

High Job Demands, Job Strain, and Iso-Strain Are Risk Factors for Sick Leave due to Mental Disorders

A Prospective Swedish Twin Study With a 5-Year Follow-Up

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Objective: To investigate whether psychosocial work environment and health behaviors are risk factors for sick leave due to mental disorders, and whether familial confounding (genetics and shared environment) explains the associations. **Methods:** Respondents ($n = 11,729$), given to complete a questionnaire in 2004 to 2006, were followed up approximately 5 years for sick leave spells due to mental disorders, using national registry data. Data were analyzed using logistic regression, and conditional logistic regression for twin pairs discordant for sick leave (cotwin control). **Results:** High job demands, job strain, and iso-strain were independent risk factors for sick leave due to mental disorders. Familial factors seem to be of importance in the associations between job support, smoking, a combination of unhealthy behaviors and sick leave. **Conclusions:** Improving the psychosocial work environment may be effective in preventing sick leave due to mental disorders.

Mental disorders are increasing as a reason for work disability in Europe.¹ In Sweden, mental disorders are the most common reasons for sick leave, accounting for 41% of all sick leave among women and 30% among men.² The most common diagnoses, constituting more than 90% of all mental sick leave spells, are stress-related disorders, mood disorders, and anxiety.² At an individual level, sick leave due to mental disorders may result in severe consequences such as premature mortality and suicide.³ At a societal level, the total cost for mental disorders including sick leave compensation in Sweden has been estimated to be more than €7 billion per year.⁴ Identifying risk factors for sick leave due to mental disorders may be useful for attempts to prevent this public health problem.

Psychosocial work conditions can have a major impact on mental well-being, and effects could be either positive or negative.^{5,6} For example, high levels of social support from supervisors and coworkers have been found to be protective against mental disorders such as depression.⁶ On the other hand, a work environment with a fast work pace and conflicting demands can have a negative effect on mental health.⁶ A poor psychosocial work environment has been found to increase the risk of sick leave and disability pension due to not only mental disorders^{7,8} but also sick leave in general.^{9,10} A

commonly used measure of the psychosocial work environment is the job demand-control-support model.¹¹ The basis of this model is that having high job demands in combination with low control is associated with poor health outcomes, especially if social support in the workplace is also low.¹²

Moreover, unhealthy behaviors such as smoking, excessive alcohol use, and a lack of physical activity have been found to be risk factors for sick leave and disability pension.^{13–19} Smoking has been linked to elevated levels of self-reported stress²⁰ and depression,²¹ which are common risk factors for sick leave due to mental disorders. Exposure to stressors such as traumatic events or a stressful work task has also been found to increase the urge to smoke, decrease the motivation to quit smoking, and also to increase the risk of relapse after quitting.²² Heavy drinking has been found to be associated with emotional exhaustion,²³ and alcohol dependence is associated with depression and anxiety.²⁴ In a systematic literature review,²⁵ both alcohol dependence and alcohol abuse were linked with disability due to anxiety and fatigue. Exercise on the other hand can be protective of feelings of fatigue and reduced energy levels²⁶ and decrease symptoms in those diagnosed with depression²⁷ and anxiety.²⁸

The majority of studies of work environment and sick leave focus only on work environment and do not take factors in the personal life, such as health behaviors, into account. Nevertheless, these aspects are not independent of each other as individuals experiencing work strain are more likely to have an unhealthy lifestyle.²⁹ Hence, in addition to being a risk factor, psychosocial work environment could be a possible confounder in the association between health behaviors and sick leave. In turn, the association between psychosocial work environment and sick leave could be influenced by health behaviors.²⁹

Furthermore, studies of work environment, health behaviors, and mental health outcomes have rarely considered the potential influence of familial factors. Discordant twin pair (cotwin) analysis provides a unique opportunity to investigate whether factors shared within twin pairs (genetics and shared environment) influence the association studied. By targeting the influence of work environment and health behaviors that is independent of familial factors, assessments of the association between these exposures and sick leave with control for familial influences may help provide some clues about the direct influence of psychosocial work environment and health behavior on future sick leave due to mental disorders. There are reasons to suspect that familial factors may influence the associations because recent studies have shown that sick leave has a moderate genetic component, explaining 36% to 50% of the total variance, among both women and men.^{30–32} Disability pension due to mental disorders has a genetic component with similar magnitude (42% to 49%).^{33,34} There is limited knowledge on the reasons for these genetic components; possibly it reflects the underlying diseases for the sick leave, but could also be a reflection of other factors associated with sick leave. Moreover, twin studies have found that smoking,^{35,36} alcohol use,³⁷ and physical activity^{38,39} are all moderately influenced by genetic factors. Familial factors have also been found to be of some importance in the association between psychosocial work environment and burnout,⁴⁰ as well as disability pension due to mental disorders.⁸

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This prospective twin study aims to investigate whether psychosocial work factors (job demands-control-support) and health behaviors (smoking, alcohol, and physical activity) are risk factors for sick leave due to mental disorders and whether the associations are influenced by familial factors.

MATERIALS AND METHODS

Participants and Data Sources

The study has a prospective cohort design. This study sample was derived from twins ($n = 25,496$) that responded to the Study of Twin Adults: Genes and Environment (STAGE), a web-based questionnaire study including twins born between 1959 and 1985 from the population-based Swedish Twin Registry.⁴¹ The response rate was 59.9%. The STAGE was an extensive survey aimed at studying diseases and exposures relevant during young adulthood and midlife and contained sections assessing work environment as well as in depth information on health behaviors.⁴²

Using the unique personal identification number of the participants, data on demographics, education, work, and income were obtained from the *Longitudinal Integration Database for Health Insurance and Labor Market Studies* register (LISA by Swedish acronym) held by Statistics Sweden.⁴³ The participants were followed up for sick leave from their STAGE response date (varying from November 1, 2004, to May 2, 2006) until December 31, 2010 (approximately 5 years), using data from the National Social Insurance Agency's database MicroData for Analyses of the Social Insurance (MiDAS). The MiDAS contains starting and ending dates and the main International Classification of Diseases (ICD)-diagnoses (from 2005 onward) on sick leave spells reimbursed by the agency for the whole population older than 16 years. After an unpaid qualifying day, sick leave is paid by the employer for 14 days, after which the agency reimburses lost income of up to 80%. A medical certificate is required after 7 days, and sick leave may be granted for full or part time. Inclusion criteria include having a confirmed STAGE interview date, being present in the LISA register at the start of the follow up, not being on sick leave or disability pension at the time of STAGE response, having sick leave in a mental disorder or no sick leave during follow up, and answering the job demands-control-support section of the STAGE (Fig. 1). The study population ($n = 11,729$) included 1621 complete same-sex pairs, whereof 901 monozygotic (MZ) and 720 same-sex dizygotic (DZ). In the sample there were 161 pairs discordant for sick leave due to mental disorders.

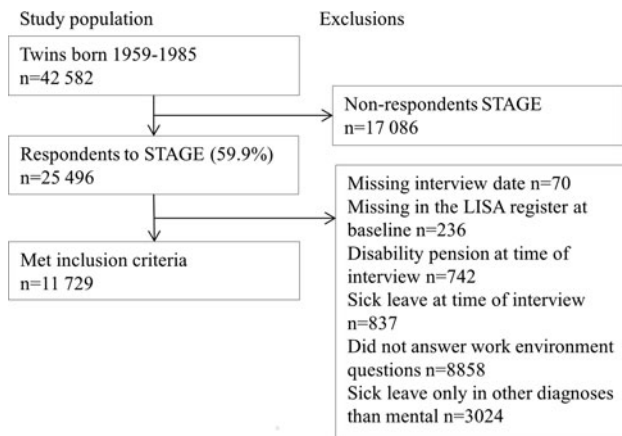


FIGURE 1. Flowchart of the study participants.

Outcome

Sick leave spells due to mental disorders were classified as diagnostic codes F00-F99 in ICD-10.^{44,45} A binary outcome variable was created with those who had at least one spell of sick leave in a mental diagnosis during the follow-up time (1) and those who had no sick leave during the follow-up (0).

Exposures

The Swedish translation of Karasek and Theorell's measure⁴⁶ was used to assess *job demands, control, and support* (11). The questionnaire includes questions such as "Does your job require you to work very fast?" (demands), "Do you have the possibility to decide for yourself how to carry out your work?" (control), and "There is good collegiality at work" (support). Answers were on a four-point Likert scale with answers: 1 = agree completely, 2 = agree somewhat, 3 = do not really agree, and 4 = do not agree at all. The mean scores of job demands control and support were calculated so that "1" indicated the best work environment (least job demands, most control, and support) and "4" the worst work environment (most job demands, least control, and support). The measures have been found to have satisfactory psychometric properties.⁴⁶ Cronbach α values in this study were 0.68 for job demands, 0.70 for control, and 0.83 for support.

A categorical variable was created using the median cutoff (job demands = 2.6; control = 1.8; support = 1.7). Those with high demands and high control were classified as having an *active job*, those with low demands and low control a *passive job*, low demands and high control a *low strain job*, and those with high demands and low control as having *job strain*. Furthermore, a subgroup among those with job strain that also had low support was created (ie, *iso-strain*).

Alcohol was measured as amount consumed on an average week. Grams of alcohol per week was calculated from questions inquiring about type, amount, and frequency of alcohol consumption using the formula Grams ALC = (Frequency Week) (Centiliters) \times (10) (%alcohol) (Gravity ALC).⁴⁷ Those answering no to the question "Have you been drinking, during the past year, beer, wine, or spirits? Beer refers to any beer that is stronger than light beer" were classified as abstainers. The guidelines for "risk use" of alcohol from the Swedish National Institute of Public Health were used to select cutoff points. A standard drink contains 12 g of alcohol and corresponds to approximately 40 mL of spirits, 150 mL of wine, or 330 mL of beer. Those consuming more than 14 standard drinks for men, or 9 standard drinks for women per week, were classified as at risk consumers and those consuming less were classified as light-moderate consumers.⁴⁸ Light-moderate consumers and abstainers were used as a reference category in the analysis.

A categorical variable *smoking* was created: current smoker and nonsmoker. The question "Have you ever smoked or used snuff" with the response alternatives—1 = never even tried, 2 = yes, tried smoking, 3 = yes, tried snuff, 4 = smoking/smoked occasionally, 5 = smoking/smoked regularly, 6 = used/using snuff occasionally, and 7 = using/used snuff regularly—was used to identify never smokers (answering 1 or 2) and ever smokers (answering 4 or 5). The individuals answering yes to one of the follow-up questions "Do you currently smoke cigarettes?" or "Do you currently smoke cigarettes occasionally or at parties?" were classified as current smokers.⁴⁹ The ever smokers answering no to these questions were classified as nonsmokers, together with the never smokers, and this group was used as the reference category.

Physical activity was measured with the question "Rate your current physical activity level on a scale from 1 to 10; 1 = very low (sedentary, mainly sitting), 5 = moderate physical activity (a few walks a week), and 10 = very high (sports/jogging several

times a week).” The question was regarding overall physical activity. Following the same procedure as Trolle-Lagerros,⁵⁰ the responses were collapsed into five categories: none (1 to 2), low (3 to 4), moderate (5 to 6), high (7 to 8), and vigorous (9 to 10). In this study, the categories “none” and “low” were collapsed into one category due to the low numbers of respondents in these groups. Vigorous was used as the reference category.

Health behaviors—a sum score was given using the amount of healthy behaviors. The median of physical activity was used as the cutoff score with the median value counted into the healthy group (ie, high or vigorous physical activity was considered healthy behavior). Drinking a light to moderate amount or abstaining from alcohol and not currently smoking were also considered being healthy behaviors. Groups were formed as follows: unhealthy (one or none of the healthy behaviors), moderately healthy (two healthy behaviors), and healthy (three healthy behaviors).⁵¹

Background Factors

Sex was entered in the analyses as a dichotomous variable. *Age* was used as a continuous variable derived from subtracting the date of responding to the STAGE questionnaire from the year of birth. *Zygosity* was measured by a set of questions assessing twin-pair similarity—a validated method with 98% accuracy.⁵² *Education* was measured as the highest level of completed education registered in the LISA database at baseline in three levels: elementary (9 years), secondary (12 years), or higher education. *Previous sick leave* was measured as presence or absence of sick leave between January 1, 2003 (spells starting in 2002 or earlier and that continued into 2003 were included), and the response date to the STAGE. *Self-rated health* was measured with the question “How do you rate your general health?” with the response alternatives 1 = excellent, 2 = good, 3 = moderate, 4 = fairly poor, and 5 = poor.⁵³ The response alternatives 4 and 5 were collapsed into one category due to the low number of respondents in these categories.

Statistical Analyses

Data were analyzed in STATA (IC 12.1). Two-sided *t* tests (continuous variables) and Chi-square tests (categorical variables) were used to test whether frequencies of exposures varied between those with no sick leave during follow-up and those with sick leave due to mental disorders. Logistic regression analyses were used to assess odds ratios (ORs) and 95% confidence intervals. Answers “do not know/do not want to answer” were treated as missing values. Two types of regression analyses were performed. First, analysis of the whole sample, including both complete pairs and singletons (where only one twin had responded or met inclusion criteria—see Fig. 1 for inclusion criteria), was performed using the cluster robust standard error to account for the statistical nonindependence for the complete pairs. Background factors were introduced in three steps. Quadratic terms were added to the models with continuous predictors to check whether they were linearly associated with the outcome. If they were found to be significant ($P < 0.05$), they were kept in the model, and the continuous predictor as well as the quadratic term was centered. Interaction terms between the health behaviors and psychosocial work environment were tested in the models.

Second, a cotwin control analysis was performed, using conditional logistic regression analysis. By performing a conditional analysis of the cases that have a twin control without sick leave (discordant twin pair), which is by matching adjusted for sex, age, and familial factors, it is possible to assess the impact of familial confounding on the associations by comparing the results to the estimates of the whole sample, adjusted for sex and age. MZ and same-sex DZ twins were included as they provide a closer match compared with opposite-sex DZ twins. In discordant twin-pair analyses, twins in a pair are optimally matched on genetic (100% for MZ pairs and on average 50% for DZ pairs) and shared environmental

factors when reared together. Stratifying the analyses on zygosity can provide further information on whether the familial confounding is due to genetic or shared environmental factors.⁵⁴ Nevertheless, due to low power in the cotwin analysis only the results including both zygosity groups together are presented.

This study has been approved by the regional ethics committee board in Stockholm (Dnr: 2007/524-31, Dnr: 2010/1346-32/5, and Dnr: 2014/311-32).

RESULTS

Descriptive Results

Frequencies of background factors stratified on sick leave status in the sample can be found in Table 1. Eight percent of the sample (972 persons) had sick leave due to mental disorders during the follow-up time, and the majority (74%) of these was women. Those who had sick leave due to mental disorders more often experienced job strain and iso-strain compared with those who did not have any sick leave during follow-up and were more often smokers and less physically active. There was no significant difference between the groups in risk use of alcohol (Table 2).

Associations Between Work Environment, Health Behaviors, and Sick Leave

An association was found between job demands and sick leave due to mental disorders, which was independent of included confounders (Table 3). Control and support were not risk factors for sick leave in the analysis adjusted for confounders, and support was not linearly associated with sick leave due to mental disorders. Having job strain and iso-strain was associated with sick leave due to mental disorders independent from included confounders.

Current smoking was found to be a risk factor for sick leave in the adjusted analysis of the whole sample. Nevertheless, risk use of alcohol and none/low or moderate physical activity were not risk factors in the adjusted analyses. Moreover, having high physical activity was protective of sick leave compared with vigorous physical activity (Table 3). A combination of two to three unhealthy behaviors was associated with sick leave due to mental disorders, whereas having one unhealthy behavior was not associated with sick leave due to mental disorders in the adjusted analysis of the whole sample.

Adjusting for the health behaviors did not majorly affect the association between psychosocial work environment and sick leave due to mental disorders; however, having an active job no longer was statistically significant after adjustment for confounders (Table 3). Also, the associations between the health behaviors and sick leave due to mental disorders were not affected by the psychosocial work environment (Table 3). No significant interactions between any of the health behaviors investigated and psychosocial work environment were found (numbers not shown).

Impact of Familial Factors

The associations between job demands, having an active job, job strain, and iso-strain and sick leave due to mental disorders were found to be independent of familial factors as the ORs in the cotwin control analysis were statistically significant and in the same direction as the ORs in the analysis of the whole sample (Table 3). Nevertheless, the associations between support, smoking, and a combination of two to three unhealthy behaviors and sick leave due to mental disorders seem to be influenced by familial factors, as the ORs were reduced and not statistically significant in the cotwin analysis, compared with the analysis adjusted for sex and age (Table 3).

DISCUSSION

This population-based prospective twin study investigated whether psychosocial work environment and health behaviors were

TABLE 1. Baseline Frequencies of Background Factors Among 11,729 Swedish Twins, Stratified by the Outcome

Background Factors	Whole Sample		Among Those With Sick Leave in Mental Diagnoses (n = 972)		Among Those With No Sick Leave (n = 10,757)	
	n (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	Mean (SD)
Sex						
Female	5,766 (49)		717* (74)		5,049* (47)	
Male	5,963 (51)		255 (26)		5,708 (53)	
Age, yrs						
20–47		35 (6.9)		36* (6.6)		35* (6.9)
Zygosity						
Monozygotic	4,028 (34)		339 (35)		3,689 (34)	
Dizygotic same sex	3,599 (31)		278 (29)		3,321 (31)	
Dizygotic opposite sex	3,824 (33)		330 (34)		3,494 (33)	
Unknown zygosity	278 (2)		25 (2)		253 (2)	
Education						
Elementary	568 (5)		61* (6)		507* (5)	
Secondary	5,687 (48)		509 (53)		5,178 (48)	
Higher education	5,474 (47)		402 (41)		5,072 (47)	
Previous sick leave						
Previous sick leave	1,570 (13)		340* (35)		1,230* (11)	
No previous sick leave	10,159 (87)		632 (65)		9,527 (89)	
Self-rated health						
Excellent	3,922 (33)		208* (22)		3,714* (35)	
Good	5,823 (50)		483 (51)		5,340 (51)	
Moderate	1,528 (13)		209 (22)		1,319 (13)	
Fairly poor/poor	187 (2)		49 (5)		138 (1)	
Missing	269 (2)					

*Differences between groups are statistically significant ($P < 0.05$). SD, standard deviation.

risk factors for sick leave due to mental disorders and whether familial factors confounded these associations. Job demands, job strain, iso-strain, smoking, and a combination of two to three unhealthy behaviors were found to be risk factors for sick leave due to mental disorders, independent of the included confounders. Familial factors seem to be of importance in explaining the associations between job support, current smoking, and a combination of unhealthy behaviors and sick leave due to mental disorders, whereas high job demands, job strain, and iso-strain were found to be risk factors for sick leave due to mental disorders, not affected by familial factors or other confounders.

Our finding that job demands, strain, and iso-strain were associated with sick leave due to mental disorders is in line with previous research.⁵⁵ This study contributes to the current literature as it also adjusted for familial factors. The finding that the associations between job demands, strain, and iso-strain and sick leave due to mental disorders were independent from familial factors suggests these factors may have a direct effect on sick leave due to mental disorders. This is supported by previous findings that reducing job strain lowered the risk for depression.⁵⁶ Hence, interventions to reduce sick leave due to mental disorders that focus on improving the psychosocial work environment, especially reducing high psychosocial job demands, may prove effective. Job demands has, in addition to being a risk factor for sick leave due to mental disorders, been found to reflect an objectively measured job stressor (overcrowding in a hospital ward)⁷ and predicts physical and psychological indicators of strain and psychological well-being.⁵⁵ Our results also indicate

that the associations between control, support, and sick leave due to mental disorders do not seem to be direct. Some aspects of control, such as high skill discretion, may also be perceived as additional job demands by some individuals, making the control variable a complex measure.^{40,57} Familial factors were found to be of importance in the association between support and sick leave due to mental disorders. Hence, how an individual perceives support may be influenced by genetic and/or shared environmental factors that also affect vulnerability to sick leave due to mental disorders. Nevertheless, when adjusting for self-rated health and previous sick leave, the OR was also no longer significant, indicating that the familial factors may be a reflection of health status. Our results also showed that health behaviors did not have a major impact on the association between psychosocial work environment and sick leave due to mental disorders, in line with another study.⁷ This indicates that a reduction of sick leave due to mental disorders among those with a poor psychosocial work environment may not be achieved by only improving health behaviors, without also focusing on the work environment.

Some previous studies have found heavy drinking to be a risk factor for sick leave,^{17,19} but this study showed that risk use of alcohol was not associated with sick leave because mental disorders. Hence, it seems that to have an increased risk for sick leave due to mental disorders a higher consumption than “risk use” is needed. As patients with mental disorders are often recommended not to drink even moderate amounts of alcohol,⁵⁸ we classified abstaining from alcohol as a healthy behavior in the summary variable. Smoking was a significant risk factor for sick leave due to mental disorders in the adjusted

TABLE 2. Baseline Frequencies of Exposures Among 11,729 Swedish Twins, Stratified by the Outcome

Exposures	Whole Sample		Among Those With Sick Leave due to Mental Disorders (n = 972)		Among Those With No Sick Leave (n = 10,757)	
	n(%)	Mean(SD)	n (%)	Mean(SD)	n (%)	Mean (SD)
Job demands (1–4)		2.5 (0.6)		2.6* (0.6)		2.5* (0.6)
Control (1–4)		1.9 (0.6)		2.0* (0.6)		1.9* (0.6)
Support (1–4)		1.6 (0.5)		1.7* (0.5)		1.6* (0.5)
Low strain	2,022 (17)		122* (12)		1,900* (18)	
Passive	3,606 (31)		268 (28)		3,338 (31)	
Active	2,446 (21)		194 (20)		2,252 (21)	
Strain	3,655 (31)		388 (40)		3,267 (30)	
Iso-strain†	1,968		226		1,742	
Alcohol use						
Light/moderate/abstainer	9,510 (81)		755 (87)		8,755 (88)	
Risk use	1,289 (11)		116 (13)		1,173 (12)	
Missing	930 (8)					
Smoking						
Nonsmoker	8,641 (74)		686* (75)		7,955* (82)	
Current smoker	1,931 (16)		230 (25)		1,701 (18)	
Missing	1,157 (10)					
Physical activity						
None/low	1,811 (15)		187* (24)		1,624* (18)	
Moderate	2,432 (21)		226 (28)		2,206 (25)	
High	3,318 (28)		232 (29)		3,086 (35)	
Vigorous	2,062 (18)		155 (19)		1,907 (22)	
Missing	2,106 (18)					
Health behavior sum score						
Healthy	3,429 (29)		225* (33)		3,204* (44)	
Moderately healthy	3,412 (29)		304 (45)		3,108 (42)	
Unhealthy	1,175 (10)		145 (22)		1,030 (14)	
Missing	3,713 (32)					

*Differences between groups are statistically significant ($P < 0.05$).

†Iso-strain is a subgroup of strain.

SD, standard deviation.

analysis of the whole sample, in line with previous research.^{14,15} Nevertheless, this study found that the association seems to be explained by familial factors. This is consistent with two other twin studies, which found that the increased risk of disability pension due to mental disorders among smokers was explained by familial factors.^{49,51} This indicates that the association between smoking and sick leave due to mental disorders may not be direct, but instead perhaps a reflection of a shared familial vulnerability. Previous research on the association between physical activity and sick leave has shown varied results. Some studies found low physical activity to be associated with sick leave.^{14,59,60} Nevertheless, the associations have been relatively weak and two randomized controlled trials found no effect of exercise interventions on sick leave.^{61,62} In this study, the association between physical activity and sick leave due to mental disorders was influenced by the confounders (ie, sex, age, education, and health status [self-rated health and previous sick leave]) similar to results by others.^{63,64} A weakness of the measurement used in this study is that it did not distinguish between leisure time and workplace physical activity. Previous studies have found that leisure time, but not workplace physical activity, improved health⁶⁵ and reduced sick leave.⁶⁶

The strengths include the large sample size, a prospective design, and the use of good-quality national register data. Also, both work environment and health behaviors were taken into account. Moreover, using a twin sample allowed adjustment for familial factors and allowed further exploration of the associations between psychosocial work environment, health behaviors, and sick leave than would a study of the general population. Familial factors, such as a genetic predisposition to mental disorders, may affect how an individual perceives work environment and at the same time may predispose to sick leave due to mental disorders. Using a twin design meant that we could confirm that the association between work environment and sick leave due to mental disorders were independent of such factors. Nevertheless, because the outcome was relatively rare, there were a low number of discordant twin pairs and as a result the cotwin model only included 2.7% of the sample. Therefore, as the assessment of the influence of familial factors was based on comparisons of the analysis of the whole sample and the cotwin model, that contained much fewer subjects, the fact that familial factors seemed to explain some of the associations needs to be interpreted with caution. Limitations of the study include that the MiDAS register used in this study contains only the primary sick leave diagnosis. Other

TABLE 3. Odds Ratios With 95% Confidence Intervals for the Associations Between Psychosocial Work Environment, Health Behaviors, and Sick Leave due to Mental Disorders in the Whole Sample (n = 11,729) and of the Complete Same Sex Pairs Discordant for the Outcome (n = 322) (Cotwin ORs)*

	Crude OR (CI)	Adjusted 1† (CI)	Adjusted 2‡ (CI)	Adjusted 3§ (CI)	Cotwin ORs (CI)
Job demands					
1–4 (continuous)	<i>1.47 (1.30–1.66)</i>	<i>1.50 (1.32–1.69)</i>	<i>1.41 (1.24–1.60)</i>	<i>1.47 (1.26–1.71)</i>	<i>1.91 (1.18–3.11)</i>
Job control					
1–4 (continuous)	<i>1.25 (1.12–1.40)</i>	<i>1.18 (1.05–1.33)</i>	1.02 (0.90–1.17)	0.98 (0.84–1.15)	1.30 (0.84–2.00)
Job support (including quadratic term)					
1–4 (continuous)	<i>1.26 (1.08–1.47)</i>	<i>1.26 (1.08–1.48)</i>	1.15 (0.98–1.36)	1.05 (0.86–1.28)	0.93 (0.53–1.64)
Low strain	1	1	1	1	1
Passive	1.25 (1.00–1.56)	1.18 (0.94–1.48)	1.02 (0.81–1.28)	0.93 (0.70–1.22)	1.60 (0.73–3.52)
Active	<i>1.34 (1.06–1.70)</i>	<i>1.40 (1.10–1.77)</i>	<i>1.30 (1.02–1.67)</i>	<i>1.27 (0.95–1.70)</i>	<i>2.93 (1.29–6.66)</i>
Strain	<i>1.85 (1.50–2.28)</i>	<i>1.74 (1.41–2.15)</i>	<i>1.40 (1.12–1.75)</i>	<i>1.38 (1.06–1.79)</i>	<i>4.42 (1.98–9.86)</i>
Iso-strain	<i>2.02 (1.61–2.54)</i>	<i>1.91 (1.52–2.41)</i>	<i>1.47 (1.16–1.88)</i>	<i>1.37 (1.03–1.82)</i>	<i>5.03 (2.04–12.44)</i>
Alcohol use					
Light-moderate/abstainer	1	1	1	1	1
Risk use	1.15 (0.93–1.41)	1.09 (0.88–1.35)	1.09 (0.87–1.35)	1.08 (0.87–1.34)	1.86 (0.74–4.67)
Smoking					
Nonsmoker	1	1	1	1	1
Current smoker	<i>1.57 (1.34–1.84)</i>	<i>1.50 (1.28–1.76)</i>	<i>1.30 (1.10–1.55)</i>	<i>1.29 (1.09–1.54)</i>	0.50 (0.23–1.07)
Physical activity					
None/low	<i>1.42 (1.13–1.77)</i>	<i>1.38 (1.10–1.73)</i>	0.91 (0.71–1.16)	0.91 (0.71–1.17)	1.05 (0.44–2.50)
Moderate	<i>1.26 (1.02–1.56)</i>	1.15 (0.93–1.430)	0.81 (0.64–1.02)	0.81 (0.64–1.02)	1.16 (0.52–2.60)
High	0.92 (0.75–1.14)	0.86 (0.70–1.07)	<i>0.75 (0.60–0.94)</i>	<i>0.75 (0.60–0.94)</i>	0.77 (0.35–1.66)
Vigorous	1	1	1	1	1
Sum score					
Healthy	1	1	1	1	1
Moderately healthy	<i>1.39 (1.16–1.67)</i>	<i>1.37 (1.14–1.64)</i>	1.06 (0.88–1.28)	1.06 (0.88–1.28)	1.15 (0.59–2.21)
Unhealthy	<i>2.00 (1.61–2.50)</i>	<i>1.86 (1.49–2.33)</i>	<i>1.34 (1.05–1.69)</i>	<i>1.34 (1.05–1.70)</i>	0.91 (0.33–2.49)

*Statistically significant associations are highlighted in italics.

†Adjusted for sex and age.

‡Adjusted for sex, age, education, previous sick leave, and self-rated health.

§Adjusted for sex, age, education, previous sick leave, self-rated health, and health behaviors sum score or job strain.

||Adjusted for sex, age, and familial (genetic and shared environmental) factors by matching.

CI, confidence interval; OR, odds ratio.

diagnoses may in fact be present because an individual can have a mental disorder, but also a secondary diagnosis or several diagnoses, which also contributed to the sick leave. The Swedish Twin Registry only contains twins born in Sweden and the STAGE only contains twins born from 1959 to 1985. Hence, generalizability may be lower to individuals born in another country, and to older persons. The health behaviors included in this study have been found to be fairly stable over time.^{67,68} Nevertheless, the behaviors may take a long time to affect health and we cannot draw conclusions on their effect on sick leave in the longer term.

CONCLUSIONS

This population-based prospective twin study found that job demands, job strain, and iso-strain were risk factors for sick leave due to mental disorders, even after adjusting for several factors including familial, health behaviors, health status, and other background factors. Hence, improving the psychosocial work environment may prove effective in measures to reduce sick leave due to mental disorders. Because familial factors seem to explain some of the associations between work environment, health behaviors, and sick leave due to mental disorders, further studies in this area should, if possible, take such factors into account.

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