

from Denmark did not find any significant associations. However, the timing and trajectory of work stress measurement before and after return to work might be a critical issue for future research.

Conclusion: The clinical implications with respect to the tertiary prevention of CVD goes to cardiac rehabilitation (CR). The 2015 recommendations from the CR section of the European Association of Cardiovascular Prevention and Rehabilitation of the European Society of Cardiology highlighted the importance of psychosocial risk factors including work stress as 'a component of every CR programme'. A couple of studies have provided preliminarily exciting evidence that CVD patients receiving a comprehensive CR programme did not experience higher work stress after return to work; they even perceived reduced psychosocial stress at work. Therefore, CR programmes consisting of training on work stress management might help employees with CVD to remain in employment longer and to prevent recurrent CVD.

PLENARY SESSIONS LECTURES

Job strain, work stress and cardiovascular diseases

Effort–reward imbalance at work and job strain as risk factors for incident coronary heart disease: results from the multi-cohort IPD-Work Consortium

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Aim: Research on work stress as a risk factor for coronary heart disease has largely focused on job strain (DC), which defines stressful work as a combination of high demands and low control. Less is known about other aspects of modern working life. We examined if effort–reward imbalance (ERI) at work – a complementary operationalisation of work stress – predicted coronary events independently from job strain. In addition, we studied the combined effect of the two work stressors on incident coronary events.

Methods: Participants were 90,164 employed men and women without coronary heart disease at baseline from 11 European prospective cohort studies (the IPD-Work Consortium). Stressful work was assessed by harmonised measures. We defined incident coronary heart disease as the first non-fatal myocardial infarction or coronary death. Study-specific estimates were pooled by random-effects meta-analysis after adjusting for relevant covariates.

Results: At baseline, 31.7% reported ERI at work, 15.9% had job strain and 9.8% were simultaneously exposed to ERI and DC. We recorded 1078 coronary events during a mean follow-up of 9.8 years. Rates of coronary events were higher among those with ERI compared to those without ERI, the respective hazard ratio being 1.16 (95% confidence interval (CI) 1.01–1.34) after adjustment for age, sex, lifestyle risk factors, socioeconomic position and job strain. Combining both measures of work stress showed the highest hazards among persons simultaneously exposed to both types of work stress. The age and sex-adjusted hazard ratio for this group compared to those with neither ERI nor DC was 1.41 (95% CI 1.12–1.76).

Conclusion: These findings suggest that work stress in terms of ERI is an independent risk factor for coronary heart disease. We observed an additive effect of ERI and DC on incident coronary heart disease, which underlies the importance of recognising different sources of work stress in research and workplace health promotion.

Occupational and leisure time physical activity, fitness, coronary heart disease, and 22-year mortality: results from the Kuopio Ischemic Heart Disease Risk Factor Study

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Aim: The aim of this study was to assess prospectively the independent effects of occupational physical activity (OPA) and conditioning leisure time physical activity (LTPA) on atherosclerosis, coronary heart disease (CHD) and mortality among 1861 working middle-aged Finnish men with and without CHD at baseline.

Methods: Fitness (VO_{2max}), OPA (work posture, energy expenditure, relative aerobic workload), conditioning LTPA, cardiovascular disease (CVD) status and potential confounders were assessed at baseline. Repeat ultrasound

measures of carotid artery intima media thickness and national hospitalisation and death registry data were used to determine progression of atherosclerosis, incidence of acute myocardial infarction (AMI) and all-cause and CHD mortality during up to 27 years of follow-up. Relative hazards with 95% confidence intervals were estimated in Cox regression models incrementally adjusting for 18 demographic, biological, behavioural, socioeconomic and psychosocial factors. Interaction effects were determined followed by analyses stratified by baseline CHD.

Result: A predominantly standing work posture was associated with (up to ninefold) accelerated four-year progression of carotid artery intima media thickness compared to no standing work; effects were strongest among men with CHD at baseline and effect sizes were comparable to smoking. Energy expenditure at work and relative aerobic workload were positively associated with 20-year incidence of AMI and 22-year all-cause and CHD mortality. Among men without CHD, each 10% increase of relative aerobic workload increased AMI risk by 18% (hazard ratio (HR) 1.18, 95% confidence interval (CI) 1.08–1.28, $P=0.001$), all-cause mortality by 15% (HR 1.15, 95% CI 1.07–1.24, $P=0.000$) and CHD mortality by 30% (HR 1.30, 95% CI 1.14–1.49, $P=0.000$). Among men with CHD the risk increases were 8%, 11% and 19%, respectively. LTPA was not associated with progression of atherosclerosis or incidence of AMI. LTPA also had no effect on mortality among healthy men but was positively associated with all-cause and CHD mortality among men with baseline CHD: each weekly hour of conditioning LTPA increased all-cause mortality risks by 10% (HR 1.10, 95% CI 1.03–1.18, $P=0.005$) and CHD mortality by 14% (HR 1.14, 1.04–1.26, $P=0.08$). These results were adjusted for age, body mass index, blood glucose, plasma fibrinogen, low-density lipoprotein and high-density lipoprotein-cholesterol, participation in a lipid-lowering drug trial, lipid-lowering and anti-hypertensive medication, systolic blood pressure, alcohol, smoking, personal income, social support at work, mental strain at work, stress from work deadlines and LTPA or OPA.

Conclusion: Conditioning LTPA did not reduce CVD risk and, among men with CHD, increased mortality risk. Prolonged standing at work accelerated the progression of atherosclerosis, especially in men with CHD. High levels of OPA in terms of energy expenditure, especially if measured as relative aerobic workload taking individual fitness into account, were associated with elevated risks of AMI incidence and all-cause and CHD mortality. Future research, CVD risk assessment and physical activity recommendations need to differentiate between OPA and LTPA and take interactions with individual fitness and cardiovascular health status into account.

Work environment and strokes: an update of the most recent findings

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Aim: Stroke is the second leading cause of death worldwide. A fourth of all stroke events occur among people of working age, and the consequences with regard to production loss, sick leave, disability compensation and premature death are considerable. Stroke is not only a leading cause of disability but also the leading preventable cause of disability. Studies investigating stroke as an outcome using work environment as a predictor are lacking compared with those on ischaemic heart disease. This study aimed to review accumulated evidence on work environments and stroke.

Methods: A narrative review was conducted to estimate the risk of several work environmental factors on stroke incident and mortality. Modifiable work-related risk factors – shift work, long working hours and psychosocial work environment – were focused on and findings were discussed compared with those of ischaemic heart disease outcomes.

Results: The literature indicates longer working hours and extensive strenuous activity during work, and sedentary/mental-type occupations as work-related risk factors of stroke. There is also evidence that occupational exposure to small and large particles is associated with an increased risk of ischaemic stroke. Unemployment also seems to be associated with a higher risk of stroke. Regarding socioeconomic status other than unemployed, some types of work, such as manual labour and housework, were found to be associated with the risk of stroke. Clear evidence is lacking of the associations between occupational noise and job insecurity and stroke. Unlike structural factors such as occupation, shift work, long working hours and psychosocial job characteristics are modifiable. A meta-analysis based on 34 studies totaling 2,011,935 people showed that shift work was associated with ischaemic stroke (risk ratio 1.05, 95% confidence interval 1.01–1.09). Another recent analysis reported the same risk level based on five cohort studies. With regard to long working hours, meta-analysis comprising data for 528,908 men and women showed employees who work more than 55 hours per week have a 33% increased risk of stroke compared with those who work a 35–40-hour week (1.33, 1.11–1.61). Evidence on psychosocial job characteristics has been accumulating for stroke incidence and morbidity. A meta-analysis based on six cohort studies totaling 138,782 participants showed high-strain jobs were associated with a more increased risk of stroke (1.22, 1.01–1.47) than low-strain jobs. The literature on the psychosocial work