Effect of Rehabilitation on Sleep Quality After Ablation for Atrial Fibrillation

Data From a Randomized Trial

Risom, Signe Stelling; Fevejle Cromhout, Pernille; Overgaard, Dorthe; Hastrup Svendsen, Jesper; Kikkenborg Berg, Selina

Published in:
The Journal of Cardiovascular Nursing

DOI:
10.1097/JCN.0000000000000476

Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

Document license:
CC BY-NC-ND

Citation for published version (APA):
Risom, S. S., Fevejle Cromhout, P., Overgaard, D., Hastrup Svendsen, J., & Kikkenborg Berg, S. (2018). Effect of Rehabilitation on Sleep Quality After Ablation for Atrial Fibrillation: Data From a Randomized Trial. The Journal of Cardiovascular Nursing, 33(3), 261-268. https://doi.org/10.1097/JCN.0000000000000476
Effect of Rehabilitation on Sleep Quality After Ablation for Atrial Fibrillation

Data From a Randomized Trial

Signe Stelling Risom, PhD, RN; Pernille Fevejle Cromhout, MSc, RN; Dorthe Overgaard, PhD, RN; Jesper Hastrup Svendsen, MD, DMSc; Selina Kikkenborg Berg, PhD, MScN, RN

Background: Low sleep quality is common in patients with atrial fibrillation (AF). Positive effects of cardiac rehabilitation on patients treated for AF with ablation have been found, but whether cardiac rehabilitation affects sleep quality is unknown. The objectives of this study were to investigate (1) differences in sleep quality between cardiac rehabilitation and usual care groups and (2) whether other factors could affect sleep quality.

Methods: From the randomized CopenHeart RFA trial, 210 patients treated for AF with ablation were included. A rehabilitation program consisting of physical exercise and psychoeducational consultations was tested. Sleep quality was measured with the Pittsburg Sleep Quality Index (PSQI) questionnaire before intervention and at the end of intervention. Anxiety, depression, and European Heart Rhythm Association scores were assessed.

Results: No difference between groups in sleep quality was found (PSQI global mean [SD] score, 6.60 [3.61] points for the cardiac rehabilitation group [n = 83] and 6.08 [3.60] points for the usual care group [n = 90]; P = .34), although improvements in sleep quality were noted in both groups. Sleep latency, duration, and efficiency were significant by type of AF at 1 month. Anxiety, depression, and higher European Heart Rhythm Association scores at 4 months were associated with a higher PSQI global mean score at the end of intervention.

Conclusion: The rehabilitation program showed no effect on sleep quality. A large proportion of patients reported poor sleep quality, and patients reporting anxiety, depression, or AF symptoms described worse sleep quality compared with patients who did not experience anxiety, depression, or AF symptoms. More research in the field is warranted.

KEY WORDS: atrial fibrillation, cardiac rehabilitation, cardiovascular diseases, sleep

Sleep is a fundamental behavior that has been shown to be associated with morbidity and recovery. Disturbed sleep is reported by up to 70% of patients with heart disease.1 Research findings have contributed to an increasing awareness of sleep and sleep disorders. Disturbance and lack of sleep are associated with a number of dysfunctions such as mood disturbance, excessive exhaustion, decreased alertness, and reaction time and have a negative effect on daytime functioning and quality of life.2 Sleep disorders increase the risk of morbidity and mortality and can contribute to the development of conditions such as hypertension and heart failure.3,4

This study was funded by the Metropolitan University College, The Heart Centre at University Hospital of Copenhagen, The Lundbeck Foundation (grant number FP 62/2011FP, 74/2012, 2014-3962); The Health Foundation (grant number 15-B-0114); and the Danish Strategic Research Council (grant number 10-092790).

The authors have no conflicts of interest to disclose.

Correspondence
Signe Stelling Risom, PhD, MSc, RN, The Heart Center, Rigshospitalet, Copenhagen University Hospital, Unit 2151, Blegdamsvej 9, 2100 Copenhagen, Denmark (signe.stelling.risom@regionh.dk).

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: 10.1097/JCN.0000000000000476
Atrial fibrillation (AF) affects approximately 2% of the population in the Western world. The prevalence of AF is growing mainly because of the increasing age of our population and because AF can be observed as a complication from other heart diseases where improved treatments have led to an increased number of patients living with heart disease. Symptoms of AF include palpitations, dyspnea, fatigue, dizziness, and syncope, and AF is observed as having a negative effect on sleep quality.

A study by Szymanski and colleagues showed that low sleep quality is common in patients with AF and affects nearly 50%. Patients with AF have shorter sleep duration and lower self-reported sleep quality than patients in sinus rhythm. Sleep quality may be especially critical to patients with AF due to shortness of breath and the disruptive experience of heart palpitations.

The cardiac rehabilitation trial, CopenHeart, included exercise training and psychoeducational consultations and demonstrated a positive primary outcome, physical capacity in patients treated with catheter ablation for AF (cardiac rehabilitation group vs usual care group, 24.3 vs 21 mL/kg per min; \( P = .003 \)). Studies have found that lifestyle rehabilitation related to sleep has positive outcomes on heart patients. The interventions have included diet, exercise, weight reduction, and lifestyle modification.

However, to our knowledge, no investigators have investigated the effect of cardiac rehabilitation on sleep quality in patients treated with ablation for AF.

Therefore, the objectives of this study were to investigate (1) differences in sleep quality between the cardiac rehabilitation and usual care groups using data from the CopenHeart trial and (2) to explore variables that possibly could affect sleep quality.

**Methods**

**Design**

This study is an explorative study and reports results on sleep quality from the CopenHeart trial. In the CopenHeart trial, a comprehensive rehabilitation program was designed and tested for patients treated for AF with catheter ablation in 2 university hospitals in Denmark. The intervention is described in detail elsewhere.

**Trial Patients and Intervention**

In total, 210 consecutive patients treated with radiofrequency catheter ablation for AF were included in the CopenHeart trial. Patients 18 years or older, Danish speaking, and providing oral and written informed consent were eligible for participation. The following patients were excluded: (1) those unable to understand trial instructions; (2) pregnant or breastfeeding women; (3) those with a reduced ability to follow the planned program due to other physical illness; (4) those who, before ablation, had been engaged in intense physical exercise or sports at a competitive level several times a week; or (5) those who were enrolled in a clinical trial that prohibited participation in additional trials.

Patients were centrally randomized 1:1 to comprehensive cardiac rehabilitation plus usual care (cardiac rehabilitation group vs usual care group). Outcome assessment, data management, analyses, and conclusions were performed by a blinded statistician and research staff.

The intervention consisted of usual care, which included 1 consultation at 3 to 4 months with a cardiologist at the treating hospital and, in addition, a physical exercise program and psychoeducational consultations. The physical exercise program was designed to increase physical capacity measured by VO\(_2\) peak. The training program consisted of graduated cardiovascular training based on intensity prescription using the Borg scale and strength exercises altered stepwise during training sessions. The program included 3 sessions per week for 12 weeks.

The aim of the psychoeducational consultations was to provide emotional support and improve coping skills and illness appraisal to enable the patients to respond appropriately to physical and psychological symptoms. The psychoeducational consultations were inspired by the 3 dimensions described in Parse’s Human Becoming Practice Methodologies. The patients were offered four 1-hour consultations over the first 6 months after enrollment. There were no specific interventions carried out that focused on sleep quality, but sleep could have been discussed in the psychoeducational consultations if wanted by the patient.

**Ethics**

The trial was approved by the local ethics committee (number H-1-2011-135) and the Danish Data Protection Agency (registration number 2007-58-0015). It was registered at ClinicalTrials.gov (NCT01523145) and complied with the Declaration of Helsinki.

**Outcome Measure**

The outcome measure for this study is sleep quality. The patients in the CopenHeart trial answered a questionnaire exploring their sleep quality at month 1 (before intervention) and month 6 (end of intervention). To explore the effect of other outcomes on sleep quality, anxiety, depression, and the severity of AF symptoms measured by the European Heart Rhythm Association (EHRA) scores were examined at 4 months (end of the physical exercise program).

**Pittsburgh Sleep Quality Index**

Sleep quality was measured by the Pittsburg Sleep Quality Index (PSQI) questionnaire. Psychometric
Evaluation of the PSQI is limited, but studies indicate that it has overall high internal homogeneity, internal consistency, and test-retest reliability. It has been confirmed in various patient groups. Cronbach’s α of .83 was demonstrated for internal consistency reliability, and validity was demonstrated as the PSQI distinguishes patients with a sleeping disorder from patients without one. The self-rated questionnaire consists of 14 questions concerning factors that might influence sleep quality. Five additional questions are answered by the bed partner or roommate. From the 19 questions, 7 component scores are grouped, all weighted equally on a 0-to-3 scale. The components include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction due to sleepiness. From the 7 component scores, a global score can be calculated. The PSQI global score ranges from 0 to 21. High scores indicate poor sleep quality. Patients scoring higher than 5 on PSQI global are characterized as poor sleepers. Patients were asked to fill out the questionnaire from usual sleep habits over the previous 30 days.

Hospital Anxiety and Depression Scale

Patients with symptoms of anxiety or depression were identified by the Hospital Anxiety and Depression Scale (HADS) questionnaire. The HADS consist of 14 items on 2 subscales: an anxiety scale (HADS-A) and a depression scale (HADS-D), with each scale including 7 items. Each item is rated from 0 to 3 points. Seven is considered a cutoff score for each subscale, a score from 0 to 7 is considered normal, and scores of 8 or higher indicate the presence of a clinical mood disorder. The HADS is extensively validated and recommended for use in cardiac patients. It is a generic instrument to identify patients with symptoms of anxiety and/or depression. Internal consistency is considered high, with a Cronbach’s α of .83 for HADS-A and .82 for HADS-D.

Statistical Analysis

Differences between groups for baseline results for PSQI at 1 month were tested using independent samples t test for binary variables. Levene test was used to verify the assumption of equal variances. Analysis of variance was used to detect whether there were age differences between groups. The difference between the intervention and usual care groups at 6 months was tested using independent samples t test.

To examine the effect of intervention group, anxiety, depression, type of AF, and the severity of AF symptoms (EHRA scores) on sleep quality, a linear regression model was used including variables measured at month 4 that were believed to possibly affect sleep quality. The model was adjusted for intervention group, age, sex, smoking, living with partner, educational level, and PSQI score at 1 month. An independent t test was undertaken to compare means for EHRA score, HADS-A and HADS-D, type of AF, and intervention group. All analyses were undertaken using SPSS version 22 (IBM Corp, Armonk, New York), and statistical significance was attained at P ≤ .05.

Results

At month 1, 194 (of 210 randomized patients) (92%) answered the PSQI questionnaire (98 from the cardiac rehabilitation group and 96 from the usual care group), and 173 patients (82%) answered the PSQI questionnaire at month 6 (83 from the cardiac rehabilitation group and 90 from the usual care group).

Baseline characteristics showed that the cardiac rehabilitation and usual care groups were well matched at baseline (Table 1). Mean age was 59 years, and approximately two-thirds were male (cardiac rehabilitation group, n = 74; usual care group, n = 77). Greater than 50% of the patients had more than 3 years of college education (cardiac rehabilitation group, n = 58; usual care group, n = 51). Patients in the cardiac rehabilitation group had a mean body mass index (BMI) of 27, and patients in the usual care group had a mean BMI of 28. Approximately 50% of the patients were taking β-blockers (cardiac rehabilitation group, n = 55; usual care group, n = 56).

At month 1 (Table 2), the overall PSQI global mean scores for patients with paroxysmal AF showed significantly longer sleep duration (P = .02) and worse sleep efficiency (P = .05) than patients with persistent AF. By contrast, patients with persistent AF had worse sleep latency (P < .01). Patients with a BMI of 24.9 or lower had better sleep latency than patients with a BMI of 25 and higher (P = .02), whereas patients with a BMI of 25 and higher experienced more sleep disturbances (P = .01).

The global mean (SD) score for PSQI at month 6 in the cardiac rehabilitation group (n = 83) was 6.60 (3.61), and in the usual care group, it was (n = 90) 6.08 (3.60; P = .34). At 1 month, 85% of the patients reported poor sleep quality (87% in the cardiac rehabilitation group and 82% in the usual care group). At 6 months, 55% of the patients reported poor sleep quality (58% in the cardiac rehabilitation group and 52% in the usual care group).

Regression analysis (Table 3) demonstrated that higher EHRA scores at 4 months were associated with a higher PSQI global mean score at 6 months (PSQI global mean [SD] score, 5.93 [3.05] for EHRA 1–2 vs 7.59 [4.26] for EHRA 3–4). The same was found for HADS-A and
We also found that more symptomatic patients had poor sleep quality. The lack of difference in sleep quality found between the cardiac rehabilitation and usual care groups was also seen in a study including patients with an ICD. We also found that more symptomatic patients experienced poorer sleep quality and patients with high scores for anxiety and depression experienced poorer sleep quality compared with patients with low scores regardless of type of AF.

It is notable that a high number of patients in this study reported low sleep quality even 6 months after ablation when most patients should be in sinus rhythm. Sleep quality has been reported to be low in other cardiac patient groups participating in cardiac rehabilitation for myocardial infarction, coronary artery bypass surgery, or cardiac catheterization.

Depression is associated with poor sleep quality. According to the International Classification of Disease, 10th Revision, sleep disturbance is a symptom of depression and sleep disorder can be a predictor for depressive relapse, as well as sleep disturbances can lead to depression. This is in line with the findings in this study where it was demonstrated that patients with high scores for depression had poor sleep quality. We found that worse AF symptoms were associated with poor sleep quality. When comparing the EHRA and PSQI scores from this study with the results that Szymanski and colleagues reported, the same trend is observed in that patients with more AF symptoms experienced worse sleep quality. The relation between AF symptoms and sleep quality is multifactorial. Atrial fibrillation is associated with an increase in sympathetic activity that can produce disturbances can lead to depression.

These findings suggest that future interventions targeting sleep quality in patients with AF should include elements to decrease AF symptoms, depression, and anxiety. The intervention tested in the CopenHeart trial aimed at providing emotional support and improving coping skills and illness appraisal to enable patients to respond appropriately to physical and psychological symptoms. Therefore, we had hypothesized that the intervention could have an influence on sleep quality, as well as the primary and secondary outcomes. Our results suggest that, in addition to addressing negative emotions, it is important to directly address poor sleep quality as well.

In recent years, obstructive sleep apnea has been found to be a strong predictor of AF with up to 40% to 50% of AF patients experiencing obstructive sleep apnea. Sleep apnea is associated with antidysrhythmic drug failures after cardioversion or catheter ablation, AF recurrence, and an increase of greater
### TABLE 2
Baseline Cross-section of Sleep Quality on All Domains at Pittsburgh Sleep Quality Index Measured at 1 Month

| Subjective Sleep Quality | Sleep Duration | Sleep Disturbances | Sleep Medications | Daytime Dysfunction | Overall PSQI Score (Global) |
|--------------------------|----------------|--------------------|-------------------|---------------------|-----------------------------|
| Age, y                   | Mean (SD)      | P                  | Mean (SD)         | P                   | Mean (SD)                   | P                  |
| 18-19                    | 1.09 (0.82)    | <0.01              | 2.94 (0.35)       | 0.01                | 1.53 (0.44)                 | 0.4               |
| 20-24                    | 1.13 (0.75)    | 0.03               | 2.91 (0.5)        | 0.03                | 1.56 (0.52)                 | 0.01              |
| 25-29                    | 1.07 (0.79)    | 0.03               | 2.97 (0.41)       | 0.03                | 1.59 (0.62)                 | 0.01              |
| 30-34                    | 1.11 (0.76)    | 0.03               | 2.91 (0.39)       | 0.03                | 1.54 (0.52)                 | 0.01              |
| 35-39                    | 1.06 (0.79)    | 0.03               | 2.91 (0.31)       | 0.03                | 1.58 (0.52)                 | 0.01              |
| 40-44                    | 1.10 (0.76)    | 0.03               | 2.93 (0.39)       | 0.03                | 1.61 (0.58)                 | 0.01              |
| 45-49                    | 1.05 (0.75)    | 0.03               | 2.90 (0.36)       | 0.03                | 1.55 (0.52)                 | 0.01              |
| 50-54                    | 1.10 (0.76)    | 0.03               | 2.92 (0.39)       | 0.03                | 1.58 (0.52)                 | 0.01              |
| 55-59                    | 1.06 (0.79)    | 0.03               | 2.91 (0.39)       | 0.03                | 1.54 (0.52)                 | 0.01              |
| 60-64                    | 1.10 (0.76)    | 0.03               | 2.93 (0.39)       | 0.03                | 1.58 (0.52)                 | 0.01              |
| 65-69                    | 1.05 (0.75)    | 0.03               | 2.90 (0.36)       | 0.03                | 1.55 (0.52)                 | 0.01              |
| >69                      | 1.03 (0.7)     | 0.03               | 2.89 (0.37)       | 0.03                | 1.52 (0.52)                 | 0.01              |
| Sex                      |                |                    |                   |                     |                             |                   |
| Female                   | 1.2 (0.67)     | 0.19               | 2.82 (0.33)       | 0.19                | 0.63 (0.64)                 | 0.19              |
| Male                     | 1.04 (0.78)    | 0.19               | 2.92 (0.34)       | 0.19                | 0.89 (0.52)                 | 0.19              |
| Living with partner      |                |                    |                   |                     |                             |                   |
| Yes                      | 1.04 (0.77)    | 0.19               | 2.92 (0.34)       | 0.19                | 0.89 (0.52)                 | 0.19              |
| No                       | 1.25 (0.69)    | 0.19               | 2.89 (0.37)       | 0.19                | 0.86 (0.64)                 | 0.19              |
| Educational level        |                |                    |                   |                     |                             |                   |
| ≤3 yr                    | 1.12 (0.77)    | 0.19               | 2.89 (0.37)       | 0.19                | 0.89 (0.52)                 | 0.19              |
| >3 yr                    | 1.07 (0.75)    | 0.19               | 2.90 (0.36)       | 0.19                | 0.88 (0.52)                 | 0.19              |
| BMI, kg/m²               |                |                    |                   |                     |                             |                   |
| <24.9                    | 1.05 (0.73)    | 0.19               | 2.89 (0.37)       | 0.19                | 0.89 (0.52)                 | 0.19              |
| ≥25                      | 1.07 (0.75)    | 0.19               | 2.90 (0.36)       | 0.19                | 0.88 (0.52)                 | 0.19              |
| Smoking                  |                |                    |                   |                     |                             |                   |
| Current smoker           | 1.07 (0.78)    | 0.19               | 2.89 (0.37)       | 0.19                | 0.89 (0.52)                 | 0.19              |
| Never                    | 1.10 (0.76)    | 0.19               | 2.90 (0.39)       | 0.19                | 0.86 (0.58)                 | 0.19              |
| Type of AF               |                |                    |                   |                     |                             |                   |
| Paroxysmal               | 1.12 (0.77)    | 0.19               | 2.86 (0.44)       | 0.19                | 0.9 (0.57)                  | 0.19              |
| Persistent               | 0.94 (0.69)    | 0.33               | 2.86 (0.56)       | 0.33                | 0.91 (0.57)                 | 0.33              |
| Symptoms of AF           |                |                    |                   |                     |                             |                   |
| Palpitations             | 1.11 (0.75)    | 0.26               | 2.88 (0.43)       | 0.26                | 0.84 (0.59)                 | 0.26              |
| Angina                   | 1.19 (0.78)    | 0.26               | 2.78 (0.49)       | 0.26                | 0.84 (0.59)                 | 0.26              |
| Dyspnea                  | 1.10 (0.76)    | 0.26               | 2.88 (0.43)       | 0.26                | 0.84 (0.59)                 | 0.26              |
| Dizziness                | 1.11 (0.76)    | 0.26               | 2.88 (0.43)       | 0.26                | 0.84 (0.59)                 | 0.26              |

(continues)
Ac a c o n n e c t i o n b e -
tween obstructive sleep apnea and AF is associated with significant atrial remodeling that is characterized by atrial enlargement, reduction in voltage, site-specific and widespread conduction abnormalities, and longer sinus node recovery.

Rehabilitation programs that included diet and lifestyle management interventions for adults with obstructive sleep apnea have shown that lifestyle interventions are effective in reducing weight and therefore also improve obstructive sleep apnea parameters.

Screening for obstructive sleep apnea is not included in the PSQI; thus, it is not known how many of the patients in our study also experienced obstructive sleep apnea, but patients with a BMI of 25 and higher experienced more sleep disturbances in this study.

**Limitations**

These analyzes were explorative, meaning that the sample size calculation was done to examine an effect of the primary (physical capacity measured by VO2 peak) and secondary (quality of life, measured on Short Form-36, Mental Component Scale) outcomes for the CopenHeart trial and not for the sleep analyzes. Therefore, the results should be considered as hypothesis generating for future trials. The PSQI has not been validated in an AF population, which is a limitation.

**Conclusion and Perspectives**

The cardiac rehabilitation program in this study consisted of physical exercise and psychoeducational
consultations. The program showed no effect on sleep quality. A large proportion of patients continued to report poor sleep quality regardless of group assignment. More symptomatic patients and patients experiencing higher levels of depressive or anxiety symptoms reported poor sleep quality. That is a concern because sleep quality is vital for a person’s physical and mental health, and therefore it could be argued that screening for sleep quality should be prioritized by health professionals caring for patients with AF. Screening for depression or anxiety may benefit AF patients with poor sleep quality. Treatment for depression or anxiety can be offered with the aim of also improving the patients’ sleep quality. Patients with AF should be examined for sleep disorders and treated if needed. Intervention trials focusing on sleep quality in patients with AF or treated for AF are warranted to guide health professionals in supporting the patients to better sleep quality. Inspiration can be found in intervention trials that include patients with other heart conditions. Trials of nonpharmacological interventions designed to improve sleep quality among patients with AF or treated for AF and interventions targeting both simple identification of sleep disorders and therapy directed against diseases such as sleep apnea are needed.

Acknowledgments

First of all, the authors thank the patients who were included in the CopenHeart RFA trial. They would also like to thank the CopenHeart staff, who were helpful in gathering the data, as well as statistician Steen Ladelund for advice on the statistical analysis for the study. They also thank public health students Iman Hassan and Anne Alexandrine Øhlers who assisted with some of the practical work in relation to this study.

REFERENCES

1. Redeker NS. Sleep, sleep disorders, and cardiac disease. In: Moser DK, Rieger B, eds. Cardiac Nursing—A Comparison to Brumwald’s Heart Disease. St Louis, MO: Saunders; 2008:228.
2. Baldwin CM, Griffith KA, Nieto FJ, O’Connor GT, Walsheen JA, Redline S. The association of sleep-disordered breathing and sleep symptoms with quality of life in the Sleep Heart Health Study. Sleep. 2001; 24(1):96–105.
3. Quan SF, Gersh BJ. Cardiovascular consequences of sleep-disordered breathing: past, present and future. Report of a workshop from the National Center on Sleep Disorders Research and the National Heart, Lung, and Blood Institute. Circulation. 2004;109(8):951–957.
4. Nieto FJ, Young TB, Lind BK, et al. Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study. Sleep Heart Health Study. JAMA. 2000;283(14):1829–1836.
5. Stewart S, Hart CL, Hole DJ, McMurray JJ. Population prevalence, incidence, and predictors of atrial fibrillation in the Renfrew/Paisley study. Heart. 2001;86(5):516–521.
6. Go AS, Hylek EM, Phillips KA, et al. Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the Anti-coagulation and Risk Factors in Atrial Fibrillation (ATRIA) Study. JAMA. 2001;285(18):2370–2375.
7. Ruigómez A, Johansson S, Wallander MA, Garcia Rodriguez LA. Predictors and prognosis of paroxysmal atrial fibrillation in general practice in the UK. BMC Cardiovasc Disord. 2005;5:20.
8. Heeringa J, van der Kappen JA, Hofman A, et al. Prevalence, incidence and lifetime risk of atrial fibrillation: the Rotterdam study. Eur Heart J. 2006;27(8):949–953.
9. Naccarelli GV, Varker H, Lin J, Schulman KL. Increasing prevalence of atrial fibrillation and flutter in the United States. Am J Cardiol. 2009;104(11):1534–1539.
10. European Heart Rhythm Association, European Association for Cardio-Thoracic Surgery, Camm AJ, et al. Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). Europace. 2010;12(10):1360–1420.
11. Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS: the Task Force for the management of atrial fibrillation of the European Society of Cardiology (ESC) developed with the special contribution of the Europea. Eur Heart J. 2016;18(11):1609–1678.
12. Szymanski F, Filipiak K, Karpinski G, Platok A, Opolski G. Occurrence of poor sleep quality in atrial fibrillation patients according to the EHRA score. Acta Cardiol. 2014;69:291–296.
13. Dorian P, Jung W, Newman D, et al. The impairment of health-related quality of life in patients with intermittent atrial fibrillation: implications for the assessment of investigational therapy. J Am Coll Cardiol. 2000;36(4):1303–1309.
14. Risom SS, Zwisler AD, Rasmussen TB, et al. Cardiac rehabilitation versus usual care for patients treated with catheter ablation for atrial fibrillation: results of the randomized CopenHeartRFA trial. Am Heart J. 2016;181:120–129.
15. Thomasouli MA, Brady EM, Davies MJ, et al. The impact of diet and lifestyle management strategies for obstructive sleep apnoea in adults: a systematic review and meta-analysis of randomised controlled trials. Sleep Breath. 2013;17:925–935.
16. Risom SS, Zwisler AD, Rasmussen TB, et al. The effect of integrated cardiac rehabilitation versus treatment as usual for atrial fibrillation patients treated with ablation: the randomised CopenHeartRFA trial protocol. BMJ Open. 2013;3(2):2012–2377.
17. Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982;14(5):377–381.
18. Parse RR. The Human Becoming School of Thought: A Perspective for Nurses and Other Health Professionals. Thousand Oaks, CA: Sage; 1998.
instruments for psychiatric practice and research. Psychiatry Res. 1989;28(2):193–213.
20. Grandner MA, Kripke DF, Yoon I-Y, Youngstedt SD. Criterion validity of the Pittsburgh Sleep Quality Index: investigation in a non-clinical sample. Sleep Biol Rhythms. 2006;4(2):129–139.
21. Agargun MY, Kara H, Solmaz M. Subjective sleep quality and suicidality in patients with major depression. J Psychiatr Res. 1997;31(3):377–381.
22. Gentili A, Weiner DK, Kuchihhatla M, Edinger JD. Test-retest reliability of the Pittsburgh sleep quality index in nursing home residents. J Am Geriatr Soc. 1995;43(11):1317–1318.
23. Owen DC, Parker KP, McGuire DB. Comparison of subjective sleep quality in patients with cancer and healthy subjects. Oncol Nurs Forum. 1999;26(10):1649–1651.
24. Smith MT, Perlis ML, Smith MS, Giles DE, Carmody TP. Sleep quality and presleep arousal in chronic pain. J Behav Med. 2000;23(1):1–13.
25. Knutson KL, Rathouz PJ, Yan LL, Liu K, Lauderdale DS. Stability of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Questionnaires over 1 year in early middle-aged adults: the CARDIA study. Sleep. 2006;29(11):1503–1506.
26. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361–370.
27. Snaith RP. The Hospital Anxiety and Depression Scale. Health Qual Life Outcomes. 2003;1:29.
28. Bambauer KZ, Locke SE, Aupont O, Mullan MG, McLaughlin TJ. Using the Hospital Anxiety and Depression Scale to screen for depression in cardiac patients. Gen Hosp Psychiatry. 2005;27(4):275–284.
29. Lee KS. Prognostic importance of sleep quality in patients with heart failure. Am J Crit Care. 2016;25(6):516–525.
30. Berg SK, Higgins M, Reilly CM, Langberg JJ, Dunbar SB. Sleep quality and sleepiness in persons with implantable cardioverter defibrillators: outcome from a clinical randomized longitudinal trial. Pacing Clin Electrophysiol. 2012;35:431–443.
31. Madrid-Valero JJ, Martínez-Selva JM, Ribeiro do Couto B, Sánchez-Romera JR, Ordoñana JR. Age and gender effects on the prevalence of poor sleep quality in the adult population. Gac Sanit. 2017;31(1):18–22.
32. Madrid-Valero JJ, Martínez-Selva JM, Ribeiro do Couto B, Sánchez-Romera JR, Ordoñana JR. Age and gender effects on the prevalence of poor sleep quality in the adult population. Gac Sanit. 2016;31(1):18–22.
33. Banack HR, Holly CD, Lowenstein I, et al. The association between sleep disturbance, depressive symp- toms, and health-related quality of life among cardiac rehabilitation participants. J Cardiopulm Rehabil Prev. 2014;34(3):188–194.
34. Lacruz ME, Schmid-Pokrzywniak A, Dragano N, et al. Depressive symptoms, life satisfaction and prevalence of sleep disturbances in the general population of Germany: results from the Heinz Nixdorf Recall study. BMJ Open. 2016;6(1):e007919.
35. World Health Organization (WHO). ICD-10 transition. Fam Pract Manag. 2011;18:39. http://www.ncbi.nlm.nih.gov/pubmed/22184833.
36. Baglioni C, Regen W, Teghen A, et al. Sleep changes in the disorder of insomnia: a meta-analysis of polysomnographic studies. Sleep Med Rev. 2013;18:195–213.
37. Wasmund SL, Li JM, Page RL, et al. Effect of atrial fibrillation and an irregular ventricular response on sympathetic nerve activity in human subjects. Circulation. 2003;107:2011–2015.
38. Linz D, Linz B, Hohl M, Bohm M. Atrial arrhythmogenesis in obstructive sleep apnea: therapeutic implications. Sleep Med Rev. 2016;26:87–94.
39. Stevenson IH, Teichtahl H, Cunnington D, Ciavarella S, Gordon I, Kalman JM. Prevalence of sleep disordered breathing in paroxysmal and persistent atrial fibrillation patients with normal left ventricular function. Eur Heart J. 2008;29(13):1662–1669.
40. Monahan K, Brewster J, Wang L, et al. Relation of the severity of obstructive sleep apnea in response to antiarrhythmic drugs in patients with atrial fibrillation or atrial flutter. Am J Cardiol. 2012;110(3):369–372.
41. Kanagala R, Murali NS, Friedman PA, et al. Obstructive sleep apnea and the recurrence of atrial fibrillation. Circulation. 2003;107(20):2589–2594.
42. Ng CY, Liu T, Shehata M, Stevens S, Chugh SS, Wang X. Meta-analysis of obstructive sleep apnea as predictor of atrial fibrillation recurrence after catheter ablation. Am J Cardiol. 2011;108(1):47–51.
43. Yaranov DM, Smyrnis A, Usatii N, et al. Effect of obstructive sleep apnea on frequency of stroke in patients with atrial fibrillation. Am J Cardiol. 2015;115(4):461–465.
44. Dimitri H, Ng M, Brooks AG, et al. Atrial remodeling in obstructive sleep apnea: implications for atrial fibrillation. Heart Rhythm. 2012;9(3):321–327.
45. Chang YL, Chiuo AF, Cheng SM, Lin KC. Tailored educational supportive care programme on sleep quality and psychological distress in patients with heart failure: a randomised controlled trial. Int J Nurs Stud. 2016;61:219–229.