

# The relationship between the nutritional status and sleep quality of patients with atrial fibrillation

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## ABSTRACT

**الأهداف:** لتقييم العلاقة بين الحالة الغذائية ونوعية النوم في المرضى الذين تم تشخيصهم بالرجفان الأذيني باعتباره بحث ارتباطي مستعرض.

**الطريقة:** أجري هذا البحث الارتباطي المستعرض على 108 مريض خلال الفترة بين ديسمبر 2017 ومارس 2018م الذين تم قبولهم لخدمات أمراض القلب في جامعتين مختلفتين، تم تشخيصهم بالرجفان الأذيني ووافقوا على المشاركة. جُمعت البيانات باستخدام جداول صحيحة دولياً من أجل تقييم العلاقة بين الحالة الغذائية ونوعية النوم للمرضى الذين يعانون من الرجفان الأذيني.

**النتائج:** اشتملت الدراسة على 47.2% من الرجال و 52.8% نساء. معظمهم (81.5%) كانوا فوق 60 عام. متوسط لعمر كان  $68.99 \pm 14.02$ . من المرضى، 13% يعانون من سوء التغذية، وكان 57.4% يعانون من خطر سوء التغذية، و29.6% لديهم التغذية الطبيعية. وأظهرت نتائج هذه الدراسة أن نوعية نومهم ساءت وزيادة النعاس أثناء النهار زادت من خطر سوء التغذية ( $p=0.000$ ).

**الخاتمة:** تدهورت جودة نوم المرضى وزيادة النعاس أثناء النهار مع زيادة خطر الإصابة زاد سوء التغذية.

**Objectives:** To evaluate the relationship between the nutritional status and sleep quality in patients diagnosed with atrial fibrillation as a cross-sectional correlational research.

**Methods:** This cross-sectional correlational research was carried out with 108 patients between December 2017 and March 2018 who were admitted to the cardiology services of 2 different universities, diagnosed with atrial fibrillation and agreed to participate. Data collection was performed using internationally valid scales in order to evaluate the relationship between the nutritional status and sleep quality of patients diagnosed with atrial fibrillation.

**Results:** Of the patients, 47.2% were men and 52.8% were women. Most of them (81.5%) were over the age of 60 years. The mean age was  $68.99 \pm 14.02$ . Of the patients, 13% were malnourished, 57.4% were at risk of malnutrition, and 29.6% had a normal nutritional status. This study determined that their sleep quality worsened and their daytime sleepiness increased as their risk of malnutrition increased ( $p=0.000$ ).

**Conclusion:** The patients' sleep quality worsened and their daytime sleepiness increased as the risk of malnutrition increased.

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Atrial fibrillation (AF) is a supraventricular tachyarrhythmia that causes the deterioration of the mechanical function of atria due to rapid, irregular and ineffective atrial activity. It is the most common tachyarrhythmia and is present in 1-2% of the general population.<sup>1</sup> Besides uncontrollable risk factors such as age and genetics, there are also controllable risk factors of atrial fibrillation. They include obesity, obstructive sleep apnea syndrome (OSAS), hypertension (HT), diabetes mellitus (DM) and alcohol consumption. To manage these risk factors, it is important to change the lifestyles of patients.<sup>2</sup> Obstructive sleep apnea syndrome is a complex syndrome characterized by

intermittent hypoxemia, carbon dioxide retention and sudden elevation of atrial pressure. It has been shown to play an important role in the development of AF.<sup>3,4</sup> Atrial fibrillation incidence is 3 times higher in the OSAS population than in the general population.<sup>5</sup> Good nutrition can protect and improve people's health and improve their quality of life.<sup>6</sup> Studies have shown pathophysiological relationships between excessive and inadequate nutrition and AF.<sup>7</sup> Considering the importance of both conditions as AF risk factors, the literature on the effect of nutritional status on sleep quality in patients with AF is insufficient. Therefore, this study will make a significant contribution to the literature.

In this study, research questions are: 1) Do the individual characteristics and health status of patients diagnosed with atrial fibrillation affect nutritional status and sleep quality? 2) What is the nutritional status and how good is the sleep quality of patients diagnosed with atrial fibrillation, and is there a relationship between them? In this study, answers to these research questions were sought.

**Methods.** This cross-sectional correlational study aimed to evaluate the relationship between the nutritional status and sleep quality in patients diagnosed with AF. This cross-sectional correlational study's data collection was performed using internationally valid scales in order to evaluate the relationship between the nutritional status and sleep quality of patients diagnosed with atrial fibrillation.

This study was conducted in 108 patients who were admitted to the cardiology departments of University-Cerrahpasa Institute of Cardiology and Istanbul University Cerrahpasa Medical Faculty, Istanbul, Turkey between December 2017 and March 2018. They were diagnosed with AF by a physician, agreed to participate, had no communication problems and knew how to read and write Turkish. Patients who did not agree to participate, had difficulties understanding questions, used narcotic analgesics that affected their communication skills, had serious mental illnesses, experienced transient ischemic attacks, and had cognitive dysfunctions, chest pain, dyspnea or tachycardia were not included.

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Data was collected between December 2017 and March 2018 in face-to-face interviews. After the study was explained to the patients and their informed consent was obtained. Data collection took approximately 30 minutes. The data were collected by a patient information form, and the Epworth sleepiness scale (ESS), Pittsburgh Sleep Quality Index (PSQI), and Mini Nutritional Evaluation Assessment-Short form that is Turkish validity and reliability scales.<sup>8-10</sup>

A patient information form, symptom evaluation scales and nutritional status scales were used for data collection. The patient information form consists of questions regarding the individual characteristics of patients and questions on disease and OSAS risk factors.<sup>11,12</sup> It also included laboratory test results confirming the diagnosis of AF and providing preliminary information on the development of complications.<sup>13,14</sup>

The ESS<sup>8</sup> was used to evaluate the daytime sleepiness of the patients, and the PSQI<sup>9</sup> was used to evaluate their sleep quality. Scores of 10 or more on the ESS indicate polysomnography and high daytime sleepiness.<sup>8</sup> Pittsburgh Sleep Quality Index scores under 4 indicate good sleep quality, and scores of 5 to 20 indicate poor sleep quality.<sup>9</sup> The long version of the Mini Nutritional Evaluation Assessment (MNA) was used to evaluate the nutritional status of the participants. It has 18 questions regarding anthropometric evaluation, general evaluation, nutritional evaluation and subjective evaluation.<sup>10</sup> These data collection tools are self-reporting questionnaires.

Permission was obtained from Medical Faculty, Istanbul University, Istanbul, Turkey, Cerrahpasa Clinical Research Ethics Committee after obtaining permissions (number: 421498) from the 2 institutions where the data were collected. In accordance with the Declaration of Helsinki, the aim of the study, the data collection process and its duration were explained to the individuals who agreed to participate in the study by signing an informed voluntary consent form. Informed verbal and written consent were obtained from the participants.

**Statistical analysis.** The Statistics Package for Social Sciences for Windows Version 22 (IBM Corp, Armonk, NY, USA) software was used to analyze the data. Number, percentage, mean and standard deviation were used as correlational research statistical methods in the evaluation of the data. T-test was used to compare quantitative continuous data between 2 independent groups and one way ANOVA test to compare quantitative continuous data between more than 2 independent groups. After the ANOVA test, Scheffé test was used as a complementary post-hoc analysis to determine the

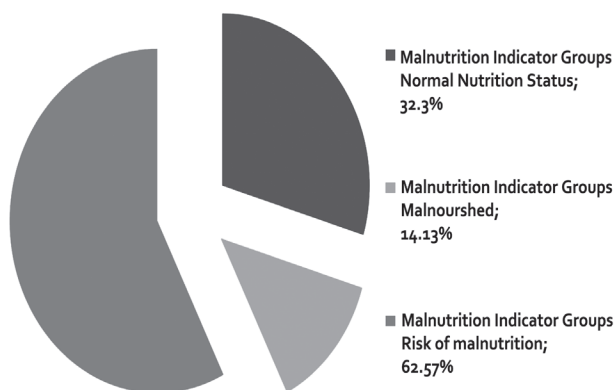
differences. Pearson correlation and regression analysis were used among the continuous variables of the study. The threshold for significance was  $p < 0.05$ .

**Results.** Of the participants, 47.2% were men, and 52.8% were women. Most of them (81.5%) were over the age of 60, and their mean age was  $68.99 \pm 14.02$ . Most of the patients with AF were diagnosed with poor sleep quality, a greater tendency to sleep during the day and high malnutrition risk (Table 1). This study found that as the age variable increased, sleep quality worsened and the risk of malnutrition increased ( $p = 0.000$ ). There was no significant difference by gender ( $p = 0.233$ ). Nutritional status of patients with atrial fibrillation is described in Figure 1.

This study determined that sleep quality worsened and daytime sleepiness increased as the patients' risk of malnutrition increased (Table 2,  $p = 0.000$ ). It also found that, as the sleep quality of individuals worsened, their daytime sleepiness increased (Table 2;  $p = 0.000$ ).

We found that, as the transferrin ( $p = 0.026$ ), high density lipoprotein (HDL)-cholesterol ( $p = 0.322$ ), hemoglobin ( $p = 0.164$ ) and hematocrit ( $p = 0.785$ ) values decreased, and the glucose ( $p = 0.003$ ), pro-brain natriuretic peptide (Pro-BNP) ( $p = 0.006$ ), low-density lipoprotein (LDL) values ( $p = 0.089$ ) and prothrombin time ( $p = 0.064$ ) increased, the risk of malnutrition also increased (Table 3).

This study found that, as HDL cholesterol value decreased, sleep quality worsened ( $p = 0.007$ ), and as the pro-BNP ( $p = 0.001$ ;  $p = 0.003$ ), glucose ( $p = 0.000$ ), creatinine ( $p = 0.048$ ;  $p = 0.217$ ), urea ( $p = 0.027$ ;  $p = 0.073$ ) and protein ( $p = 0.016$ ;  $p = 0.045$ ) values increased, sleep quality worsened, and sleepiness during the day increased (Table 3).



**Figure 1** - Distribution of malnutrition indicators according to nutritional status scores (N=108).

**Discussion.** Atrial fibrillation is a supraventricular tachyarrhythmia that causes the deterioration of the mechanical function of atria due to rapid, irregular and ineffective atrial activity.<sup>1</sup> Atrial fibrillation is the most common continuous cardiac arrhythmia in the general population.<sup>12,15</sup>

It has been reported that 60% of AF patients were women<sup>16</sup> and the male-female ratio was 1:7.<sup>17</sup> In this study, the number of AF diagnosed women (52.8%) was a little higher than men (47.2%), and the mean age (68.99) (SD=14.02) was similar to the mean age reported in the literature (Table 1).<sup>18</sup> This supports the proposition that AF prevalence increases with age.<sup>9,18</sup> Obesity, an independent risk factor of atrial fibrillation,<sup>12</sup> has been found in 25% of AF-diagnosed patients.<sup>11,21</sup> In this study, 55.6% of the patients had overweight body mass indexes (BMIs), and 14.8% had obese BMIs (Table 1). Lin et al<sup>22</sup> reported that visceral adipose tissue plays an important role in the development of AF. The pathophysiological mechanisms associated with the risk of AF and with overeating include: the effect of the chronic inflammatory condition associated with an imbalance of anti-inflammatory agents, left atrial enlargement, electromechanical dysfunction, hemodynamic changes associated with obesity, metabolic syndrome, gastro-esophageal reflux disease, OSAS, DM, and insulin resistance.<sup>7,13</sup> The incidence of AF is 3 times higher in the OSAS population than the general population,<sup>4,23</sup> and their relationship is very strong.<sup>24</sup> Studies have shown that patients with untreated OSAS experience a transition from sinus rhythm to AF during sleep.<sup>25</sup> Kayrak et al<sup>26</sup> found that the prevalence of AF patients with sleep disorders was higher by 4.8%. Our evaluation of OSAS symptoms<sup>11</sup> found that most of the patients (73.1%) woke up tired and experienced daytime sleepiness despite sufficient sleep, and experienced forgetfulness, irritability, and lack of attention (82.4%). Of the patients, 38% were told that they snored during the night, 39% said that they snored when they were exhausted, and 29.3% said that they snored every day. Other OSAS symptoms, such as headaches in the morning (68.5%) and a dry mouth and a sore throat (69.4%) were present in most of the patients.

**Evaluation of sleep quality, nutritional status and AF.** Sleep quality is defined as the status of feeling fit and ready for the new day after waking.<sup>3,27</sup> In this study presented as a research evaluating the association between AF and sleep characteristics, the researchers found no evidence that sleep duration was a risk factor for AF on its own, but they did find that sleep disorder is an important risk factor for AF. They found that

**Table 1** - Assessment of nutritional status and sleep quality according to the individual characteristics of the patients (N=108).

Individual characteristics	n (%)	ESS* Mean±SD	PSQI* Mean±SD	MNA total score* Mean±SD
For all individuals	108	12.74±3.48	11.31±3.37	21.50±3.76
<b>Gender</b>				
Male	51 (47.2)	12.76±3.01	11.72±3.07	21.30±3.83
Female	57 (52.8)	12.71±3.88	10.94 ±3.60	21.67±3.72
τ (p-value)		0.06 (0.946)	1.20 (0.233)	-0.54 (0.611)
(M±SD)	68.99±14.02			
<b>Age</b>				
60 and lower	20 (18.5)	10.40±2.99	9.20±2.50	24.00±2.50
Aged 61-70	33 (30.6)	12.15±3.08	10.27±2.91	22.22±3.539
Aged 71-80	37 (34.3)	12.73±2.84	11.78 ±2.62	21.05±3.41
80 and higher	18 (16.7)	16.44 (3.12)	14.61±3.80	18.30±3.77
F (p-value)		13.67 (0.000)	12.86 (0.000)	9.78 (0.000)
PostHoc=		2>1, 3>1, 4>1, 4>2, 4>3 (p<0.05)	3>1, 4>1, 3>2, 4>2, 4>3 (p<0.05)	1>3, 1>4, 2>4, 3>4 (p<0.05)
<b>AF diagnosis duration</b>				
24 months and less	33 (30.6)	11.81±3.20	10.39±3.45	21.78±3.57
Between 25-48 months	20 (18.5)	10.70±2.79	9.50±1.82	23.32±3.41
Between 49-72 months	23 (21.3)	12.47±2.52	11.00±2.37	21.52 ±3.01
72 months and more	32 (29.6)	15.15±3.52	13.62±3.49	20.04±4.20
F (p-value)		10.37 (0.000)	9.75 (0.000)	3.44 (0.019)
PostHoc		4>1, 4>2, 4>3 (p<0.05)	4>1, 4>2, 4>3 (p<0.05)	2>4 (p<0.05)
<b>NYHA</b>				
Class 1	14 (13)	8.85±2.38	7.50±1.82	23.82±2.72
Class 2	29 (26.9)	11.75±2.74	10.44±2.62	21.67±3.75
Class 3	43 (39.8)	14.30±3.16	12.34±3.11	21.48±3.51
Class 4	22 (20.4)	13.45±3.37	12.86±3.42	19.81±4.16
F (p-value)		13.02 (0.000)	12.61 (0.000)	3.48 (0.018)
PostHoc		2>1, 3>1, 4>1, 3>2, 4>2 (p<0.05)	2>1, 3>1, 4>1, 3>2, 4>2 (p<0.05)	1>3, 1>4 (p<0.05)
<b>BMI</b>				
Normal	32 (29.6)	12.06±4.33	10.87±3.82	21.31±3.95
Overweight	60 (55.6)	12.90±3.02	11.21±3.15	21.70±3.91
Obese	16 (14.8)	13.50±3.20	12.56±3.09	21.12±2.86
F (p-value)		1.04 (0.354)	1.40 (0.250)	0.20 (0.818)

\*Mean±SD, SD - standard deviation, NYHA - New York Heart Association Society Classification, ESS - Epworth Sleepiness Scale, PSQI - Pittsburgh Sleep Quality Index, MNA - Mini Nutritional Assessment, BMI - body mass index (normal: 18.5-24.9 kg/m<sup>2</sup>, overweight: 25-29.9 kg/m<sup>2</sup>, obese: <30 kg/m<sup>2</sup>), τ - independent group t test, F - one way ANOVA test, AF - atrial fibrillation

**Table 2** - Evaluation of the relationship between nutritional status and sleep quality scores (N=108).

	MNA screening* r (p)	MNA evaluation† r (p)	MNA total r (p)	ESS r (p)	PSQI r (p)	BMI r (p)
MNA screening	1.00 (0.000)					
MNA evaluation	0.51 (0.000)	1.00 (0.000)				
MNA total	0.79 (0.000)	0.93 (0.000)	1.00 (0.000)			
ESS	-0.33 (0.000)	-0.46 (0.000)	-0.47 (0.000)	1.00 (0.000)		
PSQI	-0.43 (0.000)	-0.57 (0.000)	-0.59 (0.000)	0.72 (0.000)	1.00 (0.000)	
BMI	-0.08 (0.397)	0.12 (0.194)	0.05 (0.571)	0.06 (0.498)	0.14 (0.137)	1.00 (0.000)

\*Mini Nutritional Assessment (MNA) screening, food intake, weight loss, mobility, psychological problems and body mass index (BMI). †MNA evaluation, autonomy, drug use, nutritional assessment, health and nutrition perception, arm and calf circumference. ‡ESS - Epworth sleepiness scale, PSQI - Pittsburgh sleep quality index, BMI (normal: 18.5-24.9 kg/m<sup>2</sup>, overweight: 25-29.9 kg/m<sup>2</sup>, obese: <30 kg/m<sup>2</sup>), r - correlation analysis, p - p-value.

**Table 3** - Correlations between nutritional status, sleep quality scores and laboratory results (N=108).

Laboratory results	MNA screening <sup>†</sup> r (p)	MNA evaluation <sup>‡</sup> r (p)	MNA total r (p)	ESS <sup>§</sup> r (p)	PSQI <sup>§</sup> r (p)
Hematocrit	0.08 (0.396)	-0.01 (0.904)	0.02 (0.785)	-0.14 (0.131)	-0.03 (0.747)
Hemoglobin	0.20* (0.034)	0.06 (0.486)	0.13 (0.164)	-0.18 (0.062)	-0.09 (0.338)
Prothrombin time	-0.23* (0.022)	-0.12 (0.215)	-0.19 (0.064)	0.08 (0.396)	0.07 (0.447)
INR	-0.07 (0.486)	0.01 (0.855)	-0.01 (0.869)	-0.03 (0.700)	-0.07 (0.452)
Sodium	0.18 (0.055)	0.11 (0.241)	0.16 (0.099)	-0.07 (0.467)	-0.16 (0.084)
Potassium	0.07 (0.454)	0.06 (0.483)	0.07 (0.414)	-0.05 (0.575)	0.02 (0.818)
Total cholesterol	-0.15 (0.369)	0.21 (0.219)	0.09 (0.573)	-0.25 (0.127)	-0.23 (0.176)
Low density lipoproteins-C	-0.51** (0.001)	-0.12 (0.487)	-0.28 (0.089)	-0.19 (0.262)	-0.17 (0.322)
High density lipoproteins-C	0.31 (0.056)	0.05 (0.731)	0.16 (0.322)	-0.11 (0.515)	-0.43** (0.007)
Albumin	0.09 (0.397)	-0.02 (0.844)	0.02 (0.832)	-0.12 (0.276)	-0.06 (0.574)
Troponin I	-0.07 (0.480)	-0.10 (0.339)	-0.11 (0.325)	0.14 (0.194)	0.14 (0.198)
Pro-BNP	-0.21 (0.077)	-0.32** (0.006)	-0.32** (0.006)	0.34** (0.003)	0.39** (0.001)
Glucose	-0.14 (0.133)	-0.31** (0.001)	-0.28** (0.003)	0.34** (0.000)	0.35** (0.000)
CRP	0.07 (0.459)	-0.05 (0.556)	-0.01 (0.912)	0.03 (0.749)	0.07 (0.422)
Transferrin	0.97* (0.026)	0.97* (0.026)	0.97* (0.026)	-0.29 (0.707)	0.07 (0.926)
Creatinine	-0.16 (0.104)	0.04 (0.688)	-0.04 (0.683)	0.12 (0.217)	0.20* (0.048)
Urea	-0.20* (0.043)	-0.008 (0.937)	-0.09 (0.364)	0.18 (0.073)	0.22* (0.027)
Protein	0.09 (0.381)	0.18 (0.093)	0.17 (0.119)	-0.22* (0.045)	-0.26* (0.016)

<sup>†</sup>MNA (Mini Nutritional Assessment) screening: food intake, weight loss, mobility, psychological problems and BMI (body mass index),  
<sup>‡</sup>MNA evaluation - autonomy, drug use, nutritional assessment, health and nutrition perception, arm and calf circumference assessment,  
<sup>§</sup>ESS - epworth sleepiness scale, PSQI - Pittsburgh sleep quality index, CRP - C-reactive protein, Pro-BNP - brain natriuretic peptide,  
\* $<0.05$ ; \*\* $<0.01$ , r - correlation analysis, p - p-value

the risk of AF development is higher for individuals who had the complaint of waking up more during the night.<sup>28</sup> Another study reported that patients with AF had poor sleep quality<sup>24</sup> and experienced more daytime sleepiness.<sup>27</sup> In our study, like the literature, the AF patients' sleep quality was poor and their daytime sleepiness high (Table 1). The literature indicates that, as the New York Heart Association (NYHA) classification rises, the daytime sleepiness of patients increases, and their sleep quality worsens.<sup>30</sup> This study, like the literature,<sup>30</sup> determined that the sleep quality of individuals with NYHA classification levels 2-4 worsened and daytime sleepiness increased (Table 1,  $p=0.000$ ). When examining the BMI of the patients, one of the OSAS diagnosis criteria,<sup>8</sup> we found that the ESS and PSQI scores were higher in overweight or obese patients, that the sleep quality of these patients worsened ( $p=0.250$ ), and their daytime sleepiness ( $p=0.354$ ) increased (Table 1).

Good nutritional status, which is known to prevent cardiovascular disease, can also effectively prevent and treat AF development.<sup>31-33</sup> Anaszewicz and Budzyński<sup>7</sup> found that the risk of malnutrition was higher in patients with AF than in patients without AF. This study found that most of the patients with AF (57%) had the risk of malnutrition, and in 13% actual malnutrition was detected (Table 1, Figure 1). The same study<sup>7</sup> found a significant relationship between BMI (mean=28.9)

(SD=5.5) and the risk of malnutrition. Our study found no significant relationship between BMI and nutritional status ( $p=0.818$ ), determining instead that all BMI categories were at risk of malnutrition (Table 1). It has been reported that, as the NYHA classification levels increase, the severity of the disease also increases.<sup>12,30</sup> Increased disease severity entails other risks. This study found the risk of malnutrition of patients with NYHA functional levels 2-4 to be high (Table 1,  $p=0.018$ ).

**Findings regarding nutrition and sleep quality.** The relationship between OSAS and nutrition disorder as an independent risk factor for the development of OSAS was first noticed in the late 1990s. The prevalence of malnutrition is higher in individuals with OSAS than it is in the general population.<sup>34</sup> There are no studies in the literature that evaluate the relationship between the nutritional status and sleep quality of patients with AF.

There is an evidence that adequate and sufficient sleep provides protection against a range of metabolic disorders such as obesity, dyslipidemia, diabetes and insulin resistance.<sup>35</sup> While Mungan et al<sup>36</sup> did not find a significant relationship between BMI and the sleep quality of AF patients, they reported that sleep quality worsened as BMI increases. Taheri et al<sup>37</sup> found a relationship between short sleep duration and increased food intake and food selection. Our study determined, like the literature, that overweight and obese patients had poor sleep quality ( $p=0.250$ ) and

more daytime sleepiness ( $p=0.354$ ) (Table 1), and that there is a significant relationship between BMI and sleep scores (Table 2,  $p=0.498$  for ESS;  $p=0.137$  for PSQI). We determined that, as the risk of malnutrition in individuals, increases daytime sleepiness increases and sleep quality worsens (Table 2,  $p=0.000$ ).

The presence of albuminuria may indicate changes in the complex cellular atherosclerotic process. Low albumin also has a prognostic meaning.<sup>38</sup> They are associated with higher AF risk, taking into account the association with cardiovascular disease risk. These findings also support the hypothesis that inflammation contributes to the etiology of AF.<sup>38</sup> The patients with low albumin ( $p=0.276$  for ESS  $p=0.574$  for PSQI) and protein levels ( $p=0.045$  for ESS;  $p=0.016$  for PSQI) and patients with high pro-BNP ( $p=0.003$  for ESS;  $p=0.001$  for PSQI) and glucose levels ( $p=0.000$ ) had poor sleep quality, more daytime sleepiness. Their sleep quality also worsened as the creatinine level increased ( $p=0.048$ ) and the HDL-cholesterol level decreased ( $p=0.007$ ) (Table 3). This study also determined that as the plasma urea level increased, sleep quality worsened ( $p=0.027$ ) and daytime sleepiness increased ( $p=0.073$ ) (Table 3).

Besides the fact that nutritional status constitutes a risk of malnutrition for cardiovascular diseases on its own, it has also been reported that there is a relationship to glucose intolerance and Pro-BNP, C-reactive protein (CRP) and LDL-cholesterol levels.<sup>40-43</sup> It has also been reported that there is a strong relationship between elevated CRP levels and impaired endothelial function,<sup>44</sup> and that CRP can be used as a stronger risk indicator for determining cardiovascular events than LDL.<sup>42</sup>

Elevated CRP levels in patients with AF suggest that inflammation may play a role in the pathogenesis of AF. Some studies have reported a strong relationship between inflammation and the likelihood of AF.<sup>45,46</sup> However, another study found that CRP may not only be a sign of inflammation in patients with AF, but may also play an active physiopathological role. It has been shown that CRP may not be a cause of the physiopathology of AF, but rather a result.<sup>47</sup> Sadanaga et al<sup>43</sup> reported that pro-BNP increase is caused by the development of atrial fibrillation and diastolic dysfunction and that the increase in pro-BNP was greater, especially when these 2 conditions were combined. It is accepted that high LDL and low HDL cholesterol levels constitute a risk factor for AF.<sup>48</sup> A study examining the relationship between AF patients and nutritional status found no significant relationship between CRP value and nutritional status, but determined that the risk of malnutrition increased as the LDL cholesterol level increased.<sup>13</sup> Our study

determined that the patients had a more normal nutrition status as the LDL cholesterol level decreased ( $p=0.089$ ) and the hemoglobin level increased ( $p=0.164$ ), and that they had risk of malnutrition as the prothrombin time ( $p=0.064$ ) and pro-BNP ( $p=0.006$ ) and glucose levels increased ( $p=0.003$ ) and the transferrin level decreased ( $p=0.026$ ) (Table 3). Transferrin and albumin levels are serum proteins used to evaluate nutritional status; however, it has been reported that evaluating these 2 parameters together with the CRP level would be more clinically relevant for proper nutritional assessment.<sup>49</sup> Our study, like the literature,<sup>13</sup> found no significant relationship between CRP value and nutritional status, but found that, as the CRP value increased, the risk of malnutrition also increased (Table 3,  $p=0.912$ ). It also determined that, as the protein and albumin values, which are among the important indicators for the assessment of the nutritional status,<sup>49</sup> and the urea value increased, the risk of malnutrition also increased (Table 3,  $p=0.364$ ).

**Study limitation.** This study's data were collected with self-reporting questionnaires, which may constitute a limitation. This study is very important for the management of patients with atrial fibrillation. Therefore, more comprehensive, longitudinal and follow-up studies can reinforce the study data.

In conclusion, this study of the relationship between the nutritional status and sleep quality of patients with atrial fibrillation determined that sleep quality worsened and daytime sleepiness increased as the risk of malnutrition increased. This study also determined that abnormalities in laboratory results indicating disease severity and nutritional status also increased the risk of malnutrition and thus adversely affected sleep quality.

The controllable risk factors responsible for the development of AF include obesity, obstructive sleep apnea syndrome, hypertension, diabetes mellitus and alcohol consumption. It is important to assess nutritional status and sleep quality in order to protect and improve the health of patients with atrial fibrillation and to improve their quality of life.

This study's results indicate that to manage the risk factors of patients diagnosed with AF, training programs should be organized in order to improve AF patients' quality of sleep, to educate them on the importance of nutrition, to increase their diet compliance to appropriate diets and to normalize their nutritional status. More comprehensive and prospective studies on the relationship between the nutritional status and sleep quality of patients with AF will fill a gap in the literature.

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