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What Makes People Want to Make Changes to Their Sleep? Assessment of Perceived Risks of Insufficient Sleep as a Predictor of Intent to Improve Sleep

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Abstract

OBJECTIVES: The objective of the present study is to identify which underlying beliefs about the impact of sleep on health may motivate change in sleep behavior.

DESIGN: A cross-sectional study conducted between 2012–2014.

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SETTING: Data were from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study conducted in Philadelphia, PA, and its surrounding regions.

PARTICIPANTS: Participants consisted of N=1007 community-dwelling adults age 22–60.

MEASUREMENTS: Respondents indicated behaviors they could improve on to facilitate sleep and their corresponding readiness to change. They were also asked items from the Sleep Practices and Attitudes Questionnaire (SPAQ) regarding the degree to which they agree with whether “not getting enough sleep” can impact a variety of health factors.

RESULTS: In adjusted analyses, stage of change was associated with degree of agreement that insufficient sleep can cause sleepiness (OR=1.17,p=0.035), weight gain (OR=1.20,p<0.0005), heart disease (OR=1.21,p=0.001), cholesterol (OR=1.13,p=0.047), hypertension (OR=1.16,p=0.014), moodiness (OR=1.42,p<0.0005), decreased energy (OR=1.30,p=0.002), absenteeism (OR=1.13,p=0.007), decreased performance (OR=1.20,p=0.003), concentration/memory problems (OR=1.23,p=0.004), diabetes (OR=1.14,p=0.042), and feeling tired (OR=1.39,p<0.0005). When sleep duration was added to the model, significant associations remained for all except cholesterol. When accounting for insomnia, significant associations were maintained for only weight, moodiness, performance, diabetes, and tiredness.

CONCLUSIONS: Degree of belief that insufficient sleep can cause outcomes such as moodiness, occupational problems, and health problems may impact whether an individual is contemplating/attempting to change their sleep-related behaviors. Targeting these key messages about the associations between sleep health with moodiness and weight gain in informational material may enhance education/outreach efforts aimed at adults.

Keywords

Sleep Health Behaviors; Moodiness; Weight Gain; Stages of Change; Sleep Health; Interventions

INTRODUCTION

Several studies have outlined the consequences of insufficient sleep across health, social, and occupational domains (1). Given these well-documented effects, a better understanding of the factors that motivate behavior change in this domain are needed. Identification of such factors may provide insight on improving sleep education and intervention efforts.

According to the transtheoretical model of behavior change, individuals progress through several different stages of change prior to modifying or adopting a new behavior (2). The first stage of the model posits that individuals are in a state of “precontemplation” where change is not considered. The second stage is “contemplation,” where an individual may consider modifying their behavior but is not planning to act within the next 6 months (2). The third stage consists of “preparation,” where the individual decides to engage in changing their behavior within the next 6 months but is not currently active in doing so. The fourth stage, “action,” describes when an individual commits to and is attempting to change. The fifth stage, “maintenance,” occurs when the change is maintained for a period of 6 months consistently. The final stage, relapse, describes the likelihood of stopping the changed behavior or reverting to previous behavior (2). This model has been adopted across

a wide range of health behaviors. For example, studies related to nicotine addiction have noted that change in behavior can be facilitated by identifying the stage of change an individual identifies with and then modifying interventions to meet the individual at that stage and facilitate progression to the next stage (3,4). Similar findings have also been noted for alcohol dependency and drug use (5,6).

Prior research has provided evidence that insufficient sleep and sleep disorders cause significant impairment in cognitive function, physical health and lead to a broad assortment of health problems (7–9). However, the specific factors that engender short or long-term changes in sleep behavior are not fully explored. Clinically, patients seek treatment when their sleep disturbances lead to problems with their health, perceived daytime cognition deficits, and sleep loss (10). A study of group-based treatment for insomnia found that a motivating factor for seeking treatment among patients was to address feelings of isolation from healthy sleepers (11). In contrast, when patients were asked reasons why they did not seek treatment for insomnia, it was reported that symptoms were perceived as trivial and self-manageable while awareness of the importance of healthy sleep was lacking (12). The contradictory findings between studies as to what predicts change in sleep habits suggests a differential relationship between certain adverse outcomes and their likelihood of serving as catalysts for change.

Accordingly, the current study aims to identify whether perceived adverse consequences of insufficient sleep are associated with reported intention to change sleeping habits, and the degree to which each variable influences this belief. Additionally, the role of baseline sleep duration and severity of insomnia symptoms on intention to change sleep behavior will be examined.

PARTICIPANTS AND METHODS

Data Source

Data were obtained from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, examining a community-dwelling sample of N=1007 adults between the ages of 22–60 in Philadelphia and 4 neighboring counties. Participants were recruited through local community centers and advertisements resulting in a diverse set of participants. All participants were free of major medical or psychiatric conditions, not pregnant, and able to provide informed consent. The institutional Review Board of the University of Pennsylvania approved this study.

Measures

Participants were asked to identify their intention to modify their sleeping habits by contemplating the following question: “Think about the single most important thing you personally could do to improve your sleep.” Responses consisted of (1) “I am not thinking of making this change;” (2) “I am thinking about making this change, but not in the next 6 months;” (3) “I am thinking about making this change in the next 6 months or so;” (4) “I am trying to make this change at the moment.” Each answer corresponds to a different stage of change as described by the transtheoretical model consisting of precontemplation

(not considered change), contemplation (considered making the change but not decided to act within the next 6 months), preparation (decided to act within the next 6 months but not acting), and action stages (attempting to make the change) (2).

The Sleep and Practices and Attitudes Questionnaire (SPAQ) (13) was also administered. Specifically, items from the social norms subscale identifying the level of agreement participants had about insufficient sleep leading to detrimental health and behavior were administered. Participants self-rated the degree to which they agreed with statements indicating that “not getting enough sleep” could cause any of the following: sleepiness, drowsy driving, weight gain, heart disease, high cholesterol, hypertension, moodiness, lower energy, decreased sex drive, missed days at work, decreased performance, memory concentration problems, diabetes, and/or tiredness on a 1–5 scale with lower scores disagreeing and higher scores agreeing with the statement. The SPAQ has previously demonstrated validity in the context of other health behaviors and sleep behaviors (13).

Covariates that were included in analyses included self-reported age, sex, education level, and race/ethnicity. These were included because not only are all of them related to sleep experience (14), but the relationship between sleep and health outcomes has been shown to vary across these sociodemographic dimensions (15). Additional covariates included sleep duration, assessed using the item from the National Health and Nutrition Examination Survey (NHANES), which records hours of sleep on a typical night (16). This variable has been found to be useful in many studies linking sleep and health outcomes (17). Insomnia severity was also assessed and was reflected by scores on the Insomnia Severity Index (ISI). The ISI is a gold-standard clinical screening tool for insomnia (18) and can reflect clinical and subclinical symptoms (19).

Statistical Analyses

To determine whether degree of belief about specific impacts of sleep loss are associated with stage of change, ordinal logistic regression analyses, with stage of change as the ordinal outcome and belief variable (as a linear variable, with higher values indicating greater degree of agreement) as predictor. These relationships were evaluated without adjustment for covariates and after adjustment for age, race/ethnicity, and education level. To examine the degree to which these relationships simply reflect level of sleep loss already experienced, sleep duration was entered as an additional covariate. Further, to assess the severity of existing insomnia symptoms, ISI score was added to a final model that included all covariates, as well as sleep duration. Finally, with the assumption that the relationships between sleep beliefs and intended behavior likely overlap across various beliefs, a forward stepwise procedure was employed, whereby all beliefs variables were evaluated simultaneously in order to establish the most parsimonious model that includes only variables that contribute unique variance, separate from all others. All statistical tests are reflected as ordinal odds ratios, or the relative odds of increasing one level of the ordinal variable, as well as 95% confidence intervals. All analyses were performed using STATA 14.0 (STATA Corp, College Station, TX).

RESULTS

Characteristics of the sample

Characteristics of the sample are reported in Table 1. Approximately 42% of the sample reported that they were trying to do something to improve their sleep. Examining those that were not actively trying to improve their sleep (i.e., in “Action” stage of change), about 24% reported that they intend to take action (i.e., in “Preparation” stage of change), about 10% reported that they had thought about taking action but had not yet begun to take action (i.e., “Contemplation” stage of change), and about 25% reported that they had not thought about making a change to their sleep (i.e., “Precontemplation” stage of change). Overall, the sample had a mean age of 34 years (standard deviation = 9.4), with 61% of the sample being female. Approximately 40% of the sample was of a racial/ethnic minority background and 56% reported a college education. The mean sleep duration of the sample was approximately 6.5 hours and the mean ISI score was approximately 11, indicating mild insomnia. The observed range for ISI scores was between 6 and 17.

Characteristics regarding perceived consequences for lack of sleep are also reported in Table 1. The proportion of the sample that endorsed agreement or strong agreement for various consequences, included 92% for sleepiness, 31% for sleepy driving, 51% for weight gain, 36% for heart disease, 32% for cholesterol, 75% for blood pressure, 93% for moodiness, 95% for energy level, 65% for sex drive, 54% for missed days at work, 81% for performance, 87% for memory, 22% for diabetes, and 97% for tiredness.

Univariate comparisons of all these variables across reported stage of change are also reported in Table 1. Higher stage of change was associated with race/ethnicity for Non-Hispanic Whites, and education in chi-square analyses. Higher stage of change was associated with shorter sleep duration and increased insomnia severity (all $p < .0001$). Significant chi-square tests across levels of beliefs relative to stage of change were seen for sleepiness, weight, heart disease, cholesterol, moodiness, energy level, performance, memory, and tiredness (all $p < 0.05$).

Beliefs about consequences of lack of sleep associated with stage of change of sleep improvement

Results of ordinal logistic regression analyses in unadjusted and adjusted models are reported in Table 2. In unadjusted analyses, increased levels of belief that not enough sleep can lead to a range of consequences was associated with increased stage of change. These consequences included sleepiness, weight, heart, blood pressure, moodiness, energy level, missed days, performance, memory, and tiredness. When analyses were adjusted for age, sex, race/ethnicity, and education (also in Table 2), results were maintained for sleepiness, weight, heart, cholesterol, blood pressure, moodiness, energy, missed days, performance, memory, diabetes, and tiredness. Of note, if a Bonferroni correction were applied, reducing the significance criterion to 0.0035, only relationships with weight, moodiness, energy level, performance, and tiredness would be maintained.

Results of analyses adjusted for sleep duration and insomnia

To explore the role of sleep characteristics in this sample, models were computed with sleep duration as an additional covariate and both sleep duration and insomnia severity as additional covariates. These results are reported in Table 3. In a model that included age, sex, race/ethnicity, education, and sleep duration, stage of change was still associated with degree of agreement that lack of sleep can result in changes to weight, heart, blood pressure, moodiness, energy level, missed days, performance, memory, diabetes, and tiredness. When insomnia severity was added to the model, associations were notably attenuated, but significant associations were still seen for weight, moodiness, performance, diabetes, and tiredness. This suggests that the relationship between these factors and attempts to improve sleep are independent of sleep duration and quality.

Stepwise regression results

As an exploration of which beliefs are overlapping with others, a forward stepwise regression analysis was performed, and results are displayed in Table 4. When all belief domains were examined, along with age, sex, and education, the final model included only moodiness and weight. To follow up on these findings, an ordinal logistic regression analysis examined a weight by moodiness interaction, but no interaction was observed ($p > 0.05$).

DISCUSSION

The current study assessed the association between the degree of belief that insufficient sleep causes various health consequences and how such beliefs may influence the level of desire to improve one's sleep. Our results suggest that consequences such as sleepiness, weight gain, heart disease, high cholesterol, moodiness, low energy level, suboptimal performance, memory problems, and tiredness were all related to stages of change. The associations between short sleep duration and weight, heart disease, blood pressure, moodiness, energy level, missed days, performance, memory, diabetes, tiredness and stages of change were positive and statistically significant at the $p < .05$ level. However, when examined with the inclusion of insomnia symptoms, statistically significant associations were maintained only for weight, moodiness, performance, diabetes, and tiredness. One reason why insomnia may yield fewer associations compared to short sleep may be because it is perceived as a more salient condition; as such, it might be a stronger motivator for improving sleep. The motivation to change and improve sleep may thus have secondary benefits that positively impact health. It is also possible that the effects of insomnia are substantially more severe than short sleep duration such that it overshadows contributions from other factors. Alternatively, short sleep may be the result of choice whereas insomnia is not, therefore, motivation to change sleep behavior may be stronger for insomnia. Despite these differences, the presence of short sleep duration or insomnia yielded a higher stage of change suggesting that experiencing insufficient sleep—in any form—leads to greater motivation for change. This makes sense, since those most satisfied with their sleep are presumably least likely to want to change it. Finally, overlapping negative consequences (e.g., sleepiness, heart disease, memory impairments, etc.) were found to be insignificant indicators of eliciting change except for moodiness and weight combined. It is interesting to note that the two factors that most robustly and independently predicted increased stage

of change were “moodiness” and “weight.” This confluence suggests that affect and weight management represent two major categories of impact of sleep loss (i.e., mental and physical health), which confer separate effects on likelihood of change. It also suggests that messages that will most resonate with individuals might make use of these concepts in some integrated fashion.

Our findings suggest that the presence of certain perceived consequences along with insufficient sleep can serve as an impetus for changing sleep behavior. Interestingly, specific factors such as weight, heart health, cholesterol, moodiness, energy level, performance, memory and tiredness were among the most significant predictors of change. It’s possible that these consequences were strongly endorsed because their manifestation may be a precursor to chronic health problems and/or occupational difficulties. Several studies have demonstrated significant associations between obesity and long-term health problems (20), cholesterol and cardiovascular disease (21), memory impairment and neurocognitive disorders (22,23), moodiness and psychological disorders (24,25), and increased job stress owing to disturbed sleep (26,27). Therefore, it may be that a seemingly apparent deterioration of health leads to re-consideration of sleeping habits. In support of this notion, participants endorsing short sleep duration and insomnia both indicated a greater desire to modify their sleeping habits. Insufficient sleep may predispose individuals towards higher stages of change because their beliefs about the negative consequences are reinforced from direct personal experience as opposed to indirect influences (i.e., from secondary sources such as friends, family, or media).

Inclusion of short sleep duration and insomnia attenuated the relationships observed between stage of change and belief of negative sleep consequences. However, significant associations remained for weight, moodiness, performance, diabetes, and tiredness in relation to the highest stage of change. This demonstrates that short sleep duration and insomnia are thought to account for only a limited number of the negative consequences endorsed by participants.

Numerous studies have documented the negative health and psychosocial outcomes of short sleep and insomnia (28). That said, an accurate, comprehensive list is not fully known of what participants may or may not view as significant consequences. Exactly how a participant views the consequences of poor sleep is important because such personal expectations may not align with research expectations. For instance, sleepy driving is a predictor of automobile accidents and injury (29) and was expected to be significantly associated with spurring sleep behavior change in the present study. However, participants did not endorse sleepy driving as a significant enough consequence to engender change. It may be that instances of sleepy driving are nonexistent or rarely occur with the sample, and as such, the issue is not viewed as a health matter related to insufficient sleep.

Patients often do not seek aid for sleep problems owing to a general lack of knowledge about the importance of sleep (11). The findings from the current study offer evidence that short sleep duration by itself or combined with insomnia and the perception of direct negative consequences may yield concrete steps toward change among those in the community. Sleep health campaigns or clinicians emphasizing the importance of sleep to the public may find

it beneficial to highlight specific consequences related to chronic health problems resulting from insufficient sleep (e.g., moodiness and weight gain)—as opposed to mentioning a litany of negative consequences that may overwhelm the message and the listener.

Limitations

The study cohort was obtained from a local community and is not generalizable to a nationally representative sample. Another limitation revolves around the question posed to participants (i.e., “Think about the single most important thing you could personally do to improve your sleep.”) where improvements were not recorded beyond asking participants to visualize them. Data were self-reported and may not offer information comparable to objective measures. In addition, the cross-sectional nature of the study limits the ability to draw causal inferences.

Conclusions and future directions

The degree to which an individual believes insufficient sleep leads to adverse consequences may influence the likelihood of changing sleep habits. In particular, negative outcomes related to mood, problems at work, and health problems may be prime areas of concern. Outreach efforts to educate and improve awareness of sleep within the local community and general population should prioritize the importance of these domains and the resulting consequences of insufficient sleep. However, education about unhealthy sleeping by itself is not a sufficient catalyst for change. These efforts should be further supplemented with resources that address barriers to achieving healthy sleep within the context of the models of behavior change. For example, it is unclear what specific factors cause an individual to advance or remain in each stage of the model. The findings from the current study indicate that certain adverse consequences are a strong motivator in enabling change, suggesting that avoidance of these negative experiences is important. While avoidance is a powerful reinforcer for change, it may not be the sole variable nor the most appropriate for lasting change. Instead, it is possible that positive messages may elicit habitual change that is maintained over a sustained period of time. For example, rather than focus on avoidance of adverse outcomes (e.g., more moodiness, weight gain, worse performance), perhaps messages could focus on positive messages (e.g., improved mental health, better weight control, improved performance). Therefore, potential avenues of future research could investigate optimal messages that contribute to modifying sleep behavior for each of the different stages of change under various forms of reinforcement.

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Table 1.

Characteristics of the Sample

Variable	Category / Units	Complete Sample	Stratified by stage of change of improving sleep				
			Pre-Contemplation	Contemplation	Preparation	Action	p
N		1,007	254	98	237	418	
Age	Years	34.0 ± 9.4	34.8 ± 10.2	33.0 ± 9.7	33.0 ± 8.6	34.3 ± 9.4	0.0925
Sex	Male	38.53%	39.76%	43.88%	40.08%	35.65%	0.383
	Female	61.47%	60.24%	56.12%	59.92%	64.35%	
Race/Ethnicity	Non-Hispanic White	59.52%	61.35%	50.00%	65.25%	57.42%	0.0267
	Black/African-American	25.02%	24.30%	29.59%	19.92%	27.27%	
	Hispanic/Latino	4.59%	2.79%	8.16%	2.97%	5.74%	
	Asian	5.48%	7.17%	9.18%	5.51%	3.59%	
	Other/Multiracial	5.38%	4.38%	3.06%	6.36%	5.98%	
Education	College	55.91%	60.63%	47.96%	54.85%	55.50%	0.0429
	Some College	30.98%	26.38%	30.61%	34.60%	31.82%	
	High School	10.53%	10.63%	15.31%	7.17%	11.24%	
	Less Than High School	2.58%	2.36%	6.12%	3.38%	1.44%	
Sleep Duration	Hours	6.46 ± 1.57	6.98 ± 1.28	6.48 ± 1.78	6.39 ± 1.42	6.17 ± 1.69	<.0001
Insomnia Severity	ISI Score	10.6 ± 6.3	6.30 ± 5.15	9.90 ± 5.11	11.46 ± 5.64	12.79 ± 6.34	<.0001
Consequence: Sleepy	Strongly Disagree	1.19%	1.18%	2.04%		1.67%	0.005
	Disagree	4.17%	4.72%	8.16%	2.11%	4.07%	
	Unsure	2.38%	1.57%	4.08%	3.38%	1.91%	
	Agree	44.89%	49.21%	54.08%	45.99%	39.47%	
	Strongly Agree	47.37%	43.31%	31.63%	48.52%	52.87%	
Consequence: Sleepy Driving	Strongly Disagree	25.92%	27.95%	20.41%	26.58%	25.60%	0.455
	Disagree	31.78%	29.13%	34.69%	36.71%	29.90%	
	Unsure	10.92%	8.66%	15.31%	10.13%	11.72%	
	Agree	21.15%	22.83%	21.43%	18.99%	21.29%	
	Strongly Agree	10.23%	11.42%	8.16%	7.59%	11.48%	
Consequence: Weight	Strongly Disagree	9.53%	11.81%	13.27%	9.70%	7.18%	0.0318
	Disagree	15.19%	20.47%	18.37%	12.66%	12.68%	
	Unsure	24.63%	22.05%	20.41%	29.11%	24.64%	
	Agree	33.37%	29.92%	35.71%	32.91%	35.17%	
	Strongly Agree	17.28%	15.75%	12.24%	15.61%	20.33%	

Variable	Category / Units	Complete Sample	Stratified by stage of change of improving sleep				p
			Pre-Contemplation	Contemplation	Preparation	Action	
Consequence: Heart	Strongly Disagree	5.96%	9.06%	9.18%	3.38%	4.78%	0.0053
	Disagree	11.32%	12.99%	20.41%	10.13%	8.85%	
	Unsure	46.38%	44.88%	38.78%	49.37%	47.37%	
	Agree	26.61%	24.80%	19.39%	29.54%	27.75%	
	Strongly Agree	9.73%	8.27%	12.24%	7.59%	11.24%	
Consequence: Cholesterol	Strongly Disagree	5.66%	7.09%	11.22%	4.22%	4.31%	0.0494
	Disagree	10.82%	14.17%	15.31%	9.28%	8.61%	
	Unsure	51.54%	46.85%	40.82%	55.27%	54.78%	
	Agree	23.93%	23.62%	26.53%	22.78%	24.16%	
	Strongly Agree	8.04%	8.27%	6.12%	8.44%	8.13%	
Consequence: Blood Pressure	Strongly Disagree	5.16%	7.87%	11.22%	3.80%	2.87%	0.0784
	Disagree	10.13%	9.84%	12.24%	9.28%	10.29%	
	Unsure	46.28%	46.06%	40.82%	46.41%	47.61%	
	Agree	29.00%	27.56%	29.59%	30.80%	28.71%	
	Strongly Agree	9.43%	8.66%	6.12%	9.70%	10.53%	
Consequence: Moodiness	Strongly Disagree	1.29%	1.97%	4.08%	0.42%	0.72%	0.0032
	Disagree	2.48%	3.94%	4.08%	2.11%	1.44%	
	Unsure	2.98%	3.54%	4.08%	2.53%	2.63%	
	Agree	45.98%	50.39%	52.04%	47.68%	40.91%	
	Strongly Agree	47.27%	40.16%	35.71%	47.26%	54.31%	
Consequence: Energy Level	Strongly Disagree	0.79%	0.79%	1.02%	0.42%	0.96%	<.0001
	Disagree	2.18%	0.79%	8.16%	0.84%	2.39%	
	Unsure	2.38%	1.97%	2.04%	3.38%	2.15%	
	Agree	40.32%	51.97%	48.98%	40.08%	31.34%	
	Strongly Agree	54.32%	44.49%	39.80%	55.27%	63.16%	
Consequence: Sex Drive	Strongly Disagree	5.16%	6.30%	7.14%	3.80%	4.78%	0.8715
	Disagree	8.04%	9.06%	10.20%	7.17%	7.42%	
	Unsure	22.24%	21.26%	25.51%	23.21%	21.53%	
	Agree	39.03%	39.37%	34.69%	41.35%	38.52%	
	Strongly Agree	25.52%	24.02%	22.45%	24.47%	27.75%	
Consequence: Missed Days	Strongly Disagree	10.03%	14.17%	10.20%	8.44%	8.37%	0.0703
	Disagree	22.84%	25.20%	21.43%	20.68%	22.97%	
	Unsure	13.01%	13.39%	17.35%	14.35%	11.00%	
	Agree	34.06%	29.13%	34.69%	39.66%	33.73%	

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Variable	Category / Units	Complete Sample	Stratified by stage of change of improving sleep					p
			Pre-Contemplation	Contemplation	Preparation	Action		
	Strongly Agree	20.06%	18.11%	16.33%	16.88%	23.92%		
Consequence: Performance	Strongly Disagree	3.18%	4.72%	5.10%	1.69%	2.63%	0.0185	
	Disagree	7.55%	9.06%	13.27%	5.49%	6.46%		
	Unsure	8.34%	7.09%	9.18%	7.59%	9.33%		
	Agree	49.35%	53.15%	48.98%	53.16%	44.98%		
	Strongly Agree	31.58%	25.98%	23.47%	32.07%	36.60%		
Consequence: Memory	Strongly Disagree	1.39%	2.76%	2.04%		1.20%	0.0021	
	Disagree	4.07%	3.15%	6.12%	2.95%	4.78%		
	Unsure	7.55%	7.48%	12.24%	7.59%	6.46%		
	Agree	47.96%	56.30%	50.00%	47.26%	42.82%		
	Strongly Agree	39.03%	30.31%	29.59%	42.19%	44.74%		
Consequence: Diabetes	Strongly Disagree	7.35%	10.63%	11.22%	5.06%	5.74%	0.1785	
	Disagree	12.61%	13.78%	17.35%	12.66%	10.77%		
	Unsure	58.49%	55.51%	48.98%	59.07%	62.20%		
	Agree	14.60%	12.99%	14.29%	15.61%	15.07%		
	Strongly Agree	6.95%	7.09%	8.16%	7.59%	6.22%		
Consequence: Tired	Strongly Disagree	0.79%	0.79%	2.04%	0.84%	0.48%	0.0077	
	Disagree	1.19%	1.57%	3.06%	0.84%	0.72%		
	Unsure	1.39%	1.97%	4.08%	0.42%	0.96%		
	Agree	33.27%	38.98%	38.78%	33.33%	28.47%		
	Strongly Agree	63.36%	56.69%	52.04%	64.56%	69.38%		

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Table 2.

Results of ordinal regression analyses examining associations between stage of change and beliefs about the impacts of sleep (unadjusted and adjusted for age, sex, race/ethnicity, and education level)

Variable	Unadjusted			Adjusted		
	OR	95% CI	p	OR	95% CI	p
Sleepy	1.16	(1.01, 1.34)	0.034	1.17	(1.01, 1.35)	0.035
Sleepy Driving	1.02	(0.93, 1.11)	0.725	1.02	(0.94, 1.12)	0.606
Weight	1.19	(1.08, 1.31)	<0.0005	1.20	(1.09, 1.33)	<0.0005
Heart	1.20	(1.07, 1.35)	0.002	1.21	(1.08, 1.36)	0.001
Cholesterol	1.12	(1.00, 1.27)	0.058	1.13	(1.00, 1.28)	0.047
Blood Pressure	1.15	(1.02, 1.29)	0.021	1.16	(1.03, 1.31)	0.014
Moody	1.40	(1.21, 1.62)	<0.0005	1.42	(1.22, 1.65)	<0.0005
Energy	1.31	(1.12, 1.53)	0.001	1.30	(1.10, 1.52)	0.002
Sex Drive	1.09	(0.98, 1.21)	0.107	1.09	(0.98, 1.21)	0.125
Missed Days	1.14	(1.04, 1.25)	0.004	1.13	(1.03, 1.24)	0.007
Performance	1.19	(1.06, 1.33)	0.003	1.20	(1.07, 1.35)	0.003
Memory	1.22	(1.06, 1.40)	0.004	1.23	(1.07, 1.41)	0.004
Diabetes	1.13	(1.00, 1.27)	0.059	1.14	(1.00, 1.29)	0.042
Tired	1.37	(1.16, 1.63)	<0.0005	1.39	(1.17, 1.66)	<0.0005

Table 3.

Results of ordinal regression analyses examining associations between stage of change and beliefs about the impacts of sleep (adjusted for covariates plus sleep duration and covariates plus sleep duration and insomnia severity)

Variable	Adjusted for Sleep Duration			Adjusted for Sleep Duration + Insomnia Severity		
	OR	95% CI	p	OR	95% CI	p
Sleepy	1.13	(0.98, 1.31)	0.093	1.04	(0.90, 1.21)	0.594
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.93	(0.85, 1.01)	0.099
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Sleepy Driving	1.01	(0.93, 1.10)	0.803	0.99	(0.90, 1.08)	0.817
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.93	(0.85, 1.01)	0.094
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Weight	1.17	(1.06, 1.30)	0.002	1.11	(1.00, 1.23)	0.046
<i>Sleep Duration</i>	0.77	(0.70, 0.87)	0.000	0.93	(0.85, 1.02)	0.108
<i>Insomnia Severity</i>				1.14	(1.11, 1.17)	0.000
Heart Disease	1.21	(1.07, 1.36)	0.002	1.13	(1.00, 1.28)	0.051
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.92	(0.85, 1.01)	0.086
<i>Insomnia Severity</i>				1.14	(1.11, 1.17)	0.000
Cholesterol	1.13	(1.00, 1.28)	0.054	1.08	(0.95, 1.23)	0.252
<i>Sleep Duration</i>	0.76	(0.70, 0.82)	0.000	0.93	(0.85, 1.01)	0.849
<i>Insomnia Severity</i>				1.14	(1.12, 1.17)	0.000
Blood Pressure	1.17	(1.03, 1.32)	0.012	1.12	(0.98, 1.27)	0.087
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.93	(0.85, 1.01)	0.083
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Moody	1.42	(1.22, 1.65)	<0.0005	1.23	(1.05, 1.44)	0.010
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.92	(0.84, 1.00)	0.063
<i>Insomnia Severity</i>				1.14	(1.12, 1.17)	0.000
Energy	1.32	(1.13, 1.56)	0.001	1.09	(0.92, 1.29)	0.335
<i>Sleep Duration</i>	0.76	(0.70, 0.82)	0.000	0.92	(0.84, 1.01)	0.079
<i>Insomnia Severity</i>				1.14	(1.11, 1.17)	0.000
Sex Drive	1.11	(1.00, 1.24)	0.050	1.06	(0.95, 1.19)	0.282
<i>Sleep Duration</i>	0.76	(0.70, 0.82)	0.000	0.92	(0.85, 1.01)	0.082
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Missed Days	1.12	(1.02, 1.23)	0.015	1.03	(0.94, 1.13)	0.526
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.93	(0.84, 1.01)	0.094
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000

Variable	Adjusted for Sleep Duration			Adjusted for Sleep Duration + Insomnia Severity		
	OR	95% CI	p	OR	95% CI	p
Performance	1.24	(1.10, 1.39)	0.001	1.13	(1.00, 1.28)	0.047
<i>Sleep Duration</i>	0.75	(0.70, 0.82)	0.000	0.92	(0.84, 1.00)	0.064
<i>Insomnia Severity</i>				1.14	(1.12, 1.17)	0.000
Memory	1.24	(1.08, 1.43)	0.002	1.06	(0.91, 1.23)	0.466
<i>Sleep Duration</i>	0.76	(0.70, 0.82)	0.000	0.92	(0.85, 1.00)	0.082
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Diabetes	1.15	(1.01, 1.30)	0.032	1.14	(1.00, 1.30)	0.047
<i>Sleep Duration</i>	0.76	(0.70, 0.82)	0.000	0.93	(0.85, 1.01)	0.088
<i>Insomnia Severity</i>				1.15	(1.12, 1.17)	0.000
Tired	1.38	(1.16, 1.65)	<0.0005	1.25	(1.05, 1.50)	0.015
<i>Sleep Duration</i>	0.76	(0.70, 0.83)	0.000	0.93	(0.85, 1.01)	0.085
<i>Insomnia Severity</i>				1.14	(1.11, 1.17)	0.000

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Table 4.

Results of forward stepwise ordinal regression analyses examining associations between stage of change and beliefs about the impacts of sleep

Variable	OR	Z score	95% CI	P
Moody	1.34	3.90	(1.16, 1.56)	<0.0001
Weight	1.15	2.88	(1.05, 1.27)	0.004

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