

## Determinants of Quality of Life in Patients After Thyroidectomy: Electrolyte Imbalance, Sleep Problems, and Fatigue

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### Abstract

**Aim:** The study was conducted to determine the effects of electrolyte levels, sleep problems, and fatigue on quality of life in patients undergoing thyroidectomy.

**Method:** The study involved 93 participants who underwent thyroidectomy from April 2023 to August 2024. The study was conducted in a descriptive design. The data of the study were collected with the Descriptive Characteristics Questionnaire Form, Fatigue Severity Scale, Richard Campbell Sleep Scale, and SF-12 Quality of Life Scale. Independent sample t-test, one-way analysis of variance, dependent sample t-test, Pearson correlation and linear regression analysis were used to evaluate the data. Ethical approval, institutional permission, academic board permission, and informed consent were obtained. Electrolyte levels, quality of life, fatigue severity and sleep scale total scores of thyroidectomy patients were evaluated face to face before discharge and by phone first month post-discharge.

**Results:** Quality of life, fatigue and sleep quality scale scores were determined as  $29.83 \pm 3.99$ ,  $38.41 \pm 20.61$ , and  $35.77 \pm 14.17$  respectively in the first month post-discharge. A significant, negative correlation was found between the quality of life and fatigue scale and the total score of the fatigue and sleep scale during the initial month following post-discharge. In the study, fatigue, sleep quality, calcium, phosphorus and magnesium levels explained 55% of the increase in quality of life after thyroidectomy.

**Conclusion:** At the conclusion of the study, it was ascertained that there was a decrease in sleep quality and quality of life, alongside an increase in fatigue levels in patients after thyroidectomy. The study helps healthcare professionals to provide better counseling to their patients and provides an up-to-date synthesis of quality of life, fatigue and sleep quality that may allow a more personalized approach.

**Keywords:** Telehealth, thyroidectomy, sleep, quality of life, fatigue.

**Tiroidektomi Sonrası Hastalarda Yaşam Kalitesinin Belirleyicileri: Elektrolit Dengesizliği, Uyku Problemleri ve Yorgunluk**

### Öz

**Amaç:** Çalışma tiroidektomi uygulanan hastalarda elektrolit düzeyleri, uyku problemleri ve yorgunluğun yaşam kalitesi üzerine etkisinin belirlenmesi amacıyla yürütülmüştür.

**Yöntem:** Çalışma Nisan 2023-Ağustos 2024 tarihleri arasında 93 tiroidektomi hastası ile tamamlanmıştır. Çalışma tanımlayıcı desende yürütülmüştür. Araştırmanın verileri tanıtıcı özellikler anket formu, Yorgunluk Şiddeti Ölçeği, Richard Campbell Uyku Ölçeği ve SF-12 Yaşam Kalitesi Ölçeği ile toplanmıştır. Verilerin değerlendirilmesinde bağımsız örneklem t-testi, tek yönlü varyans analizi, bağımlı örneklem t-testi, Pearson

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**ETHICAL STATEMENT:** In order to conduct the research, academic board permission (2021/01) from the Department of Surgical Diseases Nursing of the Faculty of Health Sciences of Erciyes University, ethical approval (2023/147) from the Ethics Committee of Clinical Research of Erciyes University, institutional permission from the Erciyes University Health Practice and Research Center, and written and verbal permission with informed consent form from the patients who volunteered to participate in the research were obtained.

korelasyon ve doğrusal regresyon analizi kullanılmıştır. Etik onay, kurum izni, akademik kurul izni ve bilgilendirilmiş onam alınmıştır. Tiroidektomi hastalarının elektrolit düzeyleri, yaşam kalitesi, yorgunluk şiddeti ve uyku ölçęi toplam puanları taburculuk öncesi yüz yüze ve taburculuk sonrası 1 ayda telefon ile değerlendirilmiştir.

**Bulgular:** Taburculuk sonrası 1. ayda yaşam kalitesi, yorgunluk ve uyku kalitesi ölçek puanları sırası ile  $29,83 \pm 3,99$ ;  $38,41 \pm 20,61$  ve  $35,77 \pm 14,17$  olduğu belirlenmiştir. Taburculuk sonrası 1. ayda yaşam kalitesi ve yorgunluk ölçęi ile yorgunluk ve uyku ölçęi toplam puanı arasında anlamlı, negatif yönde bir ilişki bulunmuştur. Çalışmada yorgunluk, uyku kalitesi, kalsiyum, fosfor ve magnezyum düzeyleri tiroidektomi sonrası yaşam kalitesindeki artmanın %55'ini açıklamaktadır.

**Sonuç:** Çalışma sonunda tiroidektomi sonrası hastaların uyku kalitesinde ve yaşam kalitesinde azalma, yorgunluk düzeyinde artış olduğu belirlenmiştir. Çalışma sağlık çalışanlarının hastalarına daha iyi danışmanlık yapmasına yardımcı olurken, daha kişiselleştirilmiş bir yaklaşıma izin verebilecek güncel bir yaşam kalitesi, yorgunluk ve uyku kalitesi sentezi sunmaktadır.

**Anahtar Sözcükler:** Tele-saęlık, tiroidektomi, uyku, yaşam kalitesi, yorgunluk.

## Introduction

Thyroid cancer is one of the most common malignancies of the endocrine system and accounts for 3.1% of global cancer incidences. According to data from the International Agency for Research on Cancer, 567 233 people were diagnosed with thyroid cancer worldwide in 2018, and 41 071 people lost their lives due to thyroid cancer. In our country, thyroid cancer, which is the fourth most common cancer, has an incidence rate of 5.9% (13.682) and a mortality rate of 0.63% (795). It is seen approximately three times more in women than in men<sup>1</sup>.

There are two main treatments for thyroid cancer: surgical removal of all or part of the thyroid gland, which plays an important role in regulating physiological development and metabolism<sup>2</sup>. It has been reported that total thyroidectomy is more effective than other options in preventing hyperthyroidism<sup>3</sup>. In addition to the positive results of thyroidectomy surgery, patients face problems such as electrolyte imbalances and related symptoms, pain, nausea and vomiting, fatigue, sleep, and nutritional problems, which negatively affect their quality of life in the postoperative period<sup>4</sup>.

One of the most common electrolyte imbalances after total thyroidectomy is hypocalcemia, which can be temporary or permanent. Hypocalcemia prolongs the length of hospital stay and can cause cramps, tingling, paresthesia, tetany, seizures, muscle spasms, and prolonged QT interval on the electrocardiogram<sup>5</sup>. Other problems experienced by patients include fatigue, mental changes, bone pain, headache, and insomnia<sup>6</sup>. Hypocalcemia can also cause changes in magnesium, phosphorus, and vitamin D levels<sup>7-9</sup>. To prevent complications that may develop due to hypocalcemia, patients are usually given calcium and vitamin D supplements during the perioperative period<sup>10</sup>.

Chronic fatigue syndrome, defined as asthenia, is a common condition after thyroidectomy. It has been determined that patients experience decreased sleep quality and fatigue after thyroidectomy<sup>11</sup>, and fatigue continues for more than a year in patients who have undergone total thyroidectomy<sup>12</sup>. Studies have found that patients' quality of life decreases after thyroidectomy<sup>13-14</sup>. Atasayar and Güler's studies have found that patients have difficulty performing daily activities after thyroidectomy, and this reduces

their quality of life<sup>13</sup>. Another study has also indicated that anxiety, depression, social dysfunction, burnout, and fatigue experienced after thyroidectomy negatively affect patients' quality of life<sup>14</sup>.

In the management of all these symptoms that occur after thyroidectomy, measuring and monitoring electrolyte levels throughout the perioperative process is of great importance in terms of reducing possible complications. There are no studies in the literature examining serum electrolyte levels, sleep, fatigue, and quality of life of patients after thyroidectomy. Therefore, this study was conducted to determine the effects of electrolyte levels, sleep problems, and fatigue on the quality of life in patients who underwent thyroidectomy.

## **Material and Methods**

The study was conducted at the Ear, Nose, and Throat (ENT) Department of Erciyes University Health Application and Research Center. The study was conducted as descriptive to determine the effects of electrolyte levels, sleep problems, and fatigue on quality of life after thyroidectomy. Patients who underwent thyroid surgery at the ENT clinic comprised the study's universe. Post-power analysis was performed for sample size and the G Power 3.1.9.4 program was used. The study was conducted with a total of 93 patients and the power of the study was found to be 99% in the post-power analysis.

## **Data Collection Tools**

Data were collected with the Descriptive Characteristics Questionnaire Form, Fatigue Severity Scale (FSS), Richard Campbell Sleep Questionnaire (RCSQ), and SF-12 Quality of Life Scale (SF-12).

### ***Descriptive Characteristics Questionnaire Form***

The descriptive characteristics questionnaire form, which was created by the researchers by scanning the literature<sup>15-20</sup>, consists of a total of 10 questions, including 5 questions about patients' sociodemographic data (age, gender, education level, occupation) and 5 questions about the clinical data after surgery (chronic disease, surgical history, smoking, American Society of Anesthesiologists (ASA) class, surgical duration).

***Fatigue Severity Scale (FSS):*** The Fatigue Severity Scale, developed by Krupp (1989)<sup>17</sup> and validated for Turkish by Armutlu et al.<sup>18</sup> (2007), consists of 9 questions. Each question takes a value between 1 (I completely disagree) and 7 (I completely agree). The lowest possible score on the scale is 9, and the highest score is 63. The FSS value is the average value of the nine sections. Patients with an FSS score of less than 4 were evaluated as "not tired" and patients with a FSS score of more than 4 were evaluated as "tired". The Cronbach  $\alpha$  value of the scale was determined to be 0.93 before discharge and 0.99 in the first month post-discharge.

***Richard Campbell Sleep Questionnaire (RCSQ):*** The Richard Campbell Sleep Questionnaire developed by Richards<sup>19</sup> (1987), and validated for Turkish by Özlü and Özer<sup>20</sup> (2015), consists of 6 questions. Items are evaluated on a chart ranging from 0 to 100 using the visual analog scale technique. The score obtained from the scale is between "0-25" and indicates very bad sleep, while the score obtained from "76-100" indicates very good sleep. As the scale score increases, the sleep quality of the patients also

increases. The Cronbach  $\alpha$  value of the scale was determined to be 0.87 before discharge and 0.96 in the first month post-discharge.

**Short Form (SF)-12 Quality of Life Scale (SF-12):** Ware<sup>21</sup> et al. (2001) developed the SF-12, which includes the same sub-dimensions by reducing the number of questions in SF-36. The Turkish validity and reliability of the scale were conducted by Soyulu and Kütük<sup>22</sup> (2021). While the items related to the physical and emotional roles of SF-12 are answered dichotomously (yes or no), the other items have Likert-type options ranging between 3 and 6. The SF-12 total score ranges from 0 to 100, with higher scores representing better health. The Cronbach  $\alpha$  value of the scale was determined to be 0.87 before discharge and 0.96 in the first month post-discharge.

### **Data Collection**

The study was conducted in the ENT department of Erciyes University Health Application and Research Center. The study sample consisted of thyroidectomy patients hospitalized between April 2023 and August 2024. Patients who did not report hypocalcemia, tingling, or numbness and whose drainage volume fell below 10 ml within 14 hours were discharged in an average of 3-4 days. They were followed up in the outpatient clinic on the 15th day post-discharge. Patients aged 18 and over who had undergone thyroidectomy surgery and had no complications were included in the study. Questionnaires were filled out by the researchers voluntarily before and after surgery, from the patient files and by asking the patients. Before starting the study, patients were given preliminary information about the study (the purpose of the study, why the study was conducted, etc.). Data were collected by phone calls during the first month after the surgery. Electrolyte values (calcium, magnesium, and phosphorus) were evaluated by accessing them from the hospital system. Data collection took 15 minutes.

### **Ethical Considerations**

In order to conduct the research, academic board permission (2021/01) from the Department of Surgical Diseases Nursing of the Faculty of Health Sciences of Erciyes University, ethical approval (date: 08.03.2023/ number: 2023/147) from the Ethics Committee of Clinical Research of Erciyes University, institutional permission from the Erciyes University Health Practice and Research Center, and written and verbal permission with an informed consent form from the patients who volunteered to participate in the research were obtained.

### **Data Evaluation**

SPSS 25.0 (Statistical Package for Social Science) package program was used in the statistical analysis of the data. Descriptive statistics are given as unit number (n), and percentage (%). Independent sample t-tests were used to compare the differences in scale scores between demographic characteristics for paired groups, and one-way analysis of variance (ANOVA) was used for comparisons between two or more groups. Paired sample t-test was used to compare the scale means of the patients before discharge and in the first month post-discharge. Linear regression analysis was used to determine significant variables predicting independent variables. Pearson correlation analysis was used to determine the relationships between scale scores. Data were evaluated at a confidence interval of 95%, and significance was assessed at  $p < 0.05$ .

## Results

The study was completed with a total of 93 thyroidectomy patients, and the mean age was 43.89. It was observed that 83.9% of the patients were female, 43.0% were primary or secondary school graduates, 82.8% were married, and 75.3% were unemployed. 60.2% of the patients had no chronic disease, 66.7% had previous surgical experience, and 91.7% were non-smokers. Also, 80.6% of participants were in the ASA II classification and 71.0% of them had surgery lasting between 2-4 hours (Table 1).

**Table 1.** Descriptive characteristics of thyroidectomy patients

	n (%)
<b>Age</b>	
18-37	29 (31.2)
38-51	34 (36.6)
52-73	30 (32.3)
<b>Age Mean±SD</b>	<b>43.89±14.13</b>
<b>Gender</b>	
Female	78 (83.9)
Male	15 (16.1)
<b>Educational Status</b>	
Illiterate	4 (4.3)
Primary School-Secondary School	40 (43.0)
High School	17 (18.3)
College and above	32 (34.4)
<b>Marital Status</b>	
Married	77 (82.8)
Single	16 (17.2)
<b>Profession</b>	
Worker	7 (7.5)
Civil Servant	10 (10.8)
Retired	6 (6.5)
Not Working	70 (75.3)
<b>Chronic Disease</b>	
Yes	37 (39.8)
No	56 (60.2)
<b>Surgery History</b>	
Yes	62 (66.7)
No	31 (33.3)
<b>Smoking</b>	
Yes	17 (18.3)
No	76 (81.7)
<b>ASA Classification</b>	
ASA I	14 (15.1)
ASA II	75 (80.6)
ASA III	4 (4.3)
<b>Duration of Surgery</b>	
0-2 hours	2 (2.2)
2-4 hours	60 (71.0)
4-6 hours	19 (20.4)
Over 6 hours	6 (6.5)
<b>Total</b>	<b>93</b>

Table 2 shows the total scores and correlation values of the scales. Before discharge, the total score of the SF-12 scale was  $29.35 \pm 3.32$ , the total score of the FSS was  $40.82 \pm 14.67$  and the total score of the RCSQ scale was  $23.77 \pm 13.38$ . No relationship was found between the scales before discharge. In the first month post-discharge, the total score of the SF-12- scale was  $29.83 \pm 3.99$ , the total score of the FSS was  $38.41 \pm 20.61$ , and the total score of the RCSQ scale was  $35.77 \pm 14.17$ . In the first month post-discharge, a significant, negative, and moderate relationship was found between the total score of the SF-12 and FSS scales ( $r = -0.492$ ,  $p < 0.01$ ). At the same time, a significant, negative, and weak correlation was found between the total score of the FSS and RCSQ scale ( $r = -0.227$ ,  $p < 0.05$ ).

**Table 2.** The mean, standard deviation, and correlation values of the scales

	<b>X<math>\pm</math>SD</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Before discharge</b>				
1.SF-12	29.35 $\pm$ 3.32	1		
2. FSS	40.82 $\pm$ 14.67	0.035	1	
3. RCSQ	23.77 $\pm$ 13.38	-0.034	-0.166	1
<b>First month post-discharge</b>				
1.SF-12	29.83 $\pm$ 3.99	1		
2. FSS	38.41 $\pm$ 20.61	-0.492**	1	
3. RCSQ	35.77 $\pm$ 14.17	0.109	-0.227*	1

Pearson rho (\*\*  $p < 0.01$ , \*  $p < 0.05$ ); SF-12 = SF-12 Quality of Life; FSS=Fatigue Severity Scales; RCSQ= Richard Campbell Sleep Quality

Table 2 presents the descriptive characteristics of thyroidectomy patients before discharge and in the first month post-discharge and the comparison of scale scores. A statistically significant difference was found between smoking status and the total FSS scale score before discharge ( $p < 0.005$ ). No statistically significant difference was found between age, gender, education status, marital status, occupation, chronic disease, surgical history, ASA classification, surgery duration, and the total FSS scale score before discharge ( $p > 0.05$ ). At the same time, no statistically significant difference was found between age, gender, education status, marital status, occupation, chronic disease, surgical history, smoking, ASA classification, surgery duration, and the total SF-12 and RCSQ scale scores before discharge ( $p > 0.05$ ).

No statistically significant difference was found between age, gender, education status, marital status, occupation, chronic disease, surgical history, smoking habit, ASA classification, and duration of surgery and the 1st-month post-discharge SF-12 scale total score ( $p > 0.05$ ). A statistically significant difference was found between age and the 1st-month post-discharge FSS scale total score ( $p < 0.005$ ). It was observed that patients between the ages of 38-51 had higher 1st month post-discharge FSS scale total scores than patients between the ages of 52-73. However, no statistically significant difference was found between gender, education status, marital status, occupation, chronic disease, surgical history, smoking habit, ASA classification, and duration of surgery and the 1st-month post-discharge FSS scale total score ( $p > 0.05$ ). A statistically significant difference was found between age and the 1st-month post-discharge PCSQ scale total score



( $p < 0.005$ ). It was observed that patients between the ages of 18-37 had higher PCSQ scale total scores in the first month post-discharge compared to patients between the ages of 38-51 and 52-73. A statistically significant difference was found between educational status and PCSQ scale total score in the first month post-discharge ( $p < 0.005$ ). It was determined that patients with a higher education level of college and above had higher PCSQ scale total scores in the first month post-discharge compared to patients with a primary-secondary school education level. A statistically significant difference was found between surgical history and PCSQ scale total score in the first month post-discharge ( $p < 0.005$ ). It was determined that PCSQ scale total scores in the first month post-discharge were higher compared to patients who had previously undergone surgery. In addition, no statistically significant difference was found between gender, marital status, occupation, chronic disease, smoking, ASA classification, surgery duration, and PCSQ scale total score in the first month post-discharge ( $p > 0.05$ ).

**Table 3.** Comparison of pre-discharge and first month post-discharge scale averages with descriptive characteristics

	Before discharge			First month post-discharge		
	SF-12	FSS	RCSQ	SF-12	FSS	RCSQ
<b>Age</b>						
18-37	29.931±3.315	39.896±15.237	24.896±12.207	29.896±3.667	35.517±21.44 <sup>ab</sup>	42.448±10.785 <sup>a</sup>
38-51	28.806±3.458	40.705±14.292	23.411±13.470	29.088±4.238	45.545±18.955 <sup>a</sup>	28.548±14.011 <sup>b</sup>
52-73	29.379±3.211	41.866±14.970	23.100±14.714	30.678±3.997	33.366±19.999 <sup>b</sup>	36.827±14.142 <sup>b</sup>
<b>Test</b>	F=0.853	F=0.132	F=0.150	F=1.226	<b>F=3.323</b>	<b>F=8.580</b>
<b>p</b>	t=0.429	t=0.876	t=0.861	p=0.298	<b>p=0.041</b>	<b>p=0.000</b>
<b>Gender</b>						
Female	29.306±3.242	41.435±14.451	24.859±13.608	29.289±3.669	39.717±20.971	36.333±14.382
Male	29.642±3.875	37.666±15.899	18.133±10.907	32.600±4.563	31.142±17.359	32.785±13.110
<b>Test</b>	t=0.018	t=0.288	t=1.253	t=0.771	t=2.024	t=0.552
<b>p</b>	p=0.893	0.593	p=0.266	p=0.382	p=0.158	p=0.459
<b>Educational Status</b>						
Illiterate	26.750±3.403	31.500±20.469	34.250±11.870	30.333±6.506	25.250±17.519	43.250±11.586 <sup>ab</sup>
Primary School-Secondary School	29.054±3.045	43.125±13.812	23.000±14.084	29.461±3.647	39.700±21.047	30.513±14.465 <sup>b</sup>
High School	30.294±3.349	39.411±13.928	23.647±14.269	30.058±4.775	44.750±17.326	35.352±13.720 <sup>ab</sup>
College and above	29.548±3.557	39.875±15.424	23.500±12.197	30.125±3.908	35.281±21.432	41.322±12.297 <sup>a</sup>
<b>Test</b>	F=1.424	F=0.963	F=0.862	F=0.197	F=1.362	<b>F=4.034</b>
<b>p</b>	p=0.241	p=0.414	p=0.464	p=0.898	p=0.260	<b>p=0.010</b>
<b>Marital Status</b>						
Married						
Single	29.554±3.396	42.129±14.272	23.233±13.297	29.946±4.033	39.026±20.518	35.081±14.050
	28.400±2.873	34.562±15.405	26.375±13.966	29.312±3.910	35.500±21.472	39.200±14.799
<b>Test</b>	t=0.342	t=0.013	t=0.014	t=0.084	t=0.268	t=0.046
<b>p</b>	p=0.560	p=0.911	p=0.904	p=0.773	p=0.606	p=0.831
<b>Profession</b>						
Worker	29.857±2.544	36.000±17.725	16.000±7.979	30.857±6.256	33.428±25.303	33.333±16.931
Civil Servant	28.22±3.929	41.600±12.971	21.000±13.256	29.900±3.695	44.300±18.744	37.222±14.131
Retired	28.000±3.346	50.833±8.035	15.833±11.267	31.000±7.293	39.800±20.462	33.333±12.225
Not Working	29.582±3.321	40.342±14.896	25.600±13.617	29.617±3.446	37.971±20.653	36.014±14.360
<b>Test</b>	F=0.831	F=1.227	F=2.122	F=0.382	F=0.418	F=0.152
<b>p</b>	t=0.480	t=0.305	t=0.103	t=0.766	t=0.740	t=0.928

<b>Chronic Disease</b>						
Yes						
No	29.400±2.912	43.189±15.104	24.918±13.643	30.055±3.405	38.432±21.750	34.911±15.046
	29.333±3.597	39.267±14.297	23.017±13.289	29.690±4.366	38.400±20.011	36.309±13.728
<b>Test</b>	t=2.036	t=0.001	t=0.019	t=3.451	t=0.835	t=0.940
<b>p</b>	p=0.157	p=0.977	p=0.891	p=0.067	p=0.363	p=0.335
<b>Surgery History</b>						
Yes						
No	29.034±3.265	40.016±14.910	23.838±12.777	30.450±4.027	36.532±19.943	35.966±13.143
	29.967±3.410	42.451±14.277	23.645±14.759	28.645±3.719	42.300±21.752	35.379±16.356
<b>Test</b>	t=0.021	t=0.959	t=0.462	t=0.055	t=0.038	<b>t=6.596</b>
<b>p</b>	p=0.885	p=0.330	p=0.498	p=0.816	p=0.846	<b>p=0.012</b>
<b>Smoking</b>						
Yes	28.125±2.753	45.000±11.258	23.235±13.259	29.411±5.220	45.352±20.472	27.625±13.622
No	29.630±3.397	39.894±15.235	23.894±13.503	29.932±3.698	36.840±20.449	37.516±13.748
<b>Test</b>	t=0.941	<b>t=6.413</b>	t=0.309	t=3.824	t=0.536	t=0.826
<b>p</b>	p=0.335	<b>p=0.013</b>	p=0.580	p=0.054	p=0.470	p=0.366
<b>ASA Classification</b>						
ASA I	29.642±2.307	42.500±13.580	23.500±11.901	30.214±4.593	40.928±21.652	33.153±13.024
ASA II	29.366±3.431	40.400±14.937	13.595±13.595	29.917±3.893	37.473±20.318	36.630±14.435
ASA III	28.500±4.991	43.000±16.512	17.750±16.520	27.000±3.559	47.000±25.651	26.333±10.969
<b>Test</b>	F=0.269	F=0.164	F=0.431	F=1.086	F=0.523	F=1.021
<b>p</b>	t=0.765	t=0.849	t=0.651	p=0.342	p=0.595	p=0.365
<b>Duration of Surgery</b>						
0-2 hours	26.000±5.656	51.500±10.606	21.500±0.707	30.500±9.912	41.000±31.112	31.000±22.627
2-4 hours	29.562±3.380	40.484±14.495	23.969±14.364	29.569±4.023	38.230±20.695	35.333±14.167
4-6 hours	29.388±2.615	38.842±16.563	22.789±10.003	31.166±3.729	37.210±20.708	40.388±14.629
Over 6 hours	28.000±4.242	47.333±10.250	25.500±15.693	28.500±2.588	43.333±21.768	28.166±7.833
<b>Test</b>	F=1.039	F=0.871	F=0.089	F=1.003	F=0.144	F=1.322
<b>p</b>	t=0.380	t=0.460	t=0.966	t=0.396	t=0.934	t=0.273

t:t-testi, F: Anova, SF-12= SF-12-TR Quality of Life; FSS=Fatigue Severity Scales; RCSQ= Richard Campbell Sleep Quality

The changes in scale scores and electrolyte levels of thyroid surgery patients before discharge and in the first month post-discharge are given in Table 4. A statistically significant difference was found between RCSQ, calcium, and magnesium levels before discharge and in the first month post-discharge ( $p<0.005$ ). No statistically significant difference was found between SF-12, FSS, and phosphorus levels before discharge and in the first month post-discharge ( $p>0.05$ ).

**Table 4.** Changes in quality of life, fatigue, sleep, and electrolytes in thyroid surgery patients before discharge and during the first month post-discharge

	Before discharge	First Month Post-discharge	Test
<b>SF-12</b>	29.35±3.32	29.83±3.99	t=-0.767 p=0.445
<b>FSS</b>	40.82±14.67	38.41±20.61	t=1.034 p=0.304
<b>RCSQ</b>	23.77±13.38	35.77±14.17	<b>t=-5.633</b> <b>p=0.000</b>



<b>Calcium</b>	8.53± 0.65	9.46±0.42	<b>t=-6.266</b> <b>p=0.000</b>
<b>Phosphorus</b>	3.57±0.87	3.78±0.76	t=-0.369 p=0.717
<b>Magnesium</b>	0.79±0.07	0.85±0.06	<b>t=-2.594</b> <b>p=0.011</b>

SF-12= SF-12-TR Quality of Life; FSS=Fatigue Severity Scales; RCSQ= Richard Campbell Sleep Quality

According to linear regression analysis, a positive and significant relationship was found between the quality of life after thyroidectomy and fatigue, sleep quality, calcium, phosphorus, and magnesium levels ( $p<0.05$ ). It also explains 55% of the factors affecting the quality of life after thyroidectomy. Fatigue, sleep quality, calcium, phosphorus, and magnesium levels explain 55% of the change in the quality of life after thyroidectomy ( $R^2$ : 0.553;  $F$ : 4.710;  $p<0.05$ ) (Table 5).

**Table 5.** Evaluation of factors affecting quality of life scale scores of thyroidectomy patients using multiple linear regression analysis

Independent Variable	B <sup>†</sup>	SE <sup>†</sup>	β <sup>†</sup>	t	p values	95% CI <sup>†</sup>	
<b>FSS</b>	-0.159	0.049	-0.607	-3.252	<b>0.009</b>	-0.268- -0.050	$R^2 = 0.553$  $F = 4.710$  <b>p=0.018</b>
<b>RCSQ</b>	0.047	0.093	0.101	0.499	0.629	-0.162- 0.255	
<b>Kalsiyum</b>	-2.579	2.359	-0.205	-1.093	0.300	-7.835- 2.677	
<b>Fosfor</b>	1.541	1.473	0.212	1.046	0.320	-1.741- 4.822	
<b>Magnezyum</b>	66.337	19.171	0.635	3.460	<b>0.006</b>	23.621- 109.052	

†B:unstandardized regression coefficient; SE:standard error; β:standardized regression coefficient; CI:confidence interval, SF-12 = SF-12 Quality of Life; FSS=Fatigue Severity Scales; RCSQ= Richard Campbell Sleep Quality

## Discussion

Thyroidectomy is frequently performed today as a surgery related to the thyroid gland, which is an important endocrine gland. Complications that may develop after thyroidectomy have been brought under control in recent years thanks to advances in technology. However, some permanent physical symptoms can significantly reduce the patient's quality of life<sup>23</sup>. Permanent physical symptoms include calcium, hemostasis problems, imbalance in thyroid hormones, and uncertainty about general health status, which are factors that reduce the quality of life for patients<sup>24</sup>. As a result, patients may experience a decrease in quality of life, sleep problems, fatigue, and a decrease in daily activity levels<sup>25</sup>. Therefore, this study was conducted descriptively to determine the effects of electrolyte levels, sleep problems, and fatigue on the quality of life in patients who underwent thyroidectomy.

In the study, it was determined that the average age of patients who underwent thyroidectomy was 43.89, and 83.9% were women. These results are consistent with the literature and it is stated that thyroid diseases are generally more common in women<sup>26-28</sup>. The reason why women are prone to thyroid diseases is associated with hormonal changes<sup>26</sup>. In patients who underwent thyroidectomy, the pre-discharge quality of life, fatigue, and sleep quality scale scores were determined to be  $29.35 \pm 3.32$ ,  $40.82 \pm 14.67$ , and  $23.77 \pm 13.38$ , respectively. When the total scale scores were examined, it was observed that the total quality of life scores were low, the total fatigue scores were high and the sleep quality scores were low. In the first month after post-discharge, there was a significant, negative, and moderate correlation between the total SF-12 and FSS scale scores. There was also a significant, negative, and weak correlation between the total FSS and RCSQ scale scores. In the first month post-discharge, the quality of life, fatigue, and sleep quality scale scores were  $29.83 \pm 3.99$ ,  $38.41 \pm 20.61$ , and  $35.77 \pm 14.17$ , respectively. Total scale scores showed that the total quality of life scores were low and remained at similar levels, the total fatigue scores were high but decreased compared to pre-discharge, and the sleep quality scores were moderate and increased compared to pre-discharge. When the changes in the scale scores and electrolyte levels of the patients before discharge and in the first month post-discharge were examined, a statistically significant difference was found between the RCSQ, calcium, and magnesium levels. In the systematic review conducted by Landry et al., it was observed that the quality of life of the patients decreased in seven studies. At the same time, it was stated that the psychological and social quality of life of the patients decreased in five studies. The main reasons for the decrease in quality of life include physical fatigue, cognitive complaints, sleep problems, pain, vocal symptoms, concentration problems, scarring, weight problems, decreased motivation, somatization, anxiety, decreased social and physical functions, and changes in roles<sup>24</sup>. When all these factors are considered, the importance of providing holistic care to thyroidectomy patients, not only physically but also psychologically and socially, becomes evident. Apparently, the increasing number of thyroid cancer cases and their detection in younger patients will maintain their importance in the coming years due to their effects on quality of life.

A prospective observational study examined sleep quality after thyroidectomy. The quality of sleep of the patients was observed to decrease during a six-month follow-up period at the conclusion of the study. This situation was particularly associated with anxiety about recurrence, postoperative complications, and neck scars<sup>25</sup>. Similarly, another study evaluating sleep quality after thyroidectomy reported that patients suffered from sleep disorders. The main reasons for sleep problems were stated to be awareness of metastatic status, treatment process, and fear of cancer. Sleep disturbances present as challenges in initiating sleep, early awakening, and numerous nocturnal awakenings. A decrease in sleep quality can lead to fatigue, mood disorders, and concentration disorders<sup>29</sup>. Therefore, studies should focus not only on evaluating sleep quality but also on the results of therapeutic treatment methods for sleep problems.

Fatigue is both a condition caused by insomnia and a factor that reduces quality of life. A study of 216 thyroidectomy patients revealed that 61% of the patients reported fatigue most of the time for 1 year after surgery<sup>12</sup>. In another study, 38.2% of the participants

reported decreased energy and 50.7% reported moderate fatigue. Young age, history of depression, comorbidity, and suppression of thyroid hormone were associated with lower energy levels. Low calcium levels and low energy levels were also associated with fatigue<sup>30</sup>. Recurrent fatigue, mental changes, pain, and insomnia caused by problems caused by electrolyte imbalances after total thyroidectomy are also problems that reduce the quality of life experienced by patients and affect a significant portion of the patients<sup>6</sup>. In the study, fatigue, sleep quality, calcium, phosphorus, and magnesium levels explained 55% of the increase in quality of life after thyroidectomy. Therefore, it is important to examine the effects of electrolyte levels, fatigue, and sleep problems on quality of life.

## **Conclusion and Recommendations**

The findings obtained from the study demonstrated that patients had decreased sleep quality, increased fatigue levels, and decreased quality of life after thyroidectomy. The relationship between quality of life and fatigue, fatigue and sleep quality was revealed. Fatigue, sleep quality, calcium, phosphorus, and magnesium levels are responsible for half of the change in quality of life after thyroidectomy. The study provides a current synthesis of quality of life, fatigue, and sleep quality that will allow a more personalized approach while helping healthcare professionals better counsel their patients. Therefore, long-term follow-up and holistic care are recommended for patients after thyroidectomy.

## **Limitations and Strengths of the Study**

The limitations of the study include being conducted in a single center, having a small sample size, and having a long data collection process. In addition, the few studies examining the effects of thyroidectomy on electrolytes, fatigue, sleep quality, and quality of life, and the short follow-up period are among the limitations. Its strength is that it provides a synthesis of electrolytes, fatigue, and sleep quality.

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## **Conflicts of Interest**

The authors declare that there are no conflicts of interest regarding the publication of this article.

## **Authors' Contributions**

**G.M.**, Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Writing – Original Draft Preparation, Writing – Review & Editing.

**Y.S.**, Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Writing – Original Draft Preparation, Writing – Review & Editing.

**S. K. K.**, Conceptualization, Investigation, Methodology, Project Administration.

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