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Original Research Article

Pain Extent, Pain Intensity, and Sleep Quality in Adolescents and Young Adults

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Abstract

Objectives. Pain has been shown to be associated with poor sleep quality. The aim of this study was to better understand the role that pain intensity and pain extent (number of painful areas) may play in the sleep quality of young people with acute and chronic pain.

Design. Cross-sectional survey.

Setting and Patients. A convenience sample of adolescents and young adults with acute or chronic pain; 414 individuals ages 12 to 24 (44% with chronic pain).

Methods. We performed a hierarchical regression analysis with sleep as the dependent variable and pain intensity, extent, age and pain chronicity as predictors.

Results. Pain extent and pain intensity made significant and independent contributions to the prediction of sleep quality (βs = 0.23 [$P < 0.001$] and 0.14 [$P < 0.01$]). Young adults reported poorer sleep than adolescents ($\beta = 0.13$, $P < 0.01$). Two significant interactions emerged: age × intensity ($\beta = 0.39$, $P < 0.05$) and chronicity × intensity ($\beta = 0.88$, $P < 0.001$).

Conclusions. Sleep quality in young people could be improved by teaching them strategies to better manage pain intensity and pain extent. Clinical trials to evaluate the efficacy of (and best timing for) pain interventions to improve sleep quality are warranted.

Key Words. Sleep Quality; Pain Extent; Pain Intensity; Chronic Pain, Adolescents; Young Adults

Introduction

Sleep interference is a common and serious problem for individuals with acute [1–3] and chronic pain [4,5], including adolescents and young adults [6–8]. For example, among young people, better sleep quality has

been found to be positively related to higher levels of academic performance [9,10], better daily functioning and improved mood [11], lower risks of morbidity and mortality [12] and the amelioration of pain symptoms [13]. Thus, an understanding of the different pain domains that might impact sleep quality, especially those that are potentially modifiable, could help inform the development of more targeted interventions that could improve sleep in young people with pain. The resulting improvements in sleep quality would then likely contribute to numerous psychological and health benefits.

The outcome domain most commonly assessed in pain-related studies is pain intensity [14]. Research indicates that higher pain intensity levels are associated with lower sleep quality both in adults and young people [5,8]. However, pain intensity is only one of many pain domains [4,6]; other pain domains may also play an important role in sleep quality.

Pain extent (i.e., the number of body areas with pain) has been found to be associated with poorer psychological and physical functioning in adolescents [15] and with employment dysfunction in adults [16]. Moreover, pain extent has been shown to explain poor physical functioning above and beyond pain intensity in studies with adults with spinal cord injuries and muscular dystrophies [17]. Similarly, a number of studies have shown that high percentages of people with chronic widespread pain (i.e., people with multiple pain locations) also report poorer sleep quality [18,19]. It is therefore possible that pain extent may also play an important role in sleep quality over and above the effects of pain intensity alone. However, to the best of our knowledge, no one has yet examined this possibility. Knowing if pain extent contributes to the prediction of sleep quality, especially if it does so over and above the effects of pain intensity, would be important to better understand who might be at greatest risk of sleep dysfunction in individuals with chronic pain, especially in young people, and therefore who might benefit from treatments designed to improve sleep in this population.

In addition to improving our understanding of the potential role that pain extent may play in sleep quality, it would be useful to understand the potential moderating influence of both: 1) the relative chronicity of pain; and 2) the chronological age of the person. As indicated previously, research has demonstrated that pain intensity is associated with poorer sleep quality in individuals with both chronic pain and acute pain [1–3]. Similarly, we know that sleep patterns change across the lifespan. For example, adolescents more often experience disrupted sleep routines than college-age young adults [20]. It is therefore possible that the role of either pain intensity or pain extent in sleep quality may differ as a function of pain chronicity (acute vs. chronic), or as a function of the age of the person (e.g., adolescent vs. college-age). Learning about these potentially moderating effects would provide clinicians with a better understanding of *when* and *for whom* treatments might be most effective.

The primary aim of this study was to better understand the roles that both pain intensity and pain extent have in the sleep quality of adolescents and young adults with acute or chronic pain. Based on previous research demonstrating the importance of these factors as predictors of physical and psychological functioning in chronic pain samples, we hypothesized that both pain intensity and pain extent would make statistically significant and independent contributions to the prediction of sleep quality. As a secondary aim, we also wanted to explore the extent to which the associations between pain (intensity and extent) and sleep quality may be moderated by age (adolescent vs. college-aged/young adult) and pain chronicity (acute vs. chronic).

Methods

Participants and Procedures

Study participants were recruited from three sources. First, we contacted 27 Spanish associations of individuals with different pain conditions, such as headache, fibromyalgia or irritable bowel syndrome. Eight of these associations agreed to assist with subject recruitment by posting the study information on their webpage and sending information about the study to their members by e-mail. We then e-mailed the members of these associations with further details about the study along with an invitation to provide responses to the study question on a secure webpage (a password was needed to log in). Individuals from three of these associations subsequently provided responses and agreed to participate. The second source of study participants was the *Universitat Rovira i Virgili*, in Catalonia, Spain. We recruited college-age participants from this source by placing poster advertisements in and around the University campus, and providing information about the study on the research group webpage. The third source was four Spanish public secondary schools, three in the Tarragona metropolitan area and one in the city of Málaga. Participants from this last source were recruited by sending e-mails to the schools' heads of departments providing the same information as the e-mails sent to the associations.

The study inclusion criteria were: 1) being between 12 and 24 years old; and 2) being able to speak and read Spanish. The study was explained to all participants before they gave their consent. In addition, for participants who were minors, parents provided consent for their children's participation.

Participants contacted through associations or advertisements in our campus or webpage provided data via an online survey; participants from schools responded online or with a paper-and-pencil version of the questionnaires, depending on the school's preference. Those who were asked to provide data online received an

e-mail with the link to an online version of the survey, instructions to complete it on their own without any assistance from their parents or teachers, and a personal code in order to ensure anonymity. Those who chose to answer using the paper-and-pencil version of the questionnaire completed it with the same instructions. Both groups needed about 15 minutes to answer the questionnaires. In order to control the interference of holidays or exam periods on participants' sleep habits, they answered the questionnaires during the school year.

A total of 535 participants provided data. However, data from 43 (8%) were excluded because they did not meet the first inclusion criteria of the study (i.e., they were under or over the targeted age). Of the remaining 492 participants, 78 (15%) were excluded because they did not provide enough information to allow us to compute the scale scores of the study variables. The final sample consisted of 414 young people aged 12 to 24 (mean age = 16; SD = 3.3) of whom 260 were girls or young women (63%).

On these 414, 180 (44%) indicated that they had chronic pain (CP). We defined chronic pain here as pain that had occurred at least once a month for at least three months. This criterion has been successfully used in previous studies [21,22]. A total of 155 (37%) responded to the pencil-and-paper version of the questionnaires, and 259 (63%) responded online. See Table 1 for additional descriptive information about the study sample. Some data from a subset of the sample (N = 138) was used for a previous study [23] but the aims and study questions associated with that previous paper were different from the aims and study questions addressed in this present study.

Table 1 Demographic information of the participants

Age	N	%	Mean (SD)
Adolescents	291	70	14.2 (1.7)
Young adults	123	30	20.2 (1.9)
Sex	**N**	%	
Men	151	37	
Women	260	63	
Pain chronicity	**N**	%	
Acute	234	56	
Chronic	180	44	
Academic status	**N**	%	
High school	329	79	
Vocational/technical school	17	4	
University	68	17	
Average pain intensity (0–10)	**Mean**	**SD**	
	4	2.5	
Pain location	**N**	%	
Head, face and mouth	177	43	
Cervical region	112	27	
Upper shoulder and upper limbs	57	14	
Thoracic region	33	8	
Abdominal region	61	15	
Lower back, lumbar spine, sacrum, and coccyx	112	27	
Lower limbs	153	37	
Pelvic region	27	7	
Anal, perineal, and genital region	19	5	
Number of pain sites	**Mean**	**SD**	
	1.8	1.2	

Measures

Pain Location

Pain location was assessed with a pain drawing that has been used in previous studies [21]. The drawing shows the front and back views of a human body, which is divided into nine areas (head, face and mouth; cervical region, upper shoulder and upper limbs; thoracic region; abdominal region; lower back, lumbar spine, sacrum, and coccyx; lower limbs; pelvic region; anal, perineal, and genital region). Participants are asked to indicate which area(s) they experienced pain in by shading those areas on the drawing if they responded using the paper-and-pencil version of the survey, and by selecting the areas in which they experienced pain if they responded to the online version. Pain location was coded based on Axis I of the IASP Classification of Chronic Pain [24], and pain extent was computed by summing the total number of areas with pain (possible range, 0 to 9). Pain drawings are commonly used in pain research [25,26], and have support for their reliability and validity [27].

Average Pain Intensity

Average global pain intensity (i.e., averaged across all pain sites) in the past month was assessed using a 0–10 numerical rating scale (NRS-11 [4,28]), with 0 = "*no pain*" and 10 = "*worst possible pain*" as the endpoints. The NRS-11 is commonly used to assess pain intensity in pain research with young people [4,29,30], and has a great deal of evidence supporting their reliability and validity in individuals as young as 6 years old [31–33].

Sleep Quality

Sleep quality was assessed using the Adolescent and Young Adult version of the Pittsburgh Sleep Quality Index (AYA-PSQI-S [23]), which is a measure adapted from the Pittsburgh Sleep Quality Index [34]. The 18-item AYA-PSQI-S can be scored to assess six components of sleep quality in the past month: sleep onset latency, sleep duration, sleep efficiency, sleep quality, sleep disturbances, and daytime dysfunction. The sum

of the components provides a score of the global sleep quality; we used this score in the current analyses. The scores provided with the scale have shown to be valid and reliable for research purposes [23].

Data Analyses

To test the primary study hypothesis, we performed a hierarchical regression analysis with AYA-PSQI-S total score as the criterion variable. We entered the measures of pain intensity and pain extent as a block in the first step. In the second step, we entered age group (dummy coded as adolescents [12–17 years old] or young adults [18–24 years old]) and pain chronicity (acute or chronic pain). In order to evaluate the moderating effects of age and pain type on the associations between the pain variables and sleep quality, we entered the terms representing the age × pain intensity, age × pain extent, and pain chronicity × pain intensity, and pain chronicity × pain extent in the third step. Finally, we entered terms representing possible 3-way interactions (age × pain chronicity × pain intensity and age × pain chronicity × pain extent) in the fourth and final step. In the event that any interaction effect(s) emerged, we planned to perform the appropriate univariate tests to explain these effects. All of the analyses were performed using SPSS 20 for Mac (IBM Corp., Armonk, NY).

Results

The results of the regression analyses are presented in Table 2. As can be seen, both average pain intensity and pain extent made significant and independent contributions to the prediction of sleep quality. The beta weights associated with these analyses are consistent with the study hypotheses, and indicate that higher levels of both pain intensity and pain extent are associated with the endorsement of more sleep problems ($\beta s = 0.23$ [$P < 0.001$] and 0.14 [$P < 0.01$]). In step 2, age made a statistically significant contribution to the prediction of sleep quality. The direction of the beta weight associated with this analysis indicates that young adults reported poorer sleep quality than adolescents ($\beta = 0.13$, $P < 0.01$). Two significant 2-way interactions emerged: age × pain intensity ($\beta = 0.39$, $P < 0.05$) and pain chronicity × pain intensity ($\beta = 0.88$, $P < 0.001$).

In order to better understand the nature of the significant interaction effects that emerged, we computed correlations between pain intensity and sleep quality for each age group and for each pain chronicity group. Pain intensity was significantly correlated with sleep quality in the older group ($R = 0.43$, $P < 0.001$) and in the chronic pain group ($R = 0.30$, $P < 0.001$). However, the associations between pain intensity and sleep quality in the younger group ($R = 0.12$, $P = 0.052$) and in the group without chronic pain ($R = 0.02$, $P = 0.74$) were weak and non-significant.

Table 2 Regression analyses predicting sleep quality

	R^2	ΔR^2	ΔF	β
Block 1	0.09	0.09	20.41*	
Average pain				0.14**
Pain extent				0.23*
Block 2	0.12	0.03	6.20**	
Average pain				0.11
Pain extent				0.20*
Age group				0.13**
Chronicity				0.08
Block 3	0.19	0.07	8.00*	
Average pain				–0.82*
Pain extent				0.15
Age group				–0.17
Chronicity				–0.22
Age × intensity				0.39***
Age × extent				0.32
Chronicity × intensity				0.88*
Chronicity × extent				–0.25
Block 4	0.19	0.01	0.42	
Average pain				–1.18***
Pain extent				0.56
Age group				–0.14
Chronicity				–0.24
Age × intensity		0.85		
Age × extent				–0.26
Chronicity × intensity				1.33***
Chronicity × extent				–0.73
Age × chronicity × intensity				–0.57
Age × chronicity × extent				0.69

*$P < 0.001$.
**$P < 0.01$.
***$P < 0.05$.

Discussion

In this study we tested the hypothesized independent effects of both pain intensity and pain extent on sleep quality in a convenience sample of adolescents and young adults. Consistent with the study hypothesis, both average pain intensity and pain extent (i.e., the number of painful areas) made significant and independent contributions to the prediction of sleep quality. Findings suggest that both pain extent and pain intensity are important factors to examine, and may play different roles of importance depending on age of the patient or the chronicity of the pain condition. These results are consistent with previous studies supporting the relationship between pain intensity and sleep [5,8], and extend these findings to the domain of pain extent. Moreover, two significant interaction effects emerged that represent new findings with important clinical relevance.

Main Effects of Pain Intensity and Pain Extent

Given the consistent finding regarding the associations between pain and poor sleep quality, as well as evidence that this association is bidirectional (i.e., if one improves, the other will also) [3], this finding supports the need for research to identify the most effective ways to jointly improve sleep quality and reduce pain in young people. For example, given the known efficacy of sleep hygiene strategies [35], research could determine if these could be effectively implemented in high school or in young adults in the community—in particular among young people with pain problems—to determine if the intervention is effective when delivered in these settings. Similarly, creative ways to provide treatments focused on improving sleep quality and reducing pain and its impact on functioning (e.g., during or after school in the school setting, via web-based strategies, etc.) should be developed and evaluated for their beneficial effects on pain. Moreover, the beneficial effects of a sleep quality treatment on the secondary benefits that might emerge from improved sleep, such as improved physical functioning and academic performance should be also studied.

Interaction Effects

We did not have any *a priori* hypotheses regarding the potential moderating effects of chronological age or pain chronicity on the associations between pain and sleep quality, because no one has yet examined these moderating effects. Nevertheless, we examined these potential moderating effects because of the recent call to understand patient characteristics that influence outcomes following psychological treatments [36,37]. Our finding of a significant moderating effect of age (i.e., pain intensity plays a larger role in sleep quality among college aged youth than adolescents in high school) suggests that college students with pain problems may be particularly responsive to (and perhaps motivated for) interventions that could teach them effective strategies for managing pain and improving sleep quality. Our finding of a significant moderating effect of pain chronicity (i.e., pain intensity plays a larger role in sleep quality in those with chronic pain than in those with acute pain) suggests that such treatments might be more beneficial if they are provided to those youths who have or who are at risk for developing chronic pain than those with just occasional pain problems.

Study Limitations

This study has some important limitations that should be considered when interpreting the findings. First, we used a cross-sectional study design, which means that we are not able to draw conclusions regarding causal associations. Thus, we cannot say from these data if pain causes more sleep problems, more sleep problems cause more pain, or if each has an influence on the other. That said, however, the research in young people cited above suggests that pain and poor sleep quality are mutually causal [3], and there is nothing in our findings that disputes this conclusion. Second, our sample was one of convenience that included youths with pain recruited from a variety of sources. The results therefore might have differed had we used clinical samples or other community samples of young people with pain. Replication of the findings is therefore needed in order to establish their generalizability. The findings should be replicated in other age groups in order to determine if pain extent is also an important variable to consider in individuals with pain who are both older than and younger than the subjects in the current study.

Summary and Conclusions

Despite the study's limitations, the results provide important additional information on the relationship between pain and sleep quality in young people. They also support the need to develop and evaluate creative ways to teach young people the skills needed to effectively prevent or manage pain and sleep problems. These treatments may be particularly useful and effective for youths with chronic pain (as opposed to acute pain) and youths who are in college (as opposed to individuals in secondary school), as these individuals may be most likely to experience the benefits of the treatment, and therefore may be most motivated to be actively engaged in treatment.

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