

Job strain and atrial fibrillation – Results from the Swedish Longitudinal Occupational Survey of Health and meta-analysis of three studies

Eleonor I Fransson^{1,2}, Maria Nordin³,
Linda L Magnusson Hanson² and Hugo Westerlund²

European Journal of Preventive
Cardiology
0(00) 1–8
© The European Society of
Cardiology 2018
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/2047487318777387
journals.sagepub.com/home/ejpc


Abstract

Background: Knowledge about the impact of occupational exposures, such as work stress, on the risk of atrial fibrillation is limited. The present study aims to investigate the association between job strain, a measure of work stress, and atrial fibrillation.

Design: Prospective cohort study design and fixed-effect meta-analysis.

Methods: Data from the Swedish Longitudinal Occupational Survey of Health (SLOSH) was utilised for the main analysis, combining self-reported data on work stress at baseline with follow-up data on atrial fibrillation from nationwide registers. Cox proportional hazard regression analyses were used to estimate hazard ratios and 95% confidence intervals (CIs). A fixed-effect meta-analysis was conducted to pool the results from the present study with results from two similar previously published studies.

Results: Based on SLOSH data, job strain was associated with an almost 50% increased risk of atrial fibrillation (hazard ratio 1.48, 95% CI 1.00–2.18) after adjustment for age, sex and education. Further adjustment for smoking, physical activity, body mass index and hypertension did not alter the estimated risk. The meta-analysis of the present and two previously published studies showed a consistent pattern, with job strain being associated with increased risk of atrial fibrillation in all three studies. The estimated pooled hazard ratio was 1.37 (95% CI 1.13–1.67).

Conclusion: The results highlight that occupational exposures, such as work stress, may be important risk factors for incident atrial fibrillation.

Keywords

Atrial fibrillation, work, stress, psychological, risk factors, cohort study

Received 17 October 2017; accepted 25 April 2018

Introduction

Atrial fibrillation is the most common type of cardiac arrhythmia and is associated with severe consequences such as a two- to five-fold increased risk of stroke and premature mortality.^{1–3} In a European perspective, it is estimated that approximately 10 million people currently suffer from atrial fibrillation, with 100,000–200,000 new-onset cases every year.² The incidence of AF has increased during recent decades and, with an ageing population, this trend is expected to continue.⁴

Even though atrial fibrillation is prevalent in the population and should be viewed as a major public health concern, there is limited knowledge about the

underlying risk factors and biological mechanisms of the disease. Except for high age and male sex, other heart diseases and hypertension have been associated with increased risk of atrial fibrillation, as well as smoking, heavy alcohol consumption, obesity, sleep apnoea

¹School of Health and Welfare, Jönköping University, Sweden

²Stress Research Institute, Stockholm University, Sweden

³Department of Psychology, Umeå University, Sweden

Corresponding author:

Eleonor I Fransson, School of Health and Welfare, Jönköping University,
P.O. Box 1026, SE-551 11 Jönköping, Sweden.

Email: eleonor.fransson@ju.se

Twitter: [@EleonorFransson](https://twitter.com/EleonorFransson)

and prolonged physical exertion.^{5–7} More research on risk factors for atrial fibrillation and underlying mechanisms for the disease has been called for.¹

It has been observed that occupational exposures, such as noise, night work, long working hours and work-related psychosocial factors, including work stress, are associated with coronary heart disease and stroke.^{8–11} However, few studies have been undertaken to explore occupational exposures in relation to atrial fibrillation risk^{12–14} and, to our knowledge, only two studies have previously been published regarding work stress and atrial fibrillation.^{15,16}

The most frequently used model for research on work stress is the demand–control model, which postulates that a job characterised by high psychological demands in combination with low control over the work situation (job strain) implies an increased risk of ill-health.^{17,18}

The aim of the present study was to investigate the association between work stress, defined as job strain, and incident atrial fibrillation in a representative sample of the Swedish working population. A further aim was to pool the results from the present study with available data from two previously published studies on the same topic.

Methods

The Swedish Longitudinal Occupational Survey of Health

In the present study, data from the Swedish Longitudinal Occupational Survey of Health (SLOSH) was utilised.¹⁹ The overall aim of SLOSH is to increase the understanding of the complex associations between labour force participation, work organisation, work environment and health. The study population is drawn from the Swedish Work Environment Survey, aiming to cover a representative sample of the working population in Sweden. The first SLOSH follow-up of these participants was carried out in 2006, with subsequent data collections every second year over the period 2008–2016. In each data collection wave after 2006, previous participants were re-invited. New participants have been added successively to the study population.

The surveys consist of postal self-completion questionnaires covering a broad range of topics, including socio-demographic characteristics, work-related factors, lifestyle and health. Registry data from national registries covering inpatient and outpatient hospital care, as well as cause-specific mortality, is also available. The response rate was 65% in 2006, 61% in 2008 and 57% in 2010.

SLOSH has been approved by the Regional Ethical Review Board in Stockholm, and all participants gave informed consent to participate in the study.

Analytical sample

For this study, we used data from participants included for the first time in SLOSH 2006, 2008 or 2010, who were gainfully employed and worked at least 30% of full-time ($N=13,477$). Participants with a history of atrial fibrillation, myocardial infarction or heart failure prior to inclusion in the study ($n=201$) or for whom information on job strain at baseline was missing ($n=76$) were excluded, leaving 13,200 participants (5980 men and 7220 women) as our analytical sample.

Work stress according to the job demand–control (job strain) model

Work stress was measured at baseline (i.e. the time of study inclusion) and was defined as job strain according to the job demand–control model. The Swedish demand–control questionnaire with five job demand items and six control items was used to measure job demands and control.²⁰ Mean response scores for job demands and control, respectively, were calculated for each participant. The median scores for job demands and control for the total study population were used as cut-points, defining high demands as demand scores strictly above the median, and low control as control scores strictly below the median.

In the main analyses, those with job strain (high demands and low control) were compared with all others. We also constructed four categories based on the combinations of job demands and control: low strain jobs (low demands, high control); passive jobs (low demands, low control); active jobs (high demands, high control); and high strain jobs (high demands, low control).

Atrial fibrillation

Incident cases of atrial fibrillation and of flutter were identified through the Swedish national inpatient, outpatient and mortality registers using ICD-10 code I48.

Potential confounders

Several socio-demographic, lifestyle and health-related factors have previously been observed to be associated with both job strain and atrial fibrillation, and could thus potentially act as confounders when studying the association between job strain and atrial fibrillation. In the analyses, the following factors were considered to be potential confounders: age in years (continuous), sex (man/woman), education (compulsory school; two years upper secondary school; three or four years upper secondary school; university education <3 years; university education ≥ 3 years), smoking (daily; occasional; no), leisure-time physical activity

(never or seldom; every now and then; regularly), body mass index (≤ 24.99 kg/m²; 25.00–29.99 kg/m²; ≥ 30.00 kg/m²) and self-reported hypertension (yes; no).

Studies included in meta-analysis

To our knowledge, only two studies have previously been published presenting results on the association between job strain and atrial fibrillation, briefly described below.

The Primary Prevention Study (PPS). PPS is a population-based cohort study conducted in Gothenburg, Sweden.¹⁵ The study includes men born between 1915 and 1925, with study baseline 1974–1977. The analyses comprised 6035 men, with an average follow-up time of 16.8 years. Job strain was measured by using a job-exposure matrix based on occupation at baseline. During follow-up, 436 atrial fibrillation cases were identified by linkage to national registers.

The Work, Lipids and Fibrinogen study (WOLF). The WOLF study is a longitudinal occupational cohort study conducted in Sweden.¹⁶ The baseline examination was carried out 1992–1998, and the analyses comprised 10,121 men and women, with a median follow-up time of 13.6 years. Job strain was measured by the Swedish Demand–Control questionnaire. In total, 253 atrial fibrillation cases were identified during follow-up using national registers.

Statistical analyses

All participants were followed from the time of inclusion in SLOSH to their first recorded atrial fibrillation event, death or end of study follow-up (31 December 2013), whichever came first. Kaplan–Meier curves were used to illustrate the hazard function for incident atrial fibrillation during follow-up by job strain category. Cox proportional hazard regression analyses were used to estimate hazard ratios and 95% confidence intervals (CIs) to evaluate the association between job strain and risk of incident atrial fibrillation. The assumption of proportional hazard over time was checked by inspecting the plot for the hazard function, and by including an interaction term between job strain and follow-up time in the Cox hazard regression model. Potential difference in the association between job strain and atrial fibrillation by sex was analysed by stratified analyses and by including an interaction term between sex and job strain in the Cox hazard regression model. All analyses were conducted using SPSS version 21.

In addition to analyses of original SLOSH data, we also performed a meta-analysis in which we pooled the

estimated hazard ratio from the present study with the results from the two previously published studies on the same topic. We pooled the study-specific hazard ratio estimates in a fixed-effect meta-analysis, using R version 3.4.2. Weights for the included studies were derived by the inverse variance method. Heterogeneity between studies was evaluated using the I^2 statistic.

Results

During a total follow-up time of 79,738 person-years (median follow-up time 5.7 years), 145 incident cases of atrial fibrillation (94 men and 51 women) were identified using national registers. The background characteristics of the study population are shown in Table 1. The mean age was 47.4 years at baseline, and 54.7% of the study population were women. Those categorised as being exposed to job strain were on average slightly younger (46.9 vs. 47.5 years), more often female, had shorter education, were smokers, exercised less often and reported a higher frequency of hypertension compared with those who were not exposed to job strain (Table 1).

The plotted hazard function showed a higher risk of atrial fibrillation for those exposed to job strain as compared with all others (Figure 1). No obvious violation of the proportional hazard assumption was observed when inspecting the plot, which was also confirmed when including a job strain*time interaction term in the Cox proportional hazard regression model.

In the Cox regression model adjusted for age, sex and education, job strain was associated with an approximately 50% higher risk of atrial fibrillation (hazard ratio 1.48, 95% CI 1.00–2.18). Further adjustment for smoking, leisure-time physical activity, body mass index and hypertension did not alter the estimated hazard ratio in any major way, but, as expected, the CIs became slightly wider when more variables were included in the model (Table 2). When analysing the four different groups based on the combinations of job demands and control, using the low strain group as reference, the estimated hazard ratios for the high strain group were similar to those observed for the job strain group when only two exposure groups were used (Table 2). Both the passive and active groups had estimated hazard ratios close to the low strain group.

When stratifying the analyses by sex, the association between job strain and atrial fibrillation was only observed in men (hazard ratio 1.79, 95% CI 1.10–2.90 for men; hazard ratio 1.02, 95% CI 0.53–1.96 for women, adjusted for age and education). However, no statistically significant effect modification was found when evaluated by including an interaction term sex*job strain in the model ($p = 0.26$).

Table 1. Background characteristics of the study population. The Swedish Longitudinal Occupational Survey of Health, inclusion years 2006, 2008 and 2010.

	Total study population N = 13,200	No strain n = 10,592	Job strain n = 2608	p-value ^a
Gender, n (%)				
Men	5980 (45.3)	4957 (46.8)	1023 (39.2)	<0.001
Women	7220 (54.7)	5635 (53.2)	1585 (60.8)	
Age, years, mean (SD)	47.4 (10.8)	47.5 (10.8)	46.9 (10.9)	0.022
Atrial fibrillation, n (%)				
No	13,055 (98.9)	10,481 (99.0)	2574 (98.7)	0.262
Yes	145 (1.1)	111 (1.0)	34 (1.3)	
Education, n (%)				
Compulsory school	2044 (15.5)	1534 (14.5)	510 (19.6)	<0.001
Two years upper secondary school	2928 (22.3)	2241 (21.2)	687 (26.5)	
Three or four years upper secondary school	2959 (22.5)	2322 (22.0)	637 (24.5)	
University education shorter than three years	1857 (14.1)	1525 (14.5)	332 (12.8)	
University education three years or longer	3359 (25.5)	2928 (27.8)	431 (16.6)	
Smoking, n (%)				
Daily	1471 (11.2)	1079 (10.3)	392 (15.1)	<0.001
Occasional	607 (4.6)	468 (4.5)	139 (5.4)	
No	11,016 (84.1)	8956 (85.3)	2060 (79.5)	
Exercise, n (%)				
Never or seldom	2597 (19.9)	2007 (19.2)	590 (22.8)	<0.001
Every now and then	4575 (35.0)	3654 (34.9)	921 (35.6)	
Regularly	5892 (45.1)	4815 (46.0)	1077 (41.6)	
Body mass index, n (%)				
≤24.99	6561 (51.0)	5294 (51.3)	1267 (50.0)	0.023
25.0–29.99	4878 (37.9)	3927 (38.1)	951 (37.5)	
≥30.0	1416 (11.0)	1098 (10.6)	318 (12.5)	
Hypertension, n (%)				
No	10,915 (84.0)	8823 (84.6)	2092 (81.6)	<0.001
Yes	2083(16.0)	1610 (15.4)	473 (18.4)	

^ap-values derived from Chi-square tests for categorical variables and t-test for continuous variable.

When pooling the results from the present study with two previously-published studies in a fixed effect meta-analysis, job strain was associated with a 37% increased risk of atrial fibrillation (hazard ratio 1.37, 95% CI 1.13–1.67), with a consistent pattern across studies. The I^2 statistic indicated that there was no heterogeneity between studies ($I^2 = 0\%$) (Figure 2).

Discussion

In the present study, we found that job strain was associated with an almost 50% increased risk of incident atrial fibrillation in the general working population in Sweden. The results were consistent with two previously published studies, and when pooling the results from all three studies, job strain was associated with a 37% higher risk of atrial fibrillation.

The present study is one of few where occupational factors have been investigated in relation to atrial fibrillation,^{12–14} with only two previously focusing on work stress.^{15,16} In accordance with the results from the present study, long working hours, which could be seen as an indicator of work-related stress, has also been found to be associated with increased atrial fibrillation risk,¹³ further strengthening the idea that occupational stress is associated with atrial fibrillation. However, in studies using more general measures of stress, the results have been mixed.^{21–23}

The biological mechanisms linking work stress to atrial fibrillation are not fully known. However, reactions to stress include physiological responses involving both the hypothalamic–pituitary–adrenal axis and the autonomous nervous system, leading to increased release of glucocorticoid hormones, such as cortisol,

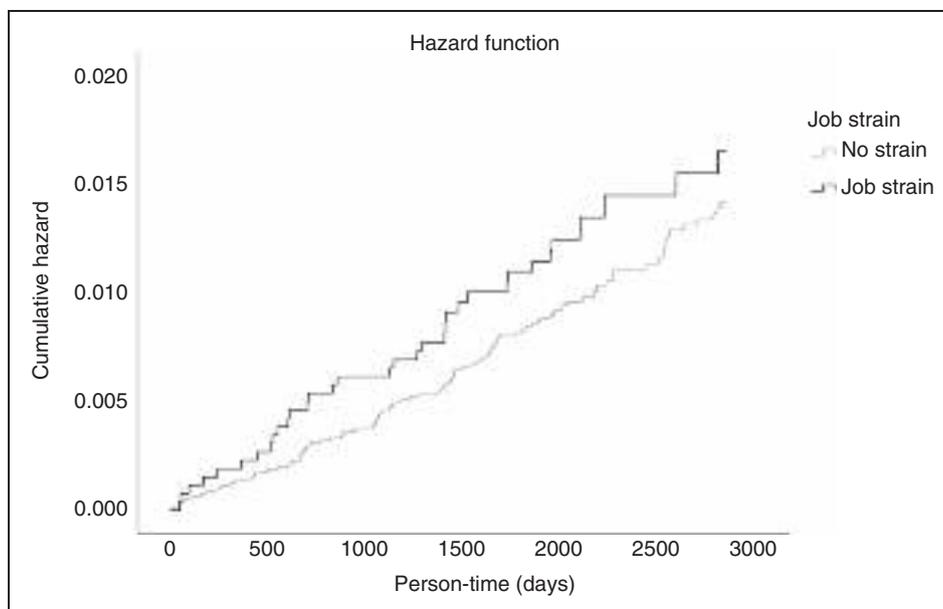


Figure 1. The hazard function for incident atrial fibrillation, the job strain versus no strain group. The Swedish Longitudinal Occupational Survey of Health, inclusion years 2006, 2008 or 2010, end of follow-up 31 December 2013.

Table 2. The association between job strain and risk of incident atrial fibrillation. Hazard ratios with 95% confidence intervals. The Swedish Longitudinal Occupational Survey of Health, inclusion years 2006, 2008 and 2010, end of follow-up 31 December 2013.

	HR (95% CI) ^a N = 13,200 AF events = 145	HR (95% CI) ^b N = 13,147 AF events = 142	HR (95% CI) ^c N = 12,993 AF events = 142	HR (95% CI) ^d N = 12,589 AF events = 134
No strain	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Job strain	1.25 (0.85–1.83)	1.48 (1.00–2.18)	1.47 (0.99–2.17)	1.46 (0.98–2.18)
Low strain	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Passive	0.85 (0.53–1.34)	1.01 (0.63–1.61)	0.98 (0.61–1.56)	1.03 (0.63–1.67)
Active	0.92 (0.59–1.43)	0.97 (0.62–1.53)	0.95 (0.60–1.50)	0.96 (0.60–1.54)
High strain	1.15 (0.73–1.81)	1.47 (0.93–2.32)	1.44 (0.91–2.28)	1.46 (0.91–2.34)

^aCrude, unadjusted model.

^bAdjusted for age, sex and education.

^cAdjusted for age, sex, education, smoking and physical activity.

^dAdjusted for age, sex, education, smoking, physical activity, body mass index and hypertension.

HR: hazard ratio; CI: confidence interval; AF: atrial fibrillation; ref.: reference

and increased sympathetic activity.^{24,25} In line with this, chronic stress has been associated with low-grade inflammatory state and elevated blood pressure.^{25–28} Both inflammation and hypertension may in turn contribute to atrial fibrosis and structural remodelling of the atrium.²⁹ Furthermore, mental stress has been observed to be associated with altered left atrial electrophysiology.³⁰ Autonomic imbalance, neurohormonal activation, altered left atrial electrophysiology, and structural remodelling of the atrium have all been proposed to play important roles in the development of atrial fibrillation,^{29,31} making a biological pathway between work stress and atrial fibrillation plausible.

The current study has several strengths. The SLOSH study has a prospective design, and is based on a large sample from the general working population in Sweden, including both men and women. An established and validated operationalisation of work stress, job strain, was used, which has frequently been used in research on work stress and cardiovascular outcomes.^{9,10} Furthermore, national registers of high quality^{32,33} were used to identify incident atrial fibrillation cases.

All three studies included in the meta-analysis in the present study used the same concept of work stress, that is, job strain based on the demand–control model, had a prospective cohort study design and the outcome was

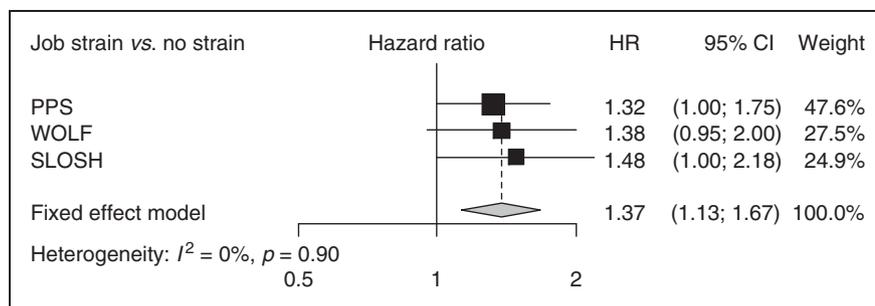


Figure 2. Study-specific estimates and pooled estimate for three studies on the association between job strain versus no strain and the risk of atrial fibrillation.

HR: hazard ratio; CI: confidence interval; PPS: the Primary Prevention Study¹⁵; WOLF: the Work, Lipids and Fibrinogen study¹⁶; SLOSH: the Swedish Longitudinal Occupational Survey of Health

identified by means of national registers, improving the comparability between studies and making the pooling of the results highly relevant. However, it should be noted that the PPS used a job-exposure matrix to measure job strain, while the demand–control questionnaire was used in the WOLF and SLOSH studies. Because of that, slightly different dimensions of the work conditions may have been captured in PPS as compared with the other two studies. Still, the estimated effect sizes were similar across the three studies.

Some limitations should also be considered. Even if the sampling procedure in SLOSH was aimed at generating a representative sample of the working population in Sweden, the participation rate has declined over more recent data collection waves. The study population can still be viewed as broadly representative, but lower participating rates have been observed for those who were younger, male, had less education and were born outside Scandinavia.

Atrial fibrillation as a disease is known to develop over several years, and the disease can remain ‘silent’ and undiagnosed by the health care system for a long time. We used high quality registers to identify incident atrial fibrillation, but we cannot preclude the possibility that some cases were not identified in our study. However, this potential misclassification of the outcome is likely to be non-differential in relation to exposure and is thus likely to yield an attenuated hazard ratio, if any effect.

Other clinical conditions, including hyperthyroidism and cardiac valvulopathy, are known to be associated with incidence of atrial fibrillation. If these conditions are present at baseline and are associated with increased likelihood of rating the work situation as stressful, the observed hazard ratios might have been slightly overestimated. However, we do not think this potential bias is likely to explain all of the association between job strain and atrial fibrillation observed in this study.

We found only two previously published articles on the same topic, both showing associations between job strain and atrial fibrillation in the same direction as those found in the SLOSH study. When doing meta-analysis including published studies, the potential effect of publication bias, that is, that studies showing negative results are less likely to be published, should always be considered. Furthermore, in the meta-analysis, all three studies were based on Swedish samples, and studies from other countries and different regions of the world are needed. Other measures or indicators of work stress, for example effort–reward imbalance and job insecurity, should also be analysed in relation to atrial fibrillation risk in order to get a more comprehensive understanding of the role of work stress as a potential risk factor for atrial fibrillation. In addition, as the results in the present study are based on observational data, the ability to draw conclusions about causation is limited.

In conclusion, our study adds further support to the hypothesis that occupational factors such as work stress may be associated with increased risk of atrial fibrillation.

Author contribution

EF contributed to the conception and design of the work, data analysis, interpretation of data and drafted the manuscript. LLMH and HW contributed to the acquisition and interpretation of data and critically revised the manuscript. MN contributed with interpretation of data and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work, ensuring integrity and accuracy.

Acknowledgements

The authors are grateful to Statistics Sweden for carrying out data collection. The authors also wish to thank all participants for making the study possible. The work presented in the article has not been presented elsewhere. The funders had

no role in the study design, collection, analysis, interpretation of the data, the writing of the report or the decision to submit the article for publication.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Eleonor I Fransson was supported by a grant from the Swedish Heart and Lung Association (#E111/16) for the work presented here. The Swedish Longitudinal Occupational Survey of Health (SLOSH) has been supported by the Swedish Research Council (VR) [#2017-00624, #2009-6192, #825-2013-1645 and #821-2013-1646], by the Swedish Research Council for Health, Working Life and Welfare (FORTE) [#2005-0734 and #2009-1077], and through the Stockholm Stress Centre of Excellence financed by the Swedish Research Council for Health, Working Life and Welfare [#2009-1758].

References

- Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. *Eur Heart J* 2016; 37: 2893–2962.
- Zoni-Berisso M, Lercari F, Carazza T, et al. Epidemiology of atrial fibrillation: European perspective. *Clin Epidemiol* 2014; 6: 213–220.
- Menke J, Luthje L, Kastrup A, et al. Thromboembolism in atrial fibrillation. *Am J Cardiol* 2010; 105: 502–510.
- Chugh SS, Havmoeller R, Narayanan K, et al. Worldwide epidemiology of atrial fibrillation: A Global Burden of Disease 2010 Study. *Circulation* 2014; 129: 837–847.
- Schoonderwoerd BA, Smit MD, Pen L, et al. New risk factors for atrial fibrillation: Causes of ‘not-so-lone atrial fibrillation’. *Europace* 2008; 10: 668–673.
- Rosiak M, Dziuba M, Chudzik M, et al. Risk factors for atrial fibrillation: Not always severe heart disease, not always so ‘lonely’. *Cardiol J* 2010; 17: 437–442.
- EHRA Scientific Committee Task Force. European Heart Rhythm Association (EHRA)/European Association of Cardiovascular Prevention and Rehabilitation (EACPR) position paper on how to prevent atrial fibrillation endorsed by the Heart Rhythm Society (HRS) and Asia Pacific Heart Rhythm Society (APHRs). *Eur J Prev Cardiol* 2017; 24: 4–40.
- Theorell T, Jood K, Jarvholm LS, et al. A systematic review of studies in the contributions of the work environment to ischaemic heart disease development. *Eur J Public Health* 2016; 26: 470–477.
- Kivimäki M, Nyberg ST, Batty GD, et al. Job strain as a risk factor for coronary heart disease: A collaborative meta-analysis of individual participant data. *Lancet* 2012; 380: 1491–1497.
- Fransson EI, Nyberg ST, Heikkilä K, et al. Job strain and the risk of stroke: An individual-participant data meta-analysis. *Stroke* 2015; 46: 557–559.
- Dragano N, Siegrist J, Nyberg ST, et al. Effort–reward imbalance at work and incident coronary heart disease: A multicohort study of 90,164 individuals. *Epidemiology* 2017; 28: 619–626.
- Skjelboe AK, Marott JL, Dixen U, et al. Occupational physical activity, but not leisure-time physical activity increases the risk of atrial fibrillation: The Copenhagen City Heart Study. *Eur J Prev Cardiol* 2016; 23: 1883–1893.
- Kivimäki M, Nyberg ST, Batty GD, et al. Long working hours as a risk factor for atrial fibrillation: A multi-cohort study. *Eur Heart J* 2017; 38: 2621–2628.
- Soliman EZ, Zhang ZM, Judd S, et al. Comparison of risk of atrial fibrillation among employed versus unemployed (from the REasons for Geographic and Racial Differences in Stroke Study). *Am J Cardiol* 2017; 120: 1298–1301.
- Torén K, Schioler L, Soderberg M, et al. The association between job strain and atrial fibrillation in Swedish men. *Occup Environ Med* 2015; 72: 177–180.
- Fransson EI, Stadin M, Nordin M, et al. The association between job strain and atrial fibrillation: Results from the Swedish WOLF study. *Biomed Res Int* 2015; 2015: 7.
- Karasek R. Job demands, job decision latitude, and mental strain: Implications for job redesign. *Adm Sci Q* 1979; 24: 285–308.
- Karasek R and Theorell T. *Healthy work: Stress, productivity and the reconstruction of working life*. New York: Basic Books, Inc., 1990.
- Magnusson Hanson LL, Theorell T, Oxenstierna G, et al. Demand, control and social climate as predictors of emotional exhaustion symptoms in working Swedish men and women. *Scand J Public Health* 2008; 36: 737–743.
- Theorell T. The demand–control–support model for studying health in relation to the work environment – an interactive model. In: Orth-Gomér K and Schneiderman N (eds) *Behavioral medicine approaches to cardiovascular disease prevention*. Mahwah, NJ: Lawrence Erlbaum Associates, 1996, pp.69–85.
- Graff S, Prior A, Fenger-Gron M, et al. Does perceived stress increase the risk of atrial fibrillation? A population-based cohort study in Denmark. *Am Heart J* 2017; 188: 26–34.
- Svensson T, Kitlinski M, Engstrom G, et al. Psychological stress and risk of incident atrial fibrillation in men and women with known atrial fibrillation genetic risk scores. *Sci Rep* 2017; 7: 42613.
- O’Neal WT, Qureshi W, Judd SE, et al. Perceived stress and atrial fibrillation: The REasons for Geographic and Racial Differences in Stroke Study. *Ann Behav Med* 2015; 49: 802–808.
- Steptoe A and Kivimäki M. Stress and cardiovascular disease: An update on current knowledge. *Annu Rev Public Health* 2013; 34: 16.1–16.18.
- Wirtz PH and von Kanel R. Psychological stress, inflammation, and coronary heart disease. *Curr Cardiol Rep* 2017; 19: 111.

26. Hänsel A, Hong S, Cámara RJA, et al. Inflammation as a psychophysiological biomarker in chronic psychosocial stress. *Neurosci Biobehav Rev* 2010; 35: 115–121.
27. Feaster M and Krause N. Job strain associated with increases in ambulatory blood and pulse pressure during and after work hours among female hotel room cleaners. *Am J Ind Med* 2018; 1–12.
28. Landsbergis PA, Dobson M, Koutsouras G, et al. Job strain and ambulatory blood pressure: A meta-analysis and systematic review. *Am J Public Health* 2013; 103: e61–e71.
29. Aldhoon B, Melenovsky V, Peichl P, et al. New insights into mechanisms of atrial fibrillation. *Physiol Res* 2010; 59: 1–12.
30. O'Neal WT, Hammadah M, Sandesara PB, et al. The association between acute mental stress and abnormal left atrial electrophysiology. *J Cardiovasc Electrophysiol* 2017; 28: 1151–1157.
31. Taggart P, Boyett MR, Logantha S, et al. Anger, emotion, and arrhythmias: From brain to heart. *Front Physiol* 2011; 2: 67.
32. Ludvigsson JF, Andersson E, Ekbom A, et al. External review and validation of the Swedish national inpatient register. *BMC Public Health* 2011; 11: 450.
33. The National Board of Health and Welfare. The Swedish National Patient Register [Patientregistret], <http://www.socialstyrelsen.se/register/halsodataregister/patientregistret> (accessed 22 March 2018).