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Behavioral and psychosocial factors associated with insomnia in adolescents with chronic pain

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Abstract

This study aimed to (1) identify differences in sleep behaviors, sleep quality, pre-sleep arousal and prevalence of insomnia symptoms in adolescents with chronic pain compared to a healthy age and sex-matched cohort, and (2) examine pain intensity, pubertal development, depression, and pre-sleep arousal as risk factors for insomnia symptoms. Participants included 115 adolescents, 12–18 years of age (73.0% female), 59 youth with chronic pain and 56 healthy youth. During a home-based assessment, adolescents completed validated measures of pain, sleep quality, sleep hygiene, pre-sleep arousal, depressive symptoms, and pubertal development. Findings revealed a significantly higher percentage of adolescents with chronic pain reporting symptoms of insomnia (54.2%) compared to healthy adolescents (19.6%), $p < .001$. Youth with chronic pain also reported higher cognitive and somatic arousal at bedtime, and lower sleep quality compared to the healthy cohort. In a logistic regression, two factors emerged as significant predictors of insomnia, having chronic pain (OR = 6.09) and higher levels of cognitive pre-sleep arousal (OR = 1.24). Level of pain intensity did not predict insomnia. While sleep disruption may initially relate to pain, these symptoms may persist into a separate primary sleep disorder over time due to other behavioral and psychosocial factors. Assessment of insomnia may be important for identifying behavioral targets for the delivery of sleep-specific interventions to youth with chronic pain.

INTRODUCTION

Sleep problems are frequently reported by children and adolescents with chronic pain [2,3,18,19,30,34]. Pediatric insomnia, a sleep disturbance of particular interest, includes difficulty falling asleep, frequent night waking, and early morning awakenings [28]. Specific estimates of insomnia are available in several studies. For example, among children

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DISCLOSURE STATEMENT

None of the authors have any conflicts to disclose.

Summary of "Behavioral and psychosocial factors associated with insomnia in adolescents with chronic pain"

More youth with chronic pain experienced difficulties initiating or maintaining sleep compared to healthy youth. Presence of chronic pain and cognitive arousal increased insomnia risk.

referred for limb pain, 54% reported insomnia symptoms [16]. In another small pilot study, over half of adolescents with mixed chronic pain conditions had difficulty falling asleep or maintaining sleep compared to 10% of healthy adolescents [25]. Importantly, in adolescents with chronic pain, insomnia has been associated with lower quality of life and increased functional limitations [16,25], suggesting that the consequences of insomnia may be far-reaching in this population. No studies, however, have specifically identified behavioral or psychosocial factors associated with insomnia symptoms in youth with chronic pain, limiting our ability to intervene with potentially modifiable factors.

Adolescents have been the focus of increasing study over the past few decades to better understand their sleep demands, patterns, and bioregulatory processes [5,8]. Adolescents often do not get enough sleep and have inconsistent and delayed sleep patterns, significant daytime sleepiness, and higher rates of insomnia compared to younger children [32,38]. Therefore, we chose to focus on an adolescent sample in the present study and to measure behavioral and psychosocial factors found to relate to sleep disturbances in previous studies on adolescent sleep.

Specifically, we assess several behaviors and processes that are important in the adult literature on insomnia [14] and are emerging as important in characterizing sleep in the child and adolescent population [13], sleep habits and pre-sleep arousal (somatic and cognitive arousal present at bedtime). In otherwise healthy youth, pre-sleep arousal, particularly cognitive arousal, has been found to relate to sleep disturbances [13]. Because laboratory studies have demonstrated that adolescents experience a delay in the timing of their sleep during puberty [6,7], pubertal development was also considered. Finally, previous work in youth with chronic pain has identified depressive symptoms as an important predictor of sleep disturbance [1,15].

The study was designed to extend previous descriptive studies of sleep problems in youth with chronic pain by specifically characterizing behavioral and psychosocial factors associated with insomnia using a case-control cohort design. Similar to previous pilot studies [25], we hypothesized that adolescents with chronic pain would have increased prevalence of insomnia symptoms, poorer sleep hygiene and sleep quality, and higher levels of cognitive and somatic arousal at bedtime compared to a group of healthy peers [1,15]. We hypothesized that more advanced pubertal development, higher pain intensity, greater depressive symptoms, poorer sleep habits, and higher levels of pre-sleep arousal would be associated with insomnia symptoms.

METHOD

Participants

This study was approved by the Institutional Review Board at the academic medical center where the study was conducted. Written informed consent was obtained from parents and guardians, and written assent was obtained from adolescents for participation in this study. Participants with chronic pain were recruited from a multidisciplinary pediatric chronic pain clinic via a letter or in person during a clinic visit. Inclusion criteria for youth with chronic pain were that (a) the participants were between 12 and 18 years and were currently receiving an evaluation from the pain clinic, (b) pain had been present for at least 3 months, (c) pain was occurring at a frequency of at least three days per week, (d) pain was not related to chronic disease, (e) there was no diagnosis of developmental disabilities, and (f) the participants were able to speak and understand English.

The healthy comparison group was recruited through postings advertising the study in the local metropolitan area. Interested participants were screened by the research team.

Inclusion criteria included (a) age between 12 and 18 years, (b) absence of chronic pain, (c) age (within six months) and sex match to an adolescent in the chronic pain group, (d) absence of any serious chronic medical conditions or developmental disabilities, (e) not receiving treatment for pain or sleep problems, and (f) ability to speak and understand English. Of 95 potential pain participants who were contacted, 20 (21.1%) were excluded due to not meeting eligibility criteria, 16 (16.8%) declined, and 59 (62.1%) were enrolled. Of 103 potential healthy participants, 41 (39.4%) were excluded, six (5.8%) declined, and 57 (55.8%) were enrolled. One healthy participant was excluded from analysis due to incomplete data.

Procedure

After the initial screening and enrollment, adolescents and their parents completed questionnaires during a study visit at the patients' home or an agreed upon public location (e.g., recreation center). Adolescent questionnaires included measures of pain, sleep quality, pre-sleep arousal, sleep hygiene, depressive symptoms, and pubertal development. Parents completed a demographics form. The parent and adolescent questionnaires were completed independently. After completion of the study, the participants were compensated for their time with gift cards to local stores.

Measures

Sociodemographics—Parents completed a background questionnaire assessing participants' age, sex, race, parental marital status, occupation, and family income.

Pain intensity—Adolescents were asked to rate usual pain intensity in the past month using an 11 point Numerical Rating Scale with anchors of 0 = no pain and 10 = worst pain possible. The NRS has demonstrated reliability and validity for assessing pain in children and adolescents[37].

Sleep quality and insomnia—Adolescents' self-perceived sleep quality was measured using the Adolescent Sleep Wake Scale (ASWS), developed by LeBourgeois and colleagues[17]. The ASWS is a 28-item self-report scale that assesses sleep quality using a 6-point scale, ranging from 1 = always to 6 = never, to describe the occurrence and frequency of which various sleep characteristics have occurred during the previous month. For this scale, higher scores indicate better sleep quality. Five behavioral dimensions of teens' sleep are measured by the ASWS, including going to bed, falling asleep, maintaining sleep, reinitiating sleep, and returning to wakefulness. Mean subscale scores are obtained and totaled over five subscales. Good internal consistency for the full ASWS has been demonstrated ($\alpha = .86$) [17]. In the current sample, internal consistency was adequate ($\alpha = .70$).

Insomnia symptoms were evaluated using two items from the ASWS assessing difficulty falling asleep ("I have trouble going to sleep") and difficulty maintaining sleep ("After waking up during the night, I have trouble going back to sleep"). Adolescents responding "quite often," "frequently, if not always," or "always" to either of these items were judged to have symptoms of insomnia.

Sleep hygiene—Sleep habits were measured using the Adolescent Sleep Hygiene Scale (ASHS), also developed by LeBourgeois and colleagues [17]. The ASHS was modified from the Children's Sleep Hygiene Scale [17]. This 24-item scale measures sleep-facilitating and sleep-inhibiting practices of 12- to 18-year olds along six conceptual dimensions: physiological, cognitive, emotional, sleep environment, substances, and sleep stability. Teens reported how often a particular event or behavior occurred within the previous month.

For example, teens identified activities carried out before bedtime or in bed while trying to fall asleep. Subscale scores range from 1 to 6, with higher scores indicating better sleep hygiene. Good internal consistency has been reported ($\alpha = .80$) [17], and was also observed in the current sample ($\alpha = .81$).

Pre-sleep arousal—Adolescents' pre-sleep arousal was assessed using the Pre-Sleep Arousal Scale (PSAS) [22], a 16-item self-report questionnaire measuring cognitive and somatic arousal experienced by individuals prior to sleep onset. Cognitive arousal is determined by questions pertaining to having racing thoughts, worry, and anxiety at bedtime. Somatic arousal is assessed with questions pertaining to experiencing unpleasant somatic symptoms, such as tense muscles, cold extremities, or pounding heart prior to falling asleep. Respondents report presence and intensity of these thoughts and experiences prior to falling asleep during a typical week. Responses are scored on a 5-point scale, ranging from 1 = not at all to 5 = extremely. Higher scores indicate greater arousal before falling asleep. Adequate internal consistency has been established and test-retest reliability has been reported in college students, healthy adults, adults with chronic insomnia[22], and recently in healthy adolescents[13]. In this study, we used a slightly modified version that has been used in previous work with adolescents [25]. In the current sample, internal consistency was adequate to good for the Somatic subscale ($\alpha = .74$), Cognitive subscale ($\alpha = .83$) and total scale ($\alpha = .88$).

Depressive symptoms—To assess depressive symptoms, adolescents completed the Center for Epidemiological Studies Depression Scale (CES-D) [27]. On the CES-D, scores are calculated by summing all items to yield a total score (range 0 – 60) with higher scores indicating greater depressive symptoms. The CES-D has demonstrated adequate one-week test-retest reliability, and validity has previously been established through relationships with other anxiety and depression measures [9,27]. In the current sample, internal consistency of the CES-D was adequate ($\alpha = .74$).

Pubertal development—Adolescent perceptions of pubertal timing and status were measured utilizing the Pubertal Development Scale (PDS). This 8-item questionnaire has been widely used and has good reliability and validity [26]. Responses are scored and categorized such that higher scores indicate more advanced pubertal status. Internal consistency in the current sample was adequate for boys and slightly lower for girls ($\alpha = .76$ and .68, respectively).

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences, Version 18.0. MANOVA analyses were used to test group differences (healthy vs. pain) in sleep characteristics including level of cognitive and somatic arousal at bedtime (pre-sleep arousal), sleep quality, and sleep hygiene. Chi-squared analyses were used to examine group differences in rate of insomnia symptoms. Logistic regression was used to examine behavioral and psychosocial predictors of insomnia symptoms. Significance level was set at $p < .05$ for all analyses.

RESULTS

Description of study groups

Sample characteristics are in Table 1. Participants included 115 adolescents ($n = 59$ adolescents with chronic pain, $n = 56$ healthy adolescents), ages 12–18 years ($M = 14.95$ years, $SD = 1.72$). The majority of the sample (73.0%) was female. The majority of adolescents were Caucasian (83.5%), and the remaining were African American (6.1%),

American Indian/Alaskan Native (2.6%), and Asian (1.7%). Families were predominantly middle class, as indicated by annual household income of more than \$70,000 reported by the majority of parents (56.5%). Adolescent self-reported height and weight revealed a mean BMI of 22.9 (SD = 7.1). The majority of the sample (88%) was at the mid- to post-pubertal stage of development. On average participants reported low to moderate levels of depressive symptoms (CES-D raw score $M = 11.35$, $SD = 8.75$); 17 participants (14.8%) were above the cut-off for clinically significant depressive symptoms. Chi-square analyses revealed more participants with pain met the clinical cut-off for depression than healthy participants ($\chi^2 = 9.39$, $p = .002$). Chi-squared and t-test analyses indicated no significant differences in age, sex, ethnicity, pubertal status, or racial background between adolescents with chronic pain and otherwise healthy adolescents. Adolescents with chronic pain reported moderate usual pain intensity ($M = 6.44$, $SD = 1.75$). The most common pain locations included head and neck (39.0%), abdomen (27.1%), and extremities (16.9%). Pain occurred daily for the majority of youth with chronic pain (78.0%). Some otherwise healthy adolescents reported acute pain during the data collection period that tended to be in the low to moderate intensity range ($M = 3.09$, $SD = 2.09$).

For the total sample, usual self-reported sleep time was 8.67 hours ($SD = 1.39$) on weeknights and 9.89 hours ($SD = 1.42$) on weekend nights. Self-reported sleep time did not differ between youth with chronic pain and healthy youth. Frequent sleep delay (going to bed greater than one hour past their usual bedtime “frequently” or “most of the time”) was reported by a similar proportion of youth with pain (50.1%) and healthy youth (30.9%).

Group differences in insomnia

Prevalence of self-reported insomnia symptoms was evaluated using the two items from the ASWS assessing difficulty falling asleep and difficulty maintaining sleep. Adolescents reporting either symptom were judged to have insomnia symptoms. We compared the prevalence of self-reported insomnia symptoms in the two study groups. As hypothesized, a significantly higher proportion of adolescents with chronic pain reported insomnia (54.2%) compared to healthy adolescents (19.6%; $\chi^2 = 14.69$, $p = .000$), and both symptoms, difficulty falling asleep and difficulty maintaining sleep, were reported at significantly higher rates in youth with chronic pain (see Table 2).

Associations among pain and sleep

Multivariate analysis of variance (MANOVA) was used to examine group differences on the total and subscale scores of the Pre-Sleep Arousal Scale, the Adolescent Sleep Hygiene Scale, and the Adolescent Sleep Wake Scale (see Table 3). As expected, adolescents with chronic pain reported having significantly higher somatic, cognitive, and total scores on the pre-sleep arousal scale indicating more arousal before falling asleep than the healthy participants. The omnibus test was significant, Wilks' lambda = .88, $F(3,96) = 7.52$, $p = .001$, with small to medium effect sizes (partial eta squared ranging from .033 to .11). Similarly, as hypothesized, on the measure of sleep quality, participants with chronic pain reported worse sleep quality on most subscales compared to healthy youth. The omnibus test was significant, Wilks' lambda = .77, $F(3,96) = 6.58$, $p = .001$, with small to large effect sizes (partial eta squared ranging from .033 to .20). However, contrary to hypotheses groups did not differ on their sleep hygiene.

Behavioral and psychosocial factors associated with insomnia

In preliminary analyses, age and sex were not significantly related to insomnia and thus were not included in the regression model. Study group (pain vs. healthy), pubertal status, depressive symptoms, sleep hygiene, pre-sleep arousal (cognitive and somatic subscales) and pain intensity were entered as predictors of insomnia symptoms. The logistic regression

model was significant ($X^2 = 37.46, p < .001$). Study group ($OR = 6.09, p = .007$) and cognitive pre-sleep arousal ($OR = 1.24, p = .004$) emerged as significant predictors of insomnia where higher rates of insomnia were associated with presence of chronic pain and higher levels of cognitive pre-sleep arousal (see Table 4).

DISCUSSION

In this case-control cohort study, we demonstrate that youth being treated for chronic pain had a nearly six-fold increased risk for insomnia symptoms. This finding extends previous studies conducted in other clinic-based populations that have suggested that insomnia symptoms are common among youth being treated for chronic pain [16]. Similar to our local comparison sample, 12% to 16% of healthy adolescents have been found in previous epidemiological studies to have clinically significant insomnia [21,24,28], indicating that insomnia is a frequent problem in this age group. Specifically, however, the high rate of difficulties in initiating sleep and maintaining sleep (54%) in our sample of youth with chronic pain highlights the magnitude of the problem in this clinical population.

Higher rates of insomnia symptoms among youth with chronic pain may be explained by a number of factors. In this study, we specifically examined behavioral and psychosocial factors. Findings indicated that high levels of cognitive arousal at bedtime significantly increased risk of insomnia. Cognitive arousal includes having thoughts, worry, and anxiety at bedtime that may interfere with settling to sleep. Future research examining the specific cognitive factors (e.g., rumination and anxiety) that impact nighttime sleep as well as interventions to modify youth's cognitions at bedtime will be important directions to further explore. A recent study in otherwise healthy youth found that catastrophizing thoughts about sleep were important predictors of sleep disturbances [12]. These types of cognitions may be particularly salient for youth with chronic pain who may also tend to catastrophize about their pain and disability [35]. Contrary to hypotheses, other behavioral and psychosocial factors that we assessed including depressive symptoms and sleep habits were not related to insomnia in the multivariate model.

Importantly, our results indicated that presence of chronic pain, rather than level of pain intensity, predicted insomnia. Although sleep disruption may initially relate to the experience of severe pain, these symptoms may persist or transform into a separate primary sleep disorder over time, such as in the case of persistent insomnia [23]. Over time, it is possible that behavioral patterns sustain sleep problems that are independent from effects on pain.

In addition, there are other factors that may play a role in the development or maintenance of insomnia symptoms that we were unable to fully assess. Sleep phase delays that occur naturally along with the pubertal development of adolescents may play a role in the development or persistence of insomnia symptoms [10]. Youth may encounter increased difficulties with trying to settle to sleep, especially on school nights, due to naturally occurring circadian rhythm shifts. Future studies are needed to understand whether circadian rhythm shifts may occur at similar times developmentally for youth with pain or whether phase delays are amplified by presence of chronic pain. Moreover, a variety of clinical variables may relate to the experience of insomnia such as therapies aimed at pain reduction (e.g., medications). Several medication classes used in the treatment of chronic pain may specifically change quality or quantity of sleep.

While further studies may shed additional light on the etiology of insomnia for adolescents with chronic pain, in the interim, treatment of these problems should be a priority. There is almost a complete absence of treatment research for sleep problems in adolescents.

Although psychological treatments, especially cognitive-behavioral therapies, have been identified as effective treatments for adult insomnia[20], there has been limited application of these interventions to youth (see [31] for a review of cognitive-behavioral treatment for childhood sleep disorders). There have been several sleep educational interventions developed and tested in youth with painful conditions including migraine headaches [4] and juvenile fibromyalgia[11] but these interventions were limited in scope and did not directly address insomnia symptoms.

Given the potential negative consequences of insomnia on the adolescent's ability to cope with chronic pain, it will be critical to develop and evaluate insomnia interventions in this population. It is possible that intervening to reduce insomnia symptoms may lead to significant improvements in pain and other health-related outcomes in youth with chronic pain. In adult chronic pain populations, some progress has been made in intervening to reduce insomnia symptoms. For example, in older adults with osteoarthritis pain and insomnia, Vitiello and colleagues [36] found that participants receiving cognitive-behavioral therapy for insomnia reported significantly improved sleep and significantly reduced pain immediately after treatment and at longer-term follow-up compared to an attention control group.

There are several limitations to our study that should be considered in interpreting our findings. Assessment of insomnia symptoms was limited to two retrospective self-report items about difficulty falling asleep and maintaining sleep, and impact of insomnia symptoms was not directly assessed. Future research should also use a combination of objective and subjective methods to assess sleep. While subjective assessment tools are important for obtaining self-report data on subjective perceptions of insomnia symptoms, objective assessment tools such as actigraphy would provide additional data on sleep duration and fragmentation. A second limitation is the use of cross-sectional data, which limits our ability to draw conclusions about the direction of effects. Future studies should examine longitudinal predictors of insomnia risk in this population including tracking the emergence of new insomnia symptoms. This information will aid in the development of preventative interventions designed to minimize the development of insomnia symptoms, and will inform the design of interventions targeted toward youth with chronic pain and comorbid insomnia. In addition, we were unable to thoroughly examine clinical pain variables such as pain diagnosis, or pain treatments (e.g., medications) and therefore may have overlooked other potential contributors to adolescent insomnia risk. The potential effect of clinical pain variables on sleep is an important area of future inquiry.

Given that many youth with chronic pain experience comorbid insomnia, and that previous studies have shown that sleep problems are associated with negative outcomes such as reduced quality of life, increased risk for somatic health and psychological problems, daytime sleepiness, and substance use [29,33,38], there is a critical need to focus attention on sleep in this population. Future research is needed to more clearly identify the etiology of insomnia in youth with chronic pain to provide more focused targets for sleep interventions. Assessment and treatment of sleep dysfunction is an important research priority in adolescent chronic pain management.

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Table 1

Sociodemographic and clinical characteristics of sample

	Chronic pain (n = 59)	Healthy (n = 56)	Total Sample (n = 115)
Characteristic	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)
Age (years)	15.12 (1.69)	14.76 (1.73)	14.95 (1.72)
Gender			
Male	17 (28.8%)	14 (25.0%)	31 (27.0%)
Female	42 (71.2%)	42 (75.0%)	84 (73.0%)
Pubertal status			
Prepubertal	2 (3.4%)	5 (8.9%)	7 (6.1%)
Early pubertal	3 (5.1%)	4 (7.1%)	7 (6.1%)
Mid-pubertal	23 (39.0%)	31 (55.4%)	54 (47.0%)
Late pubertal	11 (18.6%)	5 (8.9%)	16 (13.9%)
Post-pubertal	20 (33.9%)	11 (19.6%)	31 (27.0%)
Child racial background			
Caucasian	52 (88.1%)	44 (78.6%)	96 (83.5%)
African American	0 (0%)	7 (12.5%)	7 (6.1%)
Am. Indian/Alaska Native	2 (3.4%)	1 (1.8%)	3 (2.6%)
Asian	1 (1.7%)	1 (1.8%)	2 (1.7%)
Other/biracial	3 (5.1%)	3 (5.4%)	6 (5.2%)
Missing data	1 (1.7%)	0 (0.0%)	1 (0.9%)
Depressive symptoms (CES-D)	14.22 (9.87)	8.32 (6.15)	11.35 (8.75)
Meets clinical cut-off	14 (23.7%)	3 (5.4%)	17 (14.8%)
Primary pain location			
Head/neck	23 (39.0%)	9 (16.1%)	32 (27.8%)
Abdomen	16 (27.1%)	6 (10.7%)	22 (19.1%)
Extremities	10 (16.9%)	14 (25%)	24 (20.9%)
Back	8 (13.6%)	12 (21.4%)	20 (17.4%)
Other musculoskeletal ^a	2 (1.7%)	5 (8.9%)	7 (6.1%)
No location	0 (0.0%)	10 (17.9%)	10 (8.7%)
Pain frequency			
None	0 (0.0%)	8 (14.3%)	8 (7.0%)
<1 x/month	0 (0.0%)	13 (23.2%)	13 (11.3%)
1–3 x/month	0 (0.0%)	12 (21.4%)	12 (10.4%)
Once a week	0 (0.0%)	9 (16.1%)	9 (7.8%)
2–3 x/week	8 (13.6%)	7 (12.5%)	15 (13.0%)
3–6 x/week	5 (8.5%)	4 (7.1%)	9 (7.8%)

	Chronic pain (n = 59)	Healthy (n = 56)	Total Sample (n = 115)
Characteristic	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)
Daily	46 (78.0%)	2 (3.6%)	48 (41.7%)
Usual pain intensity	6.44 (1.75)	3.09 (2.09)	4.81 (2.55)

^a Other musculoskeletal locations include chest and shoulders

Table 2

Group differences on insomnia symptoms

Insomnia symptoms	Chronic Pain (<i>n</i> = 59) <i>N</i> (%)	Healthy (<i>n</i> = 56) <i>N</i> (%)	χ^2	<i>p</i>
1) Difficulty falling asleep (>60% time)	30 (50.8%)	10 (17.9%)	13.78	.000
2) Difficulty staying asleep (>60% time)	18 (30.5%)	4 (7.1%)	10.14	.001
Either 1) or 2)	32 (54.2%)	11 (19.6%)	14.69	.000
Both 1) and 2)	16 (27.1%)	3 (5.4%)	15.99	.000

Table 3

Group differences on sleep variables

Sleep variable	Chronic Pain (<i>n</i> = 59) <i>M</i> (<i>SD</i>)	Healthy (<i>n</i> = 56) <i>M</i> (<i>SD</i>)	<i>F</i> (1, 98)	<i>p</i>	Partial <i>Eta</i> <i>Squared</i>
Sleep hygiene					
Total	1.20 (.57)	1.09 (.44)	1.30	.257	.01
Physiological	1.30 (.85)	1.09 (.71)	2.14	.147	.02
Cognitive	2.02 (.81)	1.96 (.73)	.15	.698	.00
Emotional	1.06 (.96)	.88 (.74)	1.22	.272	.11
Sleep environment	.72 (.92)	.67 (.70)	.11	.736	.00
Substances	.08 (.28)	.05 (.34)	.14	.709	.00
Sleep stability	2.05 (1.18)	1.91 (.96)	.44	.507	.00
Sleep quality					
Total	3.83 (.56)	4.25 (.52)	17.80	.000	.14
Going to bed	3.83 (.92)	4.05 (.88)	1.70	.195	.02
Falling asleep	3.66 (.72)	4.35 (.66)	28.16	.000	.20
Maintaining sleep	4.22 (.86)	4.68 (.70)	10.12	.002	.08
Reinitiating sleep	4.37 (.75)	4.83 (.71)	11.30	.001	.09
Returning to wakefulness	3.06 (.83)	3.35 (.78)	3.83	.053	.03
Pre-sleep arousal					
Total	30.14 (9.71)	25.59 (6.33)	8.75	.004	.07
Cognitive	16.90 (5.67)	15.02 (4.57)	3.81	.053	.03
Somatic	13.24 (4.68)	10.57 (2.49)	14.33	.000	.11

Table 4

Logistic regression predicting presence of insomnia symptoms

Predictors:	β	SE B	Wald's χ^2	df	p	e^{β} (odds ratio)
Study group ^a	1.81	.67	7.40	1	.007	6.09
Pubertal status	-.06	.22	.07	1	.79	.94
Depressive symptoms	-.003	.4	.005	1	.94	.98
Sleep hygiene – total score	.31	.59	.28	1	.60	1.37
Pre-sleep arousal – cognitive	.21	.07	8.52	1	.004	1.24
Pre-sleep arousal – somatic	-.01	.09	.02	1	.90	.99
Pain intensity	-.06	.14	.19	1	.66	.94
			χ^2	Df	p	
Overall model evaluation:						
Score test			-33.12	7	.00	
Goodness-of-fit test:						
Hosmer & Lemeshow			4.13	8	.85	

Note: Cox and Snell $R^2 = .278$. Nagelkerke $R^2 = .379$.

^a pain = 1, healthy = 0