Research Article

Poor sleep in adults with pediatric-onset spinal cord injury: associations with pain, health, and activity

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Objective: To investigate medical complications that increase risk for poor sleep in adults with pediatric-onset spinal cord injury (SCI) and explore the relation of poor sleep to psychosocial outcomes.
Method: This was a cross-sectional study of individuals with pediatric-onset SCI interviewed between 2011–2015. Participants were recruited from a pediatric specialty hospital and answered questions about demographics, injury characteristics, pain, and medical complications and completed standardized outcome measures, including: Pittsburgh Sleep Quality Index, SF12v2 Health Survey, Craig Handicap Assessment and Recording Technique (CHART), and Subjective Happiness Scale.
Results: The study included 180 participants between the ages of 19 and 51 (M = 34.20 y; SD = 7.28) who sustained their SCI before the age of 19 (M = 13.48y; SD = 4.59). Participants were predominantly male (62%) and Caucasian (84%). A majority had tetraplegia (56%) and complete injuries (74%). Poor sleep occurred with greater frequency in those with tetraplegia and who were unemployed. Neck (OR = 2.80, P = 0.001), shoulder (OR = 2.15, P = 0.011), arm (OR = 3.06, P = 0.004), and lower extremity pain (OR = 2.72, P = 0.004) were associated with increased risk of poor sleep. In a logistic regression analysis, chronic medical conditions and continuous pain were most likely to be associated with poor sleep. Individuals with poor sleep reported lower levels of mobility, perceived health, and subjective happiness.
Conclusion: Pain and secondary complications significantly increase the odds of poor sleep. Furthermore, poor sleep is associated with decreased mobility and measures of well-being. Preventive measures to reduce risk factors and improve sleep quality after pediatric-onset SCI should be considered.

Keywords: Sleep, Spinal Cord Injury, Activity, Health, Pain, Happiness

An extensive body of research has explored the physical, medical, and emotional consequences following spinal cord injury (SCI). From this literature, we know that sleep is especially likely to be disrupted after SCI. Nearly 25–45% of those with SCI report problems with sleep disordered breathing.[1–3] Adults with pediatric or adult onset SCI onset also report more difficulties initiating and maintaining sleep than able-bodied peers.[4–6] In particular, those with tetraplegia are at greater risk for poor sleep[5,7] and sleep disordered breathing.[1]

There are a number of physiological explanations for why those with SCI are prone to sleep difficulties and sleep disorders. Production of melatonin, the hormone that maintains the body's circadian rhythm, may be reduced after injury, resulting in impaired sleep onset and maintenance.[8] Damage to the spinal cord can also interfere with respiratory function leading to a higher incidence of sleep-disordered breathing.[9] In the adult-onset SCI population, many of the SCI-related complications, such as spasms, pain, paresthesia, bladder distension, and incontinence, have been associated with impaired sleep.[6,8] Of the various SCI-related variables that contribute to poor sleep, pain is probably the most prevalent and significant.[6–8,10] Although characteristics of pain, such as higher pain intensity, have been shown to be associated with greater sleep interference among those with adult-onset SCI,[10] how specific pain locations impair sleep has not been as well studied.

As is the case in the general population, difficulty sleeping can cause substantial interference in an individual's life. Loss of the restorative function of sleep can cause diminished cognitive functioning, attentional difficulties, and mood disruptions.[11,12] For those with SCI, sleep problems, over and above other factors such

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as health and pain, have been shown to adversely affect mental health functioning.[5] Given this association with cognitive and psychological well-being, it seems probable that high levels of sleep difficulties are also likely to result in decreased quality of life and impede day to day activities for those with SCI. This, however, remains an understudied area in the SCI literature.

It is particularly important to study the impact of health-related variables, such as pain and sleep difficulties, for individuals who were injured at a young age. Previous research shows an accelerated relationship between aging and health for those with SCI such that health problems are experienced at a younger age compared to able-bodied peers.[13] Sleep problems or developing another chronic condition ancillary to SCI could impose even greater demands on the individual, further limiting mobility, decreasing independence, and exacerbating health complications. Consequently, understanding how sleep problems may relate to other outcomes as individuals age with a SCI is necessary so that measures can be taken to reverse potentially harmful trajectories.

The primary purpose of the present study was to explore how various medical and physical consequences of SCI, particularly pain, may relate to poor sleep in a sample of individuals with pediatric-onset SCI. An additional of goal of the study was to see how, in turn, sleep quality might relate to levels of activity and community involvement. Based on previous studies of those with adult-onset SCI, we expect that individuals with pediatric onset SCI will experience significant sleep problems as well as difficulties associated with poor sleep.[6,7,10,14] Specifically, we hypothesized that (1) SCI-related medical conditions, particularly pain variables, would be associated with increased sleep problems and (2) that those experiencing sleep difficulties would be prone to reduced activity and community involvement.

Method

Participants and Procedure

Participants were recruited from a population of patients who had either previously or were currently receiving care from one of three pediatric SCI rehabilitation programs located in Philadelphia, PA, Chicago, IL, and Sacramento, CA. Inclusion criteria were age of 19 years or older, age of injury before 19 years, and English fluency. Patients were excluded if a clinical diagnosis of moderate to severe traumatic brain injury was present. Participants were drawn from an ongoing longitudinal study and completed structured interviews on approximately an annual basis. Interviews were conducted in-person for participants aged 19–21 in conjunction with scheduled outpatient or inpatient visits to the hospital; all individuals ages 22 and older completed a phone interview. Interviews for the current study took place from 2011–2015. Details regarding participant characteristics at the time of the interview can be seen in Table 1. Participants were not compensated for their involvement. This study was approved by the Institutional Review Board and informed consent was obtained prior to participation.

Materials

The interview with participants included a number of study-specific questions about demographics, injury characteristics, medications, and medical complications. The interview questions also included items to assess the clinical characteristics of pain, including the location of pain (e.g. neck, back, shoulder, arms, wrists, and lower extremities),[15] the frequency (*In the past year, how often have you experienced?*) and duration *(In general, how long does your pain last?*) of pain,[16] and how much pain interfered with daily activities.[17] Based on their responses to questions about frequency and duration, patients were assigned to one of three pain intensity categories: no pain (no pain, or pain experienced less than 3 times a month and for no longer than a few minutes), intermittent pain (pain lasting for greater than a few minutes or occurring on a weekly basis), continuous pain (pain at least 4–5 times a week and lasting most of the day or longer). Level and severity of injury were assessed using the American Spinal Injury Association Impairment Scale (AIS) following the International Standards for Neurological Classification of Spinal Cord Injury.[18]

Self-reported sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI).[19] The PSQI has been used to validly and reliably measure quality and patterns of sleep in individuals with SCI.[20] The measure includes questions about subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month. Each of the component scores of the PSQI are summed to produce a global score of sleep functioning which can be used to differentiate "poor" sleep from "good" sleep, with a global sum of greater than 5 indicating a "poor" sleeper.

Perception of health-related quality of life, including both mental and physical health, were assessed using the SF-12v2 Health Survey.[21] Higher scores on the SF-12v2 indicate greater perceived health. Perception of general happiness was captured by the Subjective Happiness Scale,[22] a brief 4-item scale.

Table 1 Demographic and Injury Characteristics for Good and Poor Sleepers

Characteristic)	TOTAL N=177	Good Sleeper n=88	Poor Sleep n=92	
M(SD) or n (%)				
Age (Range 19–51)	34.2 (7.3)	33.2 (7.2)	35.2 (7.2)	F(1,178)=3.48, P=0.064
Age Injury (Range 0–18)	13.5 (4.6)	13.1 (4.7)	13.8 (4.4)	F(1,178)=1.02, P=0.314
Injury duration (Range 1–45)	20.2 (8.4)	19.6 (8.1)	20.9 (8.6)	F(1,178)=1.09, P=0.298
Sex				χ^2(1)=.292, P=0.589
Male	112 (62.2%)	53 (47.3%)	59 (52.7%)	
Female	68 (37.8%)	35 (51.5%)	33 (48.5%)	
Race				χ^2(1)=.111, P=0.739
Caucasian	151 (83.9%)	73 (48.3%)	78 (51.7%)	
Other	29 (16.1%)	15 (51.7%)	14 (48.3%)	
Employment Status				
not employed	76 (42.2%)	29 (38.2%)	47 (61.8%)	χ^2(2)=6.17, P=0.046
employed	87 (48.3%)	50 (57.5%)	37 (42.5%)	
student	17 (9.4%)	9 (52.9%)	8 (47.1%)	
Married (Y/N)				
No	94 (52.2%)	58 (46.0%)	68 (54.0%)	χ^2(1)=1.37, P=0.241
Yes	86 (47.8%)	30 (55.6%)	24 (44.4%)	
Etiology (5 groups)[a]				χ^2(4)=3.28, P=0.511
Vehicular/pedestrian	89 (49.4%)	44 (49.4%)	45 (50.6%)	
Violence	12 (6.7%)	5 (41.7%)	7 (58.3%)	
Fall/flying object	14 (7.8%)	5 (35.7%)	9 (64.3%)	
Sports	43 (23.9%)	21 (48.8%)	22 (51.2%)	
Medical/surgical	20 (11.1%)	13 (65.0%)	7 (35.0%)	
Tetraplegia/Paraplegia				χ^2(1)=6.33, P=0.012
Para	79 (43.9%)	47 (59.5%)	32 (40.5%)	
Tetra	101 (56.1%)	41 (40.6%)	60 (59.4%)	
Complete/ incomplete injury[b]				
Complete	129 (74.1%)	64 (49.6%)	65 (50.4%)	χ^2(1)=.357, P=0.550
Incomplete	45 (25.9%)	20 (44.4%)	25 (55.6%)	

[a]Etiology unknown/other for 2 participants; [b]Injury severity missing for 6 participants

Community participation, independence, and activity level was assessed utilizing the Craig Handicap Assessment and Recording Technique (CHART).[23] Responses to the CHART are used to calculate an overall score and separate subscales, including Physical Independence, Cognitive Independence, Mobility, Occupation, Social Integration, and Economic Self-Sufficiency, with higher scores indicating greater participation and independence in the community.

Data Analysis

First, descriptive statistics were computed to summarize participant characteristics. Next, a series of analyses were completed to examine differences in participant demographic and injury characteristics as a function of "poor" sleep quality, as defined by the PSQI. Continuous demographic and injury characteristics were examined using one-way analysis of variance (ANOVA) and categorical variables using chi-square tests. In order to identify secondary complications, pain locations, pain intensity, and pain interference associated with poor sleep, chi-square analyses were used to generate odds ratios along with confidence intervals. To examine the number of pain locations associated with poor sleep, a logistic regression was completed with sleep as the dependent variable and number of pain locations as the predictor. A final logistic regression model was run to identify which pain and secondary complications best predict poor sleep while accounting for other significant variables.

Lastly, the association between poor sleep and continuous outcome variables, such as perceived health, community participation, and subjective happiness were examined using a series of one-way ANCOVAS controlling for injury level and employment status. Due to negatively skewed distributions, participation, happiness, and perceived health variables were reflected and natural log transformed to improve normality prior to ANCOVA analyses. Statistical analyses were conducted with SPSS (IBM SPSS Statistics for Windows [computer program]. Version 22.0. Armonk, NY: IBM Corp; Released 2013).

Results

Demographic and injury characteristics for the 180 participants in the current study can be seen in Table 1. Overall, 51.1% (n=92) of the participants were in the poor sleep group. Those in the poor sleep group had significantly worse sleep scores (M = 9.66, SD = 3.29) than those not in the poor sleep group (M = 3.22, SD = 1.47), F(1,178) = 284.07, P < 0.001. On average, those with poor sleep also spent significantly fewer hours sleeping (M = 5.90, SD = 1.56 vs. M = 7.25, SD = 0.86), F(1,178) = 50.66, P < 0.001, as well as significantly fewer hours out of bed (M = 13.39, SD = 4.00 vs. M = 14.73, SD = 2.83), F(1,178) = 7.65, P = 0.006, than those not in the poor sleep category. Table 2 also summarizes the occurrence of poor sleep by demographic and injury characteristics. As the table indicates, individuals with tetraplegia were significantly more likely to be in the poor sleep group (59.4%) compared to individuals with paraplegia (40.5%). Those who were unemployed were significantly more likely to report poor sleep (61.8%) than those who were employed (42.5%) or a student (47.1%). Over a quarter of the participants (28.3%, n = 51) reported using medications to fall asleep or stay asleep (see Table 2 for list of medications). Of the individuals using sleep aids, non-benzodiazepine hypnotics, such as zolpidem or eszopiclone, were used most frequently (19.6%, N = 10), but over the counter pain medications (e.g. acetaminophen) (15.7%, N = 8) and benzodiazepines were also common (15.7%, N = 8).

Consistent with study hypotheses, odds of being a poor sleeper were significantly greater for individuals who experienced pain (Table 3). Specifically, individuals with neck (P = 0.001), shoulder (P = 0.011), arm/elbow (P = 0.004), and lower extremity pain (P = 0.004) were more likely to report poor sleep. Increasing number of pain locations was associated with greater odds of poor sleep (P < 0.001) as was pain that caused moderate to extreme interference in daily activities (P < 0.001). Relative to individuals in the no/minimal pain category (n = 32, 17.8%), individuals who reported continuous pain (n = 66, 36.7%) were at greater risk for poor sleep (P = 0.002) but those with intermittent pain (n = 82, 45.6%) were not. In terms of other secondary complications (Table 4), odds of being a poor sleeper were also higher in those with another chronic medical condition (P = 0.002), autonomic dysreflexia (P = 0.045), or the occurrence of a severe urinary tract infection (P = 0.024).

To examine which secondary complications, including pain, were most important for predicting poor sleep a logistic regression was completed using injury level and significant medical complications identified in the previous analyses as predictors of poor sleep. To minimize the number of variables in the analysis and avoid redundancy, of the pain variables, only pain intensity was used in the final logistic regression analysis.

Table 2 Medications Utilized to Facilitate Sleep in Adults with Pediatric-Onset SCI

Medication	n	%
Non-benzodiazepine hypnotics (e.g. zolpidem/eszopiclone)	10	19.6%
Benzodiazepine (e.g. diazepam/alprazolam/clonazepam)	8	15.7%
Over the counter Pain Medications (e.g. acetaminophen/ibuprofen)	8	15.7%
Over the counter Sleep Meds (e.g. Unisom)	4	7.8%
Marijuana	4	7.8%
Pain Medications Rx- (e.g. oxycodone/pregabalin)	3	5.9%
Muscle Relaxant (e.g. tizanidine/cyclobenzaprine)	3	5.9%
Melatonin	3	5.9%
Diphenhydramine	2	3.9%
Nyquil	2	3.9%
Other/Unknown (e.g. quetiapine fumarate/clonidine)	4	7.8%
TOTAL	51	100%

Table 3 Association between Pain and Poor Sleep in Individuals with Pediatric-onset SCI

	OR	95% CI	P-value
Back Pain	1.09	(0.61–1.96)	0.771
Neck Pain	2.80	(1.48–5.30)	0.001
Shoulder Pain	2.15	(1.19–3.90)	0.011
Arm/Elbow Pain	3.06	(1.42–6.63)	0.004
Wrist/Hand Pain	1.16	(0.56–2.40)	0.688
Lower Extremities Pain[a]	2.72	(1.35–5.48)	0.004
Pain Intensity[b]			
Intermittent	2.00	(0.84–4.73)	0.114
Continuous	4.11	(1.67–10.15)	0.002
Activity Interfering Pain[c]			
Little Interference	1.38	(0.67–2.82)	0.373
Moderate/Extreme Interference	6.88	(2.86–16.53)	<0.001
Number of pain locations (Range 0–6)	1.46	(1.18–1.81)	<0.001

[a]Includes legs, knees, ankles and feet; [b]Reference group no pain or infrequent pain; [c]Reference group no pain interference

Table 4 Secondary Complications Associated with Poor Sleep in Individuals with Pediatric-onset SCI

	OR	95% CI	P-value
Chronic Medical Condition[a]	3.22	(1.53–6.79)	0.002
Pressure Ulcer	1.82	(0.96–3.42)	0.063
UTI	1.12	(0.60–2.11)	0.716
Severe UTI[b]	2.82	(1.11–7.12)	0.024
Dysreflexia	1.83	(1.01–3.33)	0.045
Bladder Incontinence	1.26	(0.70–2.28)	0.436
Bowel Incontinence	2.07	(0.93–4.60)	0.070
Hospitalization	1.65	(0.82–3.30)	0.160
Kidney/Bladder Stones	1.58	(0.50–5.03)	0.435
Spasticity	1.49	(0.83–2.68)	0.183

[a]Includes asthma, cardiac disease, hypertension, stroke, diabetes, cancer and other; [b]UTI that required hospitalization or IV antibiotics.

Pain intensity was selected for inclusion over the other pain variables because it captured both the intensity and duration of pain, and so was theorized to be most representative of the experience of pain. As can be seen in Table 5, when accounting for injury level and other significant health variables, the presence of a severe UTI and autonomic dysreflexia are no longer significant, whereas continuous pain (OR = 3.67, 95% CI 1.42–9.44, P = 0.007) and the presence of another chronic medical condition (OR = 2.35, 95% CI 1.06–5.20, P = 0.036) both remained significant predictors of poor sleep. After controlling for injury level (tetraplegia vs. paraplegia) and employment status (unemployed/student vs. employed), ANCOVA analyses revealed significant differences between those reporting poor versus good sleep on measures of community participation and perceived health (Table 6). Specifically, poor sleep was associated with decreased mobility (P = 0.015), lower perceived physical health (P = 0.006), lower perceived mental health (P = 0.010), and lower overall happiness, (P = 0.004).

Discussion

Sleep problems are common among adults with both adult- and pediatric-onset SCI.[5–7,14] The current study builds upon this previous research by exploring medical complications that predict sleep problems and examining how poor sleep may be related to functioning for those with pediatric-onset SCI. As predicted, there were a number of SCI-related secondary complications that were associated with poor sleep. Over a quarter of the sample used medications as a sleep aid and the type of medication utilized varied considerably. Findings also indicated that the odds of having poor sleep increase with pain and the presence of another chronic medical condition. Additionally, individuals with poor sleep were more likely to report lower levels of independent mobility in community activities and decreased perception of health and happiness.

Table 5 Logistic Regression Model for Pain and Secondary Complications as Predictors of Poor Sleep

	OR	95%CI	P-value
Tetraplegia	1.78	(0.89–3.53)	0.101
Pain Intensity[a]			0.023
Intermittent	2.05	(0.83–5.08)	0.122
Continuous	3.67	(1.42–9.44)	0.007
Severe UTI	2.37	(0.86–6.49)	0.094
Chronic Medical Conditions	2.35	(1.06–5.20)	0.036
Dysreflexia	1.39	(0.71–2.74)	0.340

[a]Reference group no pain or infrequent pain

As would be expected, the majority of individuals who used medications for the purpose of facilitating sleep were taking non-benzodiazepine hypnotics. The use of benzodiazepines explicitly for sleep was almost as common as prescription sleep medications, which is concerning. Given the addiction potential for chronic use of benzodiazepines, these agents may not be the ideal choice to treat sleep concerns.

Although pain is a well-known correlate of sleep difficulties among those with SCI, the relation of specific pain locations experienced by patients to sleep has yet to be closely examined. In the current study, several pain locations were associated with greater odds of poor sleep. In particular, pain in the neck, shoulders, arms, and lower extremities were associated with poor sleep. Continuous pain as well as pain that caused moderate to extreme interference in other daily activities appeared to be associated with poor sleep to a greater extent than did intermittent pain or pain that caused minimal to no interference. Moreover, the more pain locations experienced, the greater the odds of poor sleep. This is particularly concerning given the pediatric-onset nature of the injuries, as these individuals are more likely to be using their arms and shoulders for activities such as wheelchair propulsion and weight-bearing for a longer period of time than those injured as adults, and thus likely to experience increasing areas of pain as they age.[24]

After pain, the finding that a chronic medical condition was one of the strongest risk factors for poor sleep is

Table 6 Sleep, Participation, and Perceived Health in Pediatric-onset SCI

	Good Sleeper† N=88	Poor Sleeper† N=92	Significance Test
CHART			
Physical Independence	93.40 (8.46)	86.60 (17.91)	F(1,175)=0.51, P=0.478
Cognitive Independence	98.68 (4.00)	94.46 (14.66)	F(1,176)=3.00, P=0.085
Mobility	92.65 (13.49)	84.00 (20.49)	F(1,176)=5.99, P=0.015
Occupation	77.01 (31.09)	68.13 (32.62)	F(1,176)=0.71, P=0.400
Social Integration	93.08 (12.20)	88.77 (17.29)	F(1,173)=1.16, P=0.283
Economic Self-sufficiency	82.64 (28.66)	76.98 (34.58)	F(1,131)=0.04, P=0.837
SF-12v2			
Physical Health Composite	46.08 (8.83)	39.17 (11.43)	F(1,176)=7.75, P=0.006
Mental Health Composite	56.36 (9.27)	53.73 (9.13)	F(1,176)=6.83, P=0.010
Subjective Happiness	5.77 (1.04)	5.26 (1.40)	F(1,176)=8.68, P=0.004

†Means reported are unadjusted raw means for those with good versus poor sleep

consistent with previous research indicating that sleep problems frequently coexist with chronic conditions such as asthma, diabetes, and angina.[25] This is also consistent with research showing that insufficient sleep, particularly the presence of a sleep disorder, is associated with increased risk of cardiovascular diseases, such as hypertension, coronary heart disease and cardiac arrhythmias.[26] This suggests that the simultaneous presence of both an SCI and an additional physical illness could compound the risk for sleep difficulties. Moreover, clinically it highlights the importance of identifying individuals with concurrent SCI and secondary chronic conditions as being at heightened risk for sleep problems.

It was also the case that severe UTI and autonomic dysreflexia were significantly associated with increased odds of poor sleep, but only when considered in isolation. When included in the final logistic regression model, these variables were no longer significant. This suggests that other variables in the equation, such as neurological level, pain, and/or chronic illness better account for the previously significant association with sleep. It was somewhat unexpected that spasticity and incontinence were not associated with increased odds of sleep problems. This is in contrast to previous studies indicating that muscle spasms and difficulties voiding were frequent disruptors of sleep for those with SCI.[6] Although only 3 individuals endorsed taking muscle relaxants explicitly for the purposes of sleep, more than 50% (n=91) of participants reported use of muscle relaxants. Consequently, one reason that individuals reporting spasticity were not at greater risk for sleep problems is that those who experience muscle spasms severe enough to disrupt sleep are likely managing those symptoms by taking muscle relaxants, which in turn would decrease the likelihood of sleep disruption.

Consistent with study hypotheses, poor sleep was associated with lower activity, but only in the domain of mobility. Those with poor sleep were significantly more likely to report decreased independence in community mobility, the ability to move around in the community, even after accounting for neurological level. Since the CHART mobility subscale captures an individual's time out of bed, days out of the house, as well as nights spent away from home, the association between poor sleep and mobility may simply be a result of individuals with poor sleep spending more time in bed or in their own home. However, the CHART mobility subscale also captures accessibility and freedom of movement in the environment and community, so this finding could also reflect the impact of fatigue-related sleep problems on the ability to move around in the environment.

Finally, individuals with poor sleep were more likely to report lower perceived mental health, physical health, and subjective happiness. This aligns well with previous findings suggesting that quality sleep is an important correlate of wellness for individuals with SCI[5,14,27] and in the general population.[28–30] It is important to note, however, that many of the studies suggesting a relationship between sleep disturbance and mental health indicate that these relations are reciprocal[31], such that mental distress disrupts sleep and poor sleep further exacerbates psychological symptoms. Although a cross-sectional study like the current one cannot make conclusive statements regarding directionality, these findings still highlight the importance of managing sleep problems for possible benefits to not only sleep quality but also perceived health and happiness.

Limitations and future directions

There are several limitations worth considering when interpreting the results of the current study. Notably, information about sleep quality and patterns were collected through self-report rather than objective measures of sleep, such as polysomnography or actigraphy. Information about medical complications and perceived health was also based on self-report. Consequently, the results are limited by the participant's ability to accurately report on their health, sleep problems, and behaviors. An additional concern includes the cross-sectional nature of the data, which makes it difficult to tease out the true directional relationship of the variables studied. Generalizability of the results is also limited due to the focus on pediatric-onset injury in patients from the same hospital system. Finally, other variables that could influence results, such as depression symptoms, were not considered. Future research, particularly prospective, longitudinal studies that include objective measurements and include a representative sample would address these issues.

Conclusion

Several medical conditions including a number of specific pain locations, ancillary medical conditions, severe UTI, and autonomic dysreflexia were found to be associated with increased odds of poor sleep in adults with SCI sustained in childhood. Moreover, individuals with pediatric-onset SCI and poor sleep had significantly lower activity levels, worse perceived health, and reduced ratings of subjective happiness. Clinically, given the associations found between sleep and other measures of health and wellness, the results of the current study emphasize the need for treatment and screening of sleep issues in addition to standard medical care. Additionally, early intervention, education, and prevention of secondary health conditions among children and adolescents may help prevent the development of sleep difficulties and other medical conditions that, in turn, will increase the likelihood of positive health outcomes in adulthood.

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