents, objective SEP was related to parent-reported sleep disturbances and subjective SEP was related with sleep quality and parent-reported sleep duration. These age differences may be related to changes in sleep patterns: children typically obtain more sleep and have earlier bed-times and adolescents typically show delayed sleep patterns associated with pubertal and circadian rhythm changes (Wolfson & Carskadon, 1998). Alternatively, results may be related to differential effects of SEP on health across childhood and adolescence (Chen et al., 2002). Children may be more affected by parenting and environmental factors linked with low objective SEP and adolescents, who are transitioning toward independence, may be more influenced by psychosocial factors tied to low subjective SEP (Chen et al., 2002).

The present study is a timely, initial step in examining subjective socioeconomic gradients for sleep in youth. Sleep has been posited as a potential mechanism by which SEP “gets

under the skin" to affect health (Van Cauter & Spiegel, 1999). Sleep quality mediates the relation between objective SEP and allostatic load in adults (Hawkley, Lavelle, Berntson, & Cacioppo, 2011). Inadequate sleep has been linked to adverse health outcomes in youth (e.g., mood disorders; Harvey, 2011). Further, lifestyle habits established in childhood (e.g., poor sleep hygiene) may track into adulthood.

Some limitations of the study include the cross-sectional design, which precludes identifying the causal direction between SEP and sleep. Although subjective SEP may affect sleep, disturbed sleep may also affect interpretation of situations via emotional dysregulation (Matthews et al., 2000). There are also other variables that may affect both SEP and sleep (e.g., perceived stress, health; Chen et al., 2002). Although subjective sleep measures have established reliability and validity, the relation between subjective SEP and subjective sleep is subject to mono-informant bias. Negative affect is a potential third variable but research suggests it does not confound the relation between subjective SEP and health in adults (Kraus, Adler, & Chen, 2013). Finally, examining subjective SEP in children (< 12 years) is exploratory, as measures have not yet been validated.

Future studies should consider longitudinal designs with repeated assessments of objective and subjective SEP and sleep indices to identify the nature and direction of the SEP-sleep relation. The influence of mediating or moderating variables (e.g., behavioral) should also be considered. The present study provides new knowledge on the relation of objective and subjective SEP with sleep, highlights the differential relation between SEP across the developmental transition from childhood to adolescence, and may inform targeted programs that promote overall sleep hygiene, especially among vulnerable, low SEP populations.

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Table 1

Univariate and Multivariate Regression Analyses for Children and Adolescents: Standardized Beta Coefficients and Exact p-Values

				Sleep duration	
	Sleep quality β (*p*)	**Daytime sleepiness β (*p*)**	**Sleep disturbances β (*p*)**	**Self-report β (*p*)**	**Parent-report β (*p*)**
			Children (n = 88)		
Univariate					
School ladder	0.10 (.353)	−0.32 ** (002)	−0.06 (.550)	−0.20 † (.058)	0.02 (.860)
Society ladder	0.14 (.174)	−0.38 *** (.000)	−0.07 (.513)	−0.08 (.444)	0.25 * (.015)
Household income	0.17 (.110)	−0.14 (.189)	−0.17 (.120)	0.29 ** (.005)	0.22 * (.033)
Parental education	0.22 * (.038)	−0.16 (.120)	0.04 (.714)	0.06 (.568)	0.25 * (.015)
Multivariate					
School ladder	0.18 (.125)	−0.32 ** (.005)	−0.01 (.916)	−0.16 (.138)	0.02 (.876)
Household income	0.06 (.626)	−0.09 (.441)	−0.22 † (.063)	0.35 ** (.002)	0.17 (.143)
Parental education	0.16 (.173)	−0.11 (.333)	0.09 (.417)	−0.11 (.319)	0.12 (.283)
Society ladder	0.15 (.173)	−0.33 ** (.002)	−0.09 (.425)	−0.10 (.347)	0.23 * (.031)
Household income	0.06 (.627)	−0.08 (.478)	−0.21 † (.075)	0.35 ** (.002)	0.14 (.210)
Parental education	0.16 (.195)	−0.09 (.412)	0.10 (.389)	−0.11 (.340)	0.11 (.336)
			Adolescents (n = 141)		
Univariate					
School ladder	0.27 ** (.001)	−0.09 (.255)	0.04 (.621)	0.07 (.418)	−0.15 † (.078)
Society ladder	0.15 † (.067)	−0.11 (.195)	−0.09 (.298)	0.09 (.295)	−0.09 (.306)
Household income	0.11 (.201)	−0.10 (.216)	−0.19 * (.027)	0.05 (.538)	0.10 (.246)
Parental education	0.10 (.219)	−0.11 (.184)	0.02 (.983)	−0.10 (.254)	0.13 (.133)
Multivariate					
School ladder	0.28 ** (.001)	−0.10 (.246)	0.05 (.512)	0.06 (.463)	−0.18 * (.037)
Household income	0.05 (.563)	−0.05 (.563)	−0.22 ** (.017)	0.08 (.407)	0.06 (.519)
Parental education	0.04 (.689)	−0.08 (.396)	0.10 (.232)	−0.15 (.091)	0.10 (.262)
Society ladder	0.15 (.097)	−0.06 (.502)	−0.03 (.735)	0.08 (.341)	−0.08 (.355)
Household income	0.02 (.831)	−0.04 (.674)	−0.21 * (.028)	0.06 (.558)	0.08 (.440)
Parental education	0.03 (.714)	−0.08 (.404)	0.11 (.230)	−0.16 (.085)	0.10 (.261)
Higher scores indicate:	Better quality	More sleepiness	More disturbances	Longer duration	Longer duration

Note. β = standardized beta coefficient. p = exact two-tailed p value. Univariate models include each SEP variable listed singularly. Multivariate models include all three SEP variables listed, as well as sex, age, BMI, puberty, ethnicity, anxiety, and depression as continuous covariates.

$^{\dagger}p < .08$.

$^{*}p < .05$.

$^{**}p < .01$.

$^{***}p < .001$.