Original Article

The Association of Perceived Stress and Atrial Fibrillation

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Highlights

- Higher perceived stress links to more AF and related symptoms.
- Independent risk factors include male sex, diabetes, dyslipidemia, cardiomyopathy, and stress; need longitudinal studies to clarify causality.

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ABSTRACT

Background and Objectives: Atrial fibrillation (AF) is the most prevalent persistent arrhythmia and imposes a substantial burden on public health and society. Given prior evidence linking psychological factors with AF, this study was conducted to investigate the association between perceived stress and arrhythmia.

Methods: In this case-control study, participants were recruited from the Outpatient Clinic of Rajaie Cardiovascular, Medical, and Research Center in Tehran, Iran, between May 2021 and September 2021 according to eligibility criteria. Data were collected through face-to-face interviews by trained research nurses using standardized checklists. Stress levels were assessed with the Perceived Stress Scale (PSS). Data were analyzed with SPSS, version 22.

Results: A total of 155 cases with arrhythmia and 144 controls were enrolled. In the case group, the mean age was 53.99 years (±14.23), with 100 males (64.5%) and 55 females (35.5%). In the control group, the mean age was 48.53 years (±13.59), with 73 males (50.7%) and 71 females (49.3%). The mean perceived stress score was 30.6 in cases and 25.07 in controls (P<0.001). Stress-related symptoms, including palpitation and chest discomfort, were more common in patients with arrhythmia than in healthy controls (P=0.015 and P<0.001, respectively). In multivariate logistic regression analysis, the risk of arrhythmia was independently associated with sex, diabetes mellitus, dyslipidemia, cardiomyopathy, concentration difficulty, chest discomfort, and stress score.

Interpretation and Conclusions: The findings demonstrate that AF is significantly associated with psychological stress and higher perceived stress scores. Interventions aimed at reducing stress in individuals at high risk of developing AF may be beneficial.

Keywords: Atrial Fibrillation; Case-Control Study; Cardiac Arrhythmia; Psychological Stress

Introduction

Cardiac arrhythmias, defined as abnormalities in heart rhythm, range from benign forms to life-threatening conditions that may result in myocardial infarction or heart failure.[1] The most prevalent persistent arrhythmia is atrial fibrillation (AF), which affects an estimated 2.7 to 6.7 million people in the United States.[2] By 2050, the prevalence is projected to increase to 5.6 to 15.9 million individuals.[2] Contributing factors include electrical instability of the myocardium and acute events, often triggered by acute mental stress or chronic psychological conditions such as depressive disorders.[3] In addition, maladaptive behaviors that may arise in response to stress, including poor dietary habits, alcohol consumption, and cigarette smoking, have been linked to the development of cardiac arrhythmias.[4]

This study aimed to investigate the association between stress and arrhythmia. Establishing a significant relationship between these variables could support preventive strategies for patients with cardiac disease through stress reduction programs and policy interventions.

Methods

We conducted a case-control study to investigate the association between perceived stress, assessed with the Perceived Stress Scale (PSS), and all types of AF. The control group was matched with AF patients based on age, sex, and relevant clinical variables and had no history of cardiac arrhythmia. Participants, including both cases and controls, were recruited from the Outpatient Clinic of Rajaie Cardiovascular, Medical, and Research Center, a large cardiovascular referral center in Tehran, Iran, between May and September 2021.

Eligible participants for the case group were adults (≥18 years) with a confirmed diagnosis of AF by a cardiologist. All AF types, including paroxysmal, persistent, and permanent, were included. Controls were companions of patients with no history of cardiac arrhythmia. Individuals with underlying conditions predisposing to arrhythmia (eg, anemia, hypothyroidism or hyperthyroidism, systemic hypertension, heart failure, history of myocardial infarction, rheumatoid arthritis, or pulmonary embolism) were excluded.

All participants were informed of the study objectives and provided signed and dated informed consent. Data on demographic characteristics, medical history, medication use, and lifestyle factors (cigarette smoking, coffee, alcohol, and tobacco consumption) were collected through face-to-face interviews by trained research nurses using standardized checklists. Participants were also asked about symptoms experienced during periods of mental stress or anxiety, including irritability, agitation, concentration difficulty, headache, sleep disorder, palpitation, chest discomfort, dizziness, muscle tension, substance use, and gastrointestinal symptoms. Stress levels were assessed with the validated PSS questionnaire.

Alternative methods were employed for participants with reading difficulties, including oral administration of questions or input from a designated proxy. To minimize recall bias, participants were encouraged to provide medical documents related to their cardiac health, thereby enhancing the accuracy of self-reported history.

The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. [5] The protocol was approved by the Ethics Committee of Rajaie Cardiovascular, Medical, and Research Center in accordance with the Declaration of Helsinki (IR.RHC.REC.1399.047).

Perceived Stress Evaluation

Perceived stress was assessed using the third edition of the Cohen and Kamark PSS. The PSS consists of 14 items that evaluate stressful life experiences during the past month. Each item is rated on a 5-point scale (0=never, 1=rarely, 2=sometimes, 3=often, 4=very often). Items 4 to 7, 9, 10, and 13 are reverse scored (ie, 0=very often to 4=never). The total score ranges from 0 to 56, with higher scores indicating greater perceived stress. The validity of the PSS has been confirmed by Vahedian Azimi et al,[6] and its reliability has been demonstrated with a Cronbach α of 0.89.

Study Size

A sample size of 299 participants was determined to provide meaningful results with a

narrow confidence interval. The calculation was based on an α error of 0.05 and a statistical power of 80%. Using data from a similar study,[6] we assumed that the proportion of high stress was 35% in cases and 20% in controls.

Statistical Analysis

The distribution of quantitative variables was assessed using the Kolmogorov-Smirnov test. Data are presented as numbers (percentages) or means (SD), as appropriate. Categorical variables were compared using the χ^2 or Fisher exact test, normally distributed variables with the independent *t* test, and non-normally distributed variables with the Mann-Whitney *U* test.

Logistic regression was used to calculate odds ratios (ORs) and 95% CIs for the association between AF and potential risk factors. A two-sided $P < 0.05$ was considered statistically significant. All analyses were performed using IBM SPSS Statistics version 22 (IBM Corp).

Results

The study included 299 participants: 155 cases with arrhythmia and 144 controls without a history of arrhythmia. All eligible individuals were accessible and included in the analysis. Findings are presented in 3 tables. (Table 1) compares demographic characteristics, medical history, and substance consumption between the groups. Stress-related symptoms are shown in (Table 2). The association between the stress score and arrhythmia was assessed using logistic regression. Variables with a significant association with arrhythmia in the univariate analysis were entered as covariates into the model to calculate ORs and 95% CIs. The risk of arrhythmia was independently associated with sex, diabetes mellitus, dyslipidemia, cardiomyopathy, concentration difficulty, chest discomfort, and the stress score (Table 3).

Table 1. Demographic characteristics, past medical history, and substance consumption in the case and control groups

Variables	Case N (%)	Control N (%)	*P*
Demographic Characteristics			
Age (y), Mean±SD	53.99 ± 14.23	48.53 ± 13.59	0.001
Sex			
Male	100 (64.5)	73 (50.7)	0.016
Female	55 (35.5)	71 (49.3)	
Marital Status			
Married	135 (87.1)	111 (77.1)	0.023
Single	20 (12.9)	33 (22.9)	
Occupation			
Employee	38 (24.5)	36 (25.4)	0.868
Retired	26 (16.8)	23 (16.2)	
Self-employed	36 (23.2)	38 (26.8)	
Homemaker	55 (35.5)	45 (31.7)	
Education			
Illiterate	30 (19.4)	18 (12.7)	0.109
Under diploma	38 (24.5)	33 (23.2)	
Diploma	39 (25.2)	29 (20.4)	
Academic	48 (31)	62 (43.7)	
Past Medical History of Disease			
Diabetes mellitus	61 (39.4)	30 (20.8)	0.001
Dyslipidemia	51 (32.9)	7 (4.9)	< 0.001
Asthma	8 (5.2)	9 (6.3)	0.685

Cerebrovascular accident	10 (6.5)	0 (0)	0.02*
Cardiovascular disease	55 (35.5)	26 (18.1)	0.001
Cardiomyopathy	17 (11)	1 (0.7)	< 0.001
Valvular heart disease	26 (16.8)	1 (0.7)	< 0.001
Heart failure	17 (11)	7 (4.9)	0.052
Substance Consumption			
Coffee			
None	126 (81.3)	103 (71.5)	0.119
1–3 cups daily	28 (18.1)	39 (27.1)	
>3 cups daily	1 (0.6)	2 (1.4)	
Cigarette Smoking			
No	103 (66.5)	99 (68.8)	0.320
Yes	47 (30.3)	36 (25)	
Past smoker	5 (3.2)	9 (6.3)	
Passive Smoking			
Yes	67 (43.2)	75 (52.1)	0.125
No	88 (56.8)	69 (47.9)	
Hookah			
Yes	142 (91.6)	121 (84)	0.044
No	13 (8.4)	23 (16)	
Opium			
Yes	141 (91)	135 (93.8)	0.367
No	14 (9)	9 (6.3)	
Alcohol Consumption			
Yes	146 (94.2)	122 (84.7)	0.007
No	9 (5.8)	22 (15.3)	

Fisher's exact test

Table 2. Stress score and stress-related symptoms in the case and control groups

Variables	Case N (%)	Control N (%)	*P*
Stress total score, Mean±SD	30.6 ± 6.37	25.07 ± 7.38	< 0.001
Irritability	35 (22.6)	27 (18.8)	0.414
Agitation	25 (16.1)	31 (21.5)	0.232
Concentration difficulty	21 (13.5)	37 (25.7)	0.008
Headache	55 (35.5)	42 (29.2)	0.244
Sleep disorder	50 (32.2)	46 (31.9)	0.954
Palpitation	96 (61.9)	69 (47.9)	0.015
Chest discomfort	69 (44.5)	35 (24.3)	< 0.001
Dizziness	22 (14.2)	25 (17.4)	0.452
Muscle tension	18 (11.6)	25 (17.4)	0.157
Drug abuse	1 (0.6)	3 (2.1)	0.355*
Gastrointestinal symptoms	20 (12.9)	28 (19.4)	0.124

*Fisher's exact test

Table 3. Multivariate odds ratios (ORs) and 95% confidence intervals (CIs) for arrhythmia by study variables

Variables	OR (95% CI)	*P*
Sex, (female)	0.25 (0.13- 0.48)	< 0.001
Diabetes mellitus	2.26 (1.15- 4.46)	0.019
Dyslipidemia	9.91 (3.54- 27.79)	< 0.001
Cardiomyopathy	35.25 (3.45- 36.29)	0.003
Concentration difficulty	0.30 (0.14- 0.67)	0.003
Chest discomfort	2.30 (1.21- 4.36)	0.011
Stress total score	1.14 (1.08- 1.19)	< 0.001

Discussion

This study aimed to investigate the relationship between perceived stress and AF in a cohort of 299 participants, comprising 155 AF cases and 144 controls. All eligible cases and controls were incorporated into the analysis, revealing a significant association between perceived stress and AF. AF cases demonstrated higher stress scores, emphasizing the significance of stress reduction in AF management.

The case group showed a higher mean age, a higher proportion of males and married individuals, and a higher prevalence of various past medical conditions than controls. Alcohol consumption and water pipe smoking were more common in controls.

Logistic regression analysis established independent associations between the risk of arrhythmia and various factors, including sex, diabetes mellitus, dyslipidemia, cardiomyopathy, concentration difficulty, chest discomfort, and perceived stress score.

The present case-control study revealed a significant connection between perceived stress score and AF arrhythmia. Notably, AF cases had a higher mean perceived stress score than controls. This observation suggests a potential bidirectional link between stress and AF arrhythmia, as AF can also lead to psychological anxiety. Given the importance of this issue, clinicians are increasingly emphasizing stress reduction in AF patients as a critical component of disease management.[7]

Perceived stress has been found to have a strong association with the significant physiological mechanisms of chronic mental stress, leading to an increased risk of AF development. This risk is further influenced by factors such as cortisol imbalance, hypertension, and unhealthy habits.[8]

Nonetheless, data regarding the potential role of emotional stress in triggering AF arrhythmias are limited, and further research is necessary to explore this connection.

A study involving 114,337 participants from the Danish National Health Survey investigated the link between lifestyle factors, perceived stress (assessed using Cohen's 10-item PSS), and the risk of AF. Over a follow-up period of 424,839 person-years, 2,172 individuals experienced their first episode of AF. The study found that the highest perceived stress quintile, as indicated by a 28% greater PSS score, was associated with an increased risk of AF compared with the lowest quintile. Significantly, this association disappeared after adjusting for baseline characteristics such as comorbidities, socioeconomic status, and lifestyle behaviors.[8]

The Framingham Offspring Study found that psychological factors, specifically symptoms of anger and hostility, were predictive of a 10-year incidence of AF arrhythmia in male participants, particularly those who were healthy. This association persisted even after adjustments for baseline and interim risk factors. Intriguingly, anger, type A behavior, and hostility did not demonstrate a significant association with the 10-year incidence of AF or total mortality in female participants.[9]

Using a nationwide Danish health registry between 1995 and 2014, a population-based case-control study by Graff et al,[10] examined 88,612 AF cases and 886,120 age and sex-matched controls based on risk-set sampling. The study aimed to evaluate the connection between the severe

psychological stress of losing a partner and the incidence of AF. The findings revealed that partner bereavement was linked to a transiently increased risk of AF during the first year, with a stronger association in cases of sudden and unexpected loss. The highest risk was observed within the first 8 to 14 days following the loss, with a gradual decline over time.

In the present study, concentration difficulty was significantly more frequent among controls than cases. Palpitation and chest discomfort were more common in AF cases, although the high prevalence of palpitations in this group could be directly attributed to AF. Dyspnea, palpitations, and fatigue are the most commonly reported symptoms among patients with AF.[11]

Kupper et al[12] enrolled 118 patients with persistent AF who were scheduled to undergo electrical cardioversion. Patients were evaluated for depression, anxiety, type D personality, perceived stress score, and AF-related symptoms. The AF group was compared with age- and sex-matched healthy controls from the general population. Patients with AF were more likely to experience anxiety and depression, and higher levels of depression were strongly associated with more arrhythmia-related symptoms. The most frequently reported symptoms were fatigue (92%), palpitation (70%), concentration difficulty (62%), dizziness (62%), and sleep disorder (58%).

In the current study, the mean age of participants differed significantly between the two groups, and AF was more prevalent in men than women and in married individuals than single individuals. The prevalence of AF has been shown to increase with age, from 0.1% in adults younger than 55 years to 9% in those aged 80 to 89 years. The majority of cases are reported in individuals aged 65 to 85 years.[13] In a community-based prospective cohort study, male sex was associated with an increased incidence of AF.[14] Among study participants, the prevalence of diabetes mellitus, dyslipidemia, cerebrovascular accident, cardiovascular disease, cardiomyopathy, and valvular heart disease was significantly higher in cases than in controls. Alcohol consumption and water-pipe smoking were also more commonly reported among cases. In a community-based prospective cohort study of 3,560 participants, hypertension, diabetes mellitus, and lower cholesterol levels were more prevalent among patients with AF.[14]

Prior investigations have identified alcohol consumption as an important trigger for acute episodes of transient AF.[15] This association was more pronounced in men, particularly with heavy alcohol intake,[16] whereas moderate consumption did not increase the risk of incident AF.[17]

In our study, multivariate analysis revealed that the risk of arrhythmia was independently associated with male sex, diabetes mellitus, dyslipidemia, cardiomyopathy, concentration difficulties, chest discomfort, and perceived stress score. In the REGARDS study conducted by O'Neal et al,[18] AF prevalence was significantly higher among individuals with elevated stress levels in multivariable analysis, after adjustments for demographic characteristics, cardiovascular risk factors (systolic blood pressure, high-density lipoprotein and total cholesterol, body mass index, smoking, diabetes mellitus, physical activity, and alcohol consumption), and other potential confounders.

Our study has several limitations. As a retrospective case-control study, it relied on the recall of past events, which introduces the potential for recall bias. Participants with arrhythmias may recall stress differently from control participants. Self-reported habits, such as smoking, alcohol or opium consumption, and stress-related symptoms, were also subject to recall biases. The selection of cases and control participants, particularly, may not be entirely representative of the general population, which could affect the generalizability of our findings. Moreover, the case-control design prevented the determination of a temporal relationship between perceived stress and AF, as it is challenging to ascertain whether stress preceded the onset of arrhythmias.

A significant limitation was that at least 50% of the control group had an education level higher than a diploma. This may be attributed to various factors, including knowledge and skills, access to economic resources, access to social support, health literacy, and job satisfaction. These factors could have contributed to the control group's greater ability to cope with stress, potentially leading to a reduction in cardiac arrhythmias within this group.

Conclusion

Our study demonstrates that AF is significantly associated with psychological stress and higher perceived stress scores. Elevated perceived stress may be a predisposing factor for the development of AF in the general population. Interventions aimed at reducing stress in individuals at high risk for AF may be beneficial. Further prospective studies are warranted to confirm these findings.

Declarations:

Ethical Approval

All participants were informed of the study's purpose and provided signed, dated informed consent. The study protocol was approved by the Ethics Committee of Rajaie Cardiovascular, Medical, and Research Center in accordance with the principles of the Declaration of Helsinki (approval code IR.RHC.REC.1399.047).

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Conflict of Interest

The authors report no conflict of interest.

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