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Assessment of Sleep Quality and Related Factors in Stroke Patients

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ABSTRACT
Purpose: The purpose of the present study was to evaluate sleep quality in stroke patients and to determine the impact of functional state, emotional state and motor recovery on sleep quality.

Materials and Method: A total of 93 patients with cerebrovascular incident related stroke and 93 healthy volunteers were included in the study. The sociodemographic data of the study group were recorded along with the clinical findings of the patients. Brunstromm motor staging was used for motor assessment, while Barthel Index (BI) and Functional Ambulation Classification were used for functional state assessment. While sleep quality was evaluated via Pittsburgh Sleep Quality index (PSQI), Hospital Anxiety and Depression Scale (HADS) was used for determining the emotional state. Functional state, motor disorder and emotional state were considered as independent variables and multiple regression analysis was used for predicting sleep quality.
Results: All sub-scores of PSQI and total score of the patients were higher at a statistically significant level for the patients in comparison with the control group ($p<0.001$). Total PSQI score was correlated with HADS anxiety and depression scores ($p<0.01$). A negative and significant correlation was observed between BI and PSQI total score. It was put forth as a result of the multiple regression analysis that HADS depression mood is the most important factor in predicting sleep quality ($p<0.01$).
Conclusion: It was presented as a result of the present study that there is a decrease in sleep quality in stroke patients in comparison with the control group. The emotional states and physical disabilities of the patients were also related with sleep quality. Since sleep quality was the most important factor in determining depression sleep quality based on the results of our study, we are of the opinion that sleep quality may be increased in stroke patients especially by early diagnosis and treatment of depression.

Keywords: Depression, disability, Pittsburgh sleep assessment scale, sleep quality, stroke

I. INTRODUCTION

Stroke is a suddenly developing clinical syndrome characterized by permanent focal neurological loss (1). It is the primary reason of disability in the world and is the third cause of death after coronary diseases and cancer (2).

Sufficient sleep duration and quality sleep is necessary for the normal functioning of the nervous system. Chronic sleep disorder has important impacts on human health and has apparent adverse impacts especially on cognition and memory (3). In addition, sleep disorder is one of the reasons of fatigue and is of significant importance since it affects the rehabilitation process and functional results (4).

Sleep disorder may be the primary cause of neurological diseases; it can also intensify the symptoms or prevent their treatment (3). There are various studies which put forth that sleep disorder is a risk factor especially for neurological diseases such as stroke and multiple sclerosis (3). It has been reported as a result of many well organized cross-sectional studies that the severity of sleep-respiration problems is related with stroke prevalence (5, 6).

Sleep-respiration and sleep-wakefulness problems are ignored in many stroke patients. However, both of these cases have a high cardiovascular risk profile in addition to sleep disorder (insomnia, hypersomnia) as a clinical characteristic (7).

The number of studies in literature examining the sleep quality of stroke patients and related factors is limited and majority of these studies focus on the quality of life. Sleep disorder is reported in previous studies at ratios varying between 10-50 % (2,7). Özvurmaz et al. (8) carried out a study examining the quality of life of stroke

patients as a result of which it was determined that their Nottingham health profile sleep sub-scores are higher at a statistically significant level in comparison with the control group. A highly significant and negative correlation was also determined between the sleep score and disability level as a result of this study. It was put forth as a result of another study that there are statistically significant relations between sleep-respiratory problems among patients and low Barthel Index (BI) at the time of discharge and during the third and twelfth month controls (9). It has also been reported in the same study that obstructive sleep apnea which is an important risk factor for stroke is an independent indicator of results related with functional recovery.

Even though objective tests make stronger contributions to the assessment of sleep, there is a need for certain setups and educated personnel in order to carry out these tests (10). Hence, Pittsburgh Sleep Quality Index (PSQI) was used which is one of the subjective assessment scales that is easier to apply and that can be applied by anyone in any environment. PSQI is a scale that is the most frequently applied scale among the adult population for subjective sleep assessment (11).

In the light of previous studies on the assessment of sleep in stroke patients, we also suggested that sleep quality is disrupted in stroke patients and that the clinical findings of the patients along with their emotional and functional states may have an impact on their sleep quality along. The aim of the present study was to evaluate the sleep quality of stroke patients and to determine the impact of functional state, motor recovery level and emotional state on sleep quality.

II. MATERIALS AND METHOD

The study was carried out among stroke patients who applied to the pulmonary diseases and physical treatment polyclinic of our hospital during the dates of March 2018-October 2019. Local ethics council approval was obtained prior to the study. The patient and control groups were briefed on the purpose and scope of the study. Those who accepted to take part in the study were asked to sign the "informed consent form" a copy of which was given to the participants. A total of 93 patients aged 24-82 who have had a stroke at least 3 months ago with sufficient cognitive functions, without any sleep problem and emotional disorder prior to the disease were included in the study. Exclusion criteria were determined as traumatic stroke, malignity or other organic factor related strokes, alcohol-substance abuse. The sociodemographic and clinical characteristics of the patients were recorded. Functional status was evaluated via BI, ambulation capacity was evaluated via Functional Ambulation Scale (FAS) while spasticity was used to evaluate via modified Ashworth scale , functional recovery level was evaluated via Brunstromm motor staging. PSQI scale was used to assess the sleep quality of the patients over a 1-month interval while Hospital Anxiety and Depression scale (HADS) was filled for the assessment of their emotional states. The control group was comprised of randomly selected healthy and volunteering individuals with similar demographic characteristics with regard to age and gender.

Pittsburgh Sleep Quality Index (PSQI)

PSQI is a sleep questionnaire used for the assessment of the sleep quality, amount of sleep, presence and severity of sleep disorder for an individual over a 1-month interval. This scale consists of 19 items and measures a total of seven sub-components of sleep quality comprised of subjective sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disturbances (C5), use of sleeping medication (C6) and daytime dysfunction (C7). Total PSQI score is obtained by summing up the seven sub-scores and varies between 0-21. PSQI total score conclusively separates good sleepers (PSQI total score $\leq$5) from poor sleepers (PSQI >5) (12).

Hospital Anxiety and Depression Scale (HADS)

HADS is a self-assessment scale developed for determining the risk of anxiety and depression in addition to measuring its level and change in severity (13,14). There is a total of 14 items each of which is scored differently. The total scores of the sub-scales are obtained by summing up the item scores. Odd numbered items measure anxiety, whereas even numbered items measure depression. It was determined as a result of a study carried out that the cutoff scores for the anxiety and depression sub-scales are 10/11 and 7/8 respectively (15).

Barthel Index (BI)

It is used for measuring the level of disability that the patients experience in activities of daily living. BI is comprised of a total of 10 primary items. It questions the help needed with feeding, transfers (from wheelchair to bed and return), grooming, toilet use, bathing, walking on a level surface, climbing stairs, dressing and the presence or absence of fecal and urinary incontinence. The total score is assessed between 0 and 100. 0-20: fully dependent, 21-61: advanced dependence, 62-90: moderate dependence, 91- 99: light dependence, 100: fully independent (16).

Functional Ambulation Classification (FAC)

It is a scale used for the assessment of the ambulation ability of the patients. It has six categories scored

between 0 and 5: FAS 0: no ambulation, FAS 1-2: patient needs support for walking, FAS 3-5: patient can walk 6 meters independently (17).

Brunnstrom motor staging

It is used for the assessment of the recovery in motor functions. The lowest stage (flaccid stage with a complete lack of voluntary movement) is stage 1 and the highest stage (isolated joint movements) is stage 6. Its reliability and validity have been proven (8).

Modified Ashworth scale

It is a method used for grading spasticity in patients. It is based on the principle of subjective grading of the resistance felt by the doctor during examination. It has six gradings: 0=no increase in muscle tone, 1=slight increase in muscle tone, with a catch and release of minimal resistance at the end of the range of motion when an affected part(s) is moved in flexion or extension, 1+= Slight increase in muscle tone, manifested as a catch, followed by minimal resistance through the remainder (less than half) of the range of motion, 2= A marked increase in muscle tone throughout most of the range of motion, but affected part(s) are still easily moved, 3= Considerable increase in muscle tone, passive movement difficult, 4= Affected part(s) rigid in flexion or extension (18).

III. STATISTICAL EVALUATION

SPSS 22 software was used for statistical calculations. Kolmogorov-Smirnov test was used for assessing whether the data are in accordance with normal distribution or not. Intergroup comparisons were carried out via independent samples t-test or Mann Whitney-U test subject to whether the data are in accordance with normal distribution or not. Chi-square test was used for calculating the difference between the proportional variables. Spearman correlation analysis was used for examining the relationship between sleep quality and the clinical findings of stroke and emotional state. PSQI was considered as a dependent variable for predicting the factors affecting sleep, while emotional state, functional state and ambulation skill were considered as independent variables which were evaluated via stepwise multiple regression analysis. Statistical significance was accepted as $p<0.05$ and the reliability interval of 95 % that does not cover one.

IV. RESULTS

The mean age of the patients was 58.20±12.60, while that of the control group was 56.90±11.00 and there was no statistically significant difference between the two groups with regard to age ($p>0.05$). Table 1 presents the sociodemographic data for the patient and control groups. Of the 93 patients, 54 (58.2 %) were male and 39 (41.8 %) were female. Almost all of the patients (95.6 %) were married and they were being looked after in the household environment by family members. While 33 patients (34.5 %) were employed prior to the disease, 60 patients (64.5 %) were unemployed. Table 2 presents the clinical characteristics of the patients along with the measurement parameters. Of the patients included in the study, 50 (53.7 %) had right hemiplegia, 38 (40.8 %) had left hemiplegia and 5 (5.5 %) had right-left hemiplegia. Of the patients, 69 (74.1 %) had ischemic related cerebrovascular case, while 24 (25.8 %) had hemorrhagic related cerebrovascular case. Upper and lower extremity Ashworth mean values were 1.38±1.26 and 1.58±1.28 respectively. While the upper extremity Brunstromm average was 2.91±1.41, the lower extremity average was 3.92±1.36. BI and FAS mean values were determined as 49.26±27.78 and 1.73±1.92 respectively. Based on the PSQI total score, 48 % of the patients suffered from sleep quality disruption (Table 2).

Table 1: Sociodemographic characteristics of the patients

Variables	Patient (n:93)	Control (n:93)	p
Age	58.20±12.60	56.80 ± 11.00	0.95
Gender			0.28
Male, n (%)	54 (% 58.2)	48 (51.7)	
Female, n (%)	39 (% 41.8)	45 (48.3)	
Marital status			0.32
Married (%)	89 (% 95.6)	91 (97.8)	
Single (%)	4 (% 4.4)	2 (2.2)	
Occupation			0.36
Employed, n (%)	60 (% 64.5)	55 (59.1)	
Unemployed, n (%)	33 (% 34.5)	38 (40.9)	
Education			0.43
None, n (%)	57 (61.3)	51 (54.7)	
Yes, n (%)	36 (38.7)	42 (45.3)	

Table 2: Clinical characteristics and measurement parameters of the patients

Clinical characteristics and measurements	Patient n:93
Side, n (%)	
Right	50 (53.7)
Left	38 (40.8)
Bilateral	5 (5.5)
Etiology, n (%)	69 (74.3)
Ischemia	24 (25.7)
Hemorrhage	
Asworth avg±SD	1.41 ±1.26
Upper extremity	1.61±1.31
Lower extremity	
Brunnstrom, avg.± SD	2.89±1.39
Upper extremity	3.89±1.36
Lower extremity	
BI, avg ± SD	49.29 ± 27.91
FAC, avg ± SD	1.69 ± 1.59
$PSQI^{Total}$, n (%)	
<5	45 (48)
>5	48 (52)

It was observed when sleep quality was evaluated that the total PSQI score and subtotal scores (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction) were higher at a statistically significant level in stroke patients in comparison with the control group ($p<0.001$) (Table 3). The relationships between the PSQI score of the patients and HADS, BI, Brunnstrom motor recovery stage and FAC are presented in Table 4. Total PSQI score ($p<0.01$) and some sub scores ($p<0.05$) were correlated with HADS anxiety and depression score at a statistically significant level. There was a negative correlation between the total PSQI score and lower extremity Brunnstrom score, FAC and BI ($p<0.01$). It was determined when the PSQI total score was considered as the dependent variable; HADS, BI and FAC were considered as independent variables that the strongest variable in determining the sleep quality of the patients is the depression level with the results presented in Table 5.

Table 3: Comparison of the patients and the control with regard to sleep quality

	Patient (n)	Control (n)	P
C1	1.48±0.89	0.59±0.49	0.001**
C2	1.74±0.97	0.61±0.69	0.002**
C3	1.09±1.31	0.61±0.59	0.004*
C4	1.20±1.19	0.10±0.41	0.001**
C5	1.41±0.59	0.81±0.49	0,003**
C6	0.61±1.17	0.04±0.28	0.001**
C7	1.49±1.00	0.49±0.60	0.002**
$PSQI^{Total}$	8.89±5.21	3.17±1.89	0.001**

C1: subjective sleep quality; C2: sleep latency; C3: sleep duration; C4: habitual sleep efficiency; C5: sleep disturbances; C6: use of sleeping medication; C7: daytime dysfunction; PSQI: Pittsburgh Sleep Quality Index. Statistical significance level p<0.01, statistical significance level p<0.001.*

Table 4: Correlations between sleep quality and emotional state, disability, motor recovery and ambulation level

	HADS Anxiety	HADS Depression	Barthel Index	Brunnstrom^{üst}	Brunnstrom^{alt}	FAC
	r	r	r	r	r	r
C1	0.289*	0.301*	-0.199	-0.199	-0.231	-0.243
C2	0.105	0.110	0.091	-0.171	-0.081	-0.031
C3	0.291*	0.299*	-0.409**	-0.169	-0.491**	-0.449**
C4	0.259*	0.321*	-0.320*	-0.159	-0.399**	-0.411**
C5	0.291*	0.199	-0.231	-0.079	-0.209	-0.251
C6	0.221	0.278*	-0.391**	-0.109	-0.402**	-0.325*
C7	0.309*	0.291*	-0.291*	-0.159	-0.269*	-0.261*
Total^{PSQI}	0.391**	0.389**	-0.329**	-0.221	-0.398**	-0.359**
BI	-0.311*	-0.409**	1.000	0.561**	0.841**	0.862**

*HADS: Hospital Anxiety and Depression Scale; FAC: Functional Ambulation Classification; C1: subjective sleep quality; C2: sleep latency; C3: sleep duration; C4: habitual sleep efficiency; C5: sleep disturbances; C6: use of sleeping medication; C7: daytime dysfunction; PSQI: Pittsburgh Sleep Quality Index. *p<0.05 **p<0.01*

Table 5: Relationship between sleep quality and independent variables

n: 93	β	t	p
HADS Anxiety	0.141	0.541	0.589
HADS Depression	0.399	3.409	0.004
Barthel Index	-0.231	-0.833	0.069
FAC	-0.199	-1.641	0.109

HADS: Hospital anxiety and depression scale, FAC: Functional ambulation classification

V. DISCUSSION

The present study was carried out for assessing sleep quality in stroke patients and to examine the impacts of emotional state, motor recovery and disability level on sleep quality. Study results put forth that there was a statistically significant deterioration in the patient group in comparison with the control group with regard to subjective sleep quality, sleep latency, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction.

Sleep disturbance is related with important psychological and physiological stresses (19) and interrupted sleep that results in daytime sleepiness causes disruptions in cognitive and functional abilities (20). It is reported that untreated sleep disturbances lead to limitations in social interaction, caregiver stress as well as increases in morbidity and mortality (21-24).

Even though there are many studies that examine the impact of various diseases on sleep quality, the number of studies evaluating sleep quality of stroke patients is limited and majority only evaluate the quality of life in stroke patients. However, it is reported in the related literature that sleep disturbances are common among stroke patients with hypersomnia in about 10-50 % of stroke patients along with excessive daytime sleepiness and insomnia (25). Mollie et al. (26) reported that sleep disturbance develops in stroke patients after 3 months. It was put forth in a study carried out on patients with subarachnoid hemorrhage that severe sleep issues developed in about one third of the patients (34 %) during the first 3 years following subarachnoid hemorrhage (27). Sleep latency and difficulties in continuing sleep were among the most frequently observed problems along with excessive daytime sleepiness and fatigue. It was determined in our study in accordance with the related literature that the ratio of sleep disturbance among stroke patients is 48 %.

There are different results with regard to sleep quality among studies that examine quality of life in stroke patients. Fadrna et al. (28) and Özvurmaz et al. (8) determined the Nottingham health profile sleep sub-score higher at a statistically significant level in stroke patients in comparison with the control group. However, Adeniyi et al. (29) carried out a study on the quality of life in which no difference was observed between the stroke patients and the control group with regard to sleep quality. PSQI was used in our study which enables a more specific assessment of sleep quality. However, we also observed that the sleep quality was worse in stroke patients in comparison with the control group. In this regard, our study supports the findings of the studies by Fadrna and Özvurmaz.

There are studies among those which evaluate the factors that may have an impact on sleep quality that

sleep disturbance is related with stress (30-33) or functional state (33). Karaca et al. (33) reported that there is a statistically significant correlation between PSQI and Functional Dependence Scale and PSQI and Beck Depression score in 42 stroke patients. It is asserted in this study that depression may have an adverse impact on the sleep quality of patients. Hayashino et al. (34) put forth in their study that PSQI scores get worse with depression in comorbid patients including stroke patients as well. Özvurmaz et al. (8) reported in their study that sleep quality is worse in the patient group with depression in comparison with the stroke group without depression. However, Kim et al. (35) carried out a study comparing stroke patients with and without insomnia as a result of which a statistically significant difference could not be determined between the two groups with regard to functional, cognitive and depressive mood. Hayashino and Karaca carried out studies in which it was determined similar to our study that there are statistically significant relations between PSQI total score and sub scores and HADS anxiety and depression scores. However, only the depression state of the patients was a determining independent factor for sleep quality. In the meantime, the BI scores and FAS scores of the patients were correlated with PSQI. Hence, treatments for improving the emotional state during the rehabilitation process may improve sleep quality while also making an impact on the disability level.

Sleep disturbances comprise a risk factor for stroke with adverse impacts on the prognosis of stroke as well (36). In this regard, early diagnosis and treatment of sleep disturbance may aid in improving the functional states of the patients while also preventing stroke recurrence. Since those with prior sleep disturbance were excluded in our study, we were unable to examine the impact of sleep disturbance in increasing the risk of stroke. Moreover, the fact that our study was a cross-sectional study and that polysomnographic assessment was not carried out can be considered as the limitations of our study.

In conclusion, disturbance in sleep quality was observed in the present study in stroke patients in comparison with the control group. Disruption in sleep quality in stroke patients is related with bad emotional state and reduced functional capacity. We are of the opinion that rehabilitation applications on stroke patients along with pharmacologic-non-pharmacologic treatment approaches for sleep disturbance and behavioral treatments may have an impact on the recovery process. We emphasize the need for carrying out further prospective sleep studies with the accompaniment of polysomnography on a greater number of patients during the post-stroke period. We think that quality of life and functional state can be improved with the treatment of sleep disturbance and that it may aid in preventing stroke recurrence.

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