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Age, job characteristics and coronary health

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Background Workplace demographics are changing in many European countries with a higher proportion of older workers in employment. Research has shown that there is an association between job strain and cardiovascular disease, but this relationship is unclear for the older worker.

Aims To investigate the association between job strain and a coronary event comparing younger and older male workers.

Methods Cases with a first-time coronary event were recruited from four coronary/intensive care units (1999–2001). Matched controls were recruited from the case's general practitioner surgery. Physical measurements were taken and self-administered questionnaires completed with questions on job characteristics, job demands and control. Unconditional logistic regression was carried out adjusting for classical cardiovascular risk factors.

Results There were 227 cases and 277 matched controls. Age stratified analyses showed a clear difference between younger (<50 years) and older (≥50 years) workers with regard to the exposure of job strain (job demands and control) and the association between these factors and cardiovascular disease. Older workers who had a coronary event were four times as likely to have high job strain [OR = 4.09 (1.29–13.02)] and more likely to report low job control [OR = 0.83 (0.72–0.95)].

Conclusions Job control emerged as a potential protective factor for heart disease and this evidence was stronger in the older male worker. Nevertheless, they were significantly more likely to have job strain. These results suggest that older workers may be more susceptible to job strain.

Key words Angina; cardiovascular disease; case-control study; job control; job demands; job strain; myocardial infarct; occupational health; older workers; younger workers.

Introduction

The association between cardiovascular health and job strain (a combination of high job demands and low job control) has been well researched, using a prospective [1–3], cross-sectional [4–6] and case-control study design for cardiovascular fatal or non-fatal endpoints. However, the association between cardiovascular health and job strain for the older worker is not so clear. Considering the increasing proportion of older workers in most westernized countries there is a need to carefully study job strain and its components specifically in the older workforce using a well-defined sampling frame.

Cardiovascular disease (CVD) accounts for nearly half of all deaths (48%) in Europe [7]. A meta-analysis of cohort studies on CVD and job strain revealed a 50% excess risk for coronary heart disease (CHD) in those who reported work stress [8]. An earlier review revealed half or more of case-control, longitudinal and cross-sectional studies found a significant association between job strain [9] and CVD for men [10]. However, the contribution of the two components of job strain, demands and control, for CVD risk is controversial. A recent systematic review of psychosocial factors in work and cardiovascular health in men revealed job strain, and specifically high demands, were a risk factor for CHD with less evidence linking low control and CHD [11]. This is contrary to previous discussions, where it had been widely accepted that high strain and/or low job control are associated with CVD [1,10,12,13]. Nevertheless, other studies have not found a relationship between job strain, job demands and/or job control and CVD [14,15]. This may in part be due to studying homogenous workers [15] or having diverse exposure factors, such as different cultures in the sample, making comparisons across the participants difficult [11].

The harmful effects of job strain on the cardiovascular system, although established, remain somewhat unclear with regard to the course the relationship takes and the specific role of age. Including older workers in a study is seen to dilute the effect of job strain on CVD [16]. This is purported to occur through the 'healthy worker survivor effect'. It was suggested that older workers who are not exposed to adverse effects from psychosocial factors [11] remain in employment or perhaps even migrate to less stressful work [4]. Conversely, a number of older workers may have to remain in employment due to financial commitments. This, to some extent, limits our knowledge of older workers with regard to potential harmful effects of job strain. There is however, research evidence suggesting that older workers are less likely to be in a high strain job than younger workers [4,17] and that stronger associations between job strain and CHD exist in younger workers as compared with older workers [1,16,18,19]. However, most studies do not age-stratify the analysis and are therefore unable to specifically address the older worker's risk [15,20].

Stratifying the analyses by age would allow a clearer picture to emerge rather than adjusting for age in the analysis, which has been a common approach used, as evident from Eller *et al.*'s [11] review. Looking specifically at younger and older workers would allow these issues to be teased out and the relationship of job strain for the older and younger worker to be investigated in isolation.

The aim of this study was to test the association between job strain and acute myocardial infarction/unstable angina in a sample of the general Irish population, with particular reference to older workers and with controls sourced from the case's general practitioner (GP) surgery.

Methods

Details of the design and participants of the 5C (Cork coronary care case-control) study have been published elsewhere [21]. In short, the 5C study was a community based case-control study carried out in the Southern area of Ireland. Cases were recruited consecutively from four Cork coronary care/intensive care units (n = 227), aged between 35 and 74 years, and admitted with a first-time coronary event (acute myocardial infarction or unstable angina). Incident density sampling was used to recruit controls frequency matched on age and sex, from the case's GP surgery (86 surgeries in total). Controls were exposed to the same living environment and had survived at least as long as the case but did not have a cardiac event. Exclusion criteria for the study included those aged < 35 years or > 74 years, those with a recorded history of prior myocardial infarction, angina, other CVD, or stroke, severe mental or physical disability and other more specific cardiovascular events as published elsewhere [21]. Residence outside of the health care catchment area was also a precluding factor for both cases and controls. Retirees and women who undertook household labour were excluded as they did not complete data on job characteristics. Twenty-two of the participants who did provide data on job characteristics were paid working women. As previous studies found gender specific differences when looking at the association between job strain and CVD [10], women were excluded from our analysis. Data were collected between 1999 and 2001.

A self-administered questionnaire was used to collect demographic details in addition to job characteristics, lifestyle factors and smoking habits. Physical measurements including weight and height were taken by a trained nurse using standard operating procedures. Diagnosis of each case was confirmed by review of available medical notes in the hospital where they were recruited. This study presents a secondary analysis.

Job characteristics were assessed using a form of the Job Content Questionnaire (JCQ) [3]. The JCQ scale was composed of nine individual questions with two subscales, job demands and job control. Job demands consisted of three questions looking at work pace, adapted from the Whitehall II questionnaire [1]. Job control was made up of decision authority, four items, and skill discretion, two items. A Likert response format was employed for the JCQ, using often, sometimes, seldom and never/almost never as the options. Cronbach α for the individual subscales were as follows; job demands α = 0.65 (cases α = 0.68, controls α = 0.62) and job control α = 0.63 (cases α = 0.67, controls α = 0.57). Job strain was calculated by forming four groups, high strain, active, low strain and the passive group. Responses were summed to define the work dimensions (job demands and job control). The median of these scores were used as the cut-off points. Job demands ranged from 3–12 and job control from 7–24. The high strain group had high job demands and low job control. The active group had high job demands and high job control. The low strain group had low job demands and high job control, and finally the passive group had both low job demands and low job control.

Socioeconomic position (SEP), obesity, smoking and family history of CVD were conceptualized as confounders. Occupational position was used as a measure of SEP as set out previously [21]. In summary, SEP was approximated by the participant's prior or current longest held occupation using nine occupational groups according to the then standard national occupational coding lists. Body mass index (BMI) was calculated from the weight and height recorded for each participant. A score of 25 or over was classed as overweight and 30 or over as obese. Current smoking habits, for the purpose of this paper, were assessed using two questions: 'Do you regularly smoke cigarettes at present?' and 'Do you currently smoke tobacco in any other form?' For ex-smokers, participants were asked to indicate if they ever were a regular smoker. Participants were then classified into current smokers or ex-smokers and non-smokers. Family history of CVD was assessed by asking 'Has anyone in your immediate family ever had a heart attack/angina?' Other potential confounders such as blood lipids and hypertension were not included in the model as most of the participants were medically controlled for these.

All analysis was conducted using PASW™ (Predictive Analytics SoftWare) version 18. The analysis was done in two parts. Initially, we described the socio-demographic variables of the sample, the cases and the controls. Then unconditional logistic regression modelling the association between job strain and heart disease was performed with adjustment for matching criteria (age) [22]. The rationale for presenting unconditional logistic regression lies primarily with the loss of information if conditional logistic regression was carried out. In some cases the matched control was not working and hence did not have relevant job characteristics completed, leading to exclusion of the working case as well if conditional logistic regression was carried out. In addition, there was broad conformity between conditional and unconditional logistic regression results.

Further adjustments were made including BMI, smoking status, SEP and family history of CVD. The dependent variable was whether the participant had had a first-time coronary event. Two separate logistic models were built. The independent variable was, in the first instance, high strain coded as one and compared with the remainder coded as 0. Then a second model was built with job demands and job control used as continuous variables and entered simultaneously to determine the independent contribution of each of the job strain components to explaining CVD variation. Age stratified analysis was then carried out with younger workers (aged 37–49 years) and older workers (aged 50–74 years) adjusting as per the complete sample.

For the purpose of this paper, those in SEP 1 and 2 were coded as 1; all others coded as 0. BMI of 25 or over, current smokers and positive family history of CVD were coded as 1. Age was used as a continuous variable. Two interaction terms between age and job demands and age and job control were also created for inclusion in the analysis.

Ethical approval for this study was obtained from the Cork Teaching Hospitals research ethics committee.

Results

Overall response rates were high, with 94% of cases (227 out of 241) and 73% of controls (277 from 377) participating. After exclusions, the available sample of the paid working population for this study was 208 males (92 cases and 116 controls). Demographic details of the sample are given in Table 1. The mean age of the sample was 55 years (SD = 8.5) with 17% from SEP 1 and 2. Twenty-eight per cent were classified as obese and 52% overweight. Specifically, 37% of cases and 22% of controls were obese. There was a significant difference between the hip measurements of the cases and controls ($P < 0.01$) and marked, but non-significant (NS) differences between their smoking status and BMI. There was no significant difference between the cases and controls with regard to job characteristics. Twenty per cent of the cases were in the high strain group versus 13% of controls.

Table 2 shows the job characteristics for both the cases and controls, age stratified. There were a higher proportion of younger cases with high demands and high control than older cases, albeit non-significant. There was, however, a significant difference between

Table 1. Demographic features of study participants

Variable	Complete sample (n = 208)	Cases (n = 92)	Controls (n = 116)
Age[a]	54.7 (8.5)	55.2 (9.3)	54.3 (7.8)
Worker >50 years[b]	149 (72%)	64 (70%)	85 (73%)
Height (cm)[a]	173.2 (5.9)	172.4 (5.9)	173.8 (5.9)
Weight (kg)[a]	84.4 (12.1)	85.4 (12.9)	83.7 (11.5)
Waist (cm)[a]	98.7 (10.9)	100.1 (11.6)	97.6 (10.4)
Hip (cm)[a]	103.7 (8.1)	101.8 (9.2)	105.1 (6.7)**
BMI (kg/m^2)[a]	28.1 (3.7)	28.7 (3.8)	27.7 (3.6)
Current smoker[b]	47 (23%)	27 (29%)	20 (17%)
SEP 1&2[b]	36 (17%)	14 (15%)	22 (19%)
High strain[b]	33 (16%)	18 (20%)	15 (13%)
Low strain[b]	53 (26%)	21 (23%)	32 (28%)
Active[b]	51 (25%)	21 (23%)	30 (26%)
Passive[b]	71 (34%)	32 (35%)	39 (34%)

**$P < 0.01$.
[a]Mean (SD).
[b]Number (proportion).

Table 2. Descriptive data for cases and controls and job characteristics

	Cases (n = 92)		Controls (n = 116)	
	<50 years (n = 28)	≥50 years (n = 64)	<50 years (n = 31)	≥50 years (n = 85)
High strain n (%)	7 (25)	11 (17)	8 (26)	7 (8)*
High job demands n (%)	14 (50)	25 (39)	13 (42)	32 (38)
High job control n (%)	14 (50)	28 (44)	12 (39)	50 (59)

*P < 0.05, difference between younger and older controls reporting high strain.

Table 3. ORs (95% confidence interval) for the association between first coronary event and job characteristics

Job Characteristics	OR (adjusted for age and BMI)	OR (adjusted for age, BMI and smoking status)	OR (fully adjusted)
M1: High strain[a]	1.89 (0.86–4.14)	1.74 (0.79–3.86)	1.74 (0.77–3.95)
M2: High job demands[b]	1.08 (0.94–1.23)	1.09 (0.95–1.24)	1.08 (0.94–1.24)
M2: High job control[b]	0.89 (0.82–0.98)	0.90 (0.82–0.99)	0.89 (0.81–0.99)

[a]M1 = Model 1 high strain. High strain is fitted as a categorical variable with no high strain as reference.
[b]M2 = Model 2 job demands and job control together. Job demands and job control were fitted as continuous variables. Job demands were adjusted for job control and job control was adjusted for job demands in the model.
Both models adjusted initially for age and BMI, then for age, BMI and smoking status. Fully adjusted model allowed for age, BMI, smoking status, SEP and family history of CVD.

the proportion of younger and older controls reporting high strain (P < 0.05). Within the age groups (younger and older participants), there was no significant difference between cases and controls with regard to high strain, high demands and high control (data not shown).

Unadjusted analysis showed that those with a coronary event were more likely to be in the high strain group, albeit non-significant, [OR = 1.64 (0.78–3.46)]. Adjustment for all covariates did not change this result significantly (Table 3). Cases were more likely to have high levels of demands, although non-significant, than those with no history of a coronary event. Those who had a coronary event were significantly less likely to have high levels of job control [OR = 0.91 (0.83–0.99) P < 0.05] in univariate analysis and independently of job demands. This association remained statistically significant when the model was fully adjusted (P < 0.05). The multiplicative interaction terms were non-significant in the model (data not shown). Justification for stratifying further analysis by age was motivated by our main research question.

Table 4 shows age stratified data. Cases in the older workers' (aged 50 years and over) group, were significantly more likely, in the fully adjusted model, to have high job strain (P < 0.05). In the partially adjusted model, older cases were significantly more likely to have high levels of job demands. However, this was attenuated in the fully adjusted model (NS). Older cases were significantly less likely to have high levels of job control [OR = 0.89 (0.80–0.99) P < 0.05] both univariately and in the fully adjusted model (P < 0.05) and independently of job demands.

Univariate analysis was non-significant for the younger workers. When adjusted for covariates, there was no evidence of increased risk of a coronary event with job strain, or increasing levels of job demands, or indeed lower levels of job control for younger workers (Table 4).

Discussion

This study revealed, from stratified analyses, that there is a clear difference between younger and older male workers with regard to the exposure of job strain, job demands and job control and the association between these factors and CVD. Our findings suggest that older workers are more susceptible to job strain, low job control and, to some extent, high job demands with regard to CVD even after adjustment for classical cardiovascular risk factors such as smoking, SEP, obesity and family history of CVD.

Interestingly, older workers who had had a coronary event were four times as likely to have reported high job strain, and more likely to report both high job demands and low job control, although the association with job control seemed stronger and more consistent. This is at odds with previous findings that reported higher associations between job characteristics and heart health for younger workers [4,16,17]. In addition, an independent link between a coronary event and high job demands is contrary to some previous findings for high job demands [2] but in keeping with other scholars [1].

Table 4. Age stratified ORs (95% confidence interval) for the association between first coronary event and job characteristics

Job characteristics	Younger workers (37–49 years of age) (n = 59)			Older workers (50–74 years of age) (n = 149)		
	OR (adjusted for age & BMI)	OR (age, BMI and smoking status)	OR (fully adjusted)	OR (adjusted for age & BMI)	OR (age, BMI and smoking status)	OR (fully adjusted)
M1: High strain[a]	0.78 (0.21–2.97)	0.68 (0.17–2.74)	0.56 (0.13–2.51)	3.26 (1.12–9.44)	3.10 (1.07–9.02)	4.09 (1.29–13.02)
M2: High job demands[b]	0.98 (0.77–1.24)	0.97 (0.76–1.24)	0.98 (0.76–1.26)	1.17 (0.99–1.38)	1.18 (1.00–1.40)	1.19 (0.99–1.43)
M2: High job control[b]	0.97 (0.82–1.15)	0.99 (0.84–1.19)	1.05 (0.87–1.27)	0.85 (0.76–0.96)	0.85 (0.76–0.96)	0.83 (0.72–0.95)

[a]M1=Model 1 high strain. High strain is fitted as a categorical variable with no high strain as reference.

[b]M2=Model 2 job demands and job control together. Job demands and job control were fitted as continuous variables. Job demands were adjusted for job control and job control was adjusted for job demands in the model.

Both models adjusted initially for age and BMI, then for age, BMI and smoking status. Fully adjusted model allowed for age, BMI, smoking status, SEP and family history of CVD.

The inclusion of workers older than 65 years of age made this a unique study.

There are several possible explanations to the findings. It may be the case that the healthy worker effect, which seems to have attenuated the association between work characteristics and heart disease in other studies, did not play a strong role in our sample. It may be possible that older workers, in this sample, were unable to migrate to less stressful jobs or even leave the workforce due to financial constraints or the mainly rural environment made changing occupations less likely [23].

In our study, having a coronary event was associated with high strain, low job control and to some extent, high job demands in the older worker. However, the pathways and mechanisms linking job strain to CVD are still not fully clarified. For example, an association between job strain and hypertension, which is a modifiable risk factor for CVD, has been found in older workers, both with a higher [24] and lower SEP [23] and by using observer-based stressor measures [25]. Furthermore, with increasing years of employment where the worker is experiencing job strain, there is an increase in average blood pressure measured during work [24,26]. Nonetheless, hypertension may not be the primary pathway between an increased risk of CHD in workers with job strain as BMI and blood lipids may also contribute [2].

In the present study, younger workers did not show any significant association between job strain nor its components and CVD. This is at odds with previous studies finding higher associations for younger workers as compared to older workers [1,16,18,19]. Although the non-significant associations between job characteristics and heart disease for the younger workers may be due to the low statistical power of this relatively small group, the ORs for the older and younger workers were distinctively different, suggesting a 'true' difference in associations.

The particular strength of the present case-control study was its careful sampling of suitable controls that provided high external validity. Using a community sample, specifically a sample taken from the case's GP surgery, improved the chances of similar work exposures, confounders [27] and health care amenities. Nevertheless, matching does not altogether eliminate confounding, therefore necessitating adjustment for SEP in the analysis [28].

Limitations to the study such as selection bias [29] were small, owing to the high participation rates of the cases and controls. However, recall bias may have inflated the associations between job strain and cardiovascular health. A coronary event may cause a patient to dwell on potential experienced stress more so than an individual without this diagnosis, although this was not the case in other studies [19,30]. In addition, if there was to be an overestimation of strength of the relationship found due to recall bias, then self-reporting of demands rather than control would be inflated [10]. Furthermore, it is improbable that recall bias would affect the differences between younger and older workers in this study as this would imply that older workers were more inclined to be subject to recall bias. Representativeness of the controls may be an issue with the possibility of young healthy males, in particular, not visiting the GP as frequently as older and unhealthy males. Nevertheless, they were thought to be more representative than hospital-based controls. In addition, information on important work-related risk factors such as noise and overtime was not available as it was secondary analysis.

The unconditional logistic regression results were presented here in preference to conditional logistic regression results. Although this could result in conservative estimates of risk [22], often little difference is found between both types of analyses [29], as per our study.

In conclusion, our data suggest that older male workers who had a coronary event had lower levels of job control and high job strain. The intricacy of the older persons work life is increased by the entwining of social, psychological and physical factors of ageing. Society's view of older workers may impact on their view of themselves. It is important for policymakers and clinicians to be alert to this as the ageing working population increases. It would be advantageous to investigate a larger sample of workers, young and old, to augment these findings. Future research should use stratified analyses to carefully investigate the differences between the younger and older workers in addition to vigilantly differentiating the different SEPs.

Key points

- Job control was seen to be a credible protective factor for heart disease, particularly for the older male worker.
- Younger and older male workers differ regarding exposure of job strain, job demands and job control and the association between these factors and cardiovascular disease.
- Older male workers who had a coronary event were four times as likely to report high job strain and more likely to relay both high levels of job demands and low job control.

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Conflicts of interest

None declared.

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Why I became an occupational physician...

I qualified in 1957 at Liverpool University where I had hardly heard of occupational medicine.

After a year in house officer jobs, I considered a career in ENT and became a senior house officer, but after 18 months, I decided that it was a mistake, although I had no clear idea about the future.

Then I spent 11 years in general practice, part of which was in Halewood near the Ford factory where many of my patients worked. I saw patients with problems attributed to their jobs and others requesting sick notes.

Realizing that I knew nothing of the work of these patients, I visited the Ford factory. I found out that a doctor was employed there but I was not able to meet him.

Then an incident occurred that was to be the turning point in my career. A heavy parcel arrived by post addressed to me in error. In it was *Hunter's Diseases of Occupations*. It looked interesting, and I kept and read it (after paying). By the time that I had finished it, I knew what I wanted to do.

I knew that there was a university department of occupational health in Manchester headed by Professor Tim Lee. Coincidentally, I was then considering returning to the Manchester area where my family lived. In 1968, I moved back there (still in general practice) and, very shortly after, applied for a vacancy of 'Appointed Factory Doctor'. To my amazement I obtained the post and gradually found other part-time jobs in occupational health.

By 1973, I was spending half my time in the field and wanted to work full time in it. I was then very fortunate to obtain another two part-time posts in the food industry and with the Central Electricity Generating Board. With these I was almost full time in occupational medicine and left general practice.

After 2 years on Professor Lee's fascinating course at Manchester University, I obtained the DIH in 1975. During and after this time, I was very grateful for Tim Lee's help and advice in becoming accredited.

Later, much of my work was in the then 'Cinderella' field of NHS occupational medicine, and I was very attracted by the challenges in that developing branch of the specialty.

The final miracle in my career was in 1983 when I obtained the first consultant post in this region. It combined clinical duties in a district health authority (later trust) with a regional advisory role. Gradually the department grew and provided occupational health care to many outside organizations. I spent a highly interesting and rewarding 15 years until my retirement from the NHS in 1998.

Looking back, I benefited from a series of very fortunate and unexpected coincidences in a career from which I have enjoyed the greatest job satisfaction.

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