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Material hardship and sleep: results from the Michigan Recession and Recovery Study

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ABSTRACT

Objective: Sleep is unequally distributed in the US population. People with low socioeconomic status report worse quality and shorter sleep than people with high socioeconomic status. Past research hypothesized that a potential reason for this link could be exposure to material hardship. This study examines the associations between several material hardships and sleep outcomes.

Methods: We use population-representative cross-sectional data (n = 730) from the Michigan Recession and Recovery Study collected in 2013 and examine the associations between 6 indicators of material hardship (employment instability, financial problems, housing instability, food insecurity, forgone medical care, and the total number of material hardships reported) and 3 sleep outcomes (short sleep, sleep problems, and nonrestorative sleep). We build multivariable logistic regression models controlling for respondents' characteristics and light pollution near their residence.

Results: In unadjusted models, all material hardships were associated with negative sleep outcomes. In adjusted models, forgone medical care was a statistically significant predictor of nonrestorative sleep (average marginal effect 0.16), as was employment instability (average marginal effect 0.12). The probability of sleep problems and nonrestorative sleep increased with a greater number of hardships overall (average marginal effects of .02 and .05, respectively). We found marginally statistically significant positive associations between food insecurity and short sleep and sleep problems.

Conclusions: This study finds that, except when considering foregone medical care, employment instability, and total count of material hardships, associations between material hardship and negative sleep outcomes are not statistically significant after adjusting for a robust set of sociodemographic and health characteristics.

Introduction

Inadequate sleep has been linked to multiple negative health outcomes, including an increased risk of diabetes, cardiovascular disease, mental health disorders, and mortality.[8] Poor sleep is not equally distributed in the US population; those of lower socioeconomic status (SES) are more likely to report suboptimal sleep duration and worse sleep quality[9,14] and are therefore more likely to suffer their negative health consequences. However, relatively little is known about the causes of the observed SES disparity in sleep.[16] This study builds on the neomaterial theoretical tradition in social epidemiology, focusing on the pathways between SES and adverse health outcomes.[20,21] We hypothesize that low SES is linked to poor sleep outcomes through material hardships, such as hunger, housing insecurity, and lack of needed medical care, which translates to physical and psychological barriers to sleep.

Material hardship may erect physical as well as physiological barriers to optimal sleep duration and quality. The preceding literature has addressed 2 specific material hardships and their relationship to sleep: food insecurity and housing instability. Food insecurity, the better documented of the two, has been linked to poor sleep outcomes in several studies. Research based on nationally representative population surveys in the United States and Mexico has found that the food insecure were more likely to report insufficient or short sleep and that this association was not explained by their sociodemographic characteristics.[5,12,19] Researchers have speculated that this association could be due to the negative effect of food insecurity on mental health or by a lack of nutrients such as vitamin B-12 or folic acid, which can alter mood and impair immunity, although these explanatory pathways have not been tested directly.[5]

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Unstable or inadequate housing could similarly jeopardize sleep quantity and duration by preventing people from finding sleeping quarters shielded from excessive heat or cold, light, noise, and danger. In a study of a population sample of US adults, Liu et al[19] found housing insecurity, defined as worry about affording rent or mortgage, to be associated with frequent insufficient sleep. Homelessness, the most extreme form of housing instability, typically means a frequent change in sleeping arrangements and the absence of a private and secure sleeping area. A recent study of homeless US adults found that, during the previous month, they experienced inadequate sleep on 13 nights and unintentionally falling asleep on 5 days on average.[27]

Most past studies have not been able to differentiate between different types of material hardships and thus could not speak to the specific pathways through which low economic resources could potentially translate to negative sleep outcomes. Often, they have relied on general combined measures of financial and material difficulties, which combine multiple heterogeneous indicators. For example, Perales and Plage[25] found an association between material hardship and shorter sleep in a population sample of Australian adults. In another study using a population sample of US midlife women, difficulty "making ends meet" was linked to restless sleep but not sleep difficulties.[10]

In addition to creating physical obstacles to sleep, material hardship could stimulate psychological distress, which may also contribute to poor sleep outcomes. Material hardship has been shown to be associated with depression[11,22] and other mood and anxiety disorders, independently of SES.[13] Depression, worry, and rumination have all been linked to bedtime agitation, insomnia, or delayed sleep onset.[3,32,33] However, researchers who examined the material hardship–psychological distress pathway directly have found that it mediates but does not fully explain the association between material hardship and poor sleep outcomes.[19] Taken together, past evidence suggests a complex combination of physiological and psychological elements underlying the relationship between material hardship and sleep outcomes.

Our study builds on the emerging material hardship and sleep literature. We argue that a more complete understanding of their connection requires a deeper examination of not only the outcome, sleep, but also of material hardship: its various types and how their differing natures may relate to sleep outcomes. Such a deeper examination will advance our theoretical grasp of the relationship, as well as inform interventions to improve the sleep outcomes of low-SES populations. We supply some of the missing pieces of the link between sleep and material hardship by analyzing the relationship between sleep and 6 separate indicators of material hardship: employment instability, financial problems, housing instability, food insecurity, forgone medical care, and total number of material hardships in a population-representative sample of working-age adults living in Southeast Michigan. We ask 2 research questions: First, are material hardships associated with short sleep, sleep problems, and nonrestorative sleep? Second, do the associations between poor sleep outcomes and material hardships persist after accounting for a robust set of sociodemographic, health, and environmental factors? Our results complicate the conclusions drawn from prior research and show that many associations between material hardship and poor sleep outcomes are not statistically significant after adjusting for a robust set of sociodemographic and health characteristics.

Data and methods

Data

The Michigan Recession and Recovery Study is a population survey of a stratified random sample of adults aged 19-64 living in the Detroit metropolitan area (Macomb, Oakland, and Wayne counties). The first wave of interviews was conducted from October 2009 to April 2010 (n = 914), the second from April to August of 2011 (n = 847), and the third and final wave was conducted from June to October of 2013 (n = 751). We relied on data collected in the third wave of the Michigan Recession and Recovery Study. Although Wave 3 has fewer observations than the preceding waves, respondents in Wave 3 were asked a more extensive set of questions about their sleep quantity and quality. Wave 3 also has the most accurate measurement of light pollution because nighttime light conditions in this wave are approximated by the earliest suitable data from the Visible Infrared Imaging Radiometer Suite (VIIRS). The VIIRS instrument records nighttime satellite imagery of greater resolution and dynamic range than other sources. It is able to capture variation in the nighttime light conditions of densely populated urban areas, which was not previously possible.[23]

Approximately 15% respondents did not respond to 1 or more questions required to construct our analytic variables. We performed multiple imputation using Stata -ice- imputation routine[28] and created 20 additional datasets with imputed responses for all respondents. After imputation, we constructed an analytic sample that excluded 18 respondents who moved out of the original sampling area and therefore did not have valid local light pollution measures. We additionally excluded from our final analytic sample 3 respondents who did not respond to questions about their sleep duration or quality. Our total analytic sample was therefore comprised of 730 respondents. All measures were constructed based on the Wave 3 data collection except for sex and race, which were collected at baseline.

Measures

Sleep outcomes

We constructed 3 sleep measures: short sleep, sleep problems, and nonrestorative sleep. To measure sleep duration, participants were asked, "How much sleep do you get in a 24 hour period?" Those who reported less than 6 hours were classified as having short sleep (14%). Sleep problems were measured by the question "Over the last two weeks, how often have you been bothered by trouble falling asleep or sleeping too much?" Respondents could select from "None at all," "Several days," "More than half the days," or "Nearly every day." Those who responded "More than half the days" or "Nearly every day" were categorized as having sleep problems (17%). Nonrestorative sleep was measured by an item "How often do you feel unrested during the day, no matter how many hours of sleep you had?" Respondents could choose from "Never," "Rarely (once a month)," "Sometimes (2-4 times per month)," "Often (2-3 times per week)," or "Almost always (4 or more times per week). Those who responded "Often (2-3 times per week)" or "Almost always (4 or more times per week)" were classified as having nonrestorative sleep (38%).

Material hardship

We constructed 6 indicators of material hardship: employment instability, financial problems, housing instability, food insecurity, forgone medical care, and a combined measure which recorded the number of material hardships respondents experienced in total out of these 5. We classified respondents as having experienced employment instability if they were unemployed or temporarily laid off during the past 12 months, or if their work hours were shortened, their wages were reduced, or they were furloughed since the time of their last interview[i] (23%). Respondents who were not in the labor force at the time of their interview were assigned to a third category (33%).

[i] The average time between Wave 2 and Wave 3 interviews was approximately 27 months.

We classified financial problems as any of the following: being behind on utility payments (electricity, gas, or water and sewer), receiving a loan or cash advance from a payday lender or check casher, having a credit card cancelled, or filing for personal bankruptcy (27%). Housing instability was defined as any of the following: being behind on rent currently or at any time since their last interview, having moved because they could no longer afford their previous home, having moved in with others to share household expenses, being behind on their mortgage payments, in the process of foreclosure, having experienced a foreclosure within the last 12 months, or being recently evicted or homeless (14%).

Food insecurity was measured with the 6-item short form of the USDA Food Security Survey Module.[34] Respondents were asked questions such as "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?" and "In the last 12 months were you ever hungry but didn't eat because you couldn't afford enough food?" We dichotomized the variable as either food secure (answering affirmatively to 0 or 1 questions) or food insecure (answering affirmatively to 2 or more questions) (22%), as defined in the guide to measuring food security by the USDA.[31] Forgone medical care was measured with items asking respondents whether since their last interview they could not afford to see a doctor or dentist or had skipped or reduced doses of prescription medication to save money. We classified respondents who responded positively to any of these experiences as having forgone medical care (22%). Our final measure of material hardship recorded the total number of measured hardships for each individual, with a range from 0 to 5. More than half of our respondents (54%) reported experiencing 1 or more material hardships.

Table 1
Population-weighted sample characteristics stratified by sleep outcome

	Sample overall	Short sleep			Sleep problems			Nonrestorative sleep		
		Yes	No	*P* value	Yes	No	*P* value	Yes	No	*P* value
n	730	113	617		143	587		279	451	
Employment instability %										
Yes	22.6	15.6	23.7		29.1	21.2	*	30.3	17.9	**
No	44.6	41.2	45.2		33.1	47.0		39.2	47.9	
Not in labor force	32.8	43.2	31.1		37.8	31.8		30.5	34.2	
Financial problems %	27.0	45.0	24.2	***	47.8	22.7	***	34.0	22.8	*
Housing instability %	14.1	27.6	11.9	*	25.2	11.8	**	15.5	13.2	
Food insecurity %	21.9	42.1	18.7	**	45.7	17.0	***	34.0	14.6	***
Forgone medical care %	21.8	42.6	18.5	***	45.6	16.9	***	32.5	15.3	***
Mean number of hardships	1.07	1.73	0.97	**	1.93	0.90	***	1.46	0.84	***
[95% CI]	[0.95, 1.20]	[1.28, 2.17]	[.86, 1.08]		[1.59, 2.28]	[0.79, 1.00]		[1.23, 1.70]	[0.69, 0.99]	
Mean age	46.3	45.6	46.4		45.9	46.4		44.4	47.5	*
[95% CI]	[44.9, 47.7]	[40.4, 50.7]	[44.6, 48.2]		[42.5, 49.2]	[44.6, 48.1]		[42.4, 46.4]	[45.6, 49.3]	
Woman %	51.8	35.2	54.5	*	59.0	50.4		57.5	48.4	
Black %	25.0	35.4	23.3	*	30.6	23.8		21.6	27.0	
Married or cohabiting %	66.0	60.0	67.0		57.5	67.8	*	58.1	70.9	**
Children %										
No children	49.3	45.4	49.9		41.8	50.8		39.9	55.0	**
5 y old or less	19.8	23.8	19.2		15.6	20.7		21.8	18.7	
All children older than 5	30.9	30.8	30.9		42.5	28.5		38.3	26.4	
Education %										
Less than high school	7.0	7.1	7.0	†	10.8	6.2	*	6.0	7.6	*
HS or some college	61.7	76.2	59.3		67.3	60.5		67.3	58.3	
Bachelor's or more	31.3	16.6	33.7		21.9	33.3		26.7	34.1	
Mean household income	$77,483	$76,265	$77,679		$49,063	$83,362	***	$66,365	$84,232	**
[95% CI]	[$65,488, $89,477]	[$41,194, $111,337]	[$66,223, $89,135]		[$39,583, $58,542]	[$70,143, $96,582]		[$56,422, $76,307]	[$69,900, $98,563]	
Employment status %										
Employed	61.2	53.7	62.4		51.3	63.2		62.1	60.6	
Unemployed	6.0	3.1	6.5		10.9	5.0		7.4	5.2	
Not in labor force	32.8	43.2	31.1		37.8	31.8		30.5	34.2	
Poor/fair self-rated health %	17.3	46.4	12.6	***	43.0	12.0	***	25.6	12.2	*
Obese (BMI ≥ 30) %	33.4	34.6	33.2		36.9	32.7		33.0	33.6	
Hazardous alcohol use %	9.3	9.9	9.2		16.9	7.7	†	13.4	6.8	*
Smokes cigarettes %	32.8	35.8	32.3		50.2	29.2	***	41.6	27.5	*
Depression %	10.5	27.3	7.8	***	44.0	3.5	***	21.0	4.1	***
Anxiety attack in last mo. %	9.9	18.2	8.6	†	36.5	4.4	***	20.9	3.2	***
Mean nighttime radiance	22.5	25.4	22.0		26.4	21.7	**	22.4	22.6	
[95% CI]	[18.0, 27.0]	[20.6, 30.1]	[17.3, 26.8]		[22.5, 30.2]	[17.0, 26.4]		[18.8, 26.0]	[17.4, 27.7]	

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Light pollution

Nighttime radiance, a measure of light pollution, could prevent optimal sleep, and living in a light polluted area may be correlated with material hardship. Suburban areas around Detroit are generally more affluent than the more densely populated and light polluted urban areas. People experiencing material hardship may be forced to opt for less desirable housing options near highways and other sources of light pollution. We therefore control for average nighttime radiance which captures the amount of light pollution in respondents' neighborhoods. Monthly radiance was calculated using satellite imagery from the VIIRS. Although there are other sources of nighttime satellite imagery, namely, the Defense Meteorological Satellite Program, those data are limited by low spatial resolution and low dynamic range.[6] In densely lit urban areas like Southeast Michigan, only the VIIRS data are able to capture spatial variations in light.[6] However, because of this sensitivity, the VIIRS instrument is vulnerable to stray light entering the satellite and distorting its radiance measurements.[24] Because stray-light–corrected monthly composites are only available from 2014 on, we used the radiance values from 2014 as proxies for light conditions during the third wave of interviews, conducted in 2013. Average monthly radiance, measured in nanowatts per steradian per square meter ($nW \cdot sr^{-1} \cdot m^{-2}$), was calculated at the census block level, and respondents were assigned the average radiance from the month in 2014 that corresponded to the month of their Wave 3 interview.

Other covariates

In multivariable models, we adjusted for sociodemographic, socioeconomic, and health characteristics that may be correlated with both sleep and material hardship, including age, sex, race (dichotomized as Black or non-Black), marital status (married/cohabiting or not), children in the household (having children 5 years old and younger, having children all older than 5, or having no children), education (less than high school, high school or some college, a bachelor's degree or more), log-transformed household income, employment status, self-rated health (dichotomized as poor/fair or good/very good/excellent), obesity (a body mass index [BMI] of 30 and above), smoking cigarettes, harmful or hazardous alcohol use (measured by the Alcohol Use Disorders Identification Test (AUDIT)[26]), an anxiety attack within the last 4 weeks, and depressive symptoms measured by the Patient Health Questionnaire-9 (PHQ-9). When scoring the PHQ-9, we excluded the third item which asked respondents about sleep problems. A score of 10 or more is often used to distinguish clinically significant symptoms in the full PHQ-9,[35] and we used the same cut-off in our analysis. Cut-offs at 8, 9, and 11 yielded results that were not substantively different.

Statistical analysis

We first examined bivariate relationships between each sleep outcome and all covariates. We then estimated logistic regression models to assess the relationship between each material hardship indicator and sleep outcome. After estimating unadjusted associations, control variables were added in blocks: beginning with sociodemographic controls (models "A"), then socioeconomic variables (models "B"), then health variables (models "C"), and finally light pollution (models "D"). The results of these logistic regression models are reported as average marginal effects (AMEs) to facilitate comparability across models. We applied survey weights to make our results representative of adults aged 19 to 64 from Southeastern Michigan and to account for attrition. All analyses were performed using Stata 15 with -mi- and -svy- commands that apply Rubin's rules to generate combined estimates from the 20 multiply imputed datasets.[29] We display AMEs of the main predictors in the tables included in the text. Full tables are included as an Appendix A.

Results

Sample characteristics

Table 1 presents weighted sample characteristics stratified by sleep outcomes. Those with short sleep were more likely to report financial problems, housing instability, food insecurity, forgone medical care, and a greater number of total hardships. Respondents with sleep problems were more likely to report financial problems, housing instability, food insecurity, forgone medical care, and a greater number of total hardships. Respondents who reported nonrestorative sleep were more likely to report employment instability, financial problems, food insecurity, forgone medical care, and a greater number of total hardships. Across outcomes, respondents reporting any sleep issues had lower education, worse self-rated health, and a greater share of them was classified as depressed.

Logistic regression models

Short sleep

Table 2 reports unadjusted AMEs capturing the association between the 6 material hardship variables and each sleep outcome. Financial problems, housing instability, food insecurity, forgone medical care, and a greater number of reported material hardships were associated with an increased probability of reporting short sleep. Although these associations persisted after adjusting for

Table 2
Unadjusted AMEs with 95% confidence intervals of material hardship on three sleep outcomes (n = 730)

	Short sleep	Sleep problems	Nonrestorative sleep
Employment instability (ref. no instability)			
Experienced employment instability	−0.032	0.094	0.176**
	[−0.081, 0.017]	[−0.032, 0.219]	[0.066, 0.285]
Not in labor force	0.055	0.070*	0.02
	[−0.043, 0.152]	[0.005, 0.136]	[−0.067, 0.106]
Financial problems	0.126**	0.180***	0.134*
	[0.044, 0.208]	[0.114, 0.246]	[0.031, 0.237]
Housing instability	0.155*	0.158**	0.044
	[0.001, 0.308]	[0.042, 0.274]	[−0.116, 0.204]
Food insecurity	0.164**	0.238***	0.266***
	[0.059, 0.268]	[0.155, 0.321]	[0.125, 0.407]
Forgone medical care	0.168**	0.238***	0.237***
	[0.060, 0.277]	[0.128, 0.348]	[0.132, 0.342]
Number of material hardships	0.044***	0.069***	0.082***
	[0.020, 0.068]	[0.051, 0.086]	[0.049, 0.114]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Table 3
Adjusted AMEs with 95% confidence intervals of material hardship on short sleep (n = 730)

	Short sleep			
	Models A	Models B	Models C	Models D
Employment instability (ref. no instability)				
Experienced hardship	−0.035	−0.046*	−0.069**	−0.071**
	[−0.083, 0.013]	[−0.084, −0.008]	[−0.117, −0.020]	[−0.119, −0.022]
Not in labor force	0.082†	0.064	−0.006	−0.007
	[−0.012, 0.176]	[−0.027, 0.156]	[−0.059, 0.046]	[−0.061, 0.047]
Financial problems	0.109*	0.098*	0.046	0.045
	[0.024, 0.194]	[0.022, 0.175]	[−0.031, 0.124]	[−0.029, 0.119]
Housing instability	0.135†	0.123*	0.051	0.050
	[−0.016, 0.286]	[0.008, 0.238]	[−0.031, 0.132]	[−0.030, 0.130]
Food insecurity	0.148*	0.127**	0.062	0.063
	[0.029, 0.267]	[0.037, 0.217]	[−0.020, 0.144]	[−0.022, 0.147]
Forgone medical care	0.144*	0.130*	0.059	0.058
	[0.036, 0.252]	[0.023, 0.237]	[−0.022, 0.139]	[−0.023, 0.139]
Number of hardships	0.040**	0.043**	0.019	0.018
	[0.011, 0.069]	[0.018, 0.068]	[−0.008, 0.046]	[−0.008, 0.045]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$
Four models were estimated for each material hardship measure, with control variables added in stages. The A models included controls for sociodemographic factors: age, sex, race, marital status, and children under 5 years old. The B models included further controls for socioeconomic status: education, household income, and employment status, except for models of employment instability where employment status was not included. The C models included further controls for health: poor or fair self-rated health, obesity, alcohol use, cigarette smoking, depression, and anxiety. The D models are fully adjusted models, which included a final control for light pollution. For all hardship measures, the difference between the AMEs in the C and D models is not statistically significant.

sociodemographic and socioeconomic controls (models A and B, Table 3), the inclusion of health and environmental variables fully attenuated the relationship between short sleep and all material hardship measures but employment instability (models D, Table 3). Employment instability was associated with 7–percentage point lower probability of short sleep. In supplementary sensitivity analysis, where we excluded respondents sleeping longer than 9 hours from the reference group, we found our results for short sleep to be substantively unchanged.

Sleep problems

Not being in the labor force, financial problems, housing instability, food insecurity, forgone medical care, and a greater number of total material hardships were all associated with a greater probability of reporting sleep problems in unadjusted models in Table 2. Although all the associations remained statistically significant after controlling for sociodemographic and socioeconomic factors (models A and B, Table 4), in the fully adjusted models, only the number of material hardships was statistically significant at conventional levels (models D, Table 4). Each additional material hardship was associated with a 2–percentage point greater probability of sleep problems. We also found a marginally statistically significant association between food insecurity and sleep problems, where food insecure people had approximately 7–percentage point greater probability of sleep problems. Depression was the only covariate statistically significantly associated with sleep problems across the fully adjusted models. In supplementary sensitivity analysis, we varied the cut-off for categorizing respondents as having sleep problems. With a less conservative coding of "several days" or more of sleep problems as opposed to "more than half the days" used in the main analysis, financial problems, food insecurity, forgone medical care, and the total number of material hardships were all statistically significant predictors of sleep problems in the fully adjusted models.

Table 4
Adjusted AMEs with 95% confidence intervals of material hardship on sleep problems (n = 730)

	Sleep problems			
	Models A	Models B	Models C	Models D
Employment instability (ref. no instability)				
Experienced hardship	0.078	0.031	−0.004	−0.002
	[−0.048, 0.205]	[−0.084, 0.146]	[−0.097, 0.090]	[−0.097, 0.093]
Not in labor force	0.077**	0.043†	−0.014	−0.013
	[0.022, 0.132]	[−0.008, 0.094]	[−0.081, 0.053]	[−0.080, 0.054]
Financial problems	0.180***	0.149***	0.040	0.043
	[0.103, 0.258]	[0.067, 0.232]	[−0.038, 0.118]	[−0.033, 0.119]
Housing instability	0.150**	0.122*	−0.004	−0.004
	[0.044, 0.257]	[0.025, 0.219]	[−0.057, 0.050]	[−0.057, 0.050]
Food insecurity	0.224***	0.196***	0.067†	0.066†
	[0.140, 0.308]	[0.122, 0.270]	[−0.002, 0.135]	[−0.001, 0.133]
Forgone medical care	0.234***	0.212***	0.081	0.082
	[0.122, 0.347]	[0.099, 0.324]	[−0.029, 0.191]	[−0.027, 0.191]
Number of hardships	0.072***	0.067***	0.022*	0.023*
	[0.050, 0.094]	[0.050, 0.083]	[0.001, 0.043]	[0.002, 0.044]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$
Four models were estimated for each material hardship measure, with control variables added in stages. The A models included controls for sociodemographic factors: age, sex, race, marital status, and children under 5 years old. The B models included further controls for socioeconomic status: education, household income, and employment status, except for models of employment instability where employment status was not included. The C models included further controls for health: poor or fair self-rated health, obesity, alcohol use, cigarette smoking, depression, and anxiety. The D models are fully adjusted models, which included a final control for light pollution. For all hardship measures, the difference between the AMEs in the C and D models is not statistically significant.

Table 5
Adjusted AMEs with 95% confidence intervals of material hardship on nonrestorative sleep (n = 730)

	Nonrestorative sleep			
	Models A	Models B	Models C	Models D
Employment instability (ref. no instability)				
Experienced hardship	0.164**	0.146*	0.126*	0.120*
	[0.052, 0.275]	[0.026, 0.265]	[0.013, 0.239]	[0.003, 0.237]
Not in labor force	0.053	0.042	−0.001	−0.005
	[−0.038, 0.144]	[−0.047, 0.131]	[−0.072, 0.070]	[−0.075, 0.065]
Financial problems	0.129*	0.097	0.016	0.009
	[0.027, 0.232]	[−0.025, 0.218]	[−0.105, 0.137]	[−0.106, 0.124]
Housing instability	0.036	0.027	−0.079	−0.076
	[−0.113, 0.185]	[−0.123, 0.176]	[−0.175, 0.017]	[−0.175, 0.023]
Food insecurity	0.253**	0.245**	0.147	0.151†
	[0.109, 0.396]	[0.099, 0.390]	[−0.033, 0.328]	[−0.029, 0.331]
Forgone medical care	0.230***	0.243***	0.159**	0.160**
	[0.130, 0.330]	[0.137, 0.348]	[0.057, 0.261]	[0.058, 0.263]
Number of hardships	0.083***	0.084**	0.049†	0.048*
	[0.048, 0.119]	[0.037, 0.131]	[−0.000, 0.098]	[0.000, 0.096]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Four models were estimated for each material hardship measure, with control variables added in stages. The A models included controls for sociodemographic factors: age, sex, race, marital status, and children under 5 years old. The B models included further controls for socioeconomic status: education, household income, and employment status, except for models of employment instability where employment status was not included. The C models included further controls for health: poor or fair self-rated health, obesity, alcohol use, cigarette smoking, depression, and anxiety. The D models are fully adjusted models, which included a final control for light pollution. For all hardship measures, the difference between the AMEs in the C and D models is not statistically significant.

Nonrestorative sleep

In unadjusted models (Table 2), we found statistically significant associations between nonrestorative sleep and employment instability, financial problems, food insecurity, forgone medical care, and a greater number of total material hardships. After adjusting for sociodemographic and socioeconomic variables (models A and B, Table 5), the relationship between nonrestorative sleep and financial problems was no longer statistically significant. In the fully adjusted models (models D, Table 5), food insecurity became marginally statistically significant with an AME of 0.15; employment instability, forgone medical care, and the number of material hardships remained statistically significant, each associated with a 12–, 16–, and 5–percentage point greater probability of nonrestorative sleep, respectively.

Discussion

Sleep is essential for a healthy life. Accordingly, one of the objectives of *Healthy People 2020*[30] is to increase the proportion of adults who obtain sufficient sleep. However, this key ingredient of health is not equitably distributed in the US population. People with low SES tend to enjoy fewer of the benefits of good sleep because they are less likely to obtain it.[14] One possible explanation for the observed SES disparity is material hardship, which might disrupt the sleep environment, cause stress or worry, and translate into sleeplessness. Prior scholarship in this field has focused on food insecurity and housing instability, both of which were found to be positively associated with poor sleep outcomes.[19] The present study adds to the emerging literature by examining the associations between multiple forms of material hardship and sleep while using a robust set of sociodemographic, SES, health, and environmental controls in a cross-sectional sample of working-age adults who lived in Southeast Michigan in 2013.

In contrast to past work, our results did not show strong evidence of associations between housing instability and sleep after adjusting for a wide range of sociodemographic and health characteristics and light pollution. Moreover, the associations between food insecurity and negative sleep outcomes were weaker than we anticipated based on past literature. Food insecurity was a marginally statistically significant predictor of sleep problems and nonrestorative sleep. In sensitivity analysis where we specified food insecurity as a continuous scale as opposed to using the USDA-recommended food insecurity threshold, we found food insecurity to be statistically significantly associated with short sleep (AME 0.02) but not with the 2 other negative sleep outcomes. The difference between our findings and the findings reported by prior studies may be attributed to our more extensive set of health and sociodemographic controls than were used in prior analysis. Our results suggest that the associations between housing instability, sleep insecurity, and negative sleep outcomes could be explained by other physical and mental health conditions. Thus, although these material hardships are correlated with worse sleep outcomes, the association may be accounted for by other negative changes in health linked to material hardship. Alternatively, poor health may be a cause of both material hardship and poor sleep. We encourage future research using larger datasets with longitudinal measurements of health, sleep, and material hardship to examine these potential mediating and confounding pathways.

In addition, we found that respondents who experienced employment instability were less likely than those with stable jobs to report short sleep but more likely to feel unrested during the day. This finding aligns with prior work showing that unemployed people sleep longer hours than their employed counterparts, likely because they have more free time available to devote to sleep.[2] We speculate that the nonrestorative nature of sleep reported by those with employment instability could be ascribed to stress,[18] but we are unable to test this directly because there is no stress measure available in our data.

Our study shows a previously undocumented link between forgone medical care and sleep quality. Forgone medical care, defined as not seeking professional medical attention when one feels it is needed or skipping doses of medication to save money, was associated with nonrestorative sleep. There are several mechanisms through which forgone medical care could contribute to poor sleep. Like other material hardships, it may operate through worry and anxiety. One may be kept up at night by concerns about not being able to access medical care, but the absence of needed care or medicine could also result in poor sleep outcomes more directly. Untreated medical conditions can lead to pain and other physical symptoms that could prevent sleep and hamper its quality. Our study is unable to adjudicate between the 2 possible pathways because we do not know the nature of the medical conditions for which respondents wished to seek medical attention. It is also possible that the respondents may

have wished to consult a medical professional about their sleep issues. If that is the case, the measured association between foregone medical care and sleep is due to endogeneity; that is, inadequate sleep was the ailment for which the care was foregone.

Finally, we discovered that a greater number of material hardships was associated with a greater probability of both sleep problems and nonrestorative sleep. It may be that each material hardship additively increases the amount of stress individual experiences and the increasing stress levels hamper their ability to enjoy needed restorative sleep. In sensitivity analysis, we found that the documented relationship is likely driven by a threshold effect, where the probability of negative outcomes is substantially increased for respondents with 1 or more hardships compared to those with no hardship but does not grow monotonically as the hardship burden rises. However, the reliability of the inferences that can be drawn based on this sensitivity analysis is compromised by the small number of respondents (16%) who reported more than 2 hardships. Further research is necessary to understand the nature of the relationship between cumulative material hardship experience and sleep.

Limitations

The data used are cross-sectional. Although it is more plausible that material hardship leads to poor sleep outcomes, the reverse may be true in certain circumstances. For example, a person with severe sleep issues may find it difficult to hold a steady job due to daytime fatigue. As sleeplessness is associated with impaired cognitive function,[1] the lack of quality sleep could also lead to poor financial decisions that translate into material hardships or to the inability to earn enough resources.

All our measures except light pollution are self-reported, including measures of sleep quantity and quality. Methodological literature has demonstrated that people tend not to be the best judges of their own sleep. Objective sleep data, for example, measured through actigraphy, may have provided more accurate measures of sleep duration than self-reported data. Prior evidence, for example, suggests that self-reported sleep tends to be longer than sleep duration recorded by actigraphy.[17] Moreover, actigraphy may be able to capture even those sleep disturbances that respondents are not themselves aware of.

We use a population sample of working-age adults living in Southeast Michigan. These results may not be generalizable to older adults whose sleep patterns differ and need not be correlated with material hardship in a manner similar to that of working age adults. Because the region was strongly affected by the Great Recession and the prevalence of material hardship was and remains particularly high in the area,[4,7] it may be that material hardship and sleep do not have the same relationship in our sample as they do in other places, where material hardship may be rarer. The unique context of the study could explain why we did not detect any associations between housing instability and negative sleep outcomes, as this form of material hardship may have become normalized in a region where 1 in 3 residents, or a total of 139,699 homes, went through a foreclosure between 2005 and 2015.[15]

Conclusion

This study is among the first to examine associations between multiple material hardship indicators and sleep. Although prior research has established material hardship as a possible pathway through which SES contributes to disparities in sleep, little is known about how specific hardships are associated with sleep and how their relationships to sleep might differ. We address this gap and discover that, after accounting for individual sociodemographic and health characteristics, material hardship measured in our study is not associated with short sleep. We find that forgone medical care and employment instability are associated with nonrestorative sleep. We find only weak evidence for the association between food insecurity and sleep problems and nonrestorative sleep. For both sleep problems and nonrestorative sleep, higher hardship burden was associated with a greater probability of an adverse sleep outcome. Our results present suggestive evidence that interventions that address material hardships, and especially forgone medical care, such as free community clinics and prescription drugs subsidies, may positively affect sleep quality in disadvantaged populations and consequently help remedy some of the persistent disparities in health in the United States. We encourage further examination of these relationships with longitudinal data on both sleep and material hardship.

Disclosure statement

The authors have nothing to disclose.

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Appendix A

Table 1
Average marginal effects with 95% confidence intervals of material hardship on short sleep, controlling for sociodemographic and socioeconomic variables (n = 730)

	Short Sleep											
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b	Model 6a	Model 6b
Employment instability (ref. no instability)												
Experienced hardship	−0.035 [−0.083, 0.013]	−0.046* [−0.084, −0.008]										
Not in labor force	0.082† [−0.012, 0.176]	0.064 [−0.027, 0.156]										
Financial problems			0.109*	0.098*								

(continued on next page)

Table 1 *(continued)*

	Short Sleep											
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b	Model 6a	Model 6b
			[0.024, 0.194]	[0.022, 0.175]								
Housing instability					0.135† [−0.016, 0.286]	0.123* [0.008, 0.238]						
Food insecurity							0.148* [0.029, 0.267]	0.127** [0.037, 0.217]				
Forgone medical care									0.144* [0.036, 0.252]	0.130* [0.023, 0.237]		
Number of hardships											0.040** [0.011, 0.069]	0.043** [0.018, 0.068]
Age	−0.001 [−0.004, 0.003]	0.000 [−0.004, 0.003]	0.001 [−0.003, 0.004]	0.000 [−0.003, 0.003]	0.001 [−0.003, 0.005]	0.000 [−0.003, 0.003]	0.000 [−0.004, 0.004]	0.000 [−0.004, 0.003]	0.000 [−0.003, 0.004]	0.000 [−0.003, 0.003]	0.001 [−0.003, 0.004]	0.000 [−0.003, 0.003]
Woman	−0.115** [−0.191, −0.039]	−0.106** [−0.181, −0.032]	−0.101** [−0.175, −0.027]	−0.105** [−0.171, −0.038]	−0.101** [−0.176, −0.027]	−0.102** [−0.170, −0.035]	−0.101* [−0.176, −0.026]	−0.102** [−0.172, −0.032]	−0.095** [−0.165, −0.026]	−0.095** [−0.161, −0.029]	−0.098** [−0.169, −0.028]	−0.099** [−0.162, −0.036]
Black	0.061† [−0.013, 0.135]	0.045 [−0.027, 0.118]	0.036 [−0.029, 0.101]	0.021 [−0.041, 0.084]	0.050 [−0.023, 0.123]	0.035 [−0.038, 0.108]	0.047 [−0.019, 0.113]	0.039 [−0.026, 0.104]	0.053 [−0.018, 0.124]	0.043 [−0.028, 0.115]	0.035 [−0.030, 0.101]	0.025 [−0.037, 0.087]
Married or cohabiting	−0.034 [−0.107, 0.039]	−0.030 [−0.094, 0.034]	−0.024 [−0.100, 0.051]	−0.018 [−0.082, 0.046]	−0.03 [−0.103, 0.044]	−0.023 [−0.085, 0.040]	−0.013 [−0.080, 0.054]	−0.008 [−0.067, 0.052]	−0.022 [−0.100, 0.055]	−0.019 [−0.086, 0.047]	−0.015 [−0.087, 0.057]	−0.011 [−0.075, 0.053]
Children (ref. no children)												
5 y old or under	0.053 [−0.083, 0.188]	0.061 [−0.073, 0.195]	0.040 [−0.105, 0.184]	0.040 [−0.094, 0.173]	0.064 [−0.074, 0.203]	0.061 [−0.066, 0.188]	0.050 [−0.095, 0.196]	0.046 [−0.090, 0.182]	0.044 [−0.088, 0.177]	0.046 [−0.078, 0.171]	0.042 [−0.098, 0.181]	0.037 [−0.091, 0.165]
All over 5 y old	0.031 [−0.052, 0.114]	0.033 [−0.048, 0.114]	0.008 [−0.069, 0.086]	0.017 [−0.059, 0.093]	0.025 [−0.051, 0.101]	0.032 [−0.043, 0.108]	0.013 [−0.065, 0.091]	0.018 [−0.059, 0.095]	0.014 [−0.068, 0.096]	0.020 [−0.061, 0.101]	0.010 [−0.067, 0.087]	0.014 [−0.061, 0.090]
Education (ref. BA or more)												
Less than high school		0.026 [−0.094, 0.145]		0.032 [−0.083, 0.146]		0.023 [−0.081, 0.128]		0.009 [−0.095, 0.113]		0.002 [−0.100, 0.104]		0.009 [−0.094, 0.112]
HS or some college		0.074 [−0.019, 0.167]		0.061 [−0.037, 0.159]		0.068 [−0.024, 0.160]		0.053 [−0.043, 0.149]		0.064 [−0.028, 0.156]		0.052 [−0.043, 0.148]
Log household income		−0.004 [−0.018, 0.009]		−0.003 [−0.018, 0.011]		−0.003 [−0.016, 0.010]		−0.003 [−0.017, 0.011]		−0.003 [−0.017, 0.011]		−0.001 [−0.015, 0.014]
Employment (ref. employed)												
Unemployed				−0.075† [−0.156, 0.006]		−0.076† [−0.155, 0.002]		−0.077* [−0.155, −0.000]		−0.083* [−0.161, −0.005]		−0.092** [−0.157, −0.027]
Not in labor force				0.070 [−0.015, 0.156]		0.063 [−0.014, 0.140]		0.057 [−0.017, 0.131]		0.040 [−0.042, 0.123]		0.065† [−0.006, 0.136]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Table 2
Average marginal effects with 95% confidence intervals of material hardship on short sleep, additionally controlling for health and light pollution variables (n = 730)

	Short Sleep											
	Model 1c	Model 1d	Model 2c	Model 2d	Model 3c	Model 3d	Model 4c	Model 4d	Model 5c	Model 5d	Model 6c	Model 6d
Employment instability (ref. no instability)												
Experienced hardship	−0.069** [−0.117, −0.020]	−0.071** [−0.119, −0.022]										
Not in labor force	−0.006 [−0.059, 0.046]	−0.007 [−0.061, 0.047]										
Financial problems			0.046 [−0.031, 0.124]	0.045 [−0.029, 0.119]								

Table 2 *(continued)*

	Short Sleep											
	Model 1c	Model 1d	Model 2c	Model 2d	Model 3c	Model 3d	Model 4c	Model 4d	Model 5c	Model 5d	Model 6c	Model 6d
Housing instability					0.051 [−0.031, 0.132]	0.050 [−0.030, 0.130]						
Food insecurity							0.062 [−0.020, 0.144]	0.063 [−0.022, 0.147]				
Forgone medical care									0.059 [−0.022, 0.139]	0.058 [−0.023, 0.139]		
Number of hardships											0.019 [−0.008, 0.046]	0.018 [−0.008, 0.045]
Age	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.003, 0.002]	−0.001 [−0.004, 0.002]	−0.001 [−0.003, 0.002]
Woman	−0.105** [−0.165, −0.045]	−0.107** [−0.171, −0.044]	−0.103** [−0.161, −0.046]	−0.105** [−0.165, −0.044]	−0.104** [−0.163, −0.044]	−0.105** [−0.167, −0.043]	−0.102** [−0.165, −0.040]	−0.104** [−0.169, −0.039]	−0.098** [−0.158, −0.038]	−0.099** [−0.162, −0.037]	−0.101** [−0.160, −0.041]	−0.102** [−0.163, −0.040]
Black	0.042 [−0.031, 0.115]	0.052 [−0.039, 0.142]	0.034 [−0.027, 0.095]	0.039 [−0.034, 0.113]	0.043 [−0.027, 0.112]	0.048 [−0.035, 0.131]	0.042 [−0.026, 0.109]	0.049 [−0.033, 0.130]	0.044 [−0.027, 0.114]	0.050 [−0.034, 0.134]	0.037 [−0.027, 0.101]	0.042 [−0.034, 0.119]
Married or cohabiting	0.004 [−0.054, 0.063]	0.000 [−0.053, 0.054]	0.008 [−0.052, 0.067]	0.005 [−0.050, 0.061]	0.005 [−0.052, 0.062]	0.002 [−0.051, 0.055]	0.011 [−0.045, 0.066]	0.008 [−0.043, 0.058]	0.005 [−0.053, 0.063]	0.002 [−0.051, 0.056]	0.007 [−0.051, 0.066]	0.005 [−0.049, 0.059]
Children (ref. no children)												
5 y old or under	0.042 [−0.064, 0.148]	0.040 [−0.071, 0.150]	0.03 [−0.083, 0.144]	0.03 [−0.087, 0.146]	0.038 [−0.074, 0.151]	0.037 [−0.080, 0.154]	0.032 [−0.082, 0.146]	0.031 [−0.087, 0.148]	0.033 [−0.079, 0.145]	0.032 [−0.083, 0.147]	0.029 [−0.085, 0.144]	0.029 [−0.089, 0.146]
All over 5 y old	0.012 [−0.070, 0.094]	0.010 [−0.076, 0.095]	0.004 [−0.073, 0.081]	0.003 [−0.076, 0.082]	0.012 [−0.064, 0.088]	0.011 [−0.068, 0.090]	0.005 [−0.074, 0.083]	0.003 [−0.079, 0.085]	0.007 [−0.073, 0.087]	0.006 [−0.077, 0.088]	0.005 [−0.072, 0.081]	0.004 [−0.075, 0.082]
Education (ref. BA or more)												
Less than high school	0.024 [−0.123, 0.171]	0.026 [−0.125, 0.177]	0.035 [−0.107, 0.177]	0.036 [−0.109, 0.181]	0.030 [−0.106, 0.167]	0.031 [−0.108, 0.170]	0.025 [−0.110, 0.160]	0.026 [−0.113, 0.165]	0.023 [−0.111, 0.156]	0.023 [−0.112, 0.159]	0.028 [−0.108, 0.163]	0.029 [−0.110, 0.167]
HS or some college	0.041 [−0.049, 0.131]	0.043 [−0.052, 0.137]	0.038 [−0.052, 0.128]	0.039 [−0.054, 0.133]	0.041 [−0.047, 0.129]	0.041 [−0.050, 0.133]	0.036 [−0.053, 0.125]	0.037 [−0.055, 0.129]	0.041 [−0.047, 0.130]	0.042 [−0.050, 0.134]	0.038 [−0.051, 0.127]	0.038 [−0.054, 0.131]
Log household income	0.004 [−0.010, 0.019]	0.004 [−0.010, 0.018]	0.005 [−0.010, 0.021]	0.005 [−0.010, 0.021]	0.006 [−0.010, 0.022]	0.006 [−0.010, 0.021]	0.006 [−0.010, 0.022]	0.006 [−0.010, 0.022]	0.006 [−0.010, 0.022]	0.006 [−0.010, 0.021]	0.006 [−0.010, 0.023]	0.006 [−0.010, 0.022]
Employment (ref. employed)												
Unemployed			−0.080† [−0.160, 0.000]	−0.079† [−0.161, 0.002]	−0.082* [−0.161, −0.002]	−0.081† [−0.161, 0.000]	−0.082* [−0.159, −0.005]	−0.081* [−0.159, −0.003]	−0.083* [−0.166, −0.000]	−0.083† [−0.166, 0.001]	−0.089* [−0.164, −0.015]	−0.089* [−0.164, −0.013]
Not in labor force			0.013 [−0.040, 0.067]	0.014 [−0.039, 0.067]	0.013 [−0.040, 0.065]	0.013 [−0.038, 0.065]	0.011 [−0.043, 0.064]	0.011 [−0.042, 0.064]	0.004 [−0.053, 0.061]	0.004 [−0.052, 0.061]	0.016 [−0.037, 0.068]	0.016 [−0.035, 0.068]
Poor/fair self-rated health	0.210** [0.082, 0.339]	0.217** [0.090, 0.345]	0.187** [0.065, 0.309]	0.191** [0.069, 0.314]	0.189** [0.071, 0.306]	0.193** [0.075, 0.311]	0.182** [0.069, 0.295]	0.187** [0.074, 0.300]	0.182** [0.055, 0.309]	0.186** [0.057, 0.316]	0.176** [0.054, 0.298]	0.180** [0.056, 0.303]
Obese	−0.028 [−0.097, 0.042]	−0.028 [−0.097, 0.040]	−0.026 [−0.099, 0.047]	−0.026 [−0.098, 0.046]	−0.027 [−0.099, 0.044]	−0.027 [−0.098, 0.043]	−0.024 [−0.093, 0.045]	−0.024 [−0.092, 0.044]	−0.024 [−0.094, 0.045]	−0.025 [−0.093, 0.044]	−0.025 [−0.096, 0.047]	−0.025 [−0.095, 0.046]
Hazardous alcohol use	−0.022 [−0.129, 0.086]	−0.02 [−0.126, 0.087]	−0.021 [−0.129, 0.087]	−0.020 [−0.128, 0.088]	−0.023 [−0.131, 0.085]	−0.021 [−0.128, 0.087]	−0.021 [−0.122, 0.079]	−0.020 [−0.120, 0.080]	−0.018 [−0.129, 0.093]	−0.016 [−0.127, 0.094]	−0.021 [−0.128, 0.087]	−0.019 [−0.127, 0.088]
Smokes cigarettes	−0.019 [−0.096, 0.058]	−0.018 [−0.095, 0.060]	−0.025 [−0.102, 0.051]	−0.024 [−0.100, 0.051]	−0.023 [−0.102, 0.056]	−0.022 [−0.101, 0.057]	−0.026 [−0.101, 0.050]	−0.025 [−0.100, 0.050]	−0.027 [−0.102, 0.049]	−0.026 [−0.101, 0.049]	−0.027 [−0.102, 0.048]	−0.026 [−0.101, 0.048]
Depression	0.178* [0.022, 0.334]	0.179* [0.021, 0.337]	0.165* [0.009, 0.321]	0.165* [0.008, 0.323]	0.166* [0.010, 0.322]	0.166* [0.009, 0.322]	0.159* [0.013, 0.305]	0.159* [0.012, 0.306]	0.161* [0.011, 0.310]	0.161* [0.010, 0.311]	0.154* [0.004, 0.304]	0.155* [0.003, 0.306]
Anxiety attack in last month	0.013 [−0.102, 0.128]	0.012 [−0.101, 0.124]	0.010 [−0.107, 0.127]	0.010 [−0.106, 0.125]	0.009 [−0.111, 0.128]	0.008 [−0.110, 0.126]	0.007 [−0.105, 0.118]	0.005 [−0.103, 0.114]	0.002 [−0.104, 0.109]	0.002 [−0.103, 0.106]	0.003 [−0.110, 0.116]	0.003 [−0.109, 0.115]
Average nighttime radiance		−0.001 [−0.003, 0.002]		0.000 [−0.003, 0.002]		0.000 [−0.003, 0.002]		−0.001 [−0.003, 0.002]		0.000 [−0.003, 0.002]		0.000 [−0.003, 0.002]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$. Note that, for all hardship measures, the difference between the AMEs for the C and D models is not statistically significant.

Table 3
Average marginal effects with 95% confidence intervals of material hardship on sleep problems, controlling for sociodemographic and socioeconomic variables (n = 730)

	Sleep problems											
	Model 7a	Model 7b	Model 8a	Model 8b	Model 9a	Model 9b	Model 10a	Model 10b	Model 11a	Model 11b	Model 12a	Model 12b
Employment instability (ref. no instability)												
Experienced hardship	0.078 [−0.048, 0.205]	0.031 [−0.084, 0.146]										
Not in labor force	0.077** [0.022, 0.132]	0.043† [−0.008, 0.094]										
Financial problems			0.180*** [0.103, 0.258]	0.149*** [0.067, 0.232]								
Housing instability					0.150** [0.044, 0.257]	0.122* [0.025, 0.219]						
Food insecurity							0.224*** [0.140, 0.308]	0.196*** [0.122, 0.270]				
Forgone medical care									0.234*** [0.122, 0.347]	0.212*** [0.099, 0.324]		
Number of hardships											0.072*** [0.050, 0.094]	0.067*** [0.050, 0.083]
Age	−0.001 [−0.005, 0.004]	0.000 [−0.004, 0.005]	0.000 [−0.004, 0.005]	0.000 [−0.004, 0.005]	0.001 [−0.004, 0.005]	0.001 [−0.003, 0.005]	0.000 [−0.005, 0.005]	0.000 [−0.005, 0.005]	0.000 [−0.004, 0.005]	0.001 [−0.003, 0.005]	0.001 [−0.004, 0.005]	0.001 [−0.003, 0.005]
Woman	0.030 [−0.043, 0.104]	0.029 [−0.047, 0.104]	0.041 [−0.034, 0.116]	0.030 [−0.047, 0.107]	0.041 [−0.034, 0.115]	0.031 [−0.044, 0.105]	0.039 [−0.039, 0.117]	0.030 [−0.047, 0.106]	0.048 [−0.021, 0.118]	0.041 [−0.028, 0.110]	0.044 [−0.028, 0.117]	0.034 [−0.038, 0.107]
Black	0.007 [−0.075, 0.090]	−0.008 [−0.083, 0.066]	−0.026 [−0.098, 0.046]	−0.040 [−0.103, 0.023]	0.000 [−0.082, 0.082]	−0.022 [−0.096, 0.051]	−0.005 [−0.079, 0.068]	−0.021 [−0.088, 0.047]	−0.004 [−0.075, 0.067]	−0.017 [−0.083, 0.049]	−0.035 [−0.098, 0.028]	−0.045 [−0.103, 0.013]
Married or cohabiting	−0.052† [−0.110, 0.006]	−0.031 [−0.087, 0.026]	−0.044† [−0.096, 0.008]	−0.023 [−0.075, 0.030]	−0.054† [−0.113, 0.006]	−0.030 [−0.088, 0.029]	−0.019 [−0.079, 0.041]	0.000 [−0.058, 0.057]	−0.034 [−0.091, 0.022]	−0.016 [−0.069, 0.037]	−0.018 [−0.068, 0.031]	−0.007 [−0.057, 0.044]
Children (ref. no children)												
5 y old or under	−0.012 [−0.130, 0.106]	−0.002 [−0.127, 0.122]	−0.031 [−0.132, 0.071]	−0.027 [−0.133, 0.078]	0.003 [−0.114, 0.119]	0.002 [−0.118, 0.121]	−0.020 [−0.142, 0.101]	−0.019 [−0.144, 0.106]	−0.021 [−0.132, 0.090]	−0.015 [−0.132, 0.103]	−0.036 [−0.144, 0.073]	−0.033 [−0.144, 0.077]
All over 5 y old	0.095 [−0.024, 0.214]	0.079 [−0.019, 0.177]	0.072 [−0.044, 0.188]	0.063 [−0.038, 0.163]	0.097† [−0.018, 0.213]	0.084† [−0.012, 0.179]	0.071 [−0.044, 0.187]	0.058 [−0.032, 0.148]	0.082 [−0.050, 0.214]	0.067 [−0.041, 0.174]	0.068 [−0.053, 0.188]	0.059 [−0.042, 0.160]
Education (ref. BA or more)												
Less than high school		0.071 [−0.054, 0.196]		0.074 [−0.064, 0.213]		0.060 [−0.069, 0.190]		0.034 [−0.104, 0.172]		0.021 [−0.127, 0.170]		0.030 [−0.106, 0.166]
HS or some college		0.041 [−0.031, 0.112]		0.020 [−0.055, 0.095]		0.037 [−0.030, 0.104]		0.011 [−0.070, 0.091]		0.020 [−0.058, 0.097]		0.005 [−0.074, 0.083]
Log household income		−0.019** [−0.031, −0.007]		−0.017** [−0.028, −0.007]		−0.019** [−0.031, −0.007]		−0.019** [−0.030, −0.007]		−0.019** [−0.031, −0.007]		−0.017** [−0.028, −0.006]
Employment (ref. employed)												
Unemployed				−0.006 [−0.129, 0.118]		0.003 [−0.133, 0.139]		−0.005 [−0.141, 0.131]		−0.023 [−0.141, 0.095]		−0.060 [−0.156, 0.037]
Not in labor force				0.033 [−0.042, 0.108]		0.027 [−0.045, 0.100]		0.019 [−0.048, 0.085]		−0.006 [−0.069, 0.057]		0.032 [−0.037, 0.101]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Table 4
Average marginal effects with 95% confidence intervals of material hardship on sleep problems, additionally controlling for health and light pollution variables (n = 730)

	Sleep problems											
	Model 7c	Model 7d	Model 8c	Model 8d	Model 9c	Model 9d	Model 10c	Model 10d	Model 11c	Model 11d	Model 12c	Model 12d
Employment instability (ref. no instability)												
Experienced hardship	−0.004 [−0.097, 0.090]	−0.002 [−0.097, 0.093]										
Not in labor force	−0.014 [−0.081, 0.053]	−0.013 [−0.080, 0.054]										
Financial problems			0.040 [−0.038, 0.118]	0.043 [−0.033, 0.119]								
Housing instability					−0.004 [−0.057, 0.050]	−0.004 [−0.057, 0.050]						
Food insecurity							0.067† [−0.002, 0.135]	0.066† [−0.001, 0.133]				
Forgone medical care									0.081 [−0.029, 0.191]	0.082 [−0.027, 0.191]		
Number of hardships											0.022* [0.001, 0.043]	0.023* [0.002, 0.044]
Age	−0.001 [−0.005, 0.002]	−0.001 [−0.005, 0.002]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.004, 0.003]	−0.001 [−0.004, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.004, 0.003]
Woman	0.005 [−0.046, 0.056]	0.006 [−0.046, 0.058]	0.006 [−0.046, 0.059]	0.008 [−0.045, 0.060]	0.005 [−0.046, 0.057]	0.006 [−0.045, 0.058]	0.008 [−0.046, 0.062]	0.008 [−0.046, 0.063]	0.015 [−0.036, 0.065]	0.016 [−0.035, 0.067]	0.010 [−0.043, 0.063]	0.011 [−0.042, 0.065]
Black	−0.004 [−0.061, 0.054]	−0.010 [−0.072, 0.053]	−0.011 [−0.069, 0.047]	−0.019 [−0.080, 0.043]	0.000 [−0.059, 0.058]	−0.006 [−0.070, 0.057]	−0.008 [−0.066, 0.050]	−0.014 [−0.077, 0.049]	−0.008 [−0.065, 0.049]	−0.015 [−0.077, 0.048]	−0.016 [−0.071, 0.039]	−0.023 [−0.083, 0.036]
Married or cohabiting	0.027 [−0.023, 0.078]	0.030 [−0.018, 0.078]	0.026 [−0.022, 0.075]	0.030 [−0.017, 0.076]	0.027 [−0.023, 0.076]	0.029 [−0.018, 0.077]	0.033 [−0.016, 0.083]	0.036 [−0.012, 0.084]	0.025 [−0.024, 0.074]	0.029 [−0.018, 0.075]	0.028 [−0.021, 0.076]	0.032 [−0.015, 0.078]
Children (ref. no children)												
5 y old or under	−0.043 [−0.134, 0.047]	−0.042 [−0.134, 0.050]	−0.044 [−0.134, 0.045]	−0.043 [−0.132, 0.046]	−0.038 [−0.133, 0.056]	−0.037 [−0.131, 0.058]	−0.041 [−0.139, 0.056]	−0.040 [−0.137, 0.057]	−0.041 [−0.139, 0.056]	−0.040 [−0.137, 0.057]	−0.045 [−0.139, 0.049]	−0.044 [−0.137, 0.050]
All over 5 y old	0.033 [−0.030, 0.097]	0.035 [−0.029, 0.100]	0.029 [−0.035, 0.092]	0.03 [−0.033, 0.094]	0.033 [−0.030, 0.096]	0.035 [−0.029, 0.098]	0.028 [−0.036, 0.091]	0.029 [−0.034, 0.093]	0.031 [−0.039, 0.102]	0.033 [−0.036, 0.103]	0.030 [−0.037, 0.097]	0.032 [−0.035, 0.099]
Education (ref. BA or more)												
Less than high school	0.043 [−0.085, 0.171]	0.041 [−0.086, 0.169]	0.052 [−0.083, 0.188]	0.051 [−0.084, 0.186]	0.049 [−0.082, 0.181]	0.048 [−0.083, 0.179]	0.040 [−0.095, 0.175]	0.038 [−0.096, 0.173]	0.030 [−0.110, 0.170]	0.029 [−0.111, 0.168]	0.042 [−0.089, 0.173]	0.040 [−0.090, 0.171]
HS or some college	−0.032 [−0.103, 0.039]	−0.034 [−0.103, 0.036]	−0.035 [−0.103, 0.032]	−0.038 [−0.104, 0.028]	−0.032 [−0.098, 0.033]	−0.034 [−0.098, 0.030]	−0.039 [−0.107, 0.029]	−0.041 [−0.108, 0.026]	−0.035 [−0.103, 0.033]	−0.037 [−0.104, 0.029]	−0.036 [−0.103, 0.031]	−0.038 [−0.104, 0.027]
Log household income	−0.002 [−0.011, 0.007]	−0.002 [−0.011, 0.007]	−0.003 [−0.011, 0.004]	−0.004 [−0.011, 0.004]	−0.003 [−0.011, 0.004]	−0.003 [−0.011, 0.004]	−0.004 [−0.012, 0.004]	−0.004 [−0.012, 0.004]	−0.004 [−0.012, 0.005]	−0.004 [−0.012, 0.004]	−0.004 [−0.012, 0.004]	−0.004 [−0.012, 0.004]
Employment (ref. employed)												
Unemployed			−0.059 [−0.164, 0.046]	−0.060 [−0.162, 0.042]	−0.050 [−0.159, 0.059]	−0.050 [−0.157, 0.057]	−0.058 [−0.160, 0.044]	−0.058 [−0.158, 0.042]	−0.061 [−0.163, 0.042]	−0.061 [−0.161, 0.040]	−0.074 [−0.173, 0.026]	−0.075 [−0.171, 0.022]
Not in labor force			−0.020 [−0.114, 0.073]	−0.021 [−0.113, 0.072]	−0.020 [−0.116, 0.075]	−0.021 [−0.116, 0.075]	−0.023 [−0.115, 0.070]	−0.023 [−0.115, 0.069]	−0.032 [−0.121, 0.057]	−0.032 [−0.121, 0.056]	−0.018 [−0.112, 0.076]	−0.018 [−0.112, 0.076]
Poor/fair self-rated health	0.155* [0.022, 0.288]	0.150* [0.010, 0.290]	0.140* [0.005, 0.274]	0.133† [−0.008, 0.274]	0.150* [0.022, 0.279]	0.145* [0.010, 0.281]	0.134† [−0.009, 0.277]	0.130† [−0.018, 0.278]	0.132† [−0.022, 0.285]	0.127 [−0.032, 0.285]	0.126† [−0.020, 0.272]	0.120 [−0.032, 0.272]
Obese	0.016 [−0.025, 0.058]	0.016 [−0.026, 0.058]	0.015 [−0.027, 0.057]	0.015 [−0.028, 0.057]	0.016 [−0.028, 0.060]	0.015 [−0.029, 0.060]	0.016 [−0.025, 0.058]	0.016 [−0.026, 0.058]	0.017 [−0.027, 0.061]	0.017 [−0.027, 0.061]	0.017 [−0.025, 0.059]	0.016 [−0.026, 0.059]
Hazardous alcohol use	0.053 [−0.029, 0.135]	0.048 [−0.032, 0.129]	0.049 [−0.032, 0.131]	0.043 [−0.036, 0.122]	0.052 [−0.028, 0.133]	0.047 [−0.031, 0.126]	0.055 [−0.028, 0.138]	0.050 [−0.032, 0.133]	0.060 [−0.028, 0.148]	0.054 [−0.032, 0.139]	0.054 [−0.032, 0.139]	0.047 [−0.036, 0.130]
Smokes cigarettes	0.047	0.046	0.042†	0.041	0.046	0.045	0.037	0.036	0.04	0.038	0.039	0.037

(continued on next page)

Table 4 *(continued)*

	Sleep problems											
	Model 7c	Model 7d	Model 8c	Model 8d	Model 9c	Model 9d	Model 10c	Model 10d	Model 11c	Model 11d	Model 12c	Model 12d
	[−0.013, 0.107]	[−0.014, 0.106]	[−0.009, 0.094]	[−0.010, 0.092]	[−0.012, 0.103]	[−0.013, 0.102]	[−0.014, 0.088]	[−0.016, 0.088]	[−0.022, 0.101]	[−0.023, 0.100]	[−0.015, 0.092]	[−0.017, 0.091]
Depression	0.411*** [0.241, 0.580]	0.408*** [0.239, 0.576]	0.412*** [0.254, 0.569]	0.409*** [0.251, 0.567]	0.425*** [0.271, 0.579]	0.423*** [0.270, 0.576]	0.401*** [0.242, 0.561]	0.400*** [0.241, 0.558]	0.396*** [0.230, 0.562]	0.393*** [0.227, 0.560]	0.390*** [0.224, 0.555]	0.387*** [0.221, 0.552]
Anxiety attack in last month	0.152† [−0.027, 0.331]	0.152† [−0.024, 0.327]	0.152 [−0.043, 0.347]	0.152 [−0.040, 0.343]	0.161† [−0.032, 0.354]	0.161† [−0.028, 0.350]	0.141 [−0.055, 0.338]	0.142 [−0.051, 0.335]	0.136 [−0.066, 0.338]	0.136 [−0.063, 0.334]	0.139 [−0.054, 0.332]	0.139 [−0.051, 0.329]
Average nighttime radiance		0.001 [−0.001, 0.002]		0.001 [−0.001, 0.002]		0.001 [−0.001, 0.002]		0.001 [−0.001, 0.002]		0.001 [−0.001, 0.002]		0.001 [−0.001, 0.002]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$. Note that, for all hardship measures, the difference between the AMEs for the C and D models is not statistically significant.

Table 5
Average marginal effects with 95% confidence intervals of material hardship on nonrestorative sleep, controlling for sociodemographic and socioeconomic variables (n = 730)

	Nonrestorative sleep											
	Model 13a	Model 13b	Model 14a	Model 14b	Model 15a	Model 15b	Model 16a	Model 16b	Model 17a	Model 17b	Model 18a	Model 18b
Employment instability (ref. no instability)												
Experienced hardship	0.164** [0.052, 0.275]	0.146* [0.026, 0.265]										
Not in labor force	0.053 [−0.038, 0.144]	0.042 [−0.047, 0.131]										
Financial problems			0.129* [0.027, 0.232]	0.097 [−0.025, 0.218]								
Housing instability					0.036 [−0.113, 0.185]	0.027 [−0.123, 0.176]						
Food insecurity							0.253** [0.109, 0.396]	0.245** [0.099, 0.390]				
Forgone medical care									0.230*** [0.130, 0.330]	0.243*** [0.137, 0.348]		
Number of hardships											0.083*** [0.048, 0.119]	0.084** [0.037, 0.131]
Age	−0.002 [−0.006, 0.001]	−0.002 [−0.005, 0.002]	−0.002 [−0.005, 0.002]	−0.001 [−0.005, 0.002]	−0.002 [−0.005, 0.002]	−0.001 [−0.005, 0.003]	−0.002 [−0.006, 0.002]	−0.001 [−0.006, 0.003]	−0.002 [−0.006, 0.002]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]	−0.001 [−0.005, 0.003]
Woman	0.067 [−0.034, 0.168]	0.074 [−0.023, 0.171]	0.074 [−0.028, 0.177]	0.079 [−0.021, 0.179]	0.076 [−0.028, 0.179]	0.081 [−0.019, 0.181]	0.075 [−0.026, 0.177]	0.082† [−0.016, 0.180]	0.083† [−0.014, 0.180]	0.095* [0.001, 0.189]	0.078 [−0.019, 0.175]	0.083† [−0.013, 0.179]
Black	−0.158** [−0.257, −0.060]	−0.176*** [−0.270, −0.081]	−0.176** [−0.287, −0.065]	−0.185** [−0.295, −0.075]	−0.149** [−0.256, −0.042]	−0.168** [−0.270, −0.067]	−0.175** [−0.271, −0.079]	−0.183*** [−0.277, −0.090]	−0.166** [−0.264, −0.069]	−0.174** [−0.272, −0.076]	−0.199*** [−0.295, −0.103]	−0.204*** [−0.299, −0.108]
Married or cohabiting	−0.182*** [−0.260, −0.103]	−0.181*** [−0.254, −0.109]	−0.182*** [−0.263, −0.102]	−0.181*** [−0.257, −0.104]	−0.192*** [−0.275, −0.109]	−0.187*** [−0.266, −0.109]	−0.153*** [−0.220, −0.087]	−0.157*** [−0.224, −0.091]	−0.171*** [−0.255, −0.087]	−0.174*** [−0.254, −0.093]	−0.153*** [−0.223, −0.083]	−0.158*** [−0.229, −0.087]
Children (ref. no children)												
5 y old or under	0.113† [−0.010, 0.236]	0.127† [−0.001, 0.254]	0.101 [−0.027, 0.230]	0.122† [−0.009, 0.253]	0.128* [0.008, 0.248]	0.144* [0.023, 0.264]	0.101 [−0.025, 0.226]	0.119† [−0.009, 0.248]	0.099 [−0.025, 0.224]	0.121† [−0.008, 0.251]	0.088 [−0.048, 0.224]	0.102 [−0.038, 0.242]
All over 5 y old	0.167*** [0.081, 0.252]	0.169*** [0.088, 0.251]	0.159** [0.058, 0.260]	0.161** [0.063, 0.260]	0.174** [0.078, 0.271]	0.172*** [0.081, 0.264]	0.155** [0.050, 0.259]	0.151** [0.056, 0.247]	0.162** [0.061, 0.263]	0.157** [0.062, 0.253]	0.148** [0.051, 0.246]	0.149** [0.053, 0.245]
Education (ref. BA or more)												
Less than high school		−0.053 [−0.179, 0.072]		−0.050 [−0.178, 0.077]		−0.053 [−0.181, 0.076]		−0.092 [−0.227, 0.043]		−0.100 [−0.242, 0.042]		−0.089 [−0.223, 0.044]
HS or some college		0.097* [0.023, 0.171]		0.084* [0.006, 0.161]		0.096* [0.015, 0.178]		0.062 [−0.023, 0.146]		0.074† [−0.010, 0.158]		0.059 [−0.021, 0.138]
Log household		−0.010		−0.014†		−0.016†		−0.014		−0.015†		−0.012

Table 5 *(continued)*

	Nonrestorative sleep											
	Model 13a	Model 13b	Model 14a	Model 14b	Model 15a	Model 15b	Model 16a	Model 16b	Model 17a	Model 17b	Model 18a	Model 18b
income		[−0.026, 0.006]		[−0.031, 0.002]		[−0.033, 0.001]		[−0.032, 0.003]		[−0.033, 0.002]		[−0.030, 0.005]
Employment (ref. employed)												
Unemployed				−0.033 [−0.198, 0.133]		−0.018 [−0.190, 0.154]		−0.055 [−0.217, 0.106]		−0.079 [−0.247, 0.089]		−0.129 [−0.305, 0.048]
Not in labor force				−0.016 [−0.090, 0.059]		−0.018 [−0.092, 0.055]		−0.036 [−0.106, 0.033]		−0.060† [−0.128, 0.009]		−0.016 [−0.087, 0.055]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$

Table 6
Average marginal effects with 95% confidence intervals of material hardship on nonrestorative sleep, additionally controlling for health and light pollution variables (n = 730)

	Nonrestorative sleep											
	Model 13c	Model 13d	Model 14c	Model 14d	Model 15c	Model 15d	Model 16c	Model 16d	Model 17c	Model 17d	Model 18c	Model 18d
Employment instability (ref. no instability)												
Experienced hardship	0.126* [0.013, 0.239]	0.120* [0.003, 0.237]										
Not in labor force	−0.001 [−0.072, 0.070]	−0.005 [−0.075, 0.065]										
Financial problems			0.016 [−0.105, 0.137]	0.009 [−0.106, 0.124]								
Housing instability					−0.079 [−0.175, 0.017]	−0.076 [−0.175, 0.023]						
Food insecurity							0.147 [−0.033, 0.328]	0.151† [−0.029, 0.331]				
Forgone medical care									0.159** [0.057, 0.261]	0.160** [0.058, 0.263]		
Number of hardships											0.049† [−0.000, 0.098]	0.048* [0.000, 0.096]
Age	−0.002 [−0.007, 0.002]	−0.002 [−0.007, 0.002]	−0.002 [−0.007, 0.003]	−0.002 [−0.007, 0.003]	−0.002 [−0.007, 0.002]	−0.002 [−0.007, 0.002]	−0.002 [−0.007, 0.003]	−0.002 [−0.007, 0.003]	−0.002 [−0.007, 0.004]	−0.002 [−0.007, 0.004]	−0.002 [−0.007, 0.003]	−0.002 [−0.007, 0.003]
Woman	0.059 [−0.032, 0.151]	0.057 [−0.035, 0.148]	0.064 [−0.035, 0.163]	0.061 [−0.037, 0.159]	0.062 [−0.037, 0.161]	0.059 [−0.039, 0.157]	0.067 [−0.032, 0.167]	0.065 [−0.034, 0.163]	0.077 [−0.021, 0.176]	0.074 [−0.023, 0.172]	0.069 [−0.029, 0.166]	0.066 [−0.031, 0.163]
Black	−0.165*** [−0.240, −0.090]	−0.152*** [−0.230, −0.074]	−0.157** [−0.253, −0.061]	−0.140** [−0.239, −0.042]	−0.144** [−0.230, −0.059]	−0.129** [−0.218, −0.041]	−0.164*** [−0.247, −0.081]	−0.148** [−0.233, −0.062]	−0.159*** [−0.240, −0.078]	−0.144** [−0.227, −0.060]	−0.177*** [−0.265, −0.089]	−0.163*** [−0.251, −0.075]
Married or cohabiting	−0.138*** [−0.198, −0.078]	−0.147*** [−0.206, −0.089]	−0.145*** [−0.212, −0.077]	−0.155*** [−0.219, −0.092]	−0.145*** [−0.211, −0.078]	−0.155*** [−0.219, −0.091]	−0.130*** [−0.195, −0.064]	−0.141*** [−0.202, −0.080]	−0.141*** [−0.210, −0.071]	−0.152*** [−0.219, −0.085]	−0.134*** [−0.203, −0.066]	−0.145*** [−0.208, −0.081]
Children (ref. no children)												
5 y old or under	0.098 [−0.053, 0.249]	0.096 [−0.054, 0.246]	0.107 [−0.037, 0.251]	0.106 [−0.039, 0.250]	0.107 [−0.030, 0.245]	0.105 [−0.032, 0.242]	0.100 [−0.041, 0.241]	0.096 [−0.044, 0.236]	0.101 [−0.044, 0.246]	0.098 [−0.047, 0.244]	0.092 [−0.057, 0.241]	0.090 [−0.060, 0.239]
All over 5 y old	0.132** [0.053, 0.212]	0.128** [0.046, 0.210]	0.134** [0.041, 0.226]	0.129* [0.034, 0.224]	0.131** [0.043, 0.219]	0.126** [0.036, 0.216]	0.127** [0.034, 0.219]	0.121* [0.025, 0.216]	0.130** [0.041, 0.220]	0.125* [0.032, 0.217]	0.126** [0.036, 0.217]	0.122* [0.028, 0.215]
Education (ref. BA or more)												
Less than high school	−0.088 [−0.222, 0.046]	−0.085 [−0.223, 0.054]	−0.082 [−0.219, 0.056]	−0.078 [−0.222, 0.065]	−0.080 [−0.219, 0.060]	−0.076 [−0.221, 0.069]	−0.093 [−0.231, 0.044]	−0.090 [−0.235, 0.055]	−0.101 [−0.236, 0.033]	−0.099 [−0.240, 0.041]	−0.091 [−0.227, 0.045]	−0.088 [−0.230, 0.053]
HS or some college	0.038 [−0.059, 0.134]	0.040 [−0.060, 0.140]	0.039 [−0.066, 0.144]	0.043 [−0.064, 0.150]	0.040 [−0.064, 0.144]	0.044 [−0.064, 0.151]	0.029 [−0.070, 0.129]	0.033 [−0.069, 0.135]	0.037 [−0.063, 0.137]	0.041 [−0.062, 0.144]	0.030 [−0.070, 0.130]	0.034 [−0.069, 0.137]

(continued on next page)

Table 6 *(continued)*

	Nonrestorative sleep											
	Model 13c	Model 13d	Model 14c	Model 14d	Model 15c	Model 15d	Model 16c	Model 16d	Model 17c	Model 17d	Model 18c	Model 18d
Log household income	0.010 [−0.006, 0.026]	0.010 [−0.006, 0.026]	0.004 [−0.011, 0.019]	0.004 [−0.011, 0.019]	0.004 [−0.010, 0.019]	0.005 [−0.010, 0.020]	0.003 [−0.011, 0.017]	0.003 [−0.012, 0.018]	0.003 [−0.011, 0.018]	0.003 [−0.012, 0.018]	0.004 [−0.011, 0.019]	0.005 [−0.011, 0.020]
Employment (ref. employed)												
Unemployed			−0.068 [−0.256, 0.120]	−0.071 [−0.256, 0.114]	−0.052 [−0.240, 0.136]	−0.057 [−0.244, 0.129]	−0.091 [−0.264, 0.082]	−0.096 [−0.268, 0.075]	−0.107 [−0.282, 0.067]	−0.112 [−0.286, 0.061]	−0.127 [−0.314, 0.059]	−0.130 [−0.314, 0.055]
Not in labor force			−0.055 [−0.124, 0.014]	−0.057† [−0.122, 0.008]	−0.052 [−0.123, 0.018]	−0.055 [−0.123, 0.013]	−0.062† [−0.129, 0.006]	−0.064* [−0.127, −0.000]	−0.078* [−0.145, −0.012]	−0.080* [−0.144, −0.017]	−0.048 [−0.119, 0.022]	−0.050 [−0.117, 0.016]
Poor/fair self-rated health	0.152 [−0.083, 0.387]	0.161 [−0.073, 0.396]	0.146 [−0.082, 0.374]	0.158 [−0.068, 0.385]	0.160 [−0.070, 0.390]	0.171 [−0.055, 0.396]	0.119 [−0.132, 0.369]	0.130 [−0.119, 0.379]	0.119 [−0.107, 0.346]	0.130 [−0.095, 0.356]	0.112 [−0.113, 0.336]	0.122 [−0.102, 0.347]
Obese	0.009 [−0.089, 0.107]	0.009 [−0.087, 0.106]	0.004 [−0.089, 0.097]	0.005 [−0.086, 0.096]	0.005 [−0.086, 0.097]	0.006 [−0.084, 0.096]	0.004 [−0.091, 0.100]	0.005 [−0.089, 0.099]	0.006 [−0.088, 0.099]	0.007 [−0.085, 0.098]	0.006 [−0.094, 0.105]	0.006 [−0.091, 0.104]
Hazardous alcohol use	0.107* [0.002, 0.211]	0.119* [0.025, 0.212]	0.104† [−0.013, 0.221]	0.119* [0.016, 0.221]	0.107† [−0.009, 0.223]	0.121* [0.017, 0.225]	0.109† [−0.003, 0.220]	0.125* [0.026, 0.224]	0.124* [0.013, 0.236]	0.140** [0.043, 0.238]	0.109* [0.001, 0.217]	0.123* [0.028, 0.218]
Smokes cigarettes	0.066 [−0.038, 0.169]	0.069 [−0.034, 0.172]	0.059 [−0.046, 0.164]	0.064 [−0.041, 0.168]	0.062 [−0.042, 0.165]	0.065 [−0.038, 0.169]	0.043 [−0.067, 0.152]	0.047 [−0.062, 0.155]	0.043 [−0.062, 0.147]	0.047 [−0.057, 0.150]	0.045 [−0.063, 0.154]	0.050 [−0.057, 0.157]
Depression	0.209** [0.063, 0.356]	0.214** [0.070, 0.358]	0.232** [0.075, 0.390]	0.239** [0.085, 0.392]	0.248** [0.104, 0.392]	0.253** [0.111, 0.395]	0.206* [0.031, 0.381]	0.211* [0.041, 0.382]	0.212* [0.045, 0.379]	0.218* [0.055, 0.380]	0.200* [0.020, 0.381]	0.206* [0.031, 0.381]
Anxiety attack in last month	0.262** [0.100, 0.425]	0.264** [0.098, 0.430]	0.265** [0.093, 0.436]	0.268** [0.093, 0.442]	0.273** [0.110, 0.436]	0.275** [0.107, 0.442]	0.247** [0.069, 0.425]	0.249** [0.067, 0.431]	0.243** [0.071, 0.414]	0.245** [0.070, 0.421]	0.244** [0.067, 0.421]	0.247** [0.066, 0.428]
Average nighttime radiance		−0.001 [−0.004, 0.001]		−0.002† [−0.004, 0.000]		−0.002† [−0.004, 0.000]		−0.002† [−0.004, 0.000]		−0.002† [−0.004, 0.000]		−0.002† [−0.004, 0.000]

*** $P < .001$, ** $P < .01$, * $P < .05$, † $P < .10$. Note that, for all hardship measures, the difference between the AMEs for the C and D models is not statistically significant.

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