ORIGINAL ARTICLE

Are there bidirectional relationships between psychosocial work characteristics and depressive symptoms? A fixed effects analysis of Swedish national panel survey data

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ABSTRACT

Objectives Psychosocial work characteristics have been prospectively associated with depressive symptoms. However, methodological limitations have raised questions regarding causality. It is also unclear to what extent depressive symptoms affect the experience of the psychosocial work environment. We examined contemporaneous (measured simultaneously) and lagged bidirectional relationships between psychosocial work characteristics and depressive symptoms, simultaneously controlling for time-stable individual characteristics.

Methods We included 3947 subjects in the Swedish Longitudinal Occupational Survey of Health (SLOSH), with self-reported job demands, control, social support, work efforts, rewards, procedural justice and depressive symptoms in four waves 2010–2016. We applied dynamic panel models with fixed effects, using structural equation modelling, adjusting for all time-stable individual characteristics such as personality and pre-employment factors.

Results Higher levels of job demands, job demands in relation to control, work efforts and efforts in relation to rewards were contemporaneously associated with more depressive symptoms (standardised β: 0.18–0.25, p<0.001), while higher levels of workplace social support, rewards at work and procedural justice were associated with less depressive symptoms (β: −0.18, p<0.001,β: −0.16, p<0.001 and β: −0.09, p<0.01, respectively). In contrast, only work efforts predicted higher levels of depressive symptoms 2 years later (β: 0.05, p<0.05). No other lagged associations were found in any direction.

Conclusions After controlling for all time-invariant confounding, our results suggest that psychosocial work characteristics predominantly affect depressive symptoms immediately or with only a short time lag. Furthermore, we found no evidence of reverse causation. This indicates short-term causal associations, although the temporal precedence of psychosocial work characteristics remains uncertain.

Key messages

What is already known about this subject?

► The causality of associations between psychosocial work characteristics and depression has been questioned, and the possibility of reverse causation also requires further study.

What are the new findings?

► Our findings suggest mainly contemporaneous associations between a range of psychosocial work characteristics and depressive symptoms when eliminating both measured and unmeasured time-stable confounding. There was little evidence of prospective relationships between work characteristics and depressive symptoms 2 years later, and finally, we found no evidence of reverse causation.

How might this impact on policy or clinical practice in the foreseeable future?

► Even though our findings could not generally confirm temporal precedence of psychosocial work characteristics, these findings are consistent with short-term causal relationships between psychosocial job characteristics and depressive symptoms. This supports continued policy and practice interventions to improve the psychosocial work environment, in order to protect and promote workplace mental health.

INTRODUCTION

There is evidence of associations between a number of psychosocial work characteristics and symptoms of depression[1 2] and clinical depression.[3] Most studies thus far have examined components of the job demand–control (JDC) model[4] in which psychological job demands refer to the pace and mental intensity of work, while job control (decision latitude) comprises decision authority and skill discretion. The job demand–control–support (JDCS) model extends the JDC model by integrating social support.[5] The strongest support for an association between psychosocial work characteristics and depressive symptoms was recently observed for job strain (combination of high demands and low control), low job control and bullying.[2] Another theoretically based model is the effort–reward imbalance model, hypothesising that perceived efforts (such as demands or obligations at work) exceeding the perceived rewards (such as salary, promotion prospects, job security, appreciation or positive feedback) result in a stress reaction.[6] An effort–reward imbalance has also been

prospectively associated with increased risk of depressive disorders.[7] The organisational justice model is another model in the previous stress-health literature.[8] Procedural justice, a specific form of organisational justice, concerning perceptions of fairness of the decision-making procedures at the workplace has been most commonly studied. Procedural justice has been prospectively associated with mental health.[9]

However, despite the vast literature demonstrating prospective relationships between job demands and control in particular, and depressive symptoms, several limitations in previous literature raise some doubt regarding causal associations.[1] One major concern is common method bias as a consequence of relying solely on self-reports. Reverse causation cannot thus be ruled out with complete confidence. Reciprocal relationships have been observed between work characteristics and depression or distress.[10 11] However, it is still unclear to what extent depressive symptoms affect the experience of the psychosocial work environment. Moreover, personality traits, family history and other pre-employment factors may be associated with both working conditions and depressive symptoms, thus confounding these associations.[1 12] One study suggested that unobserved time-invariant confounders led to overestimation of the association between work stressors such as demands, control, efforts, rewards, justice and psychological distress.[13] These work stressors were, however, still clearly associated with subsequent psychological distress in that study. However, another study only observed a 1-year lagged association between (delayed response of) job demands and poorer mental health but not for job control, work complexity, job security and fairness of pay, when eliminating measured or unmeasured time-invariant confounders.[14] Furthermore, no study thus far has to our knowledge examined bidirectional relationships between psychosocial work characteristics and depressive symptoms while also controlling for time-stable individual characteristics.

The objective of the present study was to examine bidirectional relationships between psychosocial work characteristics and depressive symptoms including both contemporaneous (ie, same measurement occasions) and lagged (ie, from one measurement occasion to the next) relationships while controlling for time-stable individual characteristics.

METHODS

Data source and study population

The data source was the Swedish Longitudinal Occupational Survey of Health (SLOSH), a nationally representative longitudinal cohort survey of gainfully employed individuals 16–64 years of age from the entire country stratified by county, sex and citizenship.[15] SLOSH participants have been followed up by postal self-completion questionnaires every second year, since 2006 until 2018 so far. One version of the questionnaire is for people in paid work, defined as those in gainful employment for at least 30% of full time on average during the past 3 months and another for people working less or who have left the labour force temporarily or permanently. All in all, 28 672 (70%) individuals had responded at least once in 2016, while 8466 had responded at least four times. Detailed information about the SLOSH study can be found elsewhere.[15]

Analytic sample

The present analysis is based on SLOSH participants who responded to the questionnaire for those in paid work in wave 3 (2010), n=9132, and who also responded to at least one more questionnaire for those in paid work during either wave 4 (2012), 5 (2014) or 6 (2016), n=7183, and finally who had data regarding depressive symptoms in waves 3–6. This resulted in a sample of 3947 individuals (figure 1). Data from waves one

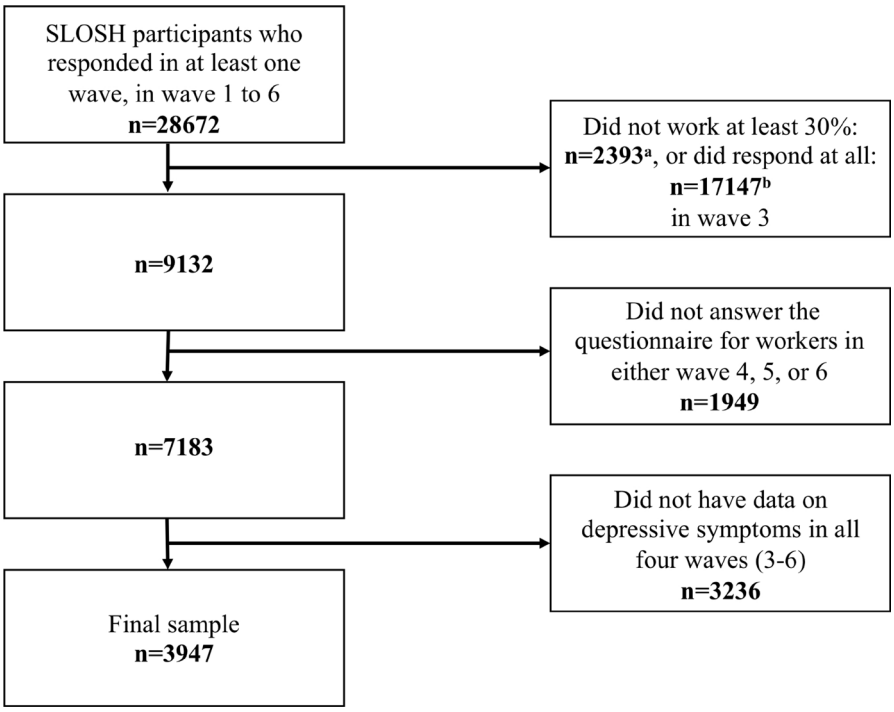

Figure 1 Flow chart describing the selection of the study sample. [a]Includes, for example, people working part time (<30% of full time), unemployed, on sick-leave, on parental leave, retired and students. [b]Some of the 17 147 individuals who did not respond at all were not invited to participate in wave 3 but first invited in later waves. Of all 40 877 individuals in the SLOSH cohort, 19 388 individuals were invited only after wave 3. SLOSH, Swedish Longitudinal Occupational Survey of Health.

and two were excluded because different measures were used for some of the psychosocial work characteristics.

Psychosocial work characteristics

We used psychosocial work characteristics measured in waves 3–6, including dimensions from the JDCS, effort–reward imbalance and organisational justice models, using self-reports. Job demands, control and social support were measured by the Demand–Control–Support Questionnaire.[16] Four items (working fast, too much effort, enough time and conflicting demands) were used to create a job demand score and five items (learn new things, high level of skill, require initiative, deciding what to do at work and deciding how to do your work) to create a job control score, ranging from 'never/almost never' (1) to 'often' (4), based on findings of measurement invariance over time.[17] We also created a continuous variable of the demand–control ratio, using a correction factor (4/5=0.8) multiplied with control due to unequal number of items. Five questions (calm and pleasant atmosphere, good spirit of unity, colleagues are there for me, people understand a bad day and get on well with my supervisors) were used to create a score reflecting social support at work ranging from 'strongly disagree' (1) to 'strongly agree' (4).

The short version of the effort–reward imbalance questionnaire, which has shown satisfactory psychometric properties, was used.[18–20] The effort scale included three items (time pressure due to work load, job become more demanding and workload increased) and reward included seven items (lack acknowledgement supervisor, poor promotion prospects, experience(d) undesirable change, job security poor, not receive respect/prestige, work prospects adequate and salary/income adequate),[20] ranging from 'strongly disagree' (1) to 'strongly agree' (4). In addition, we created a continuous variable of the effort–reward ratio, using a correction factor (3/7≈0.43) multiplied with rewards due to unequal number of items.[21]

Procedural justice was measured using a seven-item scale[8] (decisions taken correctly, bad decisions revoked/changed, all sides affected represented, decisions taken consistently, everyone give their opinion, feedback provided and people informed and possible obtain details underlying decision). Response options ranged from 'strongly agree' (1) to 'strongly disagree' (5).

In the composite scales, high values represented high demands, high control, high social support, high efforts, high rewards and high procedural justice. The demand–control ratio ranged from 0.3 to 5.0 with higher values representing higher demands in relation to control. The effort–reward ratio ranged from 0.2 to 4.0, with higher values representing more efforts in relation to rewards.

Depressive symptoms

Depressive symptoms were measured in wave three through six with a brief six-item subscale from the (Hopkins) Symptom Checklist, the Symptom Checklist-core depression scale.[22] The participants were asked how much on a 5-point Likert scale during the last week they experienced: feeling blue, feeling no interest in things, feeling lethargic or low in energy, worrying too much about things, blaming oneself for things and feeling everything is an effort, ranging from 'not at all' (0) to 'extremely' (4). These items represent core symptoms, whose selection was based on principles of clinical validity.[23] This scale has been validated and found to have good psychometric properties.[22] We used a sum scale serving as an indicator of depression severity, ranging from 0 to 24.[22]

Data analysis

Descriptive statistics in wave three and six were investigated according to a number of demographic characteristics, including sex, age, civil status (married/cohabiting vs single), occupational position (as a measure of socioeconomic status), as well as the psychosocial work characteristics and depressive symptoms. Occupational position was coded according to the Swedish socioeconomic classification based on occupation and divided into six ordered categories.

To assess the associations between psychosocial work characteristics and depressive symptoms, we applied dynamic panel models with fixed effects,[24] which were fitted using structural equation modelling (SEM) including both work characteristics and depressive symptoms as observed variables. These types of models enable assessment of the influence of lagged predictors while simultaneously adjusting for time-stable individual characteristics through the inclusion of a latent variable representing all stable characteristics of the individuals, which is a benefit of these models compared with traditional cross-lagged SEM analyses. The time-stable characteristics include both measured and unmeasured factors such as sex, personality, genetics and childhood experiences. The models hence use variation *within* individuals to estimate the relationships between variables of interest, with each individual serving as his or her own control. The panel models, including lagged values of all the variables in the model, were based on the assumption of sequential or weak exogeneity and were specified in accordance with Allison *et al*.[24] Separate models were fitted to assess the lagged association between each work characteristic (independent variables) to depressive symptoms (dependent variable) and between depressive symptoms (independent variable) to work characteristics (dependent variables). However, reciprocal causation was also accommodated by allowing the error term in each equation to correlate with future values of the time dependent predictors.[25] Cross-lagged regression coefficients were constrained to be equal across time (assumed time constant with only one coefficient estimated across the four waves) found appropriate according to χ^2 tests. The fixed effects latent variable was allowed to be correlated with all time-varying independent variables.[26] The models additionally allowed for correlations between the independent and dependent variable from the same measurement (see online supplementary figure 1). To reduce bias introduced by missing information, we used the full information maximum likelihood (FIML)[27 28] in the main models, which retains cases with missing data on any of the variables in the models shown to produce unbiased parameter estimates and standard errors, when information is missing at random or completely at random.

For comparison, corresponding traditional cross-lagged SEM analyses were also conducted that did not control for time-stable characteristics through fixed effects, but which were adjusted for sex, age, civil status and occupational position.

Standardised ß-coefficients with their 95% CIs were assessed, estimating the increase/decrease in depressive symptoms in SD associated with one SD increase/decrease in psychosocial work characteristics.

Model fit was assessed by Comparative Fit Index (CFI), Tucker-Lewis Index, (TLI), root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR), based on recommendations in the literature.[29] RMSEA values <0.05, and SRMR values <0.08, while values of CFI and TLI close to 1 were assumed to indicate a well-fitting model.[29] The analyses were conducted using the lavaan package in R.

Table 1 Characteristics of the 3947 SLOSH participants,* including depressive symptoms and psychosocial work characteristics in waves 3 (2010) and 6 (2016)

	Wave 3 (2010)			
	N	(%)	Wave 6 (2016)	
Sex				
Men	1661	42		
Women	2286	58		
Civil status				
Single	786	20		
Married or cohabiting	3107	80		
Occupational position				
Unskilled employees	510	13		
Skilled employees	597	15		
Assistant non-manual employees	533	14		
Intermediate non-manual employees	1259	32		
Professionals/upper level executives	860	22		
Self-employed	123	3		
	Mean	**(SD)**	**Mean**	**(SD)**
Age (range 23–71 years)	50.3	9.3	56.3	9.3
Depressive symptoms (range 0–24)	5.2	5.1	4.7	4.9
Demands (scale 1–4)	2.6	0.5	2.6	0.6
Control (scale 1–4)	3.3	0.5	3.3	0.5
Demand–control ratio (0.3–5)	1.0	0.3	1.0	0.3
Social support (scale 1–4)	3.1	0.5	3.2	0.5
Efforts (scale 1–4)	2.6	0.7	2.7	0.5
Rewards (scale 1–4)	2.6	0.5	2.7	0.5
Effort–reward ratio (0.2–4.0)	1.1	0.4	1.1	0.4
Procedural justice (scale 1–5)	3.3	0.9	3.2	1.0

*Missing data in wave 3: n (%): age: complete, civil status: 54 (1.4), occupational position: 65 (1.6), demands: 87 (2.2), control: 65 (1.6), demand–control ratio: 116 (2.9), job strain: 116 (2.9), social support: 142 (3.6), effort: 74 (1.9%), reward: 147 (3.7), effort–reward ratio: 181 (4.6), procedural justice: 189 (4.8).

Sensitivity analyses to assess the associations between psychosocial work characteristics and depressive symptoms were also performed among those 7183 participants, including individuals without complete data on depressive symptoms in all waves but who fulfilled the other inclusion criteria previously described.

RESULTS

Sample characteristics

Characteristics of the 3947 participants are presented in table 1. The sample consisted of individuals aged 23–71 years, predominantly females and married or cohabiting. Means and SD of the psychosocial work characteristics were very similar in wave 3 compared with wave 6. Depressive symptoms were slightly lower in wave 6. For depressive symptoms and each of the work characteristics, the majority (95%–100%) of the participants had scores that changed at least once between waves 3–4, 4–5 or 5–6 (data not shown).

Results of the traditional cross-lagged SEM models

The traditional cross-lagged SEM models showed that all psychosocial work characteristics were contemporaneously associated with depressive symptoms. All work characteristics except job control predicted subsequent depressive symptoms and the effect estimates for the associations between depressive symptoms and subsequent work characteristics were similar, indicating bidirectional lagged associations (see online supplementary table 1). However, the fit indices were relatively poor overall.

Results of the dynamic panel models with fixed effects: contemporaneous associations

The dynamic panel models with fixed effects, assessing contemporaneous associations between psychosocial work characteristics and depressive symptoms are shown in table 2. Higher job demands (ß: 0.20 95% CI 0.14 to 0.26), demand–control ratio (ß: 0.18, 95% CI 0.12 to 0.24), work effort (ß: 0.19, 95% CI 0.13 to 0.25) and effort–reward ratio (ß: 0.25, 95% CI 0.19 to 0.31) were associated with higher depressive symptoms measured simultaneously. However, social support (ß: −0.18, 95% CI −0.24 to −0.11), rewards (ß: −0.16, 95% CI −0.22 to −0.10) and procedural justice (ß: −0.09, 95% CI −0.15 to −0.02) were associated with lower depressive symptoms contemporaneously.

Results of the dynamic panel models with fixed effects: lagged associations

The corresponding estimates of lagged associations are shown in table 3. One SD increase in work effort was associated with 0.05 SD increase (95% CI 0.01 to 0.09) in depressive symptoms 2 years later, indicating that higher work effort predicted more depressive symptoms, though with a substantially smaller magnitude

Table 2 Results of the dynamic panel models with fixed effects, including fit statistics, standardised regression coefficients and 95% CIs, assessing contemporaneous associations between psychosocial work characteristics and depressive symptoms among 3947 SLOSH participants between 2010 and 2016

	n	CFI	TLI	RMSEA	SRMR	Df	χ^2	P value (χ^2)	β†	95% CI
Demands	3947	1.000	0.998	0.014	0.007	6	10.85	0.09	0.20***	0.14 to 0.26
Control	3947	1.000	1.000	0.000	0.004	6	5.03	0.54	–0.05	–0.11 to 0.02
DC ratio	3947	0.999	0.998	0.016	0.007	6	11.74	0.07	0.18***	0.12 to 0.24
Social support	3947	1.000	0.998	0.014	0.007	6	10.90	0.09	–0.18***	–0.24 to –0.11
Effort	3947	1.000	0.999	0.008	0.006	6	7.57	0.27	0.19***	0.13 to 0.25
Reward	3947	0.999	0.998	0.016	0.007	6	6.43	0.38	–0.16***	–0.22 to –0.10
ER ratio	3947	0.999	0.997	0.020	0.008	6	15.54	0.02	0.25***	0.19 to 0.31
Procedural justice	3947	1.000	1.000	0.007	0.005	6	7.19	0.30	–0.09**	–0.15 to –0.02

Adjustment for time-stable characteristics was performed by inclusion of a latent variable in the models.
*p<0.05, **p<0.01, ***p<0.001.
†Standardised β-coefficients.
CFI, Comparative Fit Index; DC ratio, demand–control ratio; ER ratio, effort–reward ratio; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker-Lewis Index.

Table 3 Results of the dynamic panel models with fixed effects, including fit statistics, standardised regression coefficients and 95% CIs, assessing bidirectional lagged associations between psychosocial work characteristics and depressive symptoms among 3947 SLOSH participants between 2010 and 2016

	n	CFI	TLI	RMSEA	SRMR	Df	χ^2	P value (χ^2)	β†	95% CI
Psychosocial work characteristics to depressive symptoms										
Demands	3947	1.000	0.998	0.014	0.007	6	10.85	0.09	0.04	−0.05 to 0.09
Control	3947	1.000	1.000	0.000	0.004	6	5.03	0.54	−0.01	−0.07 to 0.04
DC ratio	3947	0.999	0.998	0.016	0.007	6	11.74	0.07	0.03	−0.01 to 0.08
Social support	3947	1.000	0.998	0.014	0.007	6	10.90	0.09	−0.01	−0.05 to 0.03
Effort	3947	1.000	0.999	0.008	0.006	6	7.57	0.27	0.05*	0.01 to 0.09
Reward	3947	0.999	0.998	0.016	0.007	6	6.43	0.38	0.01	−0.03 to 0.04
ER ratio	3947	0.999	0.997	0.020	0.008	6	15.54	0.02	0.03	−0.01 to 0.06
Procedural justice	3947	1.000	1.000	0.007	0.005	6	7.19	0.30	0.00	−0.04 to 0.05
Depressive symptoms to psychosocial work characteristics										
Demands	3947	0.999	0.995	0.024	0.010	6	19.79	0.00	−0.01	−0.06 to 0.03
Control	3947	0.999	0.997	0.021	0.008	6	16.27	0.01	0.03	−0.01 to 0.06
DC ratio	3947	0.999	0.995	0.025	0.009	6	21.02	0.00	−0.03	−0.08 to 0.01
Social support	3947	0.999	0.997	0.018	0.008	6	13.27	0.04	−0.00	−0.05 to 0.04
Effort	3947	1.000	1.000	0.004	0.004	6	6.43	0.38	−0.01	−0.05 to 0.03
Reward	3947	1.000	0.999	0.010	0.005	6	8.41	0.21	−0.01	−0.05 to 0.04
ER ratio	3947	0.999	0.998	0.015	0.007	6	11.33	0.08	0.02	−0.02 to 0.07
Procedural justice	3947	0.998	0.993	0.027	0.014	6	22.98	0.00	−0.01	−0.06 to 0.04

Adjustment for time-stable characteristics was performed by inclusion of a latent variable in the models.
*p<0.05, **p<0.01, ***p<0.001.
†Standardised β-coefficients.
CFI, Comparative Fit Index; DC ratio, demand–control ratio; ER ratio, effort–reward ratio; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker-Lewis Index.

compared with contemporaneously. A somewhat increased risk estimate was also observed for job demands although the CI included unity. For the remaining work characteristics, the standardised beta coefficients were small in magnitude and not statistically significant, even though the directions were the same as for the contemporaneous effects. Thus, there was limited evidence of prospective associations between psychosocial work characteristics and depressive symptoms.

The bottom half of table 3 shows that depressive symptoms did not predict psychosocial work characteristics 2 years later. All beta coefficients were small in magnitude and CIs included unity.

Sensitivity analysis

The sensitivity analyses including individuals with incomplete data on depressive symptoms (n=7183) showed very similar results to the analyses including 3947 individuals (see online supplementary tables 2 and 3).

DISCUSSION

Our results indicated that only efforts at work was a predictor of depressive symptoms 2 years later, when controlling for time-stable characteristics. In the traditional SEM analyses, which did *not* control for time-stable characteristics, there were lagged associations between all psychosocial work characteristics, except control, and depressive symptoms. This accords with a relatively large share of previous research that has found prospective associations between psychosocial work characteristics and depression.[1–3 7 9] However, the traditional SEM analyses had relatively poor fit, suggesting these results should be interpreted with caution. The main analyses controlling for time-invariant characteristics did not support the traditional analyses regarding lagged associations—coefficients were both greatly attenuated and included the null, suggesting previous traditional study results may have been attributable to residual time-invariant confounding. A similar fixed effects analytic approach has also been used in a couple of previous studies.[13 14] One of the studies,[13] using similar measures of work characteristics and psychological distress, showed markedly decreased estimates of association when ruling out stable individual characteristics, although associations remained statistically significant for all work characteristics. No lagged associations were, however, investigated. Milner *et al*,[14] also investigated lagged associations and found contemporaneous associations between various work stressors and mental health, while only job demands had a lagged effect on mental health 1 year later (consistent with our suggestive findings for efforts and demands). This was largely in line with the present study supporting mainly contemporaneous associations between psychosocial work characteristics and mental health.[14] The present study cannot, however, be directly compared with the work by Milner *et al*. First, the time lag in the present study was 2 years instead of 1 year. Second, we specifically addressed depressive symptoms compared with a more general indicator of mental health. Finally, we used a slightly different way of estimating lagged associations, and we estimated bidirectional associations. To the best of our knowledge, this is the first study assessing the relationships in the opposite direction, that is, between depressive symptoms and subsequent work characteristics, controlling for unobserved time-invariant factors. A few previous studies have assessed 'reverse relationships' with more standard analytic approaches. These findings show that poor mental health or distress may affect the experience of the work environment but generally indicate that work characteristics like job demands, control, support or effort–reward imbalance are stronger predictors of mental health or distress than the other way around.[10 11 30–32] Moreover, significant lagged effects

from depressive symptoms to justice perceptions have also been observed in a previous study,[33] although some studies on organisational justice have presented mixed findings.[34–36] In earlier SLOSH work, we also showed that depressive symptoms were related to both subsequent demands and social support,[10] but this was not supported in the present analyses after taking into account both measured and unmeasured time-stable individual characteristics.

Our results question the existence of bidirectional associations, across 2 years, between major work stressors and depressive symptoms, and suggest that some of the associations observed in traditional analyses may at least partly be explained by individual characteristics like genetics, childhood experiences or stable personality traits, which were not measured and controlled for. Another possible explanation for the lack of lagged associations in the fixed effects analyses may be that only changes in the work characteristics and depressive symptoms (depending on model) are considered. This means that, for example, possible cumulative effects are not captured in our fixed effects analyses. Both changes in work characteristics and depressive symptoms, or vice versa, may have a more immediate (or delayed) influence than over a course of 2 years. Our results cannot rule out the possibility that some of the work characteristics are prospectively associated with depressive symptoms over lags shorter than 2 years.

With regard to reversed associations from depressive symptoms to work characteristics, it has, for example, been proposed that poor mental health may be related to work characteristics through the so called 'gloomy perception' (change in perception of the work environment due to ill-health) or the 'drift mechanism' (actual decrement in working conditions). Both of these mechanisms have been indicated of importance.[37] If both positive and negative changes in work characteristics occur within healthy or unhealthy individuals over time, effects could cancel each other out, which may be another explanation for a lack of observed longitudinal associations in the opposite direction than traditionally assumed.[38] Future research examining temporal bidirectional associations over shorter time lags may further the understanding of causality and temporal aspects of work stress-depressive symptoms relationships.

There are several strengths of the present study worth noting. The study was longitudinal with several repeated measures of both job characteristics and depressive symptoms, allowing us to account for the time-varying nature of these factors and dependency between the observations. This study examined a broad set of work characteristics including effort–reward imbalance and procedural justice for which previous literature on reverse relationships has been limited. In addition, we accounted for all time-stable characteristics of the individuals and thus measured covariates like sex, age and occupational position and unmeasured factors like personality and reporting style, which may give rise to common method bias. Time-stable characteristics may also include genetic factors and childhood experiences with potential long-term influence on individual health and life situation. Adjusting for time-stable individual factors should also account for prior morbidity, which may coexist with depression. Hence, the associations noted here are less subject to bias and more likely to represent causal associations than previous analyses of observational data. Furthermore, the results were coherent and internally consistent with estimates in the expected directions. Moreover, we were able to handle missing data and perform analyses in a large sample of individuals broadly representative of the Swedish working population. Using continuous measures and ratios, rather than categorical, made it possible to include more participants experiencing change in exposure, thereby increasing power and generalisability. The high degree of change in the psychosocial work characteristics contributed to relatively precise estimates. Overall, the fit of the models was good to excellent, which is usually found with lagged models considering time-invariant characteristics.[39]

Some limitations should also be acknowledged. As mentioned earlier, a time lag of 2 years between measures may be too long to observe more immediate relationships. The analyses are mainly based on repeated measures from four consecutive waves and hence may be affected by a relatively large attrition rate, potentially leading to selection. However, results from the sensitivity analyses including individuals with incomplete data on depressive symptoms were very similar, except that the prospective association between efforts and depressive symptoms was not fully supported. However, the main analyses may represent more valid estimates as missing data on both work characteristics and depressive symptoms may be missing not at random, violating the assumptions of FIML. The sample also consisted of a small proportion working part time limiting the generalisability. A conceptual overlap should also be noted between the measures of job demands and efforts, between control/support and rewards, as well as effort–reward imbalance and organisational justice.

We tested only for linear relationships between job stressors and depressive symptoms. However, we did not find different results from models considering that the variables are not perfectly linear, supporting that the variables could be treated as continuous rather than ordinal. The models estimated were quite complex relative to the number of observations, and this partly contributed to excellent fit. More df may have been preferable.[40] The sequential exogeneity assumption was not tested and if violated may bias our estimates. Although we adjusted for both unmeasured and measured factors, time-varying confounding was not considered and cannot be ruled out.

CONCLUSION

Contrary to some previous evidence, after controlling for all time-invariant confounding, our results suggest that psychosocial work characteristics predominantly affect depressive symptoms immediately or with only a short time lag. Furthermore, we found no evidence of reverse causation. This indicates short-term causal associations, although the temporal precedence of psychosocial work characteristics remains uncertain.

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Contributors JKÅ assisted in designing the study, conducted the main part of the statistical analyses and drafted the manuscript. ADL contributed to the interpretation of data and critically reviewed the manuscript. LMH designed the study initially, assisted in the analyses and contributed to the draft, especially the discussion. All authors have met criteria for authorship and taken part of the final version of the manuscript.

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REFERENCES

1 Bonde JP. Psychosocial factors at work and risk of depression: a systematic review of the epidemiological evidence. *Occup Environ Med* 2008;65:438–45.
2 Theorell T, Hammarström A, Aronsson G, *et al*. A systematic review including meta-analysis of work environment and depressive symptoms. *BMC Public Health* 2015;15:738.
3 Madsen IEH, Nyberg ST, Magnusson Hanson LL, *et al*. Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data. *Psychol Med* 2017;47:1342–56.
4 Karasek RA. Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. *Adm Sci Q* 1979;24:285–308.
5 Johnson JV, Hall EM. Job strain, work place social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health* 1988;78:1336–42.
6 Siegrist J. Adverse health effects of high-effort/low-reward conditions. *J Occup Health Psychol* 1996;1:27–41.
7 Rugulies R, Aust B, Madsen IE. Effort-reward imbalance at work and risk of depressive disorders. A systematic review and meta-analysis of prospective cohort studies. *Scand J Work Environ Health* 2017;43:294–306.
8 Moorman RH. Relationship between organizational justice and organizational citizenship behaviors: Do fairness perceptions influence employee citizenship? *J Appl Psychol* 1991;76:845–55.
9 Ndjaboué R, Brisson C, Vézina M. Organisational justice and mental health: a systematic review of prospective studies. *Occup Environ Med* 2012;69:694–700.
10 Magnusson Hanson LL, Chungkham HS, Åkerstedt T, *et al*. The role of sleep disturbances in the longitudinal relationship between psychosocial working conditions, measured by work demands and support, and depression. *Sleep* 2014;37:1977–85.
11 Tang K. A reciprocal interplay between psychosocial job stressors and worker well-being? A systematic review of the "reversed" effect. *Scand J Work Environ Health* 2014;40:441–56.
12 Elovainio M, Kivimäki M, Ek E, *et al*. The effect of pre-employment factors on job control, job strain and psychological distress: a 31-year longitudinal study. *Soc Sci Med* 2007;65:187–99.
13 Oshio T, Tsutsumi A, Inoue A. Do time-invariant confounders explain away the association between job stress and workers' mental health? Evidence from Japanese occupational panel data. *Soc Sci Med* 2015;126:138–44.
14 Milner A, Aitken Z, Kavanagh A, *et al*. Persistent and contemporaneous effects of job stressors on mental health: a study testing multiple analytic approaches across 13 waves of annually collected cohort data. *Occup Environ Med* 2016;73:787–93.
15 Magnusson Hanson LL, Leineweber C, Persson V, *et al*. Cohort Profile: The Swedish Longitudinal Occupational Survey of Health (SLOSH). *Int J Epidemiol* 2018;47:691–2.
16 Sanne B, Torp S, Mykletun A, *et al*. The Swedish Demand-Control-Support Questionnaire (DCSQ): factor structure, item analyses, and internal consistency in a large population. *Scand J Public Health* 2005;33:166–74.
17 Chungkham HS, Ingre M, Karasek R, *et al*. Factor structure and longitudinal measurement invariance of the demand control support model: an evidence from the Swedish Longitudinal Occupational Survey of Health (SLOSH). *PLoS One* 2013;8:e70541.
18 Leineweber C, Wege N, Westerlund H, *et al*. How valid is a short measure of effort-reward imbalance at work? A replication study from Sweden. *Occup Environ Med* 2010;67:526–31.
19 Siegrist J, Wege N, Pühlhofer F, *et al*. A short generic measure of work stress in the era of globalization: effort-reward imbalance. *Int Arch Occup Environ Health* 2009;82:1005–13.
20 Siegrist J, Li J, Montano D. Psychometric properties of the Effort-Reward Imbalance Questionnaire: Department of Medical Sociology, Faculty of Medicine, Duesseldorf University. *Germany* 2014.
21 Siegrist J, Starke D, Chandola T, *et al*. The measurement of effort-reward imbalance at work: European comparisons. *Soc Sci Med* 2004;58:1483–99.
22 Magnusson Hanson LL, Westerlund H, Leineweber C, *et al*. The Symptom Checklist-core depression (SCL-CD6) scale: psychometric properties of a brief six item scale for the assessment of depression. *Scand J Public Health* 2014;42:82–8.
23 Bech P. Use of rating scales in affective disorders. *Eur Psychiatr Rev* 2008;1:14–18.
24 Allison PD, Williams R, Moral-Benito E. Maximum Likelihood for Cross-lagged Panel Models with Fixed Effects. *Socius* 2017;3:1–17.
25 Wooldridge JM. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press, 2001.
26 Teachman JAY, Duncan GJ, Yeung WJ, *et al*. Covariance Structure Models for Fixed and Random Effects. *Sociol Methods Res* 2001;30:271–88.
27 Allison PD. Missing data techniques for structural equation modeling. *J Abnorm Psychol* 2003;112:545–57.
28 Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychol Methods* 2002;7:147–77.
29 Lt H, Bentler PM. Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. *Struct Equ Modeling* 1999;6:1–55.
30 Ibrahim S, Smith P, Muntaner C. A multi-group cross-lagged analyses of work stressors and health using Canadian National sample. *Soc Sci Med* 2009;68:49–59.
31 Shimazu A, de Jonge J. Reciprocal relations between effort-reward imbalance at work and adverse health: a three-wave panel survey. *Soc Sci Med* 2009;68:60–8.
32 Jonge J, Dormann C, Janssen PPM, *et al*. Testing reciprocal relationships between job characteristics and psychological well-being: A cross-lagged structural equation model. *J Occup Organ Psychol* 2001;74:29–46.
33 Eib C, Bernhard-Oettel C, Magnusson Hanson LL, *et al*. Organizational justice and health: Studying mental preoccupation with work and social support as mediators for lagged and reversed relationships. *J Occup Health Psychol* 2018;23:553–67.
34 Lang J, Bliese PD, Lang JW, *et al*. Work gets unfair for the depressed: cross-lagged relations between organizational justice perceptions and depressive symptoms. *J Appl Psychol* 2011;96:602–18.
35 Ybema JF, van den Bos K. Effects of organizational justice on depressive symptoms and sickness absence: a longitudinal perspective. *Soc Sci Med* 2010;70:1609–17.
36 Elovainio M, Heponiemi T, Jokela M, *et al*. Stressful work environment and wellbeing: What comes first? *J Occup Health Psychol* 2015;20:289–300.
37 de Lange AH, Taris TW, Kompier MA, *et al*. Different mechanisms to explain the reversed effects of mental health on work characteristics. *Scand J Work Environ Health* 2005;31:3–14.
38 van Hooff ML, Taris TW. Let's study how worker health affects the psychosocial work environment. *Scand J Work Environ Health* 2014;40:437–40.
39 Bollen KA, Brand JE. A General Panel Model with Random and Fixed Effects: A Structural Equations Approach. *Soc Forces* 2010;89:1–34.
40 Goodboy AK, Kline RB. Statistical and Practical Concerns With Published Communication Research Featuring Structural Equation Modeling. *Commun Res Rep* 2017;34:68–77.