Evaluation of Sleep Disorder in Orthopaedic Trauma Patients: a Retrospective Analysis of 1129 Cases

Hai Yang
Sichuan University West China Hospital
Yi-jia Liu
Sichuan University West China Hospital
Jia-lu Ye
Sichuan University West China Hospital
Li-hong Zhao
Sichuan University West China Hospital
Ling-li Li
Sichuan University West China Hospital
Xiao-ling Hou (296825257@qq.com)
Sichuan University West China Hospital

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Abstract

Background In the ward of trauma center, It's not unusual that the patients have sleep disorder, especially in the acute injury patients. Meanwhile, there is substantial evidence that sleep disorder is a predictor of depression and the important features of posttraumatic stess disorder.

Methods From April 2018 to July 2019, all orthopaedic trauma patients were included in the retrospective study. Patients with mental impairment and craniocerebral injury were excluded from the study. Basic demographic data were collected. Pittsburgh sleep quality index(PSQI) was used to evaluate sleep quality, Visual Analog Scale (VAS) was used to evaluate physical pain, Pittsburgh sleep quality index(PSQI) was used to evaluate sleep quality, Barthel Index (BI) was used to evaluate activities of daily living(ADL) and Injury Severity Score (ISS) classification in medical records were collected. Univariate linear regression analysis and multivariate linear regression analysis were used to identify independently related factors.

Results The average PSQI score was 6.3 (±4.0). Five hundred eighty-one (51.4%) patients had a PSQI score more than 5, indicating the presence of sleep disorder. The PSQI score was more than 10 in one hundred seventy-four (15.4%) patients. Univariate statistical analysis showed that age, gender, education, ADL (activities of daily living), and ISS classification were associated with increased PSQI scores. Marital status and pain were not associated with increased PSQI scores. When we used multivariate analysis to control for confounding variables, the gender, ADL, and ISS classification remained independently associated with PSQI (P =0.002, <0.000, and 0.002, respectively).

Conclusions In our study, the sleep disorder is both common (51.4% PSQI >5) and serious (15.4% PSQI >10) in patients who suffered from traumatic orthopaedic injury. The following factors are closed associated with sleep disorder: gender, ADL and ISS classification. Besides, age and education level have independently impact on sleep quality. Unexpectedly, we find the VAS of pain was not independently associated with seriousness of sleep quality. This is inconsistent with the results reported in some literature.

Background

Sleep disorder is highly prevalent after the traumatic events of physical trauma, and is closely related to posttraumatic stress disorder (PTSD) and depression[1, 2]. Patients who suffered from trauma often need some treatment for insomnia, nighttime arousals, and nightmares[3, 4]. In our experience, we observed that most of orthopaedic trauma patients can't fall or stay asleep easily and quickly. Difficulty falling or staying asleep is an important component diagnosis of PTSD due to repetitive nightmares because of hyperarousal and intrusive processes[5].

Besides, sleep disorder has serious impacts in general health, quality of life and physical functioning[6, 7], especially result in physical disability[7]. So it can exacerbate physical functional limitations of

orthopaedic trauma patients. A cohort study indicated a strong correlation between physical disability and long-term psychological stress which combine poor sleep quality[8]. Although treatment for sleep disorder of orthopaedic trauma patients may not beyond the scope of the surgeon's practice, we still cannot ignore this serious traumatic complication. We have duty to figure out the prevalence of sleep disorder in this patient population.

There are many articles and reviews certificated that sleep disorder is caused by trauma, especially when patients sufferd from PTSD[1, 3, 4, 9–11]. Besides, we can also find literature related to the association between orthopeadics trauma and depression[12]. Although sleep disorder may be the core feature of depression or PTSD[13], there are few studies evaluating sleep quality in orthopeadic trauma patients[14], and there are no related studies from China, especially the patients suffered acute orthopeadic trauma. This study aims to evaluate the prevalence of sleep disorder in patients in the ward of trauma center who suffered from acute orthopeadic injury. Meanwhile, we try to identify factors associated with sleep disorder,such as patients features, injury severity and physical pain.

Materials And Methods

Subjects

Following approval by our institutional review board, we had a cross-sectional and retrospective study of patients of orthopaedic truama in the ward of trauma center of West China Hospital of SCU. All these patients who were admitted to emergency department who suffered from acute physical injury including acute closed fracture, acute open fracture and skin soft tissue defect with or without multiple trauma during April 2018 to July 2019 were included. To ensure the accuracy of data, the exclusion criteria included: mental impairment, craniocerebral injury and related electronic medical records in were missing.

All qualified patients should be evaluated their Pittsburgh sleep quality index (PSQI), physical pain of Visual Analog Scale (VAS), Barthel Index (BI) and Injury Severity Score (ISS) classification by nurse Within 3 days after hospitalization, and all related data and demographic data of these patients was registered in the medical records we can collected.

Main Outcome Measurements

The PSQI questionnaire is an effective method to assess the patient's sleep quality[15]. Nineteen items generate seven parts of scores: sleep latency, sleep duration, habitual sleep efficiency, subjective sleep quality, use of sleeping medication, sleep disturbances, and daytime dysfunction. Then we sum all parts of scores, the total score is 21. For this study, we used PSQI more than 5 as indicative of sleep disorder, and PSQI was more than 10 as severe sleep disorder. We expected the impact of sleep disorder and physical pain level. We used Visual Analog Scale (VAS) to present the physical pain of acute orthopaedic traumatic patients[16, 17]. we used the VAS categorized as follows: no pain (0), mild pain (1–3), moderate pain (4–6) and severe pain (7–10).

The Barthel Index was used to assess the activities of daily living(ADL) of patients [18]. We used the 10-item scale, which included bathing, grooming, dressing, feeding, toilet use, transfers, mobility, bowels and bladder, and climbing stairs. The total score is 100, 0 score means total dependence, 100 means complete independence. In our study, we used the BI categorized as follows: severe dependence (0–40), moderate dependence (41–60) and mild dependence (61–99). Finally, we used injury severity scores (ISS) and AIS-2015 to evaluated traumatic level of patients[19, 20]. The precise ISS scores of patients couldn't be searched in medical records, but we could obtain ISS classification which is registered in the nursing assessment sheet. we used the ISS categorized as follows: severe injury (≥ 25), moderate injury (16–24) and mild injury (< 16).

Statistical analysis

Statistical analysis was used to SPSS v.22 statistical software (IBM, Armonk, NY). Demographic data and patients feature data were obtained including age, gender, marriage, and education. We divided the educational level of patients into 10 grades as follows: below primary school, primary school, junior high school, technical secondary school, senior high scool, junior college, bachelor, master, doctor and other. All categorical variables were set as dummy coding to be substituted into linear regression calculation. Mean and SD or median and interquartile ranges are reported. Univariate linear regression was used to determine potential relevant variables for sleep disorder. Then relevant variables found on univariate analysis were included in a multivariate linear regression analysis, to selected for confounding variables and isolate independent variables of sleep disorder.

Results

Medical records of 1129 patients were included in analysis, of which 680 (60.2%) were man, and 449 (39.8%) were woman. The average age was 50.4 ± 19.6 years, male average age was 46.03 ± 17.6 years, and female average age was 57.03 ± 20.5 years. 886 (78.5%) patients got married, 152 (13.4%) patients were unmarried and 91 (8.1%) patients were divorced or widowed. The total edcational level was not high. 74 (6.6%) patients didn't grauate from primary school, 281 (24.9%) patients only grauate from primary school, 331(29.3%) patients grauated from junior high school, 68(6.0%) patients grauated from technical secondary school, 130 (11.5%) patients grauated from senior high school, 101(8.9%) patients grauated from junior college, 115 (10.2%) patients got bachelor's degree, 13(1.2%) patients got master's degree and 2(0.2%) patients got dotor's degree. More than half of patients(636, 56.3%) were pure closed fracture, 182 (16.1%) patients were open fracture, 140 (12.4%) patients were multiple trauma, 59 (5.2%) patients were severely damaged truama who need to be amputated, 79 (7.0%) patients were pure skin soft tissue defect and 33 (2.9%) patients were pure dislocation.

We also selected VAS, BI, PSQI and ISS classification in medical rccords. 923(81.8%) patients were mild injury,154(13.6%)patients were moderate injury, 52 (4.6%) patients were severe injury. The average BI score was 36.7 ± 21. 5, most patients (71.2%) were severe dependence, 14.1% patients were moderate dependence, 13.9% patients were mild dependence. The average VAS score was 2.3 ± 1. 0, most patients

(89.0%) felt mild pain, 3.8% patients felt moderate pain. The average PSQI score was 6.3 ± 4.0. The distribution trend of PSQI scores is shown in Fig. 1.The presence of sleep disorder (PSQI > 5) was noted in 581 (51.5%) patients. The PSQI score was > 10 in 173 (15.4%) patients. A summary of patient demographics and other scores are given in Table 1.

Table 1
Demographic Data and Patient-Reported Outcome Measures

Variables	
Age (years)	50.4 ± 19.6
Gender	
Male	680 (60.2%)
Female	449 (39.8%)
Marital status	
Married	886 (78.5%)
Unmarried	152 (14.3%)
Divorced or widowed	81 (7.2%)
Types of injury	
Closed fracture	636 (56.3%)
Open fracture	182 (16.1%)
Severely damaged truama	59 (5.2%)
Multiple trauma	140 (12.4%)
skin soft tissue defect	79 (7.0%)
Joint dislocation	33 (2.9%)
Educational level	
Below primary school	74 (6.6%)
Primary school	281 (24.9%)
Junior high school	331 (29.3%)
Technical secondary school	68 (6.0%)
Senior high school	130 (11.5%)
Junior college	101 (8.9%)
Bachelor	115 (10.2%)
Master	13 (1.2%)
Dotor	2(0.2%)
VAS	2.3 ± 1.0

Variables	
≤ 3	1085 (96.1%)
> 3	47(3.9%)
BI(ADL)	36.7 ± 21.5
0–40(Severe dependence)	804 (71.2%)
41–60(Moderate dependence)	160 (14.1%)
61–100 (Mild dependence or no dependence)	165 (14.7%)
ISS classification	
Mild injury	923 (81.8%)
Moderate injury	154(13.6%)
Severe injury	52 (4.6%))
PSQI	6.3 ± 4.0
> 5	581 (51.5%)
> 10	173 (15.4%)
Total	1129(100%)

Note: If joint dislocation and fracture occured at the same time, it was considered as fracture. All patients of severely damaged trauma were amputated. The patients of multiple trauma were not amputated. The patients of skin soft tissue defect were not combine with any fracture or joint dislocation.

Table 2 is shown in univariate linear regression analysis of PSQI. Age,gender, marital status, education, DRG, pain, ADL and ISS classification were associated with PSQI on univariate analysis. Then these variables were evaluated with multivariate linear regression analysis. However, only the gender, ADL, and ISS classification remained independent predictors of PSQI. Age and education were not independently associated with PSQI on multivariate analysis, indicating that the significant variables on univariate analysis was influenced by confusing variables. Unexpectly, VAS did not a vital association with PSQI on univariate analysis. The detail data of multivariate analysis show in Table 3.

Table 2
Univariate Linear Regression of PSQI

Variables	B	T	P
Age	0.014	2.397	0.017
Gender	-0.764	-3.183	0.001
Marital status	0.143	0.138	0.473
Education level	-0.171	-2.739	0.006
Pain	-0.013	-0.116	0.908
ADL	-0.038	-7.019	0.000
ISS classification	1.066	4.723	0.000

Table 3
Multivariate Linear Regression of PSQI

Variables	B	T	P
Age	0.011	1.644	0.100
Gender	-0.766	-3.137	0.002
Education	-0.027	-0.404	0.686
ADL	-0.032	-5.431	0.000
ISS classification	0.741	3.108	0.002

Discussion

In our study, the sleep disorder is both common (51.4% PSQI > 5) and serious (15.4% PSQI > 10) in patients who suffered from acute traumatic orthopaedic injury. Muscatelli revealed the incidence of depression and PTSD in patients with acute orthopedic trauma through a systematic review which included 7109 subjects in the analysis. They confirmed that in patients with acute orthopedic trauma, the weighted combined prevalence of depression and PTSD was 16.8%[12]. By comparing the results of our study with the data of this study, it can be shown that the proportion of patients with severe sleep disorders is similar to the incidence of PTSD and depression. Some literature showed that sleep disorders are closely related to PTSD and depression[1, 2], So we have reason to believe that severe sleep disorders are associated with PTSD and depression. At the same time, the PSQI score > 10 could be regarded as an important indicator for predicting PTSD in patients of acute orthopeadic trauma.

One interesting thing we found is that the VAS score of physical pain is not correlated with sleep quality in our research results. Besides, the average VAS score was 2.3 ± 1. 0. It's a low level score. This is

inconsistent with our previous experience, and the literatures also pointed out that pain is closely associated with poor sleep quality[21, 22]. To solve this problem, we checked relevant medical records of the inpatient department and emergency department. we found that the treatment of preemptive and multimodal analgesia is often arranged in patients of orthopedic trauma before the patient is hospitalized. Meanwhile, Preemptive and multimodal analgesia therapy had been proven to improve the patient's own feelings of patients in hospital and accelerate recovery[23]. When the patient's pain was been controlled,the incidence of sleep disorder in this study was still highly prevalent. Therefore, orthopedic physicians should realize that merely controlling physical pain cannot significantly improve the quality of sleep of patients. They also need to pay attention to the psychological problems of patients after trauma.

We recognize that poor sleep quality is independently related to physical disability[6, 7]. At the same time, sleep disorders may also be a core feature of PTSD[13]. Therefore, comprehensive physical-psychological management is essential for patients with acute orthopedic trauma. We need to identify patients with sleep disorders early and treat them as soon as possible, which is of great significance for the accelerated recovery of patients.

Among the demographic indicators, we selected age, gender, marital status and education to perform univariate linear regression analysis with PQSI scores. A multi-center cross-sectional cohort study of 4399 outpatients including showed that the incidence of sleep disorder is different between men and women in China[24]. In this study, women had a higher incidence of sleep disorders than men. At the same time, for women, sleep disorders are highly correlated with marital status, and women who are divorced or widowed are more likely to suffer from sleep disorder[25]. For men, sleep disorders are associated with lower education levels[24]. Similar results were obtained in our research. In univariate regression, females and low education level are associated with poor sleep quality, but marital status is not related to sleep quality. After eliminating the confounding factors among multiple factors, only gender is independently related to sleep disorder. This suggests that sleep disorder in patients with acute orthopedic trauma are still unique compared to the overall population. The company of relatives and a high level of education may help stabilize the patient's mood and sleep quality, but our results showed that these help patients are limited. Necessary psychotherapy is still critical for patients who suffered from sleep loss especially female patients.

Besides,we found that the activities of daily living and the severity of trauma have a significant impact on the patient's sleep quality in our study. Most orthopeadic truama patients (71.2%) were severe dependence even if they have suffered mild injury(81.8% patients were mild injury). Most orthopedic patients have a certain degree of loss of limb function. Even if the injury is minor, they still cannot complete some normal daily activities, such as getting out of bed, combing hair, washing face, etc. There was no related literature has been found to prove that ADL in orthopedic trauma patients is directly related to sleep quality,However, there is literature to explain and illustrate the activities of daily living decline may lead to patients with depression and sleep disorder[26]. We still need stronger evidence to

prove the relationship between ADL and sleep disorders. At the same time, we observed that the severity of trauma is independently related to sleep quality. In the orthopedic ward of our trauma center, in addition to the patients in this city, we also accepted critically ill patients from other cities in Southwest China. Therefore, there was a sufficient number of patients with multiple injuries to be included in the study who suffered severe injury. These patients have higher ISS scores and worse sleep quality. In the results of a study, ISS score of orthopeadic trauma patients was positively correlated with somatic anxiety[27]. A higher degree of anxiety seriously affects the patient's sleep quality, leading to sleep disorder. There is also literature that shows that the severity of trauma is not related to sleep quality[14]. This result may be related to the low proportion of patients with multiple injuries included in this study. This requires prospective cohort studies to further confirm the relationship between trauma severity and sleep quality.

The biggest limitation of our study is the retrospective cross-sectional case analysis. All data came from the nurse's assessment of the patient's admission. The sleep quality assessment also comes from clinical nurses rather than professional investigators. This cannot guarantee the consistency of the assessment. At the same time, the ISS score lacks precise numerical values, only grade evaluation, so the statistical validity is not enough.Finally, we only collected data from a single level 1 trauma center. We still need prospective comparative studies to further clarify the impact of relevant risk factors on patients' sleep quality, so as to establish clinical prevention methods.

Conclusion

Sleep disorder in orthopedic acute trauma patients is very common and severe. Gender, ability of daily living, and severity of trauma significantly affect sleep quality. However, age, marital status and education level have limited influence on sleep quality. Females, poor ability of daily living, and severe physical trauma should be accepted as independent risk factors for sleep disorders in orthopedic acute trauma patients.

Abbreviations

PSQI: Pittsburgh sleep quality index

VAS: Visual Analogue Scale

ISS: Injury Severity Score

BI: Barthel Index

ADL: activities of daily living

Declarations

Ethics approval and consent to participate

Before the study began, we had carefully consulted the Ethics Committee and Institutional Review Board of West China Hospital. They suggested that this study did not involve special interventions for patients and we should conduct this study in compliance with the Helsinki Declaration and Inform patients fully of the purpose of the study. So, all data was fully anonymised at-source with researchers. Given the anonymous nature of the data, the ethics committee waived any requirement for patient informed consent.

Consent for publication

Not applicable.

Availability of data and materials

Datasets are available from the corresponding author on reasonable request.

Competing interests

217 The authors declare that they have no competing interests.

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Authors' contributions

HY, YL, and XH provided the ideas of this study. HY, YL, JL, LZ collected the data. HY and YL analyzed the data. LL and XH helped with the interpretation of data. LL provided the funding. All authors read and approved the final manuscript.

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References

1. Caldwell BA, Redeker N. Sleep and trauma: an overview. Issues in mental health nursing. 2005;26(7):721-38.
2. Baglioni C, Battagliese G, Feige B, Spiegelhalder K, Nissen C, Voderholzer U, et al. Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. Journal of Affective Disorders. 2011;135(1):10-9.

3. Mellman TA, Davis GC. Combat-related flashbacks in posttraumatic stress disorder: phenomenology and similarity to panic attacks. The Journal of clinical psychiatry. 1985;46(9):379-82.
4. Thordardottir EB, Hansdottir I, Valdimarsdottir UA, Shipherd JC, Resnick H, Gudmundsdottir B. The Manifestations of Sleep Disturbances 16 Years Post-Trauma. Sleep. 2016;39(8):1551-4.
5. Battle DE. Diagnostic and Statistical Manual of Mental Disorders (DSM). CoDAS. 2013;25(2):191-2.
6. Altemus M, Cloitre M, Dhabhar FS. Enhanced cellular immune response in women with PTSD related to childhood abuse. The American journal of psychiatry. 2003;160(9):1705-7.
7. Chien MY, Chen HC. Poor sleep quality is independently associated with physical disability in older adults. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine. 2015;11(3):225-32.
8. McFarlane AC. The long-term costs of traumatic stress: intertwined physical and psychological consequences. World psychiatry : official journal of the World Psychiatric Association (WPA). 2010;9(1):3-10.
9. Babson KA, Feldner MT. Temporal relations between sleep problems and both traumatic event exposure and PTSD: a critical review of the empirical literature. Journal of anxiety disorders. 2010;24(1):1-15.
10. Lommen MJ, Grey N, Clark DM, Wild J, Stott R, Ehlers A. Sleep And Treatment Outcome In Posttraumatic Stress Disorder: Results From An Effectiveness Study. Depression and anxiety. 2016;33(7):575-83.
11. Miller KE, Brownlow JA, Woodward S, Gehrman PR. Sleep and Dreaming in Posttraumatic Stress Disorder. Current psychiatry reports. 2017;19(10):71.
12. Muscatelli S, Spurr H, O'Hara NN, O'Hara LM, Sprague SA, Slobogean GP. Prevalence of Depression and Posttraumatic Stress Disorder After Acute Orthopaedic Trauma: A Systematic Review and Meta-Analysis. Journal of orthopaedic trauma. 2017;31(1):47-55.
13. Spoormaker VI, Montgomery P. Disturbed sleep in post-traumatic stress disorder: secondary symptom or core feature? Sleep medicine reviews. 2008;12(3):169-84.
14. Swann MC, Batty M, Hu G, Mitchell T, Box H, Starr A. Sleep Disturbance in Orthopaedic Trauma Patients. Journal of orthopaedic trauma. 2018;32(10):500-4.
15. Buysse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry research. 1989;28(2):193-213.
16. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine. 2001;8(12):1153-7.
17. Scott J, Huskisson EC. Graphic representation of pain. Pain. 1976;2(2):175-84.
18. Mahoney FI, Barthel DW. Functional Evaluation: The Barthel Index. Maryland state medical journal. 1965;14:61-5.

19. Baker SP, O'Neill B, Haddon W, Jr., Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14(3):187-96.
20. Loftis KL, Price J, Gillich PJ. Evolution of the Abbreviated Injury Scale: 1990-2015. Traffic injury prevention. 2018;19(sup2):S109-s13.
21. Finan PH, Goodin BR, Smith MT. The Association of Sleep and Pain: An Update and a Path Forward. The Journal of Pain. 2013;14(12):1539-52.
22. Amtmann D, Bamer AM, Askew R, Jensen MP. Cross-lagged longitudinal analysis of pain intensity and sleep disturbance. Disability and health journal. 2020;13(3):100908.
23. Ibrahim MS, Twaij H, Giebaly DE, Nizam I, Haddad FS. Enhanced recovery in total hip replacement: a clinical review. The bone & joint journal. 2013;95-b(12):1587-94.
24. Zheng W, Luo XN, Li HY, Ke XY, Dai Q, Zhang CJ, et al. Gender differences in the prevalence and clinical correlates of sleep disturbance in general hospital outpatients. Psychiatry research. 2018;269:134-9.
25. Li RHY, Wing YK, Ho SC, Fong SYY. Gender differences in insomnia—a study in the Hong Kong Chinese population. Journal of Psychosomatic Research. 2002;53(1):601-9.
26. Webb CA, Cui R, Titus C, Fiske A, Nadorff MR. Sleep Disturbance, Activities of Daily Living, and Depressive Symptoms among Older Adults. Clinical gerontologist. 2018;41(2):172-80.
27. Wu H, Zhang F, Cheng W, Lin Y, Wang Q. Factors Related to Acute Anxiety and Depression in Inpatients with Accidental Orthopedic Injuries. Shanghai archives of psychiatry. 2017;29(2):77-84.

Figures

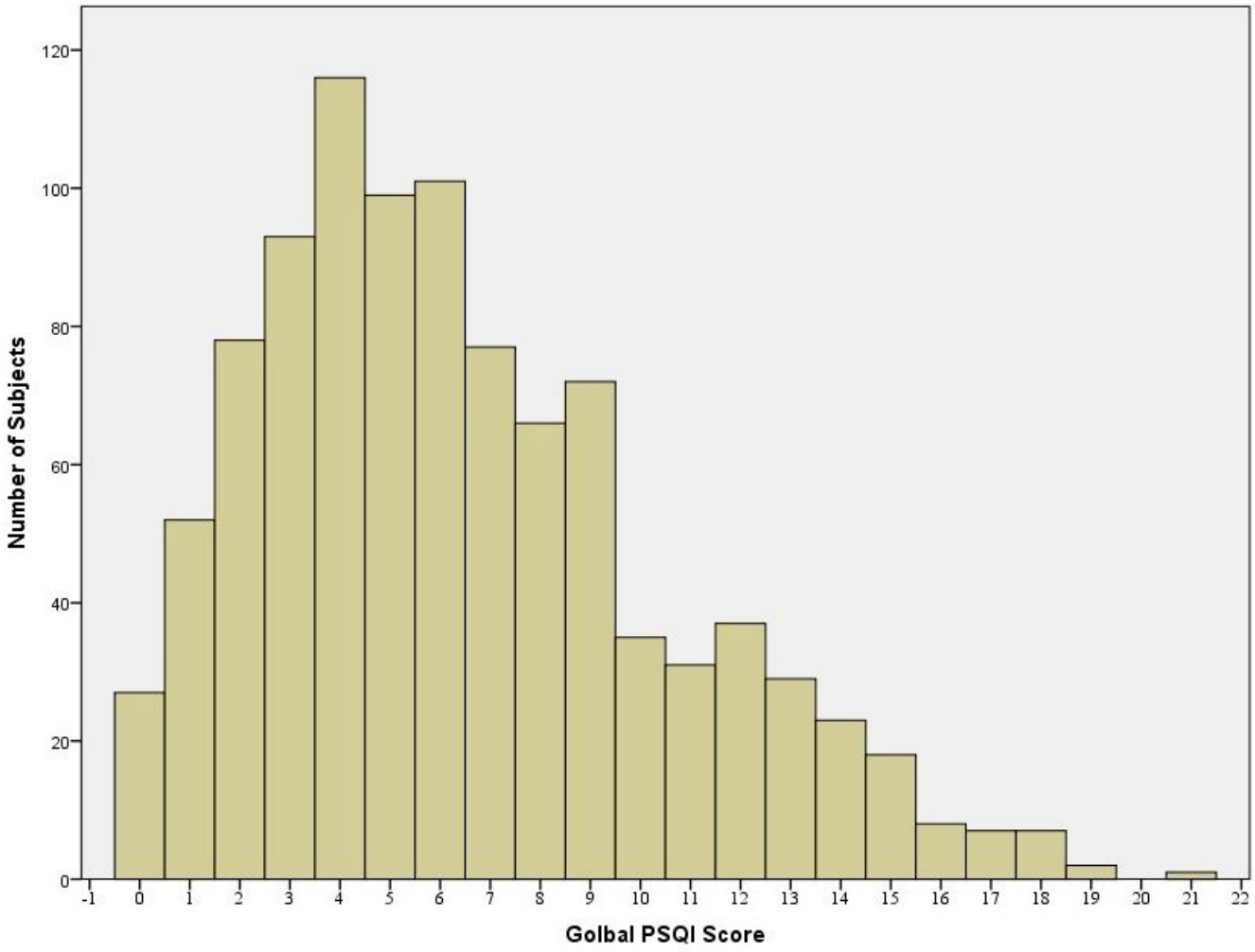

Figure 1

PSQI score distribution