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Research Article

Assessment of Sleep Quality and Level of Fatigue in Surgically Treated Patients

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Abstract

Introduction: Sleep is a physiological need of every person and ensures proper quality of physical and mental health. The symptom of fatigue lowers quality of life, making it difficult to function in physical, mental, and social dimensions. Poor sleep quality and the symptom of fatigue are often observed in surgically treated patients.

Objective and Methodology: The aim of the study was to assess the quality of sleep and the level of fatigue in surgically treated patients at three time intervals - the day before the surgery (Study I), the day of the surgery (Study II), and the day of discharge from the hospital (Study III). Additionally, an attempt was made to determine the relationship between the subjective assessment of sleep quality and the symptom of fatigue and the following variables: gender, pain, anxiety, surgical site, and surgical method. The study included 60 patients. Data were collected using the PSQI and FACIT-F questionnaires.

Conclusion: A relationship between fatigue and sleep in surgically treated patients was demonstrated. Surgically treated patients have better sleep quality at home before the procedure than during their stay in the hospital after the procedure. The location and method of the surgical procedure did not affect the patients' sleep quality. Pain was indicated as one of the main factors worsening sleep quality after surgery by 31.7% of patients. Women and men experience fatigue with different frequency and intensity. Surgically treated patients have reduced sleep quality and increased fatigue levels. Taking these aspects into account will allow for holistic planning of the treatment and care process in surgically treated patients.

Keywords: Fatigue; Hospitalization; Sleep quality; Surgical treatment

Introduction

Sleep is an integral part of human life. It affects many vital functions, from health and well-being to proper cognitive processes and even beauty. Sleep disorders reduce perception, cause fatigue, worsen relationships, and delay recovery. Sleep is extremely important for recovery. Hospitalized patients report a deterioration in sleep quality, which is most often related to noise (e.g., from operating equipment, performed procedures), the number of patients in the room, activities performed by nursing or medical staff (including the measurement of vital parameters), light (corridor lighting, medical equipment), stress before treatment, outcomes, symptoms of the disease, or simply a change in sleeping place (home-hospital). When undertaking surgical actions - operations, it is important to consider that sleep deprivation, which affects the deterioration of its quality, can cause fatigue, difficulties in remembering orders, worsens wound healing, adversely affects the cardiovascular system, or delays rehabilitation [1-3]. Fatigue is defined as a lack of energy, willingness to engage in physical activity, and initiate or maintain social relationships. It impacts the perception of pain, engagement in rehabilitation, sleep quality, self-care involvement, and also negatively affects cognition [4]. Fatigue is a symptom accompanying many disease entities that require surgical interventions. However, it is still a factor that is poorly analyzed in connection with the hospitalization of patients. The aim of the study was to assess the quality of sleep and the degree of fatigue in surgically treated patients during specific days on the ward, as well as the influence of selected factors (gender,

pain, anxiety, surgical site, surgical method) on the level of sleep quality and degree of fatigue.

Materials and Methods

Study and Participants

A cross-sectional study was conducted from March 2023 to December 2023 in the Clinical Department of General Surgery, Endocrinology, and Gastroenterological Oncology at the University Clinical Hospital in Poznan. The study included 60 patients hospitalized for planned surgical treatment. Participation in the study was voluntary, confirmed by the patient's written informed consent. The assessments were carried out on the day the patient was admitted to the department, on the day of the surgery, and on the last day of the patient's stay in the hospital. An exclusion criterion was the lack of consent or resignation during the investigation and failure to meet any of the above points. Study participants were asked to fill in the questionnaires either with the researcher's assistance or independently. Patients constituted a diverse group in terms of the disease entity; however, the study predominantly included patients admitted for surgical treatment of conditions such as: nodular goiter of the thyroid, adrenal tumor, gallstone disease, pelvic tumor, and rectosigmoid tumor, as well as hyperparathyroidism.

Methods/Questionnaires Used

Three standardized questionnaires and an authoring tool were utilized to achieve the objectives of the study. All respondents completed the same questionnaires. Patients were asked to anonymously fill out the Pittsburgh Sleep Quality Index (PSQI) questionnaire, which assesses sleep quality, the Functional Assessment of Chronic Illness Therapy - Fatigue (FACIT-F) questionnaire for fatigue, and the Spielberg's State-Trait Anxiety Inventory (STAI).

The FACIT-F questionnaire comprises five categories covering: physical state, family and social life, emotional state, functioning in everyday life, and other complaints. Each category includes several questions related to a particular area of patient functioning. Responses are rated on a 5-point Likert scale. The maximum score that can be obtained is 48, and the minimum is 0. A lower score indicates more severe fatigue symptoms. [5] The measurement tool was modified for the study group by omitting one statement ("I am too tired to eat"). The PSQI questionnaire consists of 10 questions related to patients' typical sleep habits over the last four weeks. It evaluates a broad range of sleep quality parameters such as sleep hygiene, difficulties falling asleep, problems maintaining sleep continuity, and daytime functioning. It also includes questions about the causes leading to sleep disturbances, including questions directed to the person sleeping in the same room with the patient. The sum of the points allows for the assessment of sleep quality in surgically treated patients. Responses are rated on a Likert scale. The minimum score that can be obtained is 0 points, and the maximum is 21 points, where a higher score indicates poorer sleep quality. A score above five points indicates reduced sleep quality. [6] The PSQI scales were modified for the second and third stages of the study (changing answers in some questions to yes/no) to gauge sleep quality during hospitalization, which did not last four weeks. The STAI questionnaire is designed to measure anxiety as a transient and situational state of the individual, as well as anxiety as a relatively stable personality trait. The research tool consists of two subscales, one of which (X-1) is used to measure state anxiety, assessing the level of anxiety the patient is aware of at the moment of the study. The second part (X-2) relates to trait anxiety, assessing the disposition to experience anxiety reactions, and the hypothetical strength that organizes anxiety reactions of a given individual. The point values for each part of the questionnaire can range from 20 to 80 points. Higher point values indicate a higher level of anxiety [7]. Pain was assessed using the Visual Analog Scale (VAS), scored from 0 to 10.

Statistical Analysis

Statistical analyses were conducted using the statistical software package STATISTICA 10 PL. Descriptive statistics were employed to summarize the data. Qualitative variables are presented using the count (n) and frequency (%), while measurable variables are described using the arithmetic mean (average, avg.), Standard Deviation (SD), median, minimum, and maximum values. Due to the nature of the measurable variables and the non-normality of their distribution, non-parametric tests were used: the Mann-Whitney U test (to check the significance of differences between two groups), the Kruskal-Wallis test (to check the significance of differences among at least three groups), the Friedman ANOVA (to check the significance of differences in dependent variables across three time periods), and the Spearman's rank correlation coefficient test (to explore the correlations between variables described at least on an ordinal scale). To investigate the relationships between qualitative variables, tests from the chi-squared family were used: Pearson's chi-squared test, Yates' chi-squared test (for small expected counts in 2x2 contingency tables), the chi-squared test NW (for small expected counts in contingency tables larger than 2x2), and McNemar's test (for changes in causes of poor sleep between the second and third assessments). A p-value of <0.05 was considered statistically significant.

Ethics

The study was conducted following the Helsinki Declaration and was approved by the Ethics Committee of the Poznan University of Medical Sciences. Participation in the survey was voluntary and anonymous. All participants in the study gave their

informed consent to participate in it. The informed consent form contained information about the study, its purpose, the method of answering the questions, and the possibility of withdrawing from the study at any time without suffering consequences.

Results

Characteristics of the Study Group

The subjects of the study were patients who had undergone surgical treatment. A total of 60 people completed the surveys - 49 women and 11 men. A demographic and clinical characteristic of the studied groups is presented in (Table 1).

Variables	Total (n=60)	F (n=49)	M (n=11)
Average age in years (±SD)	47.5±15.3 (18-72)	46.9±16.2 (18-72)	50.0±10.3 (32-63)
Height [cm] (±SD)	169.8±9.7 (153-202)	167.1±7.3 (153-184)	182.0±9.8 (170-202)
Weight [kg] (±SD)	74.1±21.0 (43-158)	69.4±16.9 (43-133)	95.0±25.0 (63-158)
Comorbidities (%)			
no	29 (48.3)	25 (51.0)	4 (36.4)
yes	31 (51.7)	24 (49.0)	7 (63.6)
Surgical procedure - operated site (%)			
within abdominal cavity - classic	17 (28.3)	11 (22.4)	6 (54.5)
within abdominal cavity - laparoscopic	11 (18.3)	10 (20.4)	1 (9.1)
within the thyroid gland	32 (53.3)	28 (57.1)	4 (36.4)
Method of the procedure (%)			
open	49 (81.7)	39 (79.6)	10 (90.9)
laparoscopic	11 (18.3)	10 (20.4)	1 (9.1)
Education (%)			
primary	2 (3.3)	1 (2.0)	1 (9.1)
vocational	8 (13.3)	4 (8.2)	4 (36.4)
secondary	27 (45.0)	24 (49.0)	3 (27.3)
higher	23 (38.3)	20 (40.8)	3 (27.3)
Civil status (%)			
single	9 (15.0)	7 (14.3)	2 (18.2)
married	42 (70.0)	33 (67.3)	9 (81.8)
divorced	4 (6.7)	4 (8.2)	0 (0.0)
widowed	5 (8.3)	5 (10.2)	0 (0.0)
Professional activity (%)			
employed	38 (63.3)	30 (61.2)	8 (72.7)

unemployed	1 (1.7)	1 (2.0)	0 (0.0)
pensioner/social benefits and working	1 (1.7)	0 (0.0)	1 (9.1)
pensioner	13 (21.7)	12 (24.5)	1 (9.1)
social benefit receiver	3 (5.0)	2 (4.1)	1 (9.1)
student	4 (6.7)	4 (8.2)	0 (0.0)

Abbreviations: Avg: Average; SD: Standard Deviation; F: Female; M: Male.

Table1: Demographic and clinical characteristic of the studied groups.

Stage I on the Day of Admission to the Ward

In Stage I, only the quality of sleep and the level of fatigue of the patients were analyzed.

Sleep Quality

Patients in the preoperative period, under home conditions, needed between 5 to 120 minutes to fall asleep (on average 26.1±20.5 minutes). Women, on average, took more time than men to fall asleep, however, this difference was not statistically significant ($p>0.05$). At home, patients, both women and men, slept between 5 to 11 hours (on average 7.0±1.3 hours). The majority of the subjects fell asleep within 15 minutes (46.7% overall; 42.9% of women and 63.6% of men) and slept more than 7 hours (36.7% of people; 34.7% of women and 45.5% of men). There are no statistically significant differences between women and men for the categories of time needed to fall asleep and actual sleep duration. Respondents most commonly cited waking up in the middle of the night or early morning as the reason for poor sleep. This issue affected 18 participants (30% of the group), who reported an intensification of this phenomenon three times or more during the week. This included 16 women (32.7%) and 2 men (18.2%). Another frequently mentioned cause of sleep disturbance was getting up to go to the bathroom and due to pain. There were no statistically significant differences between women and men for any of the reasons for poor sleep ($p>0.05$) (Table 2).

Category		Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
Because they couldn't fall asleep within 30 minutes (%)	not even once in the last 4 weeks	15 (25.0)	12 (24.5)	3 (27.3)	0.2586
	less than once a week	22 (36.7)	17 (34.7)	5 (45.5)	
	once or twice a week	9 (15,0)	9 (18.4)	0 (0.0)	
	three times or more per week	14 (23.3)	11 (22.4)	3 (27.3)	
Because they woke up in the middle of the night or early morning (%)	not even once in the last 4 weeks	11 (18.3)	9 (18.4)	2 (18.2)	0.7854
	less than once a week	18 (30.0)	14 (28.6)	4 (36.4)	
	once or twice a week	13 (21.7)	10 (20.4)	3 (27.3)	
	three times or more per week	18 (30.0)	16 (32.7)	2 (18.2)	
They had to get up to go to the bathroom (%)	not even once in the last 4 weeks	16 (26.7)	12 (24.5)	4 (36.4)	0.1665
	less than once a week	16 (26.7)	11 (22.4)	5 (45.5)	
	once or twice a week	10 (16.7)	9 (18.4)	1 (9.1)	
	three times or more per week	18 (30.0)	17 (34.7)	1 (9.1)	

Because they had trouble breathing (%)	not even once in the last 4 weeks	48 (80.0)	40 (81.6)	8 (72.7)	0.4829
	less than once a week	9 (15.0)	6 (12.2)	3 (27.3)	
	once or twice a week	2 (3.3)	2 (4.1)	0 (0.0)	
	three times or more per week	1 (1.7)	1 (2.0)	0 (0.0)	
Because they had a cough or were snoring loudly (%)	not even once in the last 4 weeks	39 (65.0)	33 (67.3)	6 (54.5)	0.2047
	less than once a week	15 (25.0)	10 (20.4)	5 (45.5)	
	once or twice a week	5 (8.3)	5 (10.2)	0 (0.0)	
	three times or more per week	1 (1.7)	1 (2.0)	0 (0.0)	
Because it was too cold (%)	not even once in the last 4 weeks	45 (75.0)	36 (73.5)	9 (81.8)	0.5153
	less than once a week	8 (13.3)	7 (14.3)	1 (9.1)	
	once or twice a week	4 (6.7)	4 (8.2)	0 (0.0)	
	three times or more per week	3 (5.0)	2 (4.1)	1 (9.1)	
Because it was too warm (%)	not even once in the last 4 weeks	32 (53.3)	24 (49.0)	8 (72.7)	0.2031
	less than once a week	19 (31.7)	16 (32.7)	3 (27.3)	
	once or twice a week	7 (11.7)	7 (14.3)	0 (0.0)	
	three times or more per week	2 (3.3)	2 (4.1)	0 (0.0)	
Because they had nightmares (%)	not even once in the last 4 weeks	37 (61.7)	30 (61.2)	7 (63.6)	0.2360
	less than once a week	14 (23.3)	12 (24.5)	2 (18.2)	
	once or twice a week	5 (8.3)	5 (10.2)	0 (0.0)	
	three times or more per week	4 (6.7)	2 (4.1)	2 (18.2)	
Due to pain (%)	not even once in the last 4 weeks	40 (66.7)	32 (65.3)	8 (72.7)	0.7245
	less than once a week	12 (20.0)	10 (20.4)	2 (18.2)	
	once or twice a week	3 (5.0)	3 (6.1)	0 (0.0)	
	three times or more per week	5 (8.3)	4 (8.2)	1 (9.1)	

Abbreviations: p: probability level p for the t statistic, $p<0.05$.

Table 2: Causes of poor sleep (PSQI scale) and results of the NW chi-square test.

Patients in the preoperative period at home scored between 1 to 15 points on the PSQI scale. The average PSQI score among the participants was 6.37±3.32 points and was higher in women (6.53±3.48 points) than in men (5.64±2.50 points), but this difference was not statistically significant ($p>0.05$) (Table 3).

Variable	Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
PSQI [pts]	6.37±3.32 (1-15)	6.53±3.48 (1-15)	5.64±2.50 (1-9)	0.6883

Abbreviations: mean±standard deviation; (minimum value - maximum value); p: probability level p for the t statistic, $p<0.05$.

Table 3: Descriptive statistics of the overall PSQI score among patients and results of the Mann-Whitney U test.

The majority of patients, according to the PSQI during the preoperative period in home conditions, slept poorly (61.7% of individuals - 61.2% of women and 63.6% of men). The participants had reduced sleep quality, scoring above 5 points on the PSQI scale. There is no statistically significant difference between women and men regarding the assessment of sleep quality based on the overall PSQI score (p>0.05) (Table 4).

Category		Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
PSQI (%)	sleeping well	23 (38.3)	19 (38.8)	4 (36.4)	0.8458
	sleeping poorly	37 (61.7)	30 (61.2)	7 (63.6)	

Abbreviations: p: probability level p for the t statistic, p<0.05.

Table 4: Number and frequency of patients for the assessment of sleep quality according to the overall PSQI score and the result of the NW chi-square test.

Level of Tiredness

Patients the day before surgery scored between 19 to 48 points on the FACIT-F scale (average 35.8±7.8 points) (Table 5).

Variable	Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
FACIT-F [pts]	35.8±7.8 (19-48)	35.3±7.9 (19-48)	38.0±7.2 (25-47)	0.3347

Abbreviations: mean±standard deviation; (minimum value - maximum value); p: probability level p for the t statistic, p<0.05.

Table 5: Fatigue on the FACIT-F scale in patients on the first day of the study and results of the Mann-Whitney U test.

Correlation between Sleep Quality and Level of Fatigue

In the first study, there was a statistically significant negative correlation of moderate strength (Rs=-0.456) between the level of fatigue on the FACIT-F scale in patients and sleep quality on the PSQI scale. The lower the level of fatigue in patients, the lower their score on the PSQI scale (indicating better sleep quality) (Table 6).

Pair of Variables	n	Rs	t(n-2)	p
FACIT-F [pts] & PSQI [pts]	60	-0.456	-3.90	0.0003*

Abbreviations: R: the value of the Spearman coefficient for the number n; t: the value of the t statistic checking the significance of the Rs coefficient for the number of degrees of freedom n: 2; p: probability level p for the t statistic, p<0.05.

Table 6: Result of the significance test for the Spearman rank correlation coefficient between the level of fatigue on the FACIT-F scale in patients and sleep quality on the PSQI scale.

Patients who described their sleep as “very good” during the preoperative period at home showed the lowest level of fatigue, scoring the highest (42.2 points), while those who rated their sleep as “fairly bad” showed a higher level of fatigue (29.2 points). The difference in fatigue levels among patients with different subjective sleep evaluations was statistically significant (p=0.0002). Statistically significant differences occurred between:

“very good” and “fairly good” (p=0.0386) - patients with “very good” sleep experienced less fatigue;

“very good” and “fairly bad” (p=0.0001) - patients with “very good” sleep experienced less fatigue;

“fairly good” and “fairly bad” (p=0.0277) - patients with “fairly good” sleep experienced less fatigue (Table 7).

Assessment of sleep quality(PSQI)	n	FACIT-F [pts]				p
		Avg.	SD	Min.	Max.	
very good	11	42,2	3,4	37	48	0,0002*
fairly good	36	36,2	7,0	19	46	
fairly bad	13	29,2	7,6	19	45	

Abbreviations: Avg.-average; min.-minimum; max.-maximum; SD: standard deviation; p: probability level p for the t statistic, $p<0.05$; * statistically significant, $p<0.05$.

Table 7: Descriptive statistics of the average level of fatigue on the FACIT-F scale among patients with different subjective assessments of sleep quality (PSQI) and the result of the Kruskal-Wallis test.

Study II in the Morning before the Procedure

Sleep Quality

On the night before the procedure, patients needed between 5 to 390 minutes to fall asleep (on average 55.3±60.5 minutes). One individual (a woman) did not sleep at all. Women, on average, required more time than men to fall asleep, however, this difference was not statistically significant ($p>0.05$). In the hospital, patients slept between 0 to 10 hours (on average 5.8±1.8 hours). Men slept on average longer than women, but this difference was also not statistically significant ($p>0.05$). Respondents most frequently cited waking up in the middle of the night as the reason for poor sleep. This issue affected 45 participants (75% of the group). Another commonly indicated cause of sleep disruption was difficulty falling asleep within 30 minutes and getting up during the night to go to the bathroom. There were no statistically significant differences between women and men for any of the causes of poor sleep on the night preceding the surgical procedure ($p>0.05$) (Table 8).

Category		Total n=60(%)	Female n=49 (81.7%)	Male n=11 (18.3%)	p
Did you fall asleep within 30 minutes? (%)	no	31 (51.7)	25 (51.0)	6 (54.5)	0.8326
	yes	29 (48.3)	24 (49.0)	5 (45.5)	
Did you wake up during the night? (%)	no	15 (25.0)	13 (26.5)	2 (18.2)	0.8473
	yes	45 (75.0)	36 (73.5)	9 (81.8)	
Did you have to get up during the night to go to the bathroom?(%)	no	36 (60.0)	30 (61.2)	6 (54.5)	0.9457
	yes	24 (40.0)	19 (38.8)	5 (45.5)	
Did you have trouble breathing? (%)	no	59 (98.3)	48 (98.0)	11 (100.0)	0.4092
	yes	1 (1.7)	1 (2.0)	0 (0.0)	
Did you have a cough or did you snore loudly? (%)	no	51 (85.0)	42 (85.7)	9 (81.8)	0.8885
	yes	9 (15.0)	7 (14.3)	2 (18.2)	
Were you cold? (%)	no	54 (90.0)	44 (89.8)	10 (90.9)	0.6564
	yes	6 (10.0)	5 (10.2)	1 (9.1)	
Were you too warm (%)	no	40 (66.7)	31 (63.3)	9 (81.8)	0.4090
	yes	20 (33.3)	18 (36.7)	2 (18.2)	
Did you have nightmares? (%)	no	55 (91.7)	45 (91.8)	10 (90.9)	0.6150
	yes	5 (8.3)	4 (8.2)	1 (9.1)	

Did anything hurt? (%)	no	53 (88.3)	43 (87.8)	10 (90.9)	0.8218
	yes	7 (11.7)	6 (12.2)	1 (9.1)	

Abbreviations: p: probability level p for the t statistic, $p<0.05$.

Table 8: Number and frequency of patients for the causes of poor sleep (PSQI - modified for the study) and the results of the chi-square test with Yates' correction.

Level of Fatigue

On the morning of the procedure, patients scored between 10 to 48 points on the FACIT-F scale. The average fatigue level among the subjects was 33.0±10.3 points. The average level of fatigue was higher in men (35.4±11.2 points) than in women (32.5±10.1 points), however, this difference was not statistically significant ($p>0.05$). (Table 9).

Variable	Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
FACIT-F [pts]	33.0±10.3 (10-48)	32.5±10.1 (14-48)	35.4±11.2 (10-47)	0.3492

Abbreviations: mean±standard deviation; (minimum value - maximum value); p: probability level p for the t statistic, $p<0.05$.

Table 9: Descriptive statistics of the fatigue level on the FACIT-F scale among patients and results of the Mann-Whitney U test.

Correlation between Sleep Quality and Level of Fatigue

The average level of fatigue was highest (36.0 points) in patients who rated their sleep as very good the night before the surgical procedure, and lowest (29.0 points) in patients who rated their sleep as bad. The difference in the level of fatigue among patients with different subjective sleep assessments was not statistically significant ($p>0.05$) (Table 10).

Sleep Assessment	n	FACIT-F [pts]				p
		Avg.	SD	Min.	Max.	
very good	2	36.0	12.7	27	45	0.3047
fairly good	19	35.1	9.8	15	48	
fairly bad	20	34.6	9.4	18	47	
bad	19	29.0	11.2	10	45	

Abbreviations: Avg: Average; min.-Minimum; max.-Maximum; SD-Standard Deviation; p: probability level p for the t statistic, $p<0.05$.

Table 10: Descriptive statistics of the fatigue level on the FACIT-F scale among patients with different subjective assessments of sleep quality (PSQI) and the result of the Kruskal-Wallis test.

Sleep Quality and Anxiety

On the day of the operation, patients scored between 21 to 72 points on the state anxiety scale. The average state anxiety score among the subjects was 46.4±10.9 points. The average state anxiety was higher in women (47.1±11.2 points) than in men (42.9±9.1 points), but this difference was not statistically significant ($p>0.05$). On the day of the surgical procedure, patients scored between 30 to 61 points on the trait anxiety scale. The average trait anxiety score among the subjects was 44.4±7.8 points. The average trait anxiety was higher in women (45.1±8.2 points) than in men (41.5±4.7 points), but this difference was also not statistically significant ($p>0.05$) (Table 11).

Variable	Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
X-1 [pts]	46.4±10.9 (21-72)	47.1±11.2 (21-72)	42.9±9.1 (27-59)	0.2400
X-2 [pts]	44.4±7.8 (30-61)	45.1±8.2 (30-61)	41.5±4.7 (34-51)	0.0681

Abbreviations: mean±standard deviation; (minimum value - maximum value); p: probability level p for the t statistic, $p<0.05$.

Table 11: Descriptive statistics of anxiety (STAI scale) as state (X-1) and trait (X-2) among patients and results of the Mann-Whitney U test.

The average state anxiety was highest (53.0 points) in patients who described their sleep as very good on the night before the surgical procedure, and lowest (42.3 points) in patients who rated their sleep as fairly bad. The difference in the level of state anxiety among patients with different subjective sleep assessments was statistically significant (p=0.0262). A statistically significant difference occurred only between fairly bad and bad (p=0.0464) patients who rated their sleep as bad had a higher level of anxiety (Table 12). The average trait anxiety was highest (46.3 points) in patients who described their sleep as bad on the night before the surgical procedure, and lowest (42.0 points) in patients who rated their sleep as fairly bad. The difference in the level of trait anxiety among patients with different subjective sleep assessments was not statistically significant (p=0.3994).

Assessment of sleep quality	n	Anxiety as a state X-1 [pts]				p
		Avg.	SD	Min.	Max.	
very good	2	53.0	15.6	42	64	0.0262*
fairly good	19	43.8	9.1	30	61	
fairly bad	20	42.3	10.2	21	59	
bad	19	52.5	10.7	33	72	

Abbreviations: Avg: Average; min: Minimum; max: Maximum; SD: Standard Deviation; p: probability level p for the t statistic, $p<0.05$; * statistically significant, $p<0.05$.

Table 12: Descriptive statistics of state anxiety (STAI X-1) among patients with different subjective assessments of sleep quality (PSQI) and the result of the Kruskal-Wallis test

Sleep Quality/Fatigue Level and Pain

The average intensity of pain (measured on the VAS scale) was highest in patients who described their sleep the night before surgery as fairly good (0.8±2.1 points) and lowest in those who rated their sleep as very good (0.0 points). The difference in pain intensity among patients with different subjective sleep assessments was not statistically significant (p=0.8915). There is no statistically significant correlation between the intensity of pain in patients and the level of fatigue (Rs= -0.219; p=0.0931). The intensity of pain did not influence the level of fatigue.

Sleep Quality/Fatigue Level and Site of Surgery

Among the 28 patients scheduled for abdominal surgery, 11 subjectively described their sleep as fairly bad, accounting for 39.3%, and 8 patients (28.6%) described it as fairly good. Meanwhile, among the 32 patients scheduled for thyroid gland surgery, 9 subjectively rated their sleep as fairly bad (28.1%), and 11 patients rated it as fairly good (34.4%). There is no statistically significant correlation between the planned site of the surgery and the patients' subjective assessment of sleep quality (p=0.3569). Patients who underwent surgery on the thyroid gland reported less fatigue (33.5±10.8) compared to those who had abdominal surgery (32.4±9.9). However, this difference was not statistically significant (p=0.6038).

Sleep Quality and Surgical Method

54.5% of patients who underwent laparoscopic surgery rated their sleep quality as poor, and none rated it as very good. Conversely, in the traditional open surgery method, the fewest people (4.1%) indicated that their sleep quality was very good, while the majority (36.7%) stated it was fairly good. There is no statistically significant correlation between the method of surgical treatment and the patients' subjective assessment of sleep quality (p=0.1317).

Study III on the Day of Hospital Discharge

Sleep Quality

On the night before discharge, patients needed between 4 to 270 minutes to fall asleep (average 52.4±50.5 minutes). One individual (a woman) did not sleep at all. Men required an average of 57.3±34.1 minutes to fall asleep, which was more than women (51.3±53.8 minutes), however, this difference was not statistically significant (p>0.05). In the hospital, patients slept between 0 to 10 hours (average 6.5±1.8 hours). Women (6.5±1.7 hours) slept slightly longer on average than men (6.4±2.0 hours), though this difference was not statistically significant (p>0.05). On the day of discharge, the most frequently cited reason for poor sleep was waking up in the middle of the night, affecting 45 participants (75% of the group), including 36 women (73.5%) and 9 men (81.8%). The next most common causes

of sleep disruption were difficulty falling asleep and needing to go to the bathroom at night, which were reported by 31 participants (51.7%), and pain. There were no statistically significant differences between women and men for any of these causes of poor sleep the night before discharge (p>0.05). The majority of post-operative patients had fairly good sleep the night before discharge (40%). Poor sleep was reported by 33.3% of participants (32.7% women and 36.4% men), and fairly poor sleep by 20% of individuals (20.4% women and 18.2% men). The remainder had very good sleep - 6.7% of participants (6.1% women and 9.1% men). There was no statistically significant difference between women and men in terms of the subjective assessment of sleep quality (p>0.05) (Table13).

Category		Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
Assessment of sleep (%)	very good	4 (6.7)	3 (6.1)	1 (9.1)	0.9753
	fairly good	24 (40.0)	20 (40.8)	4 (36.4)	
	fairly bad	12 (20.0)	10 (20.4)	2 (18.2)	
	bad	20 (33.3)	16 (32.7)	4 (36.4)	

Abbreviations: p: probability level p for the t statistic, p<0.05.

Table 13: Number and frequency of patients for subjective assessment of sleep quality and result of the NW chi-square test.

Level of Fatigue

On the day of discharge, patients scored between 14 to 48 points on the FACIT-F scale, with an average of 34.2±8.9 points. The average level of fatigue was lower in women (34.5±8.9 points) compared to men (32.8±9.3 points); however, this difference was not statistically significant (p>0.05) (Table 14).

Variable	Total n=60	Female n=49 (81.7%)	Male n=11 (18.3%)	p
FACIT-F [pts]	34.2±8.9 (14-48)	34.5±8.9 (14-48)	32.8±9.3 (19-47)	0.5537

Abbreviations: mean±standard deviation; (minimum value - maximum value); p: probability level p for the t statistic, p<0.05.

Table 14: Descriptive statistics of fatigue level on the FACIT-F scale among patients and results of the Mann-Whitney U test.

Correlation Between Sleep Quality and Level of Fatigue

The level of fatigue was lowest (43.3 points) in patients who described their sleep as very good on the night before discharge, and highest (31.2 points) in patients who rated their sleep as poor. The difference in the quality of life among patients with different subjective sleep evaluations was not statistically significant (p>0.05) (Table 15).

Assessment of sleep quality (PSQI)	n	FACIT-F [pts]				p
		Avg.	SD	Min.	Max.	
very good	4	43.3	4.9	36	46	0.0733
fairly good	24	35.4	7.9	23	48	
fairly bad	12	33.8	10.4	14	47	
bad	20	31.2	8.8	15	45	

Abbreviations: Avg: Average; min: Minimum; max: Maximum; SD: Standard deviation; p: probability level p for the t statistic, p<0.05.

Table 15: Descriptive statistics of quality of life on the FACIT-F scale among patients with different subjective assessments of sleep quality (PSQI) and the result of the Kruskal-Wallis test.

Sleep Quality/Fatigue Level and Pain

The average intensity of postoperative pain was highest among patients who described their sleep the night before discharge as fairly bad (2.5±2.9 points) or bad (2.5±2.3 points), and it was lowest (1.3±2.2 points) among patients who rated their sleep as very good. The difference in the level of pain intensity among patients with different subjective sleep evaluations was not statistically significant (p=0.0949 with p>0.05). There was a statistically significant negative correlation of weak strength (Rs=-0.317) between the intensity of pain and the level of fatigue. The more intensely patients felt pain, the greater fatigue they experienced (Table 16).

Pair of variables	n	Rs	t(n-2)	p
VAS & FACIT-F [pts]	60	-0.317	-2.55	0.0136*

Abbreviations: Rs: the value of the Spearman coefficient for the number n; t: the value of the t statistic checking the significance of the Rs coefficient for the number of degrees of freedom n: 2; p: probability level p for the t statistic, p<0.05; * statistically significant, p<0.05.

Table 16: Result of the significance test for the Spearman rank correlation coefficient between the intensity of pain on the VAS scale and quality of life on the FACIT-F scale.

Sleep Quality/Fatigue Level and Operation Site

Among the 28 patients who underwent abdominal cavity surgery, 12 subjectively described their sleep as fairly good, which represents 42.9%, and 8 patients (28.6%) described it as bad. Meanwhile, among the 32 patients who underwent surgery on the thyroid gland, 12 subjectively rated their sleep as fairly good (37.5%), and 12 patients rated it as bad (37.5%). There is no statistically significant correlation between the location of the surgical procedure and the subjective assessment of patients' sleep quality (p=0.9103 with p>0.05). The level of fatigue was slightly lower (34.4±9.3 points) in patients who underwent procedures in the abdominal cavity compared to patients who had surgery on the thyroid gland (34.1±8.7 points). This difference was not statistically significant (p=0.8529).

Level of Fatigue and Surgical Method

The level of fatigue was slightly lower in patients who were treated laparoscopically (34.1±9.1 points) compared to patients treated with open surgery (34.6±8.4 points). This difference was not statistically significant (p=0.9238).

Study I, II, and III -Relationships

The difference in fatigue levels among patients on various days of their hospital stay was not statistically significant (p>0.05) (Table 17).

Time	n	FACIT-F [pts.]				p
		Avg.	SD	Min.	Max.	
Study I	60	35.8	7.8	19.0	48.0	0.2101
Study II	60	33.0	10.3	10.0	48.0	
Study III	60	34.2	8.9	14.0	48.0	
	n	PSQI on a scale of 2-5 [pts.]				p
		Avg.	SD	Min.	Max.	
Study I	60	3.97	0.64	3	5	0.0000*
Study II	60	3.07	0.88	2	5	
Study III	60	3.20	0.99	2	5	

Abbreviations: Avg.-average; min.-minimum; max.-maximum; SD-standard deviation; p: probability level p for the t statistic, p<0,05; * statistically significant, p<0,05.

Table 17: Descriptive statistics of fatigue level on the FACIT-F scale and sleep quality on the PSQI scale among patients on different days of their hospital stay and the result of the Friedman ANOVA test

The average subjective assessment of sleep quality on a scale of 2-5 (2-poor, 3-fairly poor, 4-fairly good, 5-very good) was highest in patients in Study I (4 weeks before the procedure) and lowest in patients in Study II (day of the procedure). The difference in subjective sleep quality assessment among patients during various days of their hospital stay was statistically significant (p<0.0001). Statistically significant differences occurred **between:**

Study I and Study II (p<0.05) - patients rated the quality of sleep better in Study I than in Study II;

Study I and Study III (p<0.05) - patients rated the quality of sleep better in Study I than in Study III (Table17).

Between the subjective assessment of sleep quality in Study II and the subjective assessment in Study III, there was no statistically significant difference (p>0.05) (Table 18).

Time	n	Assessment of sleep quality on a scale of 2-5				p
		Avg.	SD	Min.	Max.	
Study I	60	3.97	0.64	3	5	0.0000*
Study II	60	3.07	0.88	2	5	
Study III	60	3.20	0.99	2	5	

Abbreviations: Avg: average; min: minimum; max: maximum; SD: standard deviation; p: probability level p for the t statistic, $p<0.05$; * statistically significant , $p<0.05$; Subjective assessment of sleep quality on a scale of 2-5: 2-bad, 3-fairly bad, 4-fairly good, 5- very good.

Table 18: Descriptive statistics of the subjective assessment of sleep quality (PSQI) among patients on different days of their hospital stay and the result of the Friedman ANOVA test.

The average time needed to fall asleep was highest (56 minutes) in patients in Study II (the night before the surgical procedure) and lowest (25.9 minutes) in patients in Study I (within 4 weeks before the procedure). The difference in the time needed to fall asleep among patients during the various days of hospital stay was statistically significant ($p<0.0001$). Statistically significant differences occurred between:

Study I and Study II ($p<0.05$) - patients required more time to fall asleep in Study II than in Study I;

Study I and Study III ($p<0.05$) - patients required more time to fall asleep in Study III than in Study I (Table19).

Between the time needed to fall asleep in Study II and the time needed in Study III (the last night before discharge), there was no statistically significant difference ($p>0.05$).

The average actual sleep duration was highest (7.0 hours) in patients in Study I (4 weeks before the procedure) and lowest (5.8 hours) in patients in Study II (the night before the procedure). The difference in actual sleep time among patients on the various days of hospital stay was statistically significant ($p=0.0001$). Statistically significant differences occurred between:

Study I and Study II ($p<0.05$) - patients slept longer in Study I than in Study II;

Study II and Study III ($p<0.05$) - patients slept longer in Study III than in Study II (Table 19).

Between the actual sleep time in Study I and the actual sleep time in Study III (the night before discharge), there was no statistically significant difference ($p>0.05$).

For most patients, between Study II and Study III, there were no changes in the causes of poor sleep. A statistically significant relationship occurred only for the cause of poor sleep related to pain ($p=0.0001$). Statistically, more people experienced a worsening rather than an improvement. In 19 (31.7%) patients in Study III, pain emerged as a cause of poor sleep, whereas only one patient in Study III did not complain of pain, although in Study II it was a cause of poor sleep. In the remaining 40 (66.7%) individuals, there was no change between Study II and Study III for pain as a cause of poor sleep (Figure 19).

Time	n**	Time needed to fall asleep [min.]				p
		Avg.	SD	Min.	Max.	
Study I	58	25.9	20.9	5	120	0.0000*
Study II	58	56.,0	60.8	5	390	
Study III	58	51.3	50.1	4	270	
Time	n	Actual sleep duration [hours]				p
		Avg.	SD	Min.	Max.	
Study I	60	7.0	1.3	5	11	0.0001*
Study II	60	5.8	1.8	0	10	
Study III	60	6.5	1.8	0	10	

Abbreviations: Avg: average; min: minimum; max: maximum; SD: standard deviation; p: probability level p for the t statistic, $p<0.05$; * statistically significant, $p<0.05$; n**=58, excluding two individuals (women), who did not sleep at all (one on the night before the surgical procedure, the other on the night before discharge).

Table 19: Descriptive statistics of the time needed to fall asleep and actual sleep duration (PSQI) among patients on different days of their hospital stay and the result of the Friedman ANOVA test.

Discussion

The study assessed the quality of sleep and fatigue levels among hospitalized patients awaiting surgery. Analyses were conducted across three time intervals, also checking whether factors other than hospitalization affect sleep quality and fatigue levels. The study showed that patients due to be hospitalized slept poorly the day before admission to the hospital, needing an average of about 26 minutes to fall asleep, and their average sleep duration was 7 hours. On the night before surgery, the time to fall asleep significantly increased (on average by 55.3 minutes), and sleep duration was shorter (on average 5 hours). These situations can be explained by stress related to the upcoming surgery,

concerns about prognoses, and a drastic change of environment (from home to hospital, where different organizational and topographical conditions prevail). On the night before discharge, most patients had relatively good sleep, lasting an average of 6.5 hours. The analysis of the relationship between subjective sleep quality assessment and the study stage was statistically significant-patients rated their sleep quality higher on the day of admission to the hospital than at stages II and III of the study. Patients needed less time to fall asleep on the day of admission to the hospital and slept the shortest on the night preceding the surgery. Throughout all three stages of the study, sleep was most often disrupted by waking up at night, going to the bathroom, and pain.

Although patients indicated pain as one of the factors depressing sleep, no significant correlation was shown between it and sleep quality. In a meta-analysis conducted by Burger et al. [2] on 202 scientific papers, it was indicated that hospitalized individuals mostly had shorter sleep durations than at home (on average 5.7 hours) and rated it as worse (on the PSQI sleep quality scale), especially in the group of oncology patients compared to surgical patients. Also, in assessing sleep quality using the Richard-Campbell Sleep Questionnaire (RCSQ) and the Verran and Snyder-Halpern (VSH) scale, patients rated it respectively-poor sleep and low sleep quality. Articles subjected to meta-analysis indicate that sleep deprivation in hospital conditions is influenced by environmental factors (noise, other patients in the room), reasons for hospitalization (most often symptomatic diseases, where pain dominated), or the treatment process itself (various medical procedures patients were subjected to-blood pressure measurements, medication connections, etc.).

Allen et al. [8] analyzed sleep in patients undergoing surgical operations. Patients on average slept less than the recommended 7 hours throughout their hospital stay, and the night before the planned procedure, they rated their sleep as poor (as much as 88.1% of patients). The most common reason for sleep deprivation was waking up at night. Sleep disturbances in surgical patients turned out to be significantly worse than in the second group of patients treated in the ICU. This study presents a subjective assessment of sleep quality in surgically treated patients. It was noticed that in the preoperative period (at home), patients subjectively rated the quality of sleep better than during the hospital stay. However, based on the overall PSQI score, it was shown that 61.7% of patients in the preoperative period at home slept poorly. Propper et al. [21] report that among patients after thoracic surgery, their sleep quality one month after surgery was lower than before the surgery. However, this work noted that the overall PSQI score may differ from the subjective assessment of sleep quality indicated by the patient. Differences may arise from patients' habits and the low flexibility of PSQI results interpretation. It is worth deepening future analyses of PSQI questionnaires in terms of subjective assessment of sleep quality in surgically treated patients. Binte Arman et al. [22] proved that patients who had worse sleep quality at home also presented subjectively worse sleep quality in hospital conditions. This study found no correlation between sleep quality and gender, planned surgical site, and method of operation. For gender, similar results were obtained by Şen et al. [23] and Binte Arman [22]. However, in Terp et al. [20], Ünsal et al. [24], and Javadi et al. [25], female gender was one of the factors determining poor sleep quality. Due to the lack of publications that consider all variables affecting sleep quality, it is impossible to conduct a more in-depth discussion. Further studies on a larger group of patients are indicated to better understand the characteristics of these factors. It is worth deepening the analysis of specific disease units, types of operations, anesthesia, and methods of the procedure performed. Staying in the hospital for surgical treatment, as well as the change of environment itself, is a factor that can cause stress and anxiety in patients. The course of the operation, its effects, and the associated prognoses impose a significant emotional burden on patients. During the waiting period for the procedure, the patient's psychological state is variable. Environmental factors also influence anxiety, such as unfamiliarity with the staff and their constant change, other patients in the room, various medical procedures, change of daily routine [2,26]. In a study of hospitalized patients on a surgical ward, anxiety was assessed as state and trait in the preoperative period. Based on the analysis of the results of this study, it was noted that women characterized themselves with a higher level of anxiety as state and trait than men, although no significant statistical correlation between gender and anxiety was demonstrated. Such a relationship was obtained in their studies by Robaszkiewicz-Bouakaz et al. [27] In this study, it was found that anxiety as an emotional state influenced the subjective assessment of sleep and was felt differently among patients with different subjective sleep quality in the preoperative period.

On the other hand, no relationship was found between anxiety as a trait and the subjective assessment of sleep quality. Aktas et al. [28] also indicated a positive correlation between the level of anxiety and sleep quality (the greater the anxiety of patients in the postoperative period, the worse the quality of sleep). Similar results were obtained by Özlü et al. [29], who studied the ability to cope with preoperative stress in cardiological patients. Also, studies by Palagini et al. [30] emphasized the impact of anxiety/ stress on the quality and character of sleep of hospitalized patients. Contrary data were obtained by Atay et al. [31] and Lockefeera et al. [32], where a high level of preoperative anxiety did not affect the quality of sleep of patients. The authors of the study indicate that it is important in sleep studies to subject to thorough analysis the relationships between anxiety and sleep in the perioperative period. Reduced sleep quality caused by anxiety can contribute to the increase in the feeling of its negative effects, such as an

increase in the sensation of pain sensations, reduced response to premedication, prolonged wound healing time, or ineffective convalescence. [27] Based on their own study results, it was noted that the level of fatigue on the day of admission to the hospital is lower than on the day of the surgical procedure and on the day of discharge from the hospital. The highest level of fatigue was noted on the day of the procedure. It was also noted that the level of fatigue and sleep quality on the day of the operation and on the day of discharge from the hospital did not differ statistically significantly. Fatigue, however, significantly negatively correlated with sleep on the day of admission to the hospital - the better the quality of sleep, the less fatigue the patients presented.

The difference in the level of fatigue among patients on different days of hospital stay was not statistically significant. It was shown that the level of fatigue was significantly statistically influenced by pain (on the day of discharge home), while gender, the method of operation, and its place were not. Ünsal et al. [24] indicated a strong correlation between the level of fatigue and sleep quality, also showing the influence of female gender on feeling a higher level of fatigue than men. Chou et al. [33]. studied patients in the perioperative period undergoing cardiothoracic surgery. In 73.6% of patients, high fatigue was noted before the procedure and poor sleep quality during hospitalization and in the convalescence period was significantly statistically associated with fatigue. Schei et al. [34] linked high preoperative fatigue levels with female gender and low fitness status, and in the postoperative period with complications after the procedure and low fitness status. When examining patients with brain glioma, they noticed that the severity of the disease unit affects the level of perceived fatigue. Yu et al.
[35] assessed the level of fatigue in patients after gastrointestinal surgeries. Their research results showed that laparoscopic surgery significantly significantly reduced the perception of fatigue level compared to the classic method. Similar results were obtained by Jensen et al. [36] Bączyk et al. [4] in their results indicated that surgical treatment reduced the level of fatigue in patients, compared to the preoperative period. It is important that the fatigue factor is more often taken into account in studies on patients in the hospitalization period, as well as in connection with other determinants. Fatigue itself significantly affects patients - its high level can lead to interruption of rehabilitation, cessation of taking medications, control visits, and even self-care.

Conclusion

The period of a patient's stay in the hospital, especially for surgery, is very stressful and affects many factors, including sleep and a sense of fatigue. Disturbance of either mental or physical well-being carries consequences that can negatively impact the further treatment of the patient or their convalescence. By conducting further, in-depth studies, we are able to determine the factors that adversely affect patients. Knowing these, medical staff can attempt to eliminate or reduce them.

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