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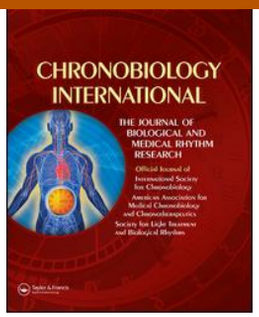

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Can psychosocial working conditions help to explain the impact of shiftwork on health in male- and female-dominated occupations? A prospective cohort study

Philip Tucker[a,b], Paraskevi Peristera[a], Constanze Leineweber[a], and Göran Kecklund[a]

[a]Stress Research Institute, Stockholm University, Stockholm, Sweden; [b]Psychology Department, Swansea University, Swansea, UK

ABSTRACT

Occupational factors are sometimes invoked to explain gender differences in the associations between shiftwork and health. We examined prospective associations between shiftwork and health, and between shiftwork and sick leave, separately for workers in female-dominated (FD) and male-dominated (MD) occupations; and whether the associations remained after controlling for psychosocial working conditions. Data from six waves of the Swedish Longitudinal Occupational Survey of Health were used to examine prospective associations with a four-year time lag between work schedule (daywork versus shiftwork involving nightwork; and daywork versus shiftwork not involving nightwork) and self-reports of depressive symptoms; incidents of short- and long-term sick leave; self-rated health; and sleep disturbance. Dynamic panel models with fixed effects were applied, using structural equation modeling. The analyses included adjustments for personal circumstances and employment conditions; and additional adjustments for psychosocial working conditions (psychological and emotional job demands; job control; worktime control; social support at work; persecution at work; and threats or violence at work). Within FD occupations, shiftwork that included night work (as compared to daytime work) predicted higher incidence of short-term sick leave (<1 week); within MD occupations, shiftwork that included nightwork predicted greater symptoms of mild depression. Despite notable differences in psychosocial working conditions between dayworkers and shiftworkers, both associations remained significant after adjustments. Thus, it was not confirmed that the associations between shiftwork and health reflected poorer working conditions of shiftworkers in either FD or MD occupations, although the possibility remains that the associations were due to other unmeasured aspects of the working environment.

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Shift work; night work; gender; health; psychosocial working conditions; sick leave

Introduction

Shiftwork appears to affect men and women differently, with respect to the impact on their health, sleep, and fatigue. Occupational factors are sometimes invoked to explain these gender-differentiated effects (e.g., Saksvik et al. 2011). These explanations are based on the premise that male and female shiftworkers tend to work in different occupational sectors. They imply that for one gender, working conditions of shiftworkers and non-shiftworkers are relatively similar; whereas for the other gender, working conditions of shiftworkers are substantially poorer than for the corresponding non-shiftworkers. Thus, some of the apparent gender differences in the impact of shiftwork may reflect the confounding of gender with occupation.

While there is a prevailing view that shiftwork has a particularly negative impact on women, the evidence is often inconsistent. For example, among studies evaluating the prospective association between shiftwork and depression separately for men and women, two found an increased risk for women but not for men (Bara and Arber 2009; Bildt and Michelsen 2002). However, one of those studies found that permanent nightwork had a greater negative impact on men's mental health (Bara and Arber 2009); while another study found an increased risk only for men, which disappeared after adjusting for psychosocial working conditions (Driesen et al. 2011). It is also unclear whether shift work affects women's sleep more than it affects men's. An early review noted that female shift workers experience more sleep problems than their male counterparts (Saksvik et al. 2011). However, a more recent systematic review reported that the majority of selected studies found no gender differences in the association between shiftwork and sleep (Booker et al. 2018), while another review noted some limited evidence of higher rates of shiftwork disorder (a circadian rhythm sleep-wake disorder specifically associated with shift work: SWD) in males than in females (Kervezee et al. 2018). Studies examining the association between shiftwork and sickness absence separately for men and women have also produced mixed findings. Of three longitudinal studies that

CONTACT Philip Tucker p.t.tucker@swan.ac.uk Stress Research Institute, Stockholm University, Stockholm, Sweden & Psychology Department, Swansea University, Swansea, UK

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have incorporated a gender perspective, the findings were: an increased risk of long-term sickness (>8 weeks) in males only, becoming non-significant after adjustments (Tuchsen et al. 2008); an increase in musculoskeletal related long-term sickness absence associated with shift/night work in men only (Foss et al. 2011); and no interaction between gender and work schedule in the prediction of sickness absence (van Drongelen et al. 2017). One potential cause of such inconsistencies is that gender may have been confounded with occupation in some studies.

Psychosocial working conditions are a key determinant of work stress, an important mediator in the pathway between shiftwork and health (Puttonen et al. 2010). The current study applies this perspective in an attempt to understand the basis of the apparent gender-related differences in the effects of shiftwork on health. Working conditions are most appropriately viewed as a feature of an occupation rather than being directly associated with one or other gender. Thus, in the current context, it is more appropriate to distinguish between workers in female-dominated occupations with workers in male-dominated occupations, rather than between female and male workers. Categorizing workers in terms of occupational groups rather than gender makes for more homogeneous study groups, thereby providing a cleaner comparison of work schedules. The factor representing female- versus male-dominated occupations is referred to as occupational gender composition (OGC). While there is some evidence to suggest that working in certain female-dominated occupations (e.g., human services) is associated with increased risk of psychological ill-health (Aagestad et al. 2016; Wieclaw et al. 2006), it remains unclear whether this is related to poorer psychosocial working conditions in those occupations (Nyberg et al. 2018). No study to date has examined OGC in the context of shiftwork.

The aim of the current study is to examine the prospective associations between work schedule and health-related outcomes, stratified by OGC, and to determine whether any such associations remain after adjusting for psychosocial working conditions. The analyses consider separately the effects of shiftwork that includes nightwork and shiftwork that does not include nightwork, as working conditions may differ between types of shiftwork. The analyses are based on a four-year time-lag, as shorter intervals may be less sensitive to some of the potential effects under consideration (Angerer et al. 2017).

Methods

Participants

Data were obtained from six waves (2008, 2010, 2012, 2014, 2016, 2018) of the Swedish Longitudinal Occupational Survey of Health (SLOSH). SLOSH is an open cohort survey of an approximately nationally representative sample of working population, with a focus on the association between work organization, work environment, and health. Since its inception in 2006, follow-ups have been conducted every second year. All labor market sectors and occupations are represented, and the number of men and women is approximately equal. The number of responses received in the waves from 2008 to 2018 was 11441, 11525, 9880, 20316, 19360, and 17841 (response rates 61.6%, 56.4%, 56.8%, 52.6%, 50.9%, and 48.2%). If a participant reported in a survey that they worked a schedule that was something other than either daywork, shiftwork with nights, or shiftwork without nights (see below for work schedule category definitions), then their responses for that wave were excluded from the analyses. Their responses were also excluded if they were working in a gender-balanced occupation (see below for occupational gender composition category definitions). In order to reduce the possibility of selection effects, responses from participants identifying as dayworkers were only included if the participant indicated in response to a question in the 2008 survey (the only year in which the question was asked) that they had no previous experience of working night shifts. Furthermore, responses from participants identifying as dayworkers were excluded if they reported working any schedule other than daywork in any other wave. The final sample after exclusions was N = 8667. Ethical approvals for SLOSH and the current study were obtained from the Regional Research Ethics Board in Stockholm and the study conforms to international ethical standards (Portaluppi et al. 2010)

Measures

Main predictor variable

Work schedule was ascertained by a question asking respondents about their normal working hours. Response options were *daywork (approx. 6.00 a.m.- 6.00 p.m.), evening work (approx. 6.00 p.m.- 10 p.m.), nightwork (approx. 6.00 p.m.- 6.00 a.m.), 2-shift shiftwork, 3-shift shiftwork, rostered work (i.e. following an ad hoc duty rota) without nightshifts, rostered work including nightshifts, discretionary/unregulated working hours*, and *other*. Participants included in the current analyses were classified as undertaking either *daywork*, *shiftwork including nightwork* (either nightwork, 3-shift shiftwork or rostered work including nights), or *shiftwork excluding nights* (2-shift shiftwork or rostered work without nights). Participants reporting evening work, discretionary/unregulated work hours, or other were excluded from the analyses.

Stratification variable

Occupational gender composition (OGC) was determined on the basis of the participant's occupation, categorized according to the four-digit level of the Swedish Occupational Classification System (SSYK 96 until 2012 and SSYK 2012 from 2014; Statistics Sweden 2012). Data on gender composition in each occupation in Sweden, according to SSYK, were derived from Statistics Sweden (www.scb.se). Participants included in the current analyses were classified as working in either a *female-dominated occupation* (*FD: >60% of the workforce is female*; N = 4938) or a *male-dominated occupation* (*MD: <40% of the workforce are female*; N = 3729). A list of the most common FD and MD occupations, by work schedule, is given in the online supplement S1. Participants in *gender-balanced occupations* (*between 40% and 60% of the workforce are female*; N = 1261) were excluded from the analyses.

Covariates

Age (at the end of the year during which the baseline questionnaire was completed, categorized as 19–30, 31–40, 41–50, 51–60 or >60 y) and gender were obtained from register data linked to questionnaire responses by means of the unique Swedish ten-digit personal identification numbers. Educational level was determined from register data indicating the respondents' highest level of education attained, categorized as *<3 years of higher education* or *≥3 years of higher education*. Age and education were treated as stable variables, and the remainder were time-varying. Civil status was determined from register data and was categorized as either *married/cohabiting* or *single*. Presence of a chronic illness was determined from participants' responses to a series of items asking whether they were currently suffering, or had previously suffered from any of the following conditions in the last two years: high blood pressure, diabetes, rheumatism, musculoskeletal disorder, asthma, obstructive pulmonary disorder, or other sickness. Respondents were classified as suffering a chronic illness if they reported any of these conditions and that it affected their lives either a little or a lot. Presence of children under 13 y at home was determined from participants' responses to a series of items asking about the number and ages of any children at home, from which participants were categorized as having either *at least one child at home under 13 years* or as *none*.

Employment status was self-reported, with participants categorized as working either *full-time* or *part-time*. Employer type was self-reported, with participants categorized as working for employers in either *the private sector, the public sector*, or *other*. Physical job demands were measured with a single item asking whether the job sometimes involved physical labor, from which participants were categorized as experiencing either *some physical job demands* or *none at all*.

Psychological job demands, job control, and social support at work were measured using the Swedish version of the Demand Control Support Questionnaire (Sanne et al. 2005). Psychological job demands were measured with five items (score range: 1 – low demands; 4 – high demands), job control was measured with six items (1 – low control; 4 – high control), and social support at work was measured with six items (1 – low support; 4 – high support). Each of the three indices was calculated as the mean of the individual items. Work time control was measured using the scale described by Ala-Mursula et al. (2005) and was calculated as the mean score of the six items (1 – low control; 5 – high control). Persecution at work and violence or threats of violence at work were each measured with single items asking how often the behavior was encountered, with participants categorized as experiencing the behavior *at least once in the last 6 months* or *never*. Emotional job demands were measured with a single item asking whether the respondent's job put them in emotionally disturbing situations (1 – never; 4 – yes, often).

Outcome variables

Sick leave was measured in two ways. Respondents were asked to report: how often they had taken sick leave for a week or less in the past 12 months, excluding leave to care for a sick child (herein referred to as short-term sick leave); and how often they had taken sick leave for more than a week in the past 12 months, excluding leave to care for a sick child (herein referred to as long-term sick leave). For both measures, response options were *never, once, 2 or 3 times* and *4 or more times*.

Depressive symptoms were measured with the question "How much during the last week have you been troubled by . . . " followed by six different core symptoms of depression (Magnusson Hanson et al. 2014). The depression index score was calculated as the mean of the six symptom scores (0 – lowest; 4 – highest).

Self-rated health (SRH) was measured with the question: "How would you rate your general state of health?" with the response alternatives *very bad, bad, neither good nor bad, good*, and *very good*.

Sleep disturbance was calculated as the mean of four items assessing the frequency of sleep symptoms experienced in the last 3 months (1 – never; 6 – always/5 times or more per week; Akerstedt et al. 2008, 2002).

Statistical methods

Cross-lagged analyses using structural equation modeling (SEM) with fixed effects (dynamic panel models with

fixed effects; Allison et al. 2017) were conducted in order to assess the associations between work schedule and outcome variables. SEM allows more accurate modeling of causal mechanisms than logistic regression, by using latent constructs to develop complex path models with direct and indirect effects. The current models use a fixed-effects latent variable correlated with all time-varying independent variables to adjust for time-invariant characteristics of the individual and therefore eliminate major sources of confounding from fixed factors (such as non-observed individual and environmental factors, e.g., genetics, region of birth, childhood conditions, and intelligence).

The analyses were stratified by OGC. For each of five health outcomes, two separate analyses compared daywork with (1) shiftwork including nights and (2) shiftwork without nights, with a four-year time lag. In addition to assessing the crude association between schedule and health outcome, each analysis adjusted for background characteristics assessed at baseline (Model 1), namely: age, educational level, civil status, presence of children under 13, employment status, and physical job demands, as well as the reported level of the outcome variable at baseline. In addition, employer type was included as a covariate in the analyses of short- and long-term sick leave; and presence of a chronic illness was included as a covariate in the analyses of long-term sick leave, depressive symptoms, self-rated health, and sleep disturbance.

In a further addition to Model 1, the analyses also adjusted for seven aspects of the psychosocial working conditions assessed at baseline, namely psychological job demands, job control, work-time control, social support, persecution at work, violence or threats at work, and emotional job demands (Model 2).

Models were used in which cross-lagged regression coefficients were constrained to be equal across time since they provided better fit (according to chi-square tests) when compared to models with regression coefficients that freely varied over time. To reduce bias introduced by missing information, the analysis used full-information maximum likelihood (FIML) estimation (Allison 2003; Schafer and Graham 2002). Model fits were assessed through the Bayesian information criterion (BIC; Hu and Bentler 1999). The analyses were conducted using the Stata command xtdpml (Williams et al. 2018) and were run in Stata 15 and Mplus 7.

Results

The distributions of the study variables in 2008 are presented in Table 1 (distributions for the other waves, 2010 to 2018, are presented in the online supplement S2). With regard to psychosocial working conditions, it is especially notable that shiftworkers in FD occupations were much more likely than other groups to report violence or threats at work. They also reported higher emotional job demands. Shiftworkers in MD occupations reported somewhat lower job control than other groups.

The results of the main analyses are presented in Table 2. Within FD occupations, there was an association between shiftwork that included night work and short-term sick leave, which remained significant after adjustments (Models 1 & 2). Within MD occupations, there was a significant association between shiftwork that included nightwork and depressive symptoms, which remained significant after adjustments (Models 1 & 2). There were no other significant associations within the analyses of either FD or MD occupations.

Discussion

The current analysis identified few significant associations between shiftwork and health in either FD or MD occupations, either before or after adjustments. Within MD occupations, shiftworkers whose schedule included nightwork were at increased risk of showing depressive symptoms, compared to dayworkers. Within FD occupations, the same type of schedule was associated with increased risk of short-term sick leave. Despite some notable differences in psychosocial working conditions between dayworkers and shiftworkers (e.g., shiftworkers in FD occupations reporting higher levels of threats and violence at work, and greater emotional demands; shiftworkers in MD occupations reporting lower levels of job control), the associations remained significant after adjustments. This suggests that the associations cannot be accounted for by the poorer psychosocial working conditions of shiftworkers, in either occupational group. This, together with the fact that only those whose schedule included nightwork were affected, suggests that chronic disruption of circadian rhythms and sleep may play a more significant role than psychosocial working conditions in accounting for the observed significant effects.

The absence of effects of shiftwork on symptoms of depression in FD occupations contrasts with several previous studies of mental health among female shiftworkers (Angerer et al. 2017; Kang et al. 2017; Lee et al. 2017). However, the current pattern of results is somewhat consistent with Driesen et al. (2011), who found that males (but not females) who worked shifts that included nightwork were at greater risk than their day-working counterparts of developing either depressed

Table 1. Distribution of the study variables in 2008 for the three schedule types, stratified by occupational gender composition.

	Dayworkers (n = 3191)		Shiftwork with nights (n = 321)		Shiftwork without nights (n = 533)	
Female dominated occupations	*N*	*%*	*N*	*%*	*N*	*%*
Gender						
Female	2042	88.7	254	85.5	434	90.4
Male	261	11.3	43	14.5	46	9.6
Age (y)						
19–30	114	5.0	17	5.7	41	8.5
31–40	394	17.1	50	16.8	92	19.2
41–50	576	25.0	100	33.7	135	28.1
51–60	843	36.6	98	33.0	150	31.3
>60	376	16.3	32	10.8	62	12.9
Educational level						
<3 y higher	1241	53.9	199	67.2	356	74.2
≥3 y higher	1062	46.1	97	32.8	124	25.8
Civil status						
Married/cohabiting	1383	60.1	161	54.2	235	49.0
Single	920	39.9	136	45.8	245	51.0
Presence of children <13						
No	2347	77.2	221	74.4	375	78.1
Yes	692	22.8	76	25.6	105	21.9
Presence of chronic illness						
Yes	886	39.0	113	38.6	205	43.2
No	1385	61.0	180	61.4	270	56.8
Employer type						
Private	633	27.9	27	9.3	83	17.5
Public	1465	64.6	256	88.6	371	78.4
Other	170	7.5	6	2.1	19	4.0
Employment status						
Full time	1573	69.4	128	43.5	246	51.7
Part time	694	30.6	166	56.5	230	48.3
Physical job demands						
Yes	1080	47.3	268	91.2	425	89.5
No	1204	52.7	26	8.8	50	10.5
Persecution at work						
Yes	259	11.4	31	10.5	75	15.7
No	2012	88.6	264	89.5	403	84.3
Violence or threats at work						
Yes	373	16.4	171	58.0	254	53.4
No	1900	83.6	124	42.0	222	46.6
Short-term sick leave						
Never	1098	48.0	147	50.2	175	36.9
Once	663	29.0	101	34.5	167	35.2
2–3 times	414	18.1	34	11.6	108	22.8
≥4 times	113	4.9	11	3.8	24	5.1
Long-term sick leave						
Never	1963	85.8	242	81.8	375	79.1
Once	260	11.4	47	15.9	78	16.5
2–3 times	38	1.7	5	1.7	14	3.0
≥4 times	27	1.2	2	0.7	7	1.5
	M	*SD*	*M*	*SD*	*M*	*SD*
Psychological job demands	2.64	0.54	2.62	0.49	2.81	0.49
Job control	3.12	0.42	3.02	0.35	2.94	0.37
Work time control	2.77	1.00	2.37	0.82	2.34	0.77
Social support	1.86	0.53	1.89	0.52	1.92	0.51
Emotional job demands	2.69	0.87	3.30	0.63	3.07	0.75
Depressive symptoms	1.99	0.89	1.83	0.88	2.02	0.90
Self-rated health	1.95	0.78	1.89	0.73	1.99	0.77
Sleep disturbance	2.58	1.05	2.45	1.04	2.64	1.07
	Dayworkers		Shiftwork with nights		Shiftwork without nights	
Male dominated occupations	*N*	*%*	*N*	*%*	*N*	*%*
Gender						
Female	412	19.2	47	15.6	54	25.6
Male	1731	80.8	254	84.4	157	74.4
Age (y)						
19–30	123	5.7	19	6.3	19	9.0
31–40	464	21.7	81	26.9	39	18.5
41–50	599	28.0	87	28.9	76	36.0
51–60	632	29.5	93	30.9	63	29.9

(*Continued*)

Table 1. (Continued).

	Dayworkers		Shiftwork with nights		Shiftwork without nights	
Male dominated occupations	*N*	*%*	*N*	*%*	*N*	*%*
>60	325	15.2	21	7.0	14	6.6
Educational level						
<3 y higher	1620	75.7	254	84.4	192	91.0
≥3 y higher	520	24.3	47	15.6	19	9.0
Civil status						
Married/cohabiting	1184	55.2	138	45.8	82	38.9
Single	959	44.8	163	54.2	129	61.1
Presence of children <13						
No	1506	70.3	220	73.1	152	72.0
Yes	637	29.7	81	26.9	59	28.0
Presence of chronic illness						
Yes	726	34.4	93	31.2	75	35.9
No	1385	65.6	205	68.8	134	64.1
Employer type						
Private	1612	76.1	199	68.2	163	78.4
Public	305	14.4	81	27.7	33	15.9
Other	200	9.4	12	4.1	12	5.8
Employment status						
Full time	1925	91.7	289	96.7	203	96.7
Part time	175	8.3	10	3.3	7	3.3
Physical job demands						
Yes	1244	58.5	264	88.0	184	87.6
No	884	41.5	36	12.0	26	12.4
Persecution at work						
Yes	202	9.6	33	11.0	38	18.0
No	1909	90.4	267	89.0	173	82.0
Violence or threats at work						
Yes	90	4.2	63	21.0	26	12.3
No	2038	95.8	237	79.0	185	87.7
Short-term sick leave						
Never	1166	55.0	163	54.3	103	49.0
Once	593	28.0	84	28.0	60	28.6
2–3 times	300	14.1	45	15.0	36	17.1
≥4 times	62	2.9	8	2.7	11	5.2
Long-term sick leave						
Never	1874	88.4	269	90.0	175	83.3
Once	192	9.1	27	9.0	30	14.3
2–3 times	36	1.7	3	1.0	3	1.4
≥4 times	17	0.8	0	0.0	2	1.0
	M	*SD*	*M*	*SD*	*M*	*SD*
Psychological job demands	2.66	0.51	2.57	0.49	2.67	0.51
Job control	3.16	0.43	2.78	0.43	2.73	0.49
Work time control	3.30	1.00	2.25	0.80	2.28	0.80
Social support	1.89	0.49	1.94	0.50	1.99	0.53
Emotional job demands	2.10	0.76	2.17	0.84	2.13	0.80
Depressive symptoms	1.86	0.85	1.79	0.84	1.98	0.85
Self-rated health	1.95	0.78	1.94	0.71	2.01	0.75
Sleep disturbance	2.35	0.97	2.56	1.03	2.48	1.02

Range of possible scores: Psychological job demands, Job control, Social support, Emotional demands, Depressive symptoms = 1 to 4; Work time control, Self-rated health = 1 to 5; Sleep disturbance = 1 to 6.

mood or depressive disorder over a 10 y follow-up. The current study has perhaps more in common with the study by Driesen et al. (2011) than it does with other studies in this area: both prospectively examined the association between shiftwork involving night work (mostly rotating shifts) and symptoms of depression in a large heterogeneous population of men and women in a European country, with a relatively long (≥4 y) follow-up. However, in contrast to the current findings, Driesen et al. (2011) reported that adjusting for a broad range psychosocial work-related factors (decision latitude, social support from supervisors, social support from coworkers, psychological job demands, emotional demands, and physically demanding work) resulted in a substantial lowering of the strength of the association. Lastly, it is worth emphasizing that the current analyses examined symptoms of mild depression and that there was no suggestion of clinically significant levels of depression in either group of shiftworkers. This is consistent with our earlier findings, based on a sub-group of

Table 2. Standardized linear regression coefficients from the cross-lagged SEM models with fixed effects.

		Female dominated occupations			Male dominated occupations		
	Schedule type	Crude	Model 1	Model 2	Crude	Model 1	Model 2
Depressive symptoms[2]	Shiftwork with nights	0.01	0.05	0.06	0.25*	0.23*	0.26*
	Shiftwork without nights	0.08	0.08	0.13	0.06	0.03	0.10
Short-term sick leave [1,3]	Shiftwork with nights	0.34*	0.37*	0.52**	−0.07	−0.06	−0.12
	Shiftwork without nights	−0.03	−0.02	−0.04	−0.09	−0.10	−0.13
Long-term sick leave [1,2]	Shiftwork with nights	0.14	0.13	0.13	−0.11	−0.12	−0.11
	Shiftwork without nights	−0.04	−0.02	−0.02	0.05	0.06	0.07
Self-rated health[2]	Shiftwork with nights	−0.09	−0.08	−0.04	0.15	0.16	0.25
	Shiftwork without nights	−0.11	−0.11	−0.09	0.08	0.06	0.01
Sleep distrurbance[2]	Shiftwork with nights	−0.02	0.04	0.07	0.09	0.04	−0.04
	Shiftwork without nights	0.05	0.05	0.07	0.14	0.12	0.21

Model 1: adjusting for outcome at baseline, age, education, civil status, children <13 y at home, employment status and physical job demands. [1] Analysis of short-term and long-term sick leave also adjusted for employer type. [2] Analysis of long-term sick leave, depressive symptoms, self-rated health and sleep disturbance also adjusted for presence of a chronic illness.
Model 2: Model 1 + Psychological job demands, job control, work-time control, social support, persecution, violence/threats, and emotional demands.
* = $p < 0.05$; ** = $p < 0.01$

the current sample, in which shiftwork was not associated with increased use of anti-depressant medication, in either men or women (Hall et al. 2019).

The association between shiftwork that includes nightwork and short-term sick leave in FD occupations does not necessarily reflect an increased risk of ill-health. Short-term sick leave can be part of a behavioral pattern or coping strategy. For example, shiftworkers may call in sick for a day or two in order to manage their fatigue and recovery, or to deal with issues of work-life conflict. The current finding is consistent with women being especially vulnerable to the fatiguing effects of nightwork (Saksvik et al. 2011), possibly leading them to use short-term sick leave as means of coping. Calling in sick to deal with work-life conflict may also play a role, although in that case effects of both forms of shiftwork could have been expected, rather than just in relation to shiftwork that includes nightwork. Fatigue and work-life conflict could be seen as acute effects of shiftwork, rather than effects that manifest after prolonged exposure to shiftwork, and so explanations in terms of these factors assume that participants classified as shiftworkers at baseline are still shiftworkers at follow-up. The current findings contrast with two recent studies of (mainly female) nurses which found that night work did not predict short-term sickness absence, although a dose–response association with the number of consecutive night shifts worked was observed (Ropponen et al. 2019; Vedaa et al. 2017).

Long-term sick-leave is a more reliable index of genuine ill-health and is thus more commonly used in studies of sick leave. The current finding of no effects of shiftwork on long-term sick leave is not without precedent. An earlier systematic review concluded that evidence of associations between either rotating shiftwork or nightwork and sick leave was inconclusive, with much inconsistency between the findings of studies judged as high-quality (Merkus et al. 2012). It was concluded that the relationship may be specific to particular populations and shiftwork schedules, suggesting that contextual factors play a significant role. The absence of effects in the current analyses may reflect the heterogeneous nature of the sample and the rather broadly defined categories of shiftwork. Another potential contributory factor is that, unlike many previous studies, the current analyses adjusted for history of sick leave (i.e., sick leave at baseline), which is strong predictor of future sick leave (van Drongelen et al. 2017).

The finding of no associations between shiftwork and sleep problems is also not without precedent (Akerstedt et al. 2015; Harma et al. 2018; Linton et al. 2015; Thun et al. 2016). Shiftworkers may habituate to poor sleep, or come to regard it as part of the job, and, therefore, do not perceive their sleep as being especially impaired (Akerstedt et al. 2015). Moreover, a questionnaire that asks about sleep problems over the last three months may be insufficiently sensitive to acute impairments of sleep that only occur on certain shifts that may be worked relatively infrequently, as part of a rotating schedule. The relatively long follow-up of four years may have further reduced the sensitivity to acute impairments of sleep.

There were no effects of shiftwork on self-rated health. One of the few previous studies to examine self-rated health as an outcome in shiftworkers found a negative association between shiftwork and self-rated health, which was attributed to selection effects (Platts et al. 2017). The current analyses sought to limit selection effects by excluding from the dayworking sample any respondents with a history of working nightshifts. This ensured that the shiftworkers were not being compared with dayworkers whose health may have been affected by prior exposure to nightwork. This strategy may explain why there was no negative association with self-rated health on this occasion. However, the strategy may not have been sufficient to eliminate selection effects entirely. The shiftworking

groups could still constitute a survivor sample whose health was relatively unaffected by shiftwork. Moreover, it was only possible to exclude those reporting in 2008 prior exposure to *nightwork*; but the possibility remains that they may have been previously exposed to shiftwork that did not include nightwork.

Residual selection effects may also underlie the finding of only a small number of significant associations. Another potential limitation was the four-year time lag which may have been too long to observe associations with at least some of the measured outcomes. The majority of measures were self-report which, as well as bringing potential issues of accuracy and reliability, may have introduced bias due to common-method variance (Podsakoff et al. 2003). While the analyses distinguished between shiftwork that either did or did not involve nightwork, it lacked more detailed information on the precise nature of the shift schedules. It is, therefore, possible that comparisons between FD and MD occupations were confounded by other shift schedule characteristics (e.g., the intensity of nightwork). Lastly, the analysis did not take into account possible changes in the participants' occupation and, hence, their OGC classification, thereby increasing the possibility of misclassification, although it seems unlikely that someone would change from an FD to an MD occupation or visa versa.

Among the main strengths of the current study, it featured a prospective design based on several repeated measures, making it possible to allow for the time-varying nature of the studied effects. The analytic approach was able to account for time-invariant characteristics that may otherwise produce biases, thereby providing more accurate estimates than in previous studies. It also accounted for changes in work schedule status between baseline and follow-up (approximately 7% changed work schedule status). The analysis also accounted for missing values, making it possible to draw upon a large and broadly representative sample of the Swedish working population.

In conclusion, there were few associations between work schedule and future health in either MD or FD occupations. This was despite efforts to reduce the likelihood of selection effects, although the existence of residual selection effects cannot be ruled out. Nightwork was associated with depressive symptoms in MD occupations and short-term sick leave in FD occupations. It was not confirmed that these associations reflected poorer working conditions of shiftworkers, although it remains a possibility that they were due to other unmeasured aspects of the working environment.

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Declaration of interests

The authors declare no conflicts of interest.

ORCID

Philip Tucker http://orcid.org/0000-0002-8105-0901
Constanze Leineweber http://orcid.org/0000-0001-8433-2405
Göran Kecklund http://orcid.org/0000-0001-7457-7302

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