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Job strain and ischaemic disease: does the inclusion of older employees in the cohort dilute the association? The WOLF Stockholm Study

M Kivimäki,^{1,2} T Theorell,^{3,4} H Westerlund,⁴ J Vahtera,² L Alfredsson^{5,6}

¹International Institute for Society and Health, Department of Epidemiology and Public Health, University College London, London, UK; ²Finnish Institute of Occupational Health, Helsinki, Finland; ³Karolinska Institutet, Stockholm, Sweden; ⁴National Institute for Psychosocial Medicine, Stockholm, Sweden; ⁵Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden; ⁶Stockholm Center of Public Health, Stockholm County Council, Stockholm, Sweden

Correspondence to: Professor M Kivimäki, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK; m.kivimaki@ucl.ac.uk

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ABSTRACT

Objective: Evidence on the association between job strain and ischaemic disease is mixed. This study examined whether including older age individuals in a cohort used to assess job strain attenuates findings towards the null.

Design: A prospective cohort study with baseline screening in 1992–5. A follow-up for ischaemic disease until 2003 was based on linkages to national registries. Ischaemic disease was corroborated by objective criteria (hospitalisation as a result of acute myocardial infarction, unstable angina or ischaemic stroke; or death from ischaemic heart disease, cardiac arrest or ischaemic stroke).

Participants: 3160 male employees aged 19–65 years without pre-existing or current ischaemic disease.

Results: 93 cases of incident ischaemic disease were recorded. In the 19–55 year age group, the participants with job strain had a 1.76 (95% CI 1.05 to 2.95) times higher age-adjusted risk of incident ischaemic disease than those free of strain. Further adjustment for conventional cardiovascular risk factors had little effect on this association, but the impact of job strain was reduced by 70% to non-significant after the inclusion of employees older than 55 years in the cohort (hazard ratio 1.22, 95% CI 0.75 to 1.96).

Conclusions: Including older employees in a cohort may dilute the effect of job strain on cardiovascular disease and is a potential reason for inconsistent findings in previous studies.

Controversy remains regarding the status of job strain (a combination of high work demands and low job control) as a risk factor for cardiovascular disease (CVD).^{1,2} Although many studies support this association,^{3–5} notable exceptions with negative findings also exist^{6,7} and little is known about the reasons for these inconsistencies.^{4,8–11}

We hypothesised that age plays a role in the association between job strain and CVD. Among older employees, the effect of job strain may be attenuated as a result of a healthy worker survivor bias. Retirement during follow-up removes job strain and this exposure misclassification may also reduce the effect of job strain. Furthermore, an increasing number of other age-related causes of CVD may diminish risk ratios for job strain in comparison with non-strain, as the other causes figure into both the numerator and the denominator of the ratio. In this study we thus examined whether including older employees in the cohort to be studied diluted the effect of job strain on ischaemic disease.

METHODS

Sample

Data were drawn from the WOLF (Work, Lipids, Fibrinogen) Stockholm Study, a prospective cohort study of employees 19–65 years of age from 40 companies in a wide range of industrial branches in the Stockholm area.^{12,13} The commonest branches were the pharmaceutical industry, transportation, public administration, telecommunications, sales work, teaching, the mechanical industry, construction work and banking. A total of 3239 men and 2459 women participated in the clinical examination and questionnaire survey in 1992–5 (participation 76%). Records of hospital admissions and deaths by the end of 2003 were obtained from national registers and were linked to the data. We restricted our analyses to men only, because the number of incident cases of ischaemic disease among women was too small for a meaningful analysis ($n = 23$).

Baseline screening

We measured work demands (five-item scale, Cronbach alpha 0.73) and job control (six-item scale, alpha 0.77) using the Swedish Demand–Control Questionnaire, a widely used standard self-administered survey measure.¹⁴ Both scales were constructed by calculating the mean of the response scores of the individual questions. We defined the combination of a work demand score above the median and a job control score below the median as indicating job strain, whereas all other combinations indicated non-strain.

Age, education, salary, occupational group, smoking status and a physical activity score were all self-reported. Systolic and diastolic blood pressure, body mass index, waist circumference, total cholesterol, high-density lipoprotein and low-density lipoprotein¹⁵ cholesterol, serum glucose and plasma fibrinogen were measured.

Follow-up

Hard endpoint outcomes for ischaemic disease were defined as hospital admission with a main diagnosis registered as acute myocardial infarction (International Classification of Diseases (ICD) version 9 code 410; ICD-10 code I21), unstable angina (ICD-9 code 411; ICD-10 code I20.0), or ischaemic stroke (ICD-9 codes 433–434; ICD-10 code I63); or death with a registered underlying cause of ischaemic heart disease (ICD-9 codes 410–414; ICD-10 codes I20–I25), cardiac arrest (ICD-9 code 427; ICD-10 code I46) or ischaemic stroke (ICD-9 codes 433–434; ICD-10 code I63). Records

of hospital admissions and deaths were obtained from 14 March 1963 until 31 December 2003. Incident caseness was defined as the first event occurring after the baseline screening. Those with prevalent ischaemic disease at baseline in 1992–5 were determined by incident ischaemic disease between 1963 and the baseline screening and were excluded from the analysis (24 men).

Statistical analysis

The following three composite outcome measures were constructed to determine incident ischaemic disease cases: (1) acute myocardial infarction or cardiac death; (2) as measure 1 with the addition of unstable angina and (3) as measure 2 with the addition of ischaemic stroke. For each incident ischaemic disease outcome, we calculated age-adjusted hazard ratios from Cox proportional hazards analyses for job strain versus no job strain (the reference) while treating age (19–49, 50–59, 60–65 years) as a categorical variable. As risk estimates have varied between studies depending on whether or not employees older than 55 years were included,^{6 10 11} we used this cut-off point and tested the effect of an interaction between job strain and age group (19–55 versus 56–65 years) on incident ischaemic disease by including the corresponding interaction term in a model that already included the main effects. In the analysis for the age group 19–55 years, we also adjusted for age as a continuous variable to reduce residual confounding. In the examination of the contribution of potential confounders and mediators to the association between job strain and ischaemic disease, the age-adjusted models were also adjusted for baseline characteristics. All of the analyses were carried out using SAS version 9.2 statistical software (SAS Institute, Cary, North Carolina, USA).

RESULTS

The final sample with full data included 3160 men. During a mean follow-up of 9.7 years, 50 participants experienced their first acute myocardial infarction, 31 had unstable angina, 21 died from cardiac disease and 20 experienced ischaemic stroke, a total of 93 incident ischaemic events. In the age group 19–55 years, the participants with job strain had a 1.76 (95% CI 1.05 to 2.95) times higher age-adjusted risk of incident ischaemic disease than those free of strain (table 1). The impact of job strain was reduced by 70% to non-significant after employees older than 55 years were included in the cohort. There was an interaction between job strain and age group (19–55 versus 56–65 years) on ischaemic disease and this interaction remained statistically significant after additional adjustment for age as a continuous variable ($p < 0.05$).

Among the men aged 19–55 years, the association between job strain and ischaemic disease was attenuated by 11% after adjustment for education, salary and occupational group and by 10% after adjustment for smoking and physical inactivity. No attenuation was found after adjustment for biological risk factors, although these factors were strong predictors of incident ischaemic disease.

DISCUSSION

This study of Swedish working men showed that the inclusion of older employees in a cohort could result in a substantial reduction in the effect of job strain on ischaemic disease. In the age group 19–55 years, the men with job strain had a 1.8 times higher age-adjusted risk of incident ischaemic disease during the 10-year follow-up than those free of strain. The effect dropped by 70% to non-significant after the employees older than 55 years were included in the cohort.

Variation in the proportion of older employees could explain some (but not all)^{16 17} of the inconsistencies in previous prospective cohort studies.^{6 7 11 18–21} An association between job strain or its components and CVD has been found in studies using younger cohorts, such as the Western Electric Study of men aged 38–56 years,¹⁸ the Whitehall II Study of civil servants aged 35–55 years,¹¹ a random sample of the male Swedish working population aged 18–65 years¹⁹ and the VALMET Study of men and women aged 17–65 years.²⁰ In contrast, such an association was not observed in the Framingham Offspring Study of men and women aged up to 77 years⁶ and the Nurses' Health Study of women aged 46–71 years.⁷

We assessed job strain with a predetermined standard self-administered questionnaire. Twenty-four per cent of the eligible population was lost at baseline as a result of non-response. Because a similar magnitude of non-response has been reported

What this study adds

- ▶ Identifying potential reasons for inconsistencies in evidence may help to clarify the true effect of job strain on CVD
- ▶ Among men aged 19–55 years, job strain was associated with a 1.8 times higher age-adjusted risk of incident ischaemic disease
- ▶ The impact of job strain was reduced by 70% to non-significant after employees older than 55 years were included in the cohort

Table 1 Age-adjusted associations of job strain with incident ischaemic disease among men free of apparent ischaemic disease at baseline: the WOLF Stockholm Study, 1992–2003

	No of men	Acute MI, cardiac death, unstable angina or ischaemic stroke		Acute MI, cardiac death or unstable angina		Acute MI or cardiac death	
		No of events	HR (95% CI)	No of events	HR (95% CI)	No of events	HR (95% CI)
Men aged 19–65 years							
Job strain							
No	2487	71	1.00	57	1.00	41	1.00
Yes	673	22	1.22 (0.75 to 1.96)	18	1.24 (0.73 to 2.10)	14	1.35 (0.73 to 2.48)
Men aged 19–55 years							
Job strain							
No	2197	47	1.00	39	1.00	28	1.00
Yes	603	21	1.76 (1.05 to 2.95)	17	1.70 (0.96 to 3.01)	13	1.82 (0.94 to 3.51)

HR, Hazard ratio; MI, myocardial infarction.

Policy implications

- ▶ Including older employees in a cohort may reduce the observed effects of job strain.
- ▶ This possibility should be taken into account in future analyses of job strain and CVD.

in previous studies,^{6 10 11 20} the effect of non-response on the association between job strain and CVD was unlikely to be very different in the present study when compared with that in earlier investigations. Supporting the generalisability of our study, the median response scores of the job strain components were the same as those found for a representative sample of the male working population in Sweden in 2006 (median work demand 2.6; median job control 3.2).²²

Our main outcome included both coronary heart disease and ischaemic stroke, but the effects were largely similar for non-fatal myocardial infarction, definite angina and cardiac death. These outcomes have commonly been used in previous studies.^{10 11 18 19} To reduce reporting bias, we focussed on diagnoses based on objective criteria (eg, electrocardiography, enzymes and computed tomography or magnetic resonance imaging). In contrast, the causes of hospital admission that are strongly influenced by patient's reports of symptoms to the attending doctor (eg, ill-defined heart disease, haemorrhoids or "other" circulatory disorders) were not included in our outcome. Loss to follow-up was minimal and comprised only those individuals who emigrated during the study period.

In conclusion, our data suggest that including older employees in a study sample may result in a substantial reduction in the association between job strain and ischaemic disease. Further research with age-group analyses among men, women and different ethnic groups is needed to confirm the generalisability of these findings. We recommend that age structure be taken into account in future studies of job strain and CVD.

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Competing interests: None declared.

Ethics approval: This study was conducted according to the guidelines of the Helsinki declaration, and the protocol was approved by the ethics committee of the Karolinska Institutet.

Contributors: MK was guarantor for the paper. MK, TT, HW, JV and LA designed the hypothesis, analysed or interpreted the data and wrote the paper.

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