Is the association between job strain and carotid intima-media thickness attributable to preemployment environmental and dispositional factors? The prospective Cardiovascular Risk in Young Finns Cohort Study

Taina Hintsa, Mika Kivimäki, Marko Elovainio, Jussi Vahtera, Mirka Hintsanen, Jorma S A Viikari, Olli T Raitakari and Liisa Keltikangas-Järvinen

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Is the association between job strain and carotid intima-media thickness attributable to preemployment environmental and dispositional factors? The Cardiovascular Risk in Young Finns Study.

Taina Hintsa[1], Mika Kivimäki[1 2], Marko Elovainio[3], Jussi Vahtera[4], Mirka Hintsanen[1], Jorma S.A. Viikari[4] Olli T. Raitakari[5] & Liisa Keltikangas-Järvinen[1]

1 Department of Psychology, University of Helsinki, Finland
2 Department of Epidemiology and Public Health, University College London Medical School, London, UK
3 National Research and Development Centre for Welfare and Health (STAKES), Helsinki, Finland
4 Finnish Institute of Occupational Health, Turku, Finland
5 Department of Medicine, University of Turku, Finland
6 Department of Clinical Physiology, University of Turku, Finland

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Correspondence concerning this article should be addressed to Taina Hintsa, Department of Psychology, P.O. Box 9, FIN-00014 University of Helsinki, Finland. Phone: +358 9 191 29524, Fax: +358 9 191 29521. Electronic mail may be sent to taina.hintsa@helsinki.fi

ABSTRACT

Objectives. Most previous studies of job strain and cardiovascular risk have been limited to adult data. It remains unclear whether this association might be explained by factors present already before entering work life. We examined whether preemployment family factors and participants' own dispositional factors contribute to the relationship between job strain and carotid intima-media thickness (CIMT) among male employees.
Methods. The sample was 494 men from the Cardiovascular Risk in Young Finns Study. Parental socioeconomic position and parental life dissatisfaction were assessed at age 9 to 21 years and components of type A behavior (Hunter-Wolf) were assessed at age 12 to 24 before the participants had entered labor market. Job strain, education and CIMT were assessed at age 27 to 39 years when all the participants were employed.
Results. There was an association between higher job strain and increased CIMT in adulthood 0.59 mm [95% CI 0.42-0.76] which was only little affected on adjustment for parental socioeconomic position and parental life dissatisfaction as well as participants' education. However, the job strain/CIMT relationship attenuated 17% to non-significant after taking into account the effect of participants' type A behavior components.
Conclusions. In this contemporary cohort of men, lack of leadership (a type A behavior component) contributed to the association between job strain and carotid intima-media thickness 15 years later whereas preemployment family factors had only a modest effect on this association.

INTRODUCTION

Job strain is suggested to be a risk factor for cardiac events or coronary heart disease.[1, 2] Recently, an association between job strain and an early atherosclerotic process, as indicated by carotid intima-media thickness (CIMT), has been documented in men aged under forty years of age.[3] Considering that atherosclerosis develops over a long period of time and that work career at that age is still relatively short, the question of confounding by preemployment environmental and dispositional factors raises. However, as most previous studies have been limited to adult data, it remains unclear whether the association between job strain and cardiovascular risk is explained by environmental and dispositional factors present already before entering work life that affect both job strain and coronary health.

Although work stress is suggested mainly to originate from work,[4] it is also possible that work stress is to some extend affected by factors present before entering work life. For example, earlier literature has found a link between neuroticism and a tendency to report the occurrence of stress in the future [5] and a relationship between preemployment family factors with adulthood work stress.[4, 6, 7]

In studies of cardiovascular disease, personality characteristics that may be present already before entering the work life, have been paid attention to for a long time. In late 1950s, Friedman and Rosenman found that type A behavior behavior pattern, characterized by feelings of time urgency, competitive style and anger/hostility, was associated with increased cardiovascular disease risk.[8] Prospective investigations in the 1970s, such as the Western Collaborative Group study [9] and the Framingham Heart study, [10] provided further support for this notion, but subsequent failure to replicate these findings in the 1980s [11-13] focused interest on the components of type A behavior instead of the global rating.[14] Among adolescents, type A behavior pattern has found to be comprised of several components, such as aggression, leadership, responsibility and eagerness-energy.[15, 16] A recent study from the population-based Cardiovascular Risk in Young Finns cohort showed that the eagerness-energy component of type A behavior pattern measured at age 12 to 24 was positively associated with CIMT among men aged 27 to 39.[17]

Other preemployment factors may also be important. Low socioeconomic position has been associated with job strain.[18] Negative family atmosphere is related to shorter length of schooling,[19] and to the hostility component of type A behavior among adult men.[20] Furthermore, maternal life dissatisfaction has been related to the total type A behavior score in adolescence.[21] Because preemployment family and dispositional factors, including family history of coronary heart disease, may directly or indirectly affect stress-related exposures and perceptions in adulthood,[6, 19, 21, 22] it may be justified to ask whether these factors might contribute to the relationship between job strain and early atherosclerosis.

We examined the role of environmental and dispositional factors already present before entering work life in the relationship between job strain and carotid intima-media thickness in men because the job strain/CIMT relationship is previously observed only in men in CRYF data.[3] Among the men participating the Cardiovascular Risk in Young Finns study, job strain was associated with increased CIMT even when family history of CHD and childhood and adulthood biological coronary risk factors were taken into account.[3, 23] However, the effects of developmental context and emotional support indicated by socioeconomic conditions, emotional family atmosphere and

personality factors on this relationship have not been studied so far. In this study, we hypothesized that preemployment environmental and dispositional factors, such as parental socioeconomic position, parental life satisfaction, family history of coronary heart disease and participants' type A behavior components would contribute to the job strain-CIMT relationship.

METHODS

Participants

The Cardiovascular Risk in Young Finns Study is an ongoing follow-up study of coronary heart disease risk factors in Finnish children, adolescents and young adults.[24] The first cross-sectional study was conducted in 1980 when age cohorts of 3, 6, 9, 12, 15 and 18 years were randomly sampled on the basis of social-security numbers, resulting in a total of 3596 participants. The loss of participants is approximately 34% after 21 years with the reasons for loss to follow-up including lack of time, unwillingness to participate and absence from the place of residence at the time of examination. [25]

In the present study, we included only men, as the relationship between job strain and CIMT is present in men but not in women in the Young Finns study.[3] First of all, the youngest cohort (n=295) was excluded because they did not self-report type A behavior components. Thus, the eligible population was 1469 men, i.e. 83% of all male participants at baseline. Furthermore, because we examined preemployment effects on job strain-CIMT relationship, the inclusion criteria were that the participants did not work full time in 1986 when the preemployment factors were assessed and that they were employed in 2001 at the time job strain and CIMT were measured. Therefore, we excluded participants working full-time already in 1986 (n=278), those who were not employed in 2001 (n=145) and those with missing information on current employment in 2001 (n=552). Thus, the final cohort comprised 494 men.

Preemployment factors

Participants' education was measured as completed school years. Parental socioeconomic position (SEP) was measured as the household income and completed school years of the mother and the father in 1983. Parental life satisfaction was measured on a scale from the Operation Family Study questionnaire [26] in 1983, the participants being from six to 21 years of age. The questionnaire covered both maternal and paternal satisfaction as a mother/father, as a spouse and with her/his work role. The average score was calculated to form an index of parental life satisfaction, larger values indicating higher levels of life satisfaction. The scale reliability (Cronbach α) was .72 for maternal life satisfaction and .76 for paternal life satisfaction. Family history of coronary heart disease was assessed using baseline and follow-up data. Family history was considered positive if either participants' father or mother had been diagnosed with coronary heart disease, suffered from myocardial infarction, or if either of them have had percutaneous coronary intervention or coronary by-pass surgery at or before the age of 55 years.[23]

Components of type A behavior

Components of type A behavior were self-rated with the Hunter-Wolf A-B Rating Scale (HWolf) [16, 27] in 1986. The type A behavior scale consists of 23 items and four subscales, 1) impatience-

aggression, seven items, e.g., “I lose my temper easily”, 2) leadership, six items, e.g., “I am always a leader in activities”, 3) hard-driving, three items, e.g., “I am hard-driving and competitive”, and 4) eagerness-energy component, seven items, e.g., “I always feel hurried”, The response was given with a seven point scale in a form of a ladder (put an “X” on the step where you are on). We calculated the means of response scores across the scale items with higher values indicating higher level of type A behavior in each subscale. The Cronbach alpha reliabilities of the subscales vary between .55 and .69. HWolf has been documented to be especially suitable for measuring type A behavior in adolescents.[28]

Job strain

Job control was measured on the Job Content Questionnaire,[29] which contains nine items, e.g., ”I can make independent decisions at my work” (1=agree, 5=do not agree) (Cronbach α .85). Job demands (α .59) were measured using a three-item scale from the Occupational Stress Questionnaire,[30] which has been validated in Finland in 25000 employees. The items included, “Does your work have phases that are too difficult?, I must hurry to get my work done and Is your work mentally straining?”. The responses were given on a scale ranging from 1=strongly disagree to 5=strongly agree. The continuous linear job strain indicator was obtained by subtracting demands from control.[31]. There are also other possible job strain formulations suggested in the literature: *a quotient term* (demand score divided by control score), a *tertile term* (distributions of demands and control divided in tertiles, then the highest two tertiles of demands combined with lowest two tertiles of control form the high strain category, and the lowest two tertiles of demands combined with the highest two tertiles of control form the low strain category, all other combinations form the intermediate strain category), *a quadrant term* (dichotomizing demands and control at the medians, low demands and high control form the strain category and all other combinations no-strain category), and a multiplicative interaction term (control x demands) [31] Of these job strain formulations, the tertile, linear and quotient terms of job strain have been reported to be associated with CIMT in men, but not the quadrant term and the multiplicative interaction term.[3]

Carotid intima-media thickness

The measurement of carotid intima-media thickness (CIMT) has previously been described in detail.[25] In brief, CIMT was measured with ultrasound mainframes (Sequoia 512 ultrasound, Acuson, Mountain View, Calif with 13.0-MHz linear array transducers). The left common carotid artery was scanned by ultrasound technicians according to a standardized protocol. A minimum of 4 measurements of the common carotid wall were taken to derive mean CIMT. The between-observer coefficient of variation was 5.2 % and the between-visit coefficient of variation 6.4%.[25] The measurements were done between September 2001 and January 2002.

Statistical analyses

The differences between participants and excluded persons were tested with t-tests, and the associations between predictor variables were studied by calculating Pearson correlations.
In multivariate analyses, the number of participants with full information on all study variables can be small relative to the actual sample size. In addition to this, considering that the participants were required not to work in 1986, and to work in 2001, the number of participants included would have been very low. Therefore, a missing value analysis was done, and the missing data were completed

by the expectation-maximation (EM-algorithm) method [32]. The EM-algorithm has two steps. First, in the estimation step the missing data are imputed by predicted scores in a series of regressions where every missing variable is regressed on the remaining variables for a particular case. Second, in the maximization step, the imputed data set is submitted for maximum likelihood estimation [33]. The two steps are repeated until a stable solution is obtained. This method has been referred as producing quite unbiased estimates of mean and standard error (SE).[34, 35] We imputed 9-30% of the data depending on the variable (table 1). An age-adjusted job strain/CIMT relationship exists in an unimputed data among 478 men with measurements of both job strain and CIMT.[3]

The relationships between preemployment factors and job strain were studied with linear regression analyses controlling for age and education. To examine the contribution of parental SEP, life satisfaction and participants' type A behavior components to the relationship between job strain and carotid intima-media thickness, a series of multivariate linear regression analyses were done using preemployment factors as covariates. Statistical analyses were done with SPSS statistical software 15.0 version.

RESULTS

The participants were not different from the excluded persons with respect to biological coronary risk factors in 1980, such as BMI, HDL- and LDL-cholesterol, triglycerides, systolic and diastolic blood pressure (all p-values >0.050). Mean BMI was 17.16 (S.D.= 2.68) kg/m2, HDL-C 1.53 (S.D.= 0.30) mmol/L, LDL-C 3.37 (S.D.= 0.71) mmol/L, triglycerides -0.75 (S.D.=0.50) mmol/L, systolic blood pressure 112 (S.D. =11) mm Hg and diastolic blood pressure 69 (S.D.=10) mm Hg. Participants did not differ from excluded ones in parental life satisfaction in 1983, type A behavior subscales in 1986, or participants job strain or CIMT in 2001 (all p-values >0.050). The education of participants' mothers and fathers in 1983 was somewhat higher (10.5 years vs. 10.0 years; 10.1 years vs. 9.7 years, respectively, p-values <0.050) than that of the excluded and participants' parents had somewhat higher income in 1983 than the parents of the excluded ones (6.0 vs. 5.6 kFIM per year, p<.010). Participants were more educated (15.1 years vs. 13.4 years, p<.001) than the excluded persons.

The sample characteristics are shown in table 1. Descriptive statistics were almost identical between original and imputed datasets. Further analyses were done in the imputed dataset.

TABLE 1
Sample characteristics.

		Un-imputed data	Range		Imputed data[a]
	n	mean±S.E.		n	mean±S.E.
Age[b]	494	30.93±0.16		494	30.93±0.16
Family history of CHD[c]	494	12% positive	0, 1	494	12% positive
Family income	449	6.04±0.09	1-8	494	6.04±0.08
Mother's education	443	10.46±0.16	2-26	494	10.39±0.16
Father's education	389	10.13±0.20	2-25	494	10.02±0.16
Maternal life satisfaction	431	4.03±0.03	1-5	494	4.03±0.03
Paternal life satisfaction	372	4.08±0.04	1-5	494	4.08±0.04
Aggression	425	3.63±0.04	1-7	494	3.64±0.03
Leadership	425	4.34±0.04	1-7	494	4.32±0.03
Hard-driving	424	4.69±0.05	1-7	494	4.69±0.04
Eagerness-energy	424	4.65±0.03	1-7	494	4.65±0.03
Education	491	15.07±0.15	9-25	494	15.08±0.15
Strain	342	-.54±0.02	-1.89-1.06	494	-.51±0.02
IMT	445	.59±0.01	0.40-1.07	494	.59±0.01

[a] based on the EM-algorithm method

[b] 27yrs n=138; 30 yrs n=180; 33 yrs n=92; 36 yrs n=53; 39 yrs n=31

[c] Family history was considered positive if either participants' father or mother had been diagnosed with coronary heart disease, suffered from myocardial infarction, or if either of them have had percutaneous coronary intervention or coronary by-pass surgery at or before the age of 55 years.

The Pearson correlations showed that leadership component of type A behavior correlated positively with family income ($r = 0.10$, $p<0.05$), fathers' education ($r = 0.14$, $p<0.01$) and participants' educational attainment ($r = 0.12$, $p<0.01$) (table 2). The job strain components, job demands and job control, correlated positively with each other ($r = 0.21$, $p<0.001$).

TABLE 2
Bivariate correlations (Pearson) between independent variables.

	1	2	3	4	5	6	7	8	9	10	11
1 Age											
2 Family history of CHD	.072										
3 Family income	.080	-.032									
4 Mother's education	-.057	-.048	.400**								
5 Father's education	-.020	-.028	.490**	.710**							
6 Mother's life satisfaction	-.025	-.041	.001	-.032	-.038						
7 Father's life satisfaction	.026	.002	-.034	-.019	-.057	.667**					
8 Participant's aggression	-.185**	-.036	-.015	-.015	.028	-.042	-.042				
9 Participant's leadership	.071	.007	.103*	.081	.139*	.053	.067	.207**			
10 Participant's hard-driving	.148*	-.002	.074	.001	-.010	-.017	-.005	-.191**	.091+		
11 Participant's eagerness-energy	.131*	.017	.128*	.094*	.145*	.010	.042	.162**	.311**	.064	
12 Participant's education	.266**	.056	.267**	.278	.340**	-.152*	-.102+	-.079	.117*	.112+	.097+

** p<.001, * p<.01, + p<.05

In the age-adjusted model, father's life dissatisfaction and participants' low leadership predicted higher job strain in men. In the age- and education adjusted model both maternal and paternal life dissatisfaction as well as participants' low leadership predicted higher job strain (table 3).

TABLE 3.
Unstandardized regression coefficients of preemployment factors predicting job strain in men at age 27-39.

	Model 1[a]		Model 2[b]	
	β	95%CI	β	95%CI
Family history of CHD	-.088	-.188 to .012	-.023	-.033 to -.013
1983				
Family income	-.012	-.030 to .005	-.002	-.020 to .016
Mother's education	-.004	-.014 to .006	.003	-.007 to .013
Father's education	-.010	-.019 to .010	-.003	-.012 to .007
Maternal life satisfaction	-.042	-.094 to .010	-.061	-.113 to -.010
Paternal life satisfaction	-.056	-.106 to -.005	-.070	-.120 to -.020
1986				
Aggression	.001	-.043 to .045	-.002	-.045 to .041
Leadership	-.095	-.137 to -.053	-.086	-.128 to -.044
Hard-driving	-.007	-.041 to .027	-.001	-.035 to .033
Eagerness-energy	-.018	-.071 to .036	-.010	-.062 to .043
2001				
Education	-.023	-.033 to -.013	na[c]	

[a] Model 1: adjusted for age [b] Model 2: adjusted for age and education [c] not applicable

The results of multivariate linear regression analyses showed that adjustment for preemployment parental socioeconomic position weakened the relationship between job strain and CIMT by 4%, and that parental life satisfaction adjustment strengthened job strain/CIMT relationship (8%) whereas adjustment for preemployment type A behavior components attenuated the job strain/CIMT relationship by 17% to non-significant. Despite the fact that adjustments for preemployment factors had an effect on job strain/CIMT relationship, it remained significant after full adjustment (table 4).

TABLE 4
Unstandardized regression coefficients of job stain and preemployment factors predicting CIMT in men at age 27-39.

	Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]		Model 5[e]		Model 6[f]	
	β	95%CI	β	95%CI	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Age	.006	.004 to .008	.006	.004 to .008	.006	.004 to .008	.006	.004 to .008	.006	.004 to .008	.006	.004 to .008
Family history of CHD	.042	.019 to .047									.043	.020 to .065
1983												
Family income			.001	-.004 to .005							.001	-.004 to .005
Mother's education			.001	-.003 to .004							.001	-.002 to .004
Father's education			-.003	-.006 to .000							-.003	-.006 to .000
Maternal life satisfaction					.022	.008 to .038					.024	.008 to .040
Paternal life satisfaction					-.011	-.026 to .005					-.012	-.028 to .003
1986												
Aggression							.001	-.010 to .011			.002	-.009 to .012
Leadership							-.012	-.022 to -.001			-.011	-.022 to -.001
Hard-driving							-.005	-.013 to .003			-.005	-.013 to .003
Eagerness-energy							.012	-.001 to .025			.013	.000 to .026
2001												
Education									-.001	.003 to .002	.001	-.002 to .003
Job strain	.023	.003 to .043	.022	.001 to .042	.025	.004 to .045	.019	-.001 to .040	.022	.002 to .043	.022	.001 to .043

[a] Model 1: adjusted for age and family history of CHD [b] Model 2: adjusted for age and parental socioeconomic position
[c] Model 3: adjusted for age and parental life satisfaction [d] Model 4: adjusted for age and Type A behavior components
[e] Model 5: adjusted for age and education [f] Model 6: fully adjusted

Furthermore, we repeated the analyses using different formulations of job strain, as well as the components of job strain. The quotient term of job strain was associated with CIMT in age-adjusted analyses but not in fully adjusted analyses (table 5). The regression beta coefficient reduction of age-adjusted model compared to fully adjusted model was 14 % (the tertile term of job strain) and 26% (the quotient term). In addition, multivariate regression analyses shown in tables 4 and 5 were repeated with these alternative operationalisations of job strain controlling for biological coronary risk factors, but this did not change the results.

TABLE 5.
Unstandardized regression coefficients of different job stain formulations and its components predicting CIMT in men at age 27-39.

	Model 1[a]		Model 2[b]	
Job strain formulation	β	95%CI	β	95%CI
Tertile	.014	.004 to .024	.012	.002 to .023
Quotient	.042	.007 to .078	.031	-.005 to .067
Quadrant	.008	-.011 to .026	.006	-.013 to .024
Multiplicative (interaction)	.001	-.002 to .003	.001	-.001 to .004
Job strain component				
Job control	-.008	-.020 to .004	-.003	-.017 to .010
Job demands	.012	-.002 to .026	.013	-.001 to .027

[a] Model 1: adjusted for age
[b] Model 2: fully adjusted (age, family history of CHD, family income, parental education, parental life satisfaction, participants education)

DISCUSSION

In this study of 494 healthy young men aged 27 to 39 years, higher job strain was associated with higher CIMT. Preemployment family factors did not markedly attenuate the job strain/CIMT relationship, although the parental socioeconomic position slightly weakened the relationship, while parental life satisfaction slightly strengthened it. Preemployment leadership component of type A behavior attenuated the association between job strain and CIMT by 17% to non-significant. These results suggest that preemployment factors may contribute to the job strain/CIMT relationship in healthy men, and furthermore that preemployment disposition may have greater influence on this relationship than environmental family factors.

In the present study, the age-adjusted analyses of family factors and job strain showed that paternal life dissatisfaction predicted job strain of men. When an additional adjustment for participants' education was made, both maternal and paternal life dissatisfaction were predictive of job strain. This finding is in line with previous studies that have indicated that parental life dissatisfaction is linked to various negative outcomes in adolescence and in adulthood.[21, 36] Parents' mmarital life dissatisfaction has been related to behavior problems and psychopathology in adolescent offspring.[36] In the Cardiovascular Risk in Young Finns sample, childhood maternal life dissatisfaction as such predicted depressive tendencies in adolescent girls, and when life satisfaction was associated with hostility also in boys.[20]

Although it has been documented that the relationship between job strain and CIMT is not accounted for by conventional risk factors for atherosclerosis, e.g., age, SES, childhood risk factors, health behavior, biological factors, in our cohort,[3] a recent meta-analysis showed that the association between job strain and cardiovascular disease can be substantially attenuated after adjustment for adulthood SES, biological factors and health behavior related factors.[2] Our finding that preemployment family factors had only a modest effect on the job strain/ CIMT relationship is not completely in accordance with previous findings reporting impact of socioeconomic status on longitudinal accumulation of cardiovascular risks.[37]

We found that of the four components of type A behavior, low leadership was associated with increased risk of job strain and early atherosclerosis. This finding is in line with previous reports from the Cardiovascular Risk in Young Finns study[38] linking low leadership as measured by A Finnish Multicenter Study measure (AFMS) to somatic risk factors of CHD, such as blood pressure and BMI. The AFMS-leadership measure[38] and the HWolf-leadership measure are highly correlated.[39] It is not known exactly what the lack of leadership implies and why low leadership predicts a risk. High leadership is related to a low level of risk factors as well as somatic well-being, e.g., it is related to high social and general self-esteem, popularity among peers, high achievement standards and perseverance.[39] This suggests that high leadership may represent a non-risk component of type A behavior.

Previous literature shows that the role of leadership with respect to stress and disease is far from clear. In the 1950's, high leadership was linked with high physiological stress in both humans and other primates, but in the 1960's low leadership was associated with stress-related diseases.[40] In a recent review by van Vugt (2006) leadership in humans is linked with initiative taking, task competency and (social) intelligence.[41] Lower leadership predicted lower educational attainment in this sample, as well as in the whole CRYF population. This link is a possible explanation for your

finding that low leadership predisposes to the selection of high strain employment later in life, as lower education is known to increase the possibility to end up in a job with low control and high demands in adulthood.[4, 42]

In addition, high eagerness-energy had a symptomatic direct association with CIMT. This finding points to the same direction as do previous studies; eagerness-energy has been linked to various biological risk factors for coronary heart disease in the current as well as in other samples: the eagerness-energy component has been associated with high levels of serum cholesterol and triglycerides in children and adolescents,[27] with longer physiological recovery time after exposure to stress,[43] diastolic blood pressure in eighteen-year-old girls,[38] and thicker adulthood CIMT in men over different developmental periods during a fifteen-year follow-up.[17] The HWolf eagerness-energy component has been suggested as being conceptually close to JAS-S speed and impatience.[17] Although eagerness-energy has been documented as relating to risk factors for cardiovascular heart disease, it was not an independent predictor of job strain in the present study, a potential reason for finding only a symptomatic association with early atherosclerosis in these data.

The current findings add to the strain – health literature by adopting a life-course perspective and suggest that in addition to traditional risk factors, personality factors from the period before entering work life may contribute to the strain–health associations. Hence, job strain may not originate entirely from occupational settings. Job strain is documented to increase the risk for cardiovascular events/disease,[2] but in addition, personality may to contribute to perceived job strain and the job strain/CIMT association in men. Our findings do not answer a global question on the importance of personality versus (work) environment on health. However, we suggest that the success of organizational interventions in attempting to modify job strain has thus far been relatively modest and may in part be related to the fact that effects of personality are largely ignored when work stress is considered to originate mainly from work.[4, 44]

There are at least two important advantages to this study. First, it combines a population-based data with a follow-up period of up to eighteen years, elements only very rarely available for study. Second, we applied a longitudinal study design in which type A behavior components were measured before the participants entered work life. Hence, neither work nor job strain could have exerted any effect on the type A behavior component level (e.g. an increase or decrease of type A behavior).

There are, however, several limitations that should be taken into account when interpreting these findings. First, missing data can be a problem in epidemiological studies. In multivariate analyses, the number of participants with full information on all study variables can be small relative to the actual sample size. Therefore, data imputation takes into account at least some of the lost information. Furthermore, whether information is missing at random, is taken into account by the EM-method whereas the complete case analysis ignores this. The EM-algorithm used in this study is documented to provide quite unbiased estimates.[34, 35] The studied sample was representative of the baseline population with respect to cardiovascular risk factors. However, the participants' parents and the participants themselves were slightly more educated than the excluded persons. Thus, it is not possible to completely exclude the possibility of selection bias in this study. Second, despite the eighteen-year follow-up period, the study population was under forty years of age when job strain and CIMT were assessed. It is possible that the relationships between preemployment factors, job strain and CIMT may differ from those observed in this study at later life stages when

clinical conditions become more common. In addition, the job strain was obtained by a self-report measure, due to which the response style may partly explain our findings. Furthermore, as our analysis on job strain-CIMT association was based on a relatively small number of participants, including a wide range of covariates in the model decreased stability of the job strain effect and widened confidence intervals. Third, components of type A behavior may have different implications for educational performance,[45] and for work stress and health.[39] Further research is needed to clarify this issue. Furthermore, given that we assessed personality with four scales but work stress only with two scales, a more comprehensive assessment of personality than work stress might have overestimate the effect of personality on the association between job strain and CIMT. Finally, our sample corresponded to the vast majority of the Finnish population in 1980, when the study was launched; the study sample was thus racially and culturally homogenous. The present results cannot therefore be generalized to other ethnic and cultural groups.

Conclusions

This study provides prospective evidence that excess risk for CIMT in employees perceiving job strain may, in part be related to their preemployment disposition, but less likely be related to preemployment family factors. Thus, the results suggest that type A behavior components, such as preemployment lack of leadership, contribute to the association between job strain and CIMT in later life.

Competing interests

The authors do not have any competing interests.

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