ORIGINAL RESEARCH

The Relationship Between Sleep Quality and Clinical and Demographic Factors After Stroke

İnme Sonrası Uyku Kalitesi ile Klinik ve Demografik Faktörler Arasındaki İlişki

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Abstract

Objective: Post-stroke sleep disturbances are significant complications that impact the rehabilitation process. This study aimed to evaluate sleep quality in post-stroke patients and examine its relationship with clinical and demographic factors, including functional and psychological status.

Method: This cross-sectional study included 92 post-stroke patients in inpatient rehabilitation. Sleep quality was assessed using the Pittsburgh sleep quality index (PSQI), with patients categorized into good (≤5) and poor (>5) sleep groups. Depression and anxiety symptoms were measured with the hospital anxiety and depression scale (HADS). Functional status and motor recovery were evaluated using the modified Barthel index (MBI) and the Brunnstrom motor assessment, respectively.

Results: Fifty percent of participants had poor sleep quality. No significant differences were observed between groups in age, gender, stroke type, or body mass index (p>0.05). Compared with the good sleep quality group, the poor sleep quality group had significantly shorter time since stroke (p=0.013), lower Brunnstrom motor stage scores (p<0.001), greater dependency as indicated by MBI scores (p<0.001), and higher HADS depression scores (p<0.001) and anxiety scores (p=0.002). In addition, PSQI scores were significantly negatively correlated with stroke duration, Brunnstrom stages, and MBI scores, and were positively correlated with HADS scores.

Conclusion: Half of the stroke patients in this study had poor sleep quality, which was significantly associated with impaired motor recovery, reduced independence in daily activities, and

Öz

Amaç: İnme sonrası uyku bozuklukları, rehabilitasyon sürecini olumsuz etkileyen önemli komplikasyonlar arasında yer almaktadır. Bu çalışmanın amacı, inme sonrası hastalarda uyku kalitesini değerlendirmek ve uyku kalitesinin fonksiyonel ve psikolojik durum da dahil olmak üzere klinik ve demografik faktörlerle ilişkisini incelemektir.

Yöntem: Bu kesitsel çalışmaya, yataklı rehabilitasyon programına alınan 92 inme hastası dahil edilmiştir. Uyku kalitesi Pittsburgh uyku kalitesi indeksi (PUKİ) kullanılarak değerlendirilmiş ve hastalar iyi (≤5) ve kötü (>5) uyku kalitesi gruplarına ayrılmıştır. Depresyon ve anksiyete belirtileri hastane anksiyete ve depresyon ölçeği (HADÖ) ile değerlendirilmiştir. Fonksiyonel durum ve motor iyileşme düzeyi sırasıyla modifiye Barthel indeksi (MBİ) ve Brunnstrom motor değerlendirmesi kullanılarak ölçülmüştür.

Bulgular: Katılımcıların %50'sinin kötü uyku kalitesine sahip olduğu saptanmıştır. Gruplar arasında yaş, cinsiyet, inme tipi veya vücut kitle indeksi açısından anlamlı bir fark bulunmamıştır (p>0,05). İyi uyku kalitesine sahip grupla karşılaştırıldığında, kötü uyku kalitesine sahip grupta inme süresinin daha kısa olduğu (p=0,013), Brunnstrom motor evrelerinin daha düşük olduğu (p<0,001), MBİ puanlarına göre bağımlılık düzeyinin daha yüksek olduğu (p<0,001) ve HADÖ depresyon (p<0,001) ve anksiyete (p=0,002) puanlarının daha yüksek olduğu bulunmuştur. Ayrıca, PUKİ puanlarının inme süresi, Brunnstrom evreleri ve MBİ puanları ile negatif; HADÖ puanları ile ise pozitif yönde anlamlı korelasyon gösterdiği saptanmıştır.

Sonuç: Bu çalışmada, inme hastalarının yarısının kötü uyku kalitesine sahip olduğu ve bu durumun bozulmuş motor iyileşme, günlük

Abstract

increased anxiety and depression. These findings emphasize the importance of regular sleep assessments and multidisciplinary sleep management within post-stroke rehabilitation programs.

Keywords: Activities of daily living, depression, rehabilitation, sleep quality, stroke

Öz

yaşam aktivitelerinde azalmış bağımsızlık ve artmış anksiyete ve depresyon düzeyleriyle anlamlı derecede ilişkili olduğu gösterilmiştir. Bu sonuçlar, inme sonrası rehabilitasyon programları kapsamında düzenli uyku değerlendirmesinin yapılması ve multidisipliner bir yaklaşımla uyku yönetiminin sağlanmasının gerekliliğini vurgulamaktadır.

Anahtar kelimeler: Günlük yaşam aktiviteleri, depresyon, rehabilitasyon, uyku kalitesi, inme

Introduction

Stroke is one of the leading causes of long-term disability worldwide, resulting in significant physical, cognitive, and psychological impairments that affect patients' quality of life (1). While the primary focus of rehabilitation is often motor recovery, secondary complications can significantly hinder this process (2). Sleep disorders exhibit a complex, bidirectional relationship with stroke; they not only act as a risk factor for stroke but also serve as a significant post-stroke complication that adversely affects rehabilitation outcomes (3,4).

Post-stroke sleep disturbances, encompassing insomnia, fragmented sleep, and hypersomnia, may arise from direct structural damage to sleep-regulating brain centers (e.g., thalamus, brainstem) or secondary to psychological factors such as depression and anxiety (5).

Previous studies have reported that up to 60% of post-stroke patients experience poor sleep quality or related sleep disorders (6). This is clinically important because sleep is not merely a resting state but a vital physiological process that supports neuroplasticity, memory consolidation, and motor learning, which are foundational to stroke rehabilitation (7). Sleep disorders have also been associated with worsening functional status and poor prognosis, which are key targets of post-stroke rehabilitation (8). However, the relationships between sleep quality and demographic factors, stroke characteristics, and psychological status remain heterogeneous in the literature, and conflicting results have been reported. Furthermore, the relationship between sleep and psychological status creates a "vicious cycle". Post-stroke depression and anxiety are strong predictors of poor sleep, yet sleep disturbances themselves can exacerbate these psychiatric symptoms, further hindering functional independence and activities of daily living (9). Given the growing evidence supporting improved clinical outcomes following stroke rehabilitation, it is critical to more fully understand how post-stroke sleep disorders relate to clinical and demographic variables.

This study aimed to evaluate post-stroke patients' sleep quality and to examine its relationship with clinical and demographic factors, including motor function, independence in daily activities, and psychological symptoms.

Materials and Methods

This cross-sectional, descriptive, observational study was designed and conducted in accordance with STROBE guidelines (10). It was conducted between 15.02.2025 and 28.02.2025 at a tertiary hospital. Of 138 post-stroke patients assessed for eligibility, 92 were included in the study. A detailed analysis of the patient selection process and exclusion criteria is shown in the Figure 1. Patients were categorized into two groups based on sleep quality using the Pittsburgh sleep quality index (PSQI) cut-off values.

This study was conducted following approval by the Local Ethics Committee of İstanbul Physical Therapy Rehabilitation Training and Research Hospital (approval number: 2025-02, date: 06.02.2025). All volunteers provided written informed consent for this study, which adhered to the principles outlined in the Declaration of Helsinki.

Inclusion Criteria

• Patients were between 18 and 80 years old

• History of hemorrhagic or ischemic stroke

• Voluntarily agreed to participate in the study.

Exclusion Criteria

• History of pre-stroke insomnia

• Pre-existing psychiatric diseases (e.g., bipolar disorder, depression, schizophrenia, or anxiety)

• Pre-stroke psychiatric medication use

• History of sleep apnea syndrome (confirmed via medical records and patient self-reports)

• Inability to cooperate or complete study-related questionnaires

• Presence of other neurological diseases.

Data for all patients, including demographic details (age, gender, level of education, occupation, marital status), were recorded. Stroke-specific characteristics, such as time since onset, etiology, lesion location, and the affected side, were also evaluated.

Outcomes

PSQI

The PSQI was developed by Buysse et al. (11). The Turkish version, whose validity and reliability were established by Agargun et al. (12), was used to assess patients' sleep quality. The PSQI evaluates sleep quality over the past month through 24 items addressing various components such as sleep duration, sleep latency, subjective sleep quality, use of sleep medication, habitual sleep efficiency, sleep disturbances, and daytime dysfunction. The total score ranges from 0 to 21, with scores above 5 indicating poor sleep quality (12).

Hospital Anxiety and Depression Scale (HADS)

The Turkish validity and reliability study of the HADS was conducted by Aydemir (13). HADS is a 14-item self-assessment tool designed to assess anxiety and depression symptoms, with seven items per subscale. Patients are asked to rate each item on a scale from 0 to 3. The maximum score for both the anxiety and depression subscales is 21. A score of 8 or higher on the depression subscale indicates clinically significant depressive symptoms, and a score of 11 or higher on the anxiety subscale indicates clinically significant anxiety (14).

Modified Barthel Index (MBI)

To evaluate the functional status and dependency level of patients, the Turkish version of the MBI, whose reliability and validity have been confirmed, was used. This index comprises 10 key items assessing various aspects of daily living, including feeding, transfers between bed and wheelchair, personal hygiene, toilet use, bathing, mobility on flat surfaces or in a wheelchair, stair climbing, dressing, and control of bladder and bowel functions. The total score ranges from 0 to 100, with interpretation as follows: 0-20 points indicate total dependence, 21-61 points indicate severe dependence, 62-90 points indicate moderate dependence, 91-99 points indicate mild dependence, and 100 points indicate full independence (15).

Brunnstrom Motor Assessment

The Brunnstrom motor assessment was employed to evaluate motor function in the hemiplegic upper extremity, the lower extremity, and the hand in patients following stroke.

Figure 1. Flow chart of the study

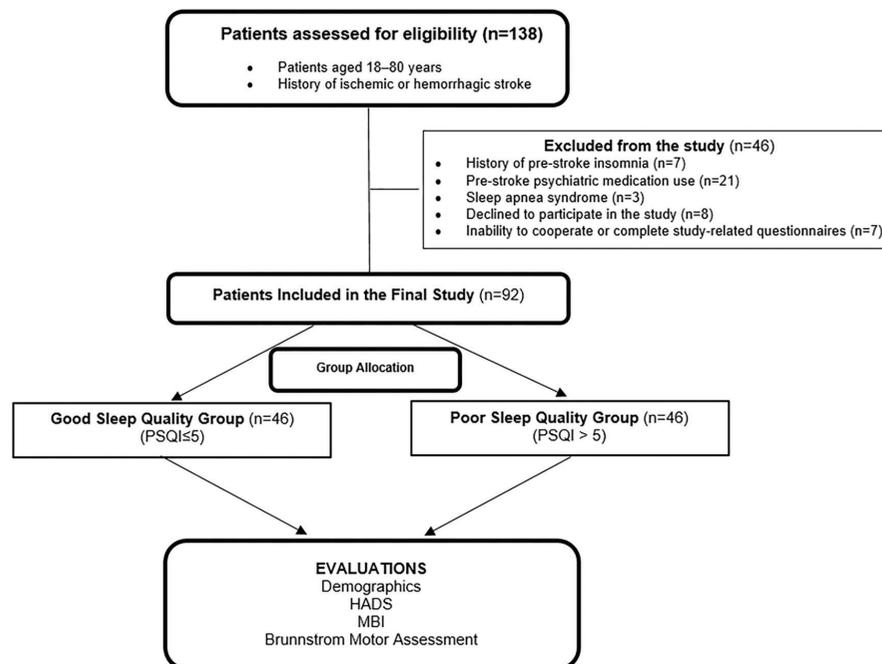Of the 138 patients assessed for eligibility, 92 were included in the final study after excluding 46 patients who did not meet the inclusion criteria, declined to participate, or were unable to cooperate. Participants were allocated into two groups based on their Pittsburgh sleep quality index (PSQI) scores: the good sleep quality group (PSQI ≤5, n=46) and the poor sleep quality group (PSQI >5, n=46)

This scale classifies motor recovery into six stages, with Stage 1 representing the absence of voluntary movement and Stage 6 indicating near-normal motor control (16).

Sample Size

The sample size of the study was calculated using G*Power software (version 3.1.9.4; Franz Faul, Universität Kiel, Germany). Based on a medium effect size of 0.3 for the correlation test, a significance level of 5% (α=0.05), and a statistical power of 90%, the minimum required sample size was calculated to be 92 participants in total (17).

Statistical Analysis

The normality of the distribution of continuous variables was assessed using the Kolmogorov-Smirnov test with Lilliefors correction. Continuous variables were summarized as mean ± standard deviation and minimum-maximum values, whereas non-normally distributed data were summarized as median (interquartile range). Categorical variables were summarized as frequencies (percentages). Comparisons between two independent groups were made using the Mann-Whitney U test for non-normally distributed data. The homogeneity of categorical variables between groups was assessed using the Pearson chi-square test. Statistical significance was set at p<0.05. Spearman's rank correlation coefficient was used to evaluate the relationships between PSQI scores and clinical variables because the data did not meet the normality assumption. Data analyses were performed using IBM SPSS Statistics version 21.0.

Results

A total of 92 patients with stroke were included in the study. The mean age was 65.63 ± 7.94 years. 65.2% of the patients were male. 71.7% of the patients had a history of ischemic stroke. The majority of patients (63%) had lesions in the middle cerebral artery territory, and 55.4% had left hemiplegia (Table 1).

Participants were divided into two groups with good (PSQI≤5) and poor (PSQI>5) sleep quality according to the cut-off values of PSQI scores. Fifty percent of patients had poor sleep quality. There were no statistically significant differences between the groups with good and poor sleep quality in terms of age, gender, etiology, and body mass index (BMI) (p>0.05). Compared with the good sleep quality group, the poor sleep quality group had a significantly shorter time since stroke (p=0.013), lower Brunnstrom motor stages (p<0.001), greater dependency as indicated by MBI scores (p<0.001), and higher HADS depression (p<0.001) and anxiety scores (p=0.002) (Table 2).

Analysis of the relationship between PSQI scores and clinical and demographic parameters revealed no significant correlation with age or BMI. However, significant negative correlations were observed between PSQI scores and stroke duration (r=-0.269, p=0.010); Brunnstrom stages of the upper extremity (r=-0.615, p<0.001), hand (r=-0.523, p<0.001), and lower extremity (r=-0.575, p<0.001); and the MBI (r=-0.605, p<0.001). Additionally, there was a significant positive correlation between PSQI scores and HADS depression (r=0.503, p<0.001) and anxiety (r=0.393, p<0.001) scores (Table 3).

Table 1. Patients' demographic and stroke characteristics		n (%)	Mean ± SD	Min-max
Age (years)			65.63±7.94	45-78
Height (cm)			164.98±8.69	148-181
Weight (kg)			79.29±12.77	48-110
BMI (kg/m²)			29.23±4.90	21.72-41.02
Stroke duration (months)			4.64±2.77	1-14
Gender	Male	60 (65.2%)		
	Female	32 (34.8%)		
Marital status	Married	72 (78.3%)		
	Single	20 (21.7%)		
Etiology	Ischemic	66 (71.7%)		
	Hemorrhagic	26 (28.3%)		
Plegic side	Right	41 (44.6%)		
	Left	51 (55.4%)		
Lesion location	MCA	58 (63.0%)		
	ACA	15 (16.3%)		
	Posterior circulation	19 (20.7%)		
SD: Standard deviation, BMI: Body mass index, MCA: Middle cerebral artery, ACA: Anterior cerebral artery, Min-max: Minimum-maximum				

Table 2. Comparison of clinical characteristics by PSQI				
		Sleep quality		
		Good	**Poor**	**p-value**
		(n=46)	**(n=46)**	
Age (years)		65.04±7.92	66.21±8.01	0.484[U]
BMI (kg/m²)		29.03±4.50	29.42±5.32	0.749[U]
Gender	Male	34 (56.67%)	26 (43.33%)	0.080[P]
	Female	12 (37.5%)	20 (62.5%)	
Etiology	Ischemic	34 (50.75%)	33 (49.25%)	0.815[P]
	Hemorrhagic	12 (48%)	13 (52%)	
Stroke duration (months)		5.46±3.26	3.82±1.90	**0.013[U]**
Brunnstrom upper extremity		5.00 (3.00-6.00)	2.00 (1.00-2.00)	**<0.001[U]**
Brunnstrom hand		5.00 (3.00-6.00)	2.00 (1.00-3.00)	**<0.001[U]**
Brunnstrom lower extremity		4.00 (3.00-5.25)	3.00 (2.00-3.00)	**<0.001[U]**
MBI		77.50 (63.75-85.00)	35.00 (20.00-56.25)	**<0.001[U]**
HADS depression		7.00 (6.00-11.25)	13.00 (10.75-16.25)	**<0.001[U]**
HADS anxiety		6.00 (4.00-14.00)	12.50 (7.75-18.00)	**0.002[U]**

[P]: Pearson chi-square, [U]: Mann-Whitney U test, the data were presented as mean ± standard deviation or frequency (percentage) or median (interquartile range).
HADS: Hospital anxiety and depression scale, BMI: Body mass index, MBI: Modified Barthel index

Table 3. Correlation between PSQI scores and other parameters		
	PSQI scores	
	r	**p-value**
Age (years)	0.091	0.391
BMI (kg/m²)	0.080	0.448
Stroke duration (months)	-0.269	**0.010**
Brunnstrom upper extremity	-0.615	**<0.001**
Brunnstrom hand	-0.523	**<0.001**
Brunnstrom lower extremity	-0.575	**<0.001**
MBI	-0.605	**<0.001**
HADS depression	0.503	**<0.001**
HADS anxiety	0.393	**<0.001**

PSQI: Pittsburgh Sleep quality index, BMI: Body mass index, HADS: Hospital anxiety and depression scale, MBI: Modified Barthel index

Discussion

In this study, 50% of stroke patients had poor sleep quality. Significant relationships were found between sleep quality and functional staging, and between sleep quality and the level of independence in activities of daily living. Moreover, as sleep quality worsened, patients also exhibited higher depression and anxiety symptom scores.

In a study conducted in Canada, 61.6% of 682 stroke patients reported at least one type of sleep-related complaint (18). In a prospective cohort study conducted among 403 stroke patients in Northwest Ethiopia, 50.1% were evaluated as having poor sleep quality based on PSQI scores (8). In another study, 60% of 100 stroke patients had poor sleep quality, and the mean global PSQI score was reported as 9.13±14.40 (6). In a study evaluating chronic stroke patients, the mean global PSQI score was found to be 6.5±4.2, and 53% of the patients were reported to have sleep disturbances (19). In the study by Silva et al. (20), the PSQI scores were reported as 8.5±4.4. In our study, the mean total PSQI score was 7.47±5.75, which was lower compared to other studies in the literature. However, when the sample was divided into two groups according to clinically significant cut-off values, 50% of patients had poor sleep quality, which is consistent with the literature.

In our study, the mean age of the patients was 65.63±7.94 (range: 45-78), and no significant relationship was found between age and sleep quality. Conflicting findings exist in the literature on this subject. Nilsson et al. (19) did not find a significant relationship between sleep problems and age (73±11; range: 30-91). Alabdali et al. (6) found no association between age and sleep quality in patients, most of whom were aged 51-59 years. Similarly, other studies have reported no significant association between age and sleep quality, which aligns with our findings (3,18,20). In contrast to these findings, a study involving 277 patients with a mean age of 70.7±7.5 (range: 55-85) reported that the mean age was higher in the group with insomnia (21). Likewise, in the study by Palomäki et al. (22), age (mean 55.2 years; range 27-70 years) was identified as an independent risk factor for insomnia-related symptoms. Further research with

larger sample sizes and more homogeneous patient groups is needed to clarify the relationship between age and sleep quality.

In this study, sleep quality was rated as "poor" in 62.5% of female stroke patients, compared with 43.3% of male patients. Although this difference was not statistically significant, it may be considered clinically meaningful. Several studies have reported inconsistent results on this subject. A study of 682 stroke patients found no significant association between gender and sleep problems (18). Similarly, other studies have reported no association between sleep quality and gender (3,6). In the study by Nilsson et al. (19), however, sleep quality was significantly lower in female patients. In the study by Bakken et al. (23), PSQI total scores were higher in women during the acute phase, whereas actigraphy showed that total sleep duration was longer in women than in men. At the 6-month follow-up, the differences between genders in both objective and subjective measures were no longer observed (23). In our study, sleep quality was assessed only subjectively. Moreover, no specific distinction was made between the acute and chronic phases, and our study population consisted of patients between 1 and 14 months post-stroke. Such variations may account for the differing results regarding the relationship between gender and sleep quality across studies.

In a study conducted in a rehabilitation unit that followed post-stroke patients, improvements in sleep quality paralleled improvements in FIM scores (3). In the study by Silva et al. (20), functional status was assessed using the modified rankin scale and was found to be significantly associated with sleep quality. Although our study did not involve longitudinal follow-up, a significant relationship was found between sleep quality and Brunnstrom stages and MBI scores, both of which reflect functional independence. We believe this may be explained by better adherence to and participation in rehabilitation among patients with good sleep quality, resulting in more favorable functional recovery outcomes.

In a previous study, PSQI scores were >5 in 69.3% of patients with hemorrhagic stroke, indicating poorer sleep quality than in those with ischemic stroke (6). Similarly, other studies have reported a more pronounced deterioration in sleep quality following hemorrhagic stroke. In the study by Kojic et al. (24), sleep disorders were found to be 1.41 times more common after hemorrhagic stroke. Although Pasic et al. (25) observed no statistically significant difference in sleep disorders between the two groups, higher rates were reported in the hemorrhagic stroke group (76.8% vs. 82.5%). It has been suggested that the extensive damage and inflammatory response caused by

hemorrhagic strokes in regions such as the brainstem and thalamus—areas critical for sleep regulation—may contribute to the development of sleep disturbances (6). Contrary to these findings, our study found similar rates of sleep problems in both hemorrhagic and ischemic stroke patients. Other studies have reported no significant difference in this regard (19,26). The discrepancies in the literature may be due to various factors such as lesion location, the extent of the affected brain region, patient clinical parameters, the presence or absence of cerebral edema following hemorrhagic stroke, and differences in treatment approaches.

In a study of chronic stroke patients, a significant relationship was found between depression and sleep quality (27). Similarly, Silva et al. (20) found that sleep quality was associated with depressive symptoms. In a study that followed stroke patients under the age of 65, those classified as having chronic insomnia at 12 months showed higher rates of depression, anxiety, and physical limitations (26). Another study demonstrated that depression is an independent factor associated with insomnia (22). Leppävuori et al. (21) reported an independent association between insomnia and anxiety. Consistent with the literature, our study found that HADS scores for anxiety and depression were significantly higher in participants with poor sleep quality.

This study has strengths. One of its strengths is that all assessments were conducted in face-to-face interviews by the same physiatrist, an expert in the field. Additionally, the sample size was determined based on a power analysis. Moreover, the PSQI, which was used to assess sleep quality, is a widely accepted tool with proven validity and reliability.

Study Limitations

An important limitation of our study is that we used a subjective assessment based solely on patient self-reports to evaluate sleep quality, rather than using objective tools such as polysomnography or actigraphy. Furthermore, the study was conducted at a single center. Additionally, since the analyses were primarily bivariate, potential confounding between variables such as stroke duration, motor stage, functional independence, and HADS scores cannot be ruled out. Consequently, independent associations and causality cannot be inferred from our results. Due to its cross-sectional design, patients' pre-stroke sleep patterns and mood states are unknown. Future multicenter studies with larger sample sizes, multivariable analyses, and longitudinal follow-up designs are needed to obtain more comprehensive results.

Conclusion

In conclusion, the study showed that sleep quality was significantly impaired in 50% of stroke patients. Sleep quality is a key parameter that influences patient participation in rehabilitation and alters treatment response. Furthermore, psychological conditions such as anxiety and depression appear to affect sleep quality. Therefore, assessing and improving sleep quality in stroke patients is an integral part of rehabilitation.

Ethics

Ethics Committee Approval: This study was conducted following approval by the Local Ethics Committee of İstanbul Physical Therapy Rehabilitation Training and Research Hospital (approval number: 2025-02, date: 06.02.2025).

Informed Consent: All volunteers provided written informed consent for this study, which adhered to the principles outlined in the Declaration of Helsinki.

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Footnotes

Authorship Contributions

Concept: E.K., B.Ş.A., M.A., N.K., N.P., Design: E.K., B.Ş.A., M.A., N.K., N.P., Data Collection or Processing: E.K., M.A., Analysis or Interpretation: E.K., Literature Search: E.K., B.Ş.A., M.A., Writing: E.K., B.Ş.A., M.A.

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