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Work-Related Stress May Increase the Risk of Vascular Dementia

Ross Andel, PhD^{a,b}, Michael Crowe, PhD^c, Elizabeth A. Hahn, BS^a, James A. Mortimer, PhD^d, Nancy L. Pedersen, PhD^{e,f}, Laura Fratiglioni, MD, PhD^g, Boo Johansson, PhD^h, and Margaret Gatz, PhD^{e,f}

^aSchool of Aging Studies, University of South Florida, Tampa, Florida

^bInternational Clinical Research Center, St. Anne's University Hospital, Brno, Czech Republic

^cDepartment of Psychology, University of Alabama at Birmingham, Birmingham, Alabama

^dDepartment of Epidemiology and Biostatistics, University of South Florida, Tampa, Florida

^eDepartment of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden

^fDepartment of Psychology, University of Southern California, Los Angeles, California

^gAging Research Center, Karolinska Institutet and Stockholm University, Stockholm, Sweden

^hDepartment of Psychology, Göteborg University, Sweden

Abstract

OBJECTIVES—We examined job control, job demands, social support at work, and job strain (ratio of demands to control) in relation to risk of any dementia, Alzheimer's disease (AD), and vascular dementia (VaD).

DESIGN—A cohort study.

SETTING—The population-based Study of Dementia in Swedish Twins.

PARTICIPANTS—A total of 257 dementia cases (167 AD, 46 VaD) and 9,849 non-demented individuals.

MEASUREMENTS—Dementia diagnoses were based on telephone screening for cognitive impairment followed by in-person clinical work-up. An established job exposure matrix was matched to main occupation categories to measure work characteristics.

RESULTS—In generalized estimating equations (adjusted for the inclusion of complete twin pairs), lower job control was associated with greater risk of any dementia (odds ratio [OR]=1.17, 95% confidence interval [95%CI] 1.04-1.31) and VaD specifically (OR=1.39, 95% CI 1.07-1.81). Lower social support at work was associated with increased risk of dementia (OR=1.15, 95% CI 1.03-1.28), AD (OR=1.14, 95% CI 1.00-1.31), and VaD (OR=1.28, 95% CI=1.02-1.60). Greater job strain was associated with increased risk of VaD only (OR=1.28, 95% CI 1.02-1.60).

Corresponding Author: Ross Andel, PhD; School of Aging Studies; 4202 East Fowler Ave., MHC 1323; University of South Florida; Tampa, Florida 33620; Office: (813) 974-9743; Fax: (813) 974-9754; randel@usf.edu. **Alternate Corresponding Author:** Elizabeth Hahn; School of Aging Studies; 4202 East Fowler Ave., MHC 1312; University of South Florida; Tampa, Florida 33620; Office: (813) 974-9439; Fax: (813) 974-9754; ehahn@usf.edu.

Conflicts of interest

None of the authors had any (financial or personal) conflicts of interest.

Authors' contributions

The following authors participated in the design of this study: R.Andel, M.Crowe, E.A.Hahn, and M.Gatz. The following authors participated in data analyses: R.Andel, and E.A.Hahn. All authors contributed to manuscript preparation and revising.

especially in combination with low social support (OR=1.35, 95% CI 1.11-1.64). Age, gender, education, and cardiovascular disease were controlled. Results were not explained by work complexity or manual work. No differences in work-related stress scores were observed in the 54 twin pairs discordant for dementia, although only two pairs included a twin with VaD.

CONCLUSION—Work-related stress including low job control and low social support at work may increase the risk of dementia, particularly VaD. Modification to work environment that includes attention to social context and provision of meaningful roles for the workers may contribute to the efforts to promote cognitive health.

Keywords

Work-related stress; job strain; dementia; vascular dementia

INTRODUCTION

Chronic exposure to stress can have many detrimental health consequences. Persistent stress can lead to overactivation of the hypothalamic-pituitary-adrenal (HPA) axis and, in turn, chronic elevation of glucocorticoids (e.g., cortisol) and proinflammatory cytokines (e.g., IL-6). This process has been linked to accelerated biological aging¹ and accelerated brain aging specifically², possibly due to allostatic load that disrupts homeostasis and can lead to dysregulation of body systems including the cardiovascular and nervous systems³. The personality trait of neuroticism^{4, 5} and post-traumatic stress disorder⁶ – both markers of chronic stress – have been associated with cognitive impairment in later life and dementia. However, little is known about the potential role of work-related stress in dementia risk, despite the fact that for most adults a large portion of life is spent at work.

In the past 30 years, the job strain model^{7, 8} has been widely used in research. It posits that jobs associated with low job control, high job demands, low social support at work, and combinations of these factors are stressful and lead to poorer health outcomes. The model has been predictive of health problems such as cardiovascular disease^{9, 10}, although there is mixed support for the job strain model as a whole.

Few studies to date have applied this model to studying risk of dementia, despite evidence that cardiovascular disease and dementia have many common risk factors.¹¹ Initial evidence that high control and high job strain may increase the risk of dementia and Alzheimer's disease (AD) comes from a recent study by the Kungsholmen Project.¹² In related research, greater challenge and control at work were associated with a reduced risk of dementia¹³, but no associations were found between self-reported high job demands and dementia.¹⁴ Neither study used theory-based measures.

The concept of work complexity^{15, 16} should be considered when studying work-related stress in relation to dementia. Higher work complexity appears to reduce the risk of dementia^{17, 18}, likely by supporting cognitive reserve via intellectual engagement. It can be argued that job control and demands also reflect engagement to some extent, therefore making work complexity a potentially important confound in this line of research.

Building on previous research, we hypothesized that lower job control, lower social support at work, and greater job strain would be associated with increased risk of any dementia, as well as subtypes of AD and vascular dementia (VaD), after controlling for potential confounding effects of age, gender, and education. We then tested whether work complexity, manual work, or vascular diseases (a factor particularly likely to underlie the results with VaD as the outcome) may explain the results. We also tested the possibility that greater job strain relates to dementia outcomes more strongly when combined with lower

social support. In research with cardiovascular outcomes, this combination is considered to confer a greater effect than job strain alone.^{8, 9} Finally, we tested whether results may vary between men and women, those with high versus low work complexity, or former manual versus non-manual workers. To test these hypotheses, we applied the job strain model of stress^{7, 8} to data from the population-based Study of Dementia in Swedish Twins (HARMONY).

METHODS

Participants

Participants were members of the Swedish Twin Registry¹⁹—a population-based registry of all twins residing in Sweden—who were 65 years of age or older in 1998 when the HARMONY (taken from the Swedish words for “health” [Hälsa], “genes” [Rv], “environment” [Miljö], “and” [Och], and “new” [NY]) study began a follow-up of all twins, including cognitive screening and in-person evaluation for dementia, as described in detail elsewhere.²⁰ Briefly, cognitive screening used the previously validated Telephone Cognitive Screening Protocol (TELE).²¹ Individuals who screened positive for cognitive dysfunction and their co-twins were contacted for an in-person clinical diagnostic evaluation for dementia, which followed the diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV).²² Differential diagnoses were made according to National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS–ADRDA) criteria for AD²³ and National Institute of Neurological Disorders and Stroke and Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDS–AIREN) criteria for vascular dementia.²⁴

In all, 20,206 participants were eligible for screening and 14,435 were reached by phone. In logistic regression models, the 5,771 non-participants were older by 0.16 years (odds ratio [OR]:1.02; 95% confidence interval [CI]: 1.01-1.02) and less likely to be men by 4% (OR: 0.78, 95% CI: 0.73-0.83). Information about gainful main lifetime occupation was available for 10,166 participants (Figure 1). Of these, 47 could not be included (<0.5%) because they had occupations for which job strain scores were not available, and 13 dementia cases had only self-reports of occupation available. Therefore, 10,106 participants (5,260 members of complete twin pairs and 4,846 individual twins) were used. Of these, 257 were classified as dementia cases (167 with AD and 46 with VaD) and 9,849 as controls. The average age at dementia onset was 76.8 years ($SD=8.2$ years).

Of the 257 dementia cases, 54 had a co-twin in the study who was alive and who was confirmed to be without dementia. Of these, 13 pairs were monozygotic and 41 were dizygotic (24 were opposite-gender); 28 were discordant for AD and 2 for VaD. On average, the time between estimated age of onset in a case and assessment in the non-demented co-twin was 6.1 years ($SD=5.5$ years).

Measures

Occupation—Indicators of work-related stress derived from the job strain model^{7, 8} were applied to the main lifetime occupation collected during HARMONY telephone screening. Knowledgeable informants (a spouse or an adult child) were used for those who could not respond themselves or had dementia. All gainful occupations were coded according to the Nordic version of the International Standard Classification of Occupation (ISCO) manual.

The *job demands* measure reflects work load stressors (e.g., intense, hectic work schedule, extreme work load). *Job control* reflects the extent to which one can use personal judgment

and assert control in the workplace. *Social support at work* reflects possibilities for helpful social interaction and support from co-workers and supervisors. *Job strain* was measured as the ratio of job demands to job control.²⁵

We applied the previously validated psychosocial job exposure matrix,^{8, 25,26} which is linked with ISCO scheme and includes scores for job control, job demands, and social support at work, to each occupation. Reported internal consistency was .79, .70, and .75 for job control, demands, and support. The score range is 0–10 for each dimension. There were positive correlations between job control and demands ($r=.44, p<.001$), job control and support ($r=.14, p<.001$), and job demands and support ($r=.09, p<.001$).

Illustrative occupations with low (below the median) job control included housekeepers, nurses, bookkeepers, clerks, and metal workers; common occupations with high job demands included nurses, clerks, shop assistants, farmers, and forest workers; and common occupations with low social support included shop assistants, elementary school teachers, vehicle drivers, tailors, and nurses.

Covariates—The covariates were age at screening (in years), gender, and level of education (basic [<7 years; corresponding to mandatory education for this cohort] vs. more than basic [≥ 7 years]), cardiovascular disease, work complexity, and manual work. Vascular diseases including hypertension, heart disease (ischemic heart disease, cardiac heart disease, cardiac dysrhythmia, and heart failure), and stroke were obtained from self- or informant-reports during the screening phase. Additionally, records of hypertension, heart disease, and stroke between 1969 and 2001 were derived from the inpatient registry system, which included up to eight discharge diagnoses coded according to the International Classification of Diseases (ICD) 8 through 1986 and ICD-9 thereafter. Medical conditions included hypertension (ICD-8 codes 400–404, ICD-9 codes 401–405), ischemic heart disease (ICD-8 and ICD-9 codes 410–414), cardiac dysrhythmia, heart failure or other myocardial insufficiency (ICD-8 and ICD-9 codes 427 and 428), and stroke (ICD-8 and ICD-9 codes 430–438).

To measure work complexity, we used theory-based scores developed and validated in the 1970s for use with occupational categories in the 1970 US Census.^{27–29} Parallel scores are not available in other countries but the scores have shown predictive validity for cognitive decline and dementia in Swedish^{17, 30,31} and Canadian¹⁸ samples. First, we matched occupational categories from the ISCO coding scheme with categories in the 1970 US Census using two raters, one based in the US and one in Sweden. There was a high inter-rater agreement, partly because the two schemes are largely parallel. Then, we applied the scores for complexity of work with data and people to the main occupation. One advantage was that the scores were developed when the participants were still part of the work force. We have previously published detailed information regarding the matching procedure and reliability estimates of the work complexity scores¹⁷, as well as data on work complexity and risk of dementia^{17, 18, 31}.

We found correlations between complexity of work with data and job control ($r=.44, p<.001$), job demands ($r=.39, p<.001$), and social support at work ($r=.39, p<.001$). Complexity of work with people was correlated with job control ($r=.44, p<.001$) and demands ($r=.47, p<.001$), but not with support ($r=.01, p<.58$), underscoring that having an occupation that involves complex work with people (e.g., a telephone operator or a shop manager) does not necessarily entail the presence of support from co-workers.

Manual (blue collar) work was determined based on the ISCO codes applied to the main occupation. Manual work was negatively correlated with job control ($r=-.59$, $p<.001$), demands ($r=-.61$, $p<.001$), and support ($r=-.23$, $p<.001$).

Data Analysis

We used generalized estimating equations (GEE) models to examine risk of all types of dementia while adjusting for pair wise clustering of participants. Since lower job control and lower social support at work were hypothesized to increase risk of dementia, these two variables were reverse scored so that positive estimates would indicate greater risk for lower control and support. Since we were most interested in the independent contribution of control, demands, and support to the risk of dementia, these measures were entered into models simultaneously. Job strain, entered separately, was converted to a z-score for ease of interpretation. An interaction of increasing job strain and decreasing social support was tested by entering the product of job strain and social support at work (mean-centered), as well as the two variables. When the results for all types of dementia were statistically significant, we proceeded to examine the risk of AD and VaD separately.

In twin analyses, we calculated the mean difference score and used a paired-samples t-test. Due to a small number of cases, only risk of all types of dementia was assessed. We used SAS software version 9 and a two-tailed .05 level of significance.

RESULTS

Analyses with the entire sample

Characteristics of participants are presented in Table 1. Cases were older than controls and included more women with the exception of cases with VaD. Controls were more educated and differed from cases in all work characteristics. Cases were more likely to have had history of stroke and heart disease.

In main analyses (see Table 2), lower job control and lower social support at work were independently associated with increased risk of dementia. The association between greater job strain (i.e., the ratio of job demands to job control) and increased risk of dementia was non-significant ($p=.10$). Since the association between job demands and dementia was particularly weak ($p>.50$), this variable was excluded from further analyses. In subsequent analyses with AD and VaD examined separately, we found the results to be weaker for AD and more pronounced for VaD than for all types of dementia considered together, including a significant association between greater job strain and risk of VaD. Excluding nurses or other specific occupations with low scores on job control and/or social support did not affect the results substantively.

Complexity of work did not explain the results. Somewhat surprisingly, adding manual work had a very limited effect on the results. To understand this finding better, we tested whether work-stress may account for the previously established association between manual work and dementia. We excluded education as a covariate due to its collinearity with manual work. We found that the significant association between manual work and dementia (OR: 1.49, 95% CI:1.06-2.10) was largely explained when indicators of job strain were added (OR:1.16, 95% CI:0.75-1.80). In the final models (far right column in Table 2), Vascular disease also had some but only relatively limited effect on the results.

Then we tested whether working in more isolated conditions may affect the role of job strain in dementia. In fully adjusted models, a significant interaction of job strain by social support was found in relation to dementia ($p<.05$) and, subsequently, with VaD alone ($p<.001$). In analyses stratified by social support, there were no significant results for all types of

dementia but greater job strain was associated with increased risk of VaD only (OR:1.35, 95% CI: 1.11-1.64) in jobs with low ($\leq$ median) social support, but not in jobs with high ($>$ median) social support (OR:0.82, 95% CI: 0.33-1.98).

In additional, stratified analyses (Table 3), we found a generally similar pattern of results for men and women, participants with low versus high work complexity and former manual versus non-manual workers. Exceptions to this pattern included an association between lower job control and greater risk of dementia in women but not in men and an association between lower social support and risk of AD among manual but not non-manual workers.

In analyses with twin pairs discordant for dementia, paired t-tests indicated that the mean values were similar for the cases and their non-demented co-twins for job control (mean difference=-0.02, t[53]: 0.11, p=.915), job demands (mean difference=0.01, t[53]: 0.05, p=.958), social support (mean difference=0.15, t[53]: 0.80, p=.427), and job strain (mean difference=-0.02, t[53]: 0.37, p=.710).

DISCUSSION

We examined the association between indicators of job strain and risk of dementia, plus AD and VaD alone, in the population-based Swedish Twin Registry. We found that lower job control and lower social support at work were independently associated with increased risk of dementia overall and VaD specifically. The results seemed to be more pronounced for social support at work than for job control. Greater job strain was significantly associated with greater risk of VaD only, particularly in combination with low social support at work.

Our findings for lower job control, greater job strain and increased risk of dementia are consistent with results of the only previous study on this topic published so far.¹² Our study was first to test low social support at work (opportunities for helpful interaction and support from coworkers and supervisors) as a risk factor and to obtain separate estimates for VaD. Taken together, our results support the hypothesis that work-related stress may increase the risk of dementia, especially VaD, and that social support at work may play a particularly important role in this association. The relative strength of the results for VaD supports a cardiovascular pathway. Specifically, chronic stress is known to lead to dysregulation in body systems such as the cardiovascular system, a process referred to as allostasis.³ Accelerated aging of the cardiovascular system may in turn reduce the time to dementia onset. In this regard, however, the finding that statistical adjustment for vascular diseases, known to be associated both with work-related stress⁹ and dementia³² did not weaken the results more substantially was unexpected. Although a lack of mediation by vascular factors was also found in a study of job strain and dementia with another population¹², this result may deserve further attention.

Our results were not explained by complexity of work, which presumably reflects intellectual engagement at work. In fact, the results for lower social support were strengthened when complexity of work was controlled, likely by better partitioning of work-related stress and work complexity. This pattern can be viewed as supporting the notion that the results are attributable to work-related stress, not engagement (or lack thereof) at work.

We previously reported that high complexity of work with people showed a particularly strong association with reduced risk of dementia.¹⁷ The finding that lower social support at work stands out as a risk factor among work stress indicators supports the notion that social factors are especially salient among modifiable risk factors for dementia,³³ which is encouraging with respect to targeted intervention strategies. Although it could be difficult to alter work-related activities in general, such as to increase autonomy or increase/reduce job

demands, modifying work environment to facilitate more social support and interaction among co-workers may be more feasible in most circumstances.

We found significant results for indicators of job strain while controlling for manual work, an established risk factor for dementia³⁴ and a likely confound. In addition, we found in a post-hoc analysis that a significant association between manual work and dementia in our sample was explained by job strain indicators, suggesting that work-related stress may explain the role of manual work in dementia but not vice-versa.

Once adding appropriate control variables, job demands alone did not yield significant associations with dementia, a finding reported previously using a similar (self-reported) measure,¹³ as well as using an identical occupation-based measure.¹² It may be that mental exercise offered by some demanding jobs (beyond what we captured by controlling for work complexity) could have contributed to these null findings, hence offsetting at least partially the negative effects of stress associated with high job demands. However, higher demands were related to VaD when examined relative to lower control (greater job strain). In addition, this result was magnified when restricted to those with below-median levels of social support at work, indicating that social support from coworkers and/or supervisors may serve as a buffer against job strain. That these results were only relevant for VaD can be interpreted as additional evidence for the potential role of work-related stress in brain degeneration subsequent to vascular aging.

Our analyses estimated separately for men and women, those with high versus low complexity occupations, and former manual and non-manual workers mostly yielded a relatively consistent pattern of results. This is important because individuals with occupational characteristics previously found protective against dementia, such as high work complexity^{17, 18, 31} or non-manual work³⁴, may still be at an elevated risk of dementia when their jobs reflect higher levels of stress.

We did not obtain significant findings for the 54 available twin pairs discordant for dementia, possibly due to the small sample size. In particular, our findings with the entire sample seemed to be driven by associations with VaD, but only 2 out of the 54 dementia-discordant twin pairs included a case with VaD. It is still possible that the results may be partially attributable to familial influences. In previously published twin analyses, we found that reporting physical symptoms in response to emotional stress (upset stomach, headache or noticeable heart beating) was associated with a greater risk of dementia;¹⁴ but we also found high intra-pair consistency in ratings for reactivity, which implies the importance of familial factors.

Several limitations should be noted. With respect to study design, this study involves analysis of prevalent dementia cases, which may expose the results to confounding by differential survival. In addition, underlying causes of dementia subtypes are often difficult to ascertain prior to autopsy. However, we used widely accepted diagnostic criteria and a consensus process to assure their careful application. The particular VaD criteria that we used are stringent, explaining the small number of VaD cases. Further, some members of the HARMONY study could not be interviewed as a result of refusal or illness and absence of an informed proxy. This may have led to some data missing not at random, a phenomenon that is often unavoidable. Finally, the sample of twins discordant for dementia was rather small. Further research is needed to uncover the potential role of familial factors in the association between work-related stress and dementia.

With respect to the measure of occupation, we did not know the duration of main occupation, which was likely to vary across participants, such as men and women. However, we controlled for gender in the main analyses and did not find substantially stronger results

for men in stratified analyses. It is unlikely that exposure varied in any other systematic way that would strengthen the association between work-related stress and dementia. Also important to note is that exit rates and job mobility were very low in Sweden until the late 1980s³⁵.

With respect to measuring stress, some may argue that work-related stress is an individually perceived phenomenon, whereas we present it as an objective phenomenon that affects all exposed individuals. Previous findings with occupation-based scores support the validity of objective measurement of stress in the context of work.^{8, 36} There is also evidence that work-related stress presents with physiological stress response regardless of subjective perception of stress.³⁷ Accounting for stressors outside of work may have been informative. However, these measures were not available. Some of this variance may have been captured in the adjustment for education and manual work. Finally, we tested work-related stress within only one, albeit most widely established, model. Other models such as the effort-reward imbalance model³⁸ or the organizational injustice model³⁹ may be useful in understanding any work-related stress-dementia link.

In conclusion, our most notable findings were that lower job control, lower social support at work, and greater job strain were associated with increased risk of dementia, particularly VaD. Modification to work environment that includes attention to social context and provision of meaningful roles for the workers may contribute to the efforts to promote cognitive health.

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Figure 1.
Flowchart of the two analytical samples used in this study.

Table 1

Characteristics of the Sample

	All	Non-demented	Dementia cases			Non-demented vs. cases ^b	
			All cases	AD	VaD	p(AD)	p(VaD)
n	10,106	9,849	257	167	46		
Age at screening, mean ($\pm$ SD)	72.7 (6.2)	72.4 (6.0)	81.6 (6.6)	82.5 (6.2)	80.5 (6.3)	<.001	<.001
% women	52	52	58	64	43	.044	.250
Education, % more than basic	47	47	28	28	22	<.001	.001
Hypertension, %	33	33	35	34	44	.448	.141
Heart disease, %	12	10	84	83	87	<.001	<.001
Stroke, %	7	6	32	14	80	<.001	<.001
Non-manual occupation, %	50	50	32	34	22	<.001	.003
Complexity with data, mean ($\pm$ SD)	3.0 (1.6)	3.0 (1.6)	2.7 (1.5)	2.7 (1.6)	2.6 (1.6)	.005	.005
Complexity with people, mean ($\pm$ SD)	1.7 (1.6)	1.7 (1.6)	1.3 (1.1)	1.3 (1.1)	1.2 (1.1)	<.001	<.001
Job control ^a , mean ($\pm$ SD)	5.2 (1.3)	5.2 (1.3)	5.6 (1.2)	5.6 (1.1)	5.9 (1.4)	<.001	.003
Job demands ^a , mean ($\pm$ SD)	4.6 (1.4)	4.6 (1.4)	4.2 (1.4)	4.1 (1.4)	4.2 (1.4)	<.001	.065
Social support at work ^a , mean ($\pm$ SD)	1.4 (1.1)	1.4 (1.1)	1.7 (1.3)	1.7 (1.3)	1.8 (1.4)	<.001	.032

AD = Alzheimer's disease; VaD = vascular dementia; SD = standard deviation.

^a Variables were reverse scored so that higher values would indicate more work-related stress.

^b p-values are based on separate generalized estimating equations models for clustered data.

Table 2

Indicators of Work-Related Stress and Dementia among Cases with All Types of Dementia (n=257), Alzheimer's Disease (n=167) and Vascular Dementia (n=46) versus Non-demented Participants (n=9,849)

	aOR ^a (95% CI)	aOR ^b (95% CI)	aOR ^c (95% CI)	aOR ^d (95% CI)
<i>All types of dementia</i>				
Lower job control	1.17 (1.04–1.31)	1.14 (1.02–1.29)	1.13 (0.99–1.28)	1.06 (0.92–1.23)
Higher job demands	1.00 (0.90–1.11)	1.03 (0.92–1.15)	1.04 (0.92–1.18)	1.02 (0.89–1.17)
Lower social support	1.15 (1.03–1.28)	1.23 (1.09–1.39)	1.21 (1.07–1.38)	1.21 (1.04–1.40)
Greater job strain	1.10 (0.98–1.25)	1.10 (0.97–1.24)	1.11 (0.98–1.25)	1.08 (0.94–1.24)
<i>Subsequent analyses with dementia subtypes</i>				
<i>Alzheimer's disease</i>				
Lower job control	1.15 (1.00–1.31)	1.10 (0.95–1.27)	1.10 (0.94–1.29)	1.04 (0.88–1.23)
Lower social support	1.15 (1.01–1.32)	1.23 (1.05–1.45)	1.24 (1.05–1.45)	1.22 (1.02–1.46)
Greater job strain	0.99 (0.84–1.17)	0.99 (0.84–1.17)	0.99 (0.85–1.17)	0.95 (0.79–1.13)
<i>Vascular dementia</i>				
Lower job control	1.39 (1.04–1.85)	1.40 (1.03–1.91)	1.35 (0.97–1.88)	1.33 (0.94–1.87)
Lower social support	1.30 (1.04–1.63)	1.39 (1.11–1.75)	1.37 (1.09–1.73)	1.31 (0.97–1.78)
Greater job strain	1.35 (1.08–1.64)	1.34 (1.07–1.68)	1.34 (1.08–1.66)	1.33 (1.05–1.69)

Note. aOR = adjusted odds ratio; 95% CI = 95% Confidence Interval; results with p<.05 are in bold.

Job strain job control, job demands, and social support at work were entered simultaneously; job strain (the ratio of job demands to job control) was tested in a separate model. Job demands was excluded from subsequent analyses because it was not associated with all types of dementia initially.

^a Adjusted for age, sex, and level of education.

^b Adjusted for previous covariates and complexity of work with data and people.

^c Adjusted for previous covariates and manual vs. non-manual work.

^d Adjusted for previous covariates and vascular diseases.

Table 3

Analyses Stratified by Gender, Above-Median Complexity of Work with Data or People (versus Not) and Manual versus Non-Manual Work

	Gender		Work complexity		Manual/non-manual work	
	Men	Women	Low ^d	High ^d	Manual	Non-manual
aOR^b (95% CI)	aOR^b (95% CI)	aOR^b (95% CI)	aOR^c (95% CI)	aOR^c (95% CI)	aOR^d (95% CI)	aOR^d (95% CI)
<i>All types of Dementia</i>						
N cases/controls	107/4726	150/5123	121/3749	136/6100	174/4877	83/4972
Lower job control	1.02 (0.82–1.27)	1.21 (1.01–1.46)	1.12 (0.91–1.37)	1.07 (0.89–1.29)	1.08 (0.92–1.27)	1.13 (0.74–1.73)
Lower social support	1.24 (1.02–1.51)	1.23 (1.02–1.49)	1.12 (0.93–1.35)	1.21 (1.05–1.39)	1.23 (1.07–1.42)	1.16 (0.72–1.87)
Greater job strain	1.13 (0.90–1.41)	1.09 (0.95–1.26)	1.08 (0.92–1.26)	1.16 (0.96–1.39)	1.08 (0.94–1.24)	1.20 (0.90–1.61)
<i>Alzheimer's disease</i>						
N cases/controls	60/4726	107/5123	79/3749	88/6100	111/4877	56/4972
Lower job control	0.96 (0.72–1.27)	1.14 (0.93–1.40)	1.15 (0.91–1.45)	0.98 (0.78–1.24)	1.06 (0.87–1.27)	1.26 (0.74–2.15)
Lower social support	1.25 (0.95–1.64)	1.26 (1.01–1.57)	1.21 (0.98–1.48)	1.18 (0.98–1.42)	1.29 (1.09–1.53)	0.69 (0.34–1.42)
Greater job strain	1.03 (0.71–1.48)	0.97 (0.81–1.16)	0.97 (0.78–1.19)	1.06 (0.82–1.37)	0.94 (0.77–1.15)	1.13 (0.80–1.60)
<i>Vascular dementia</i>						
N cases/controls	26/4726	20/5123	22/3749	24/6100	36/4877	10/4972
Lower job control	1.41 (0.92–2.17)	1.38 (0.75–2.51)	1.20 (0.77–1.87)	1.07 (0.89–1.29)	1.43 (0.99–2.08)	1.24 (0.43–3.56)
Lower social support	1.40 (1.05–1.87)	1.37 (0.87–2.16)	1.44 (0.98–2.13)	1.21 (1.05–1.39)	1.37 (1.07–1.76)	1.74 (0.87–3.49)
Greater job strain	1.36 (1.06–1.74)	1.30 (0.94–1.80)	1.22 (0.91–1.64)	1.51 (1.19–1.94)	1.32 (1.05–1.66)	2.34 (0.80–6.89)

Note. aOR = adjusted odds ratio; CI = Confidence Interval; results with p≤.05 are in bold. Job control and social support were entered into the same model; job strain was entered into a separate model. Job demands was excluded because it was not associated with dementia initially.

^a Low complexity: below or at median on complexity of work with data and people; high complexity: above median on either dimension.

^b Adjusted for age, level of education, work complexity, and manual work.

^c Adjusted for age, sex, level of education, and manual work.

^d Adjusted for age, sex, level of education, and work complexity.