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Associations Between Job-Strain, Physical Activity, Health Status, and Sleep Quality Among Swedish Municipality Workers

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Objective: To examine the associations between work-stress and physical activity (PA) with sleep quality while controlling for covariates, including social support. **Methods:** A cross-sectional study among employees of a municipality ($n = 2765$). Data from respondents ($n = 1973$) with good/poor sleep quality were included. Prevalence ratios (PR) were estimated using modified Poisson regression analyses. **Results:** A significant interaction was observed between job-strain and self-reported health in the explanation of sleep quality. Consequently, interaction (job strain × self-rated health) adjusted PRs were calculated. The PRs for high job strain were 1.986 (95% CI 1.58 to 2.49) and 1.220 (95% CI 1.04 to 1.44) compared with the reference groups. **Conclusions:** Findings show that high job strain and low PA levels are associated with poor sleep quality, and that self-rated health plays an important moderating role in the association between job strain and sleep quality.

Keywords: employees, protective factors, work-stress

Poor sleep quality is a widely spread public health concern and is related to among others a higher risk for developing dementia,[1] heart disease,[2] diabetes,[3] and obesity.[4] Sleep quality includes difficulty falling asleep, staying asleep, number of awakenings in night and feeling rested upon waking.[3,5] About one-third of the general adult population experience difficulties falling asleep or staying asleep at any given time.[6] The most often self-reported cause of sleep problems are work-related stressors.[7] A recent meta-analysis examining the association between psychosocial work stressors and sleep quality found a clear link between work stressors, such as workload, perceived control and work-life conflict, and sleep quality.[8] A theory that is often used to explain how psychosocial work factors exert stress on employees is the demand-control theory, which proposes that an imbalance between the demands placed on the worker and the person's decision latitude or control results in stress, especially so-called job-strain (ie, high demands, low control).[9] High job-demands and low job-control have in turn been shown to be related to poor sleep quality and fatigue.[10]

As sleep is of crucial importance for both mental and physical health it is essential to reduce, the causes of poor sleep quality. In order to reduce the negative effects of work stress on sleep, protective factors need to be identified that may modify this relationship. One of these potential protective factors is physical activity. Several studies have examined the effects of physical activity on sleep. Two recent meta-analyses showed that regular physical activity improved overall sleep quality.[11,12] Moreover, physical activity has been shown to protect against stress,[13] including work stress.[14,15] Teisala et al[16], for example, observed that higher physical activity levels were associated with lower stress levels during working hours as well as with lower stress levels throughout the day. Another factor that has been shown to have a protective effect on sleep quality is social support.[10] Moreover, social support has been found to moderate the stress sleep relationship by reducing the negative effects of work stress on sleep quality.[17] We are unaware of any previous studies that have explored a possible moderating effect of physical activity on the association between work-stress and sleep quality.

Objectives

The objective of this cross-sectional study is therefore to examine the associations between work stress and physical activity with sleep quality while controlling for relevant covariates, including social support from coworkers and superior. In the present study work-stress will be operationalized as job-strain according to Karasek demands-control theory.[9] This study will provide further understanding of a potential moderating role of physical activity in the relationship between job-stress and sleep quality, which may have important implications for interventions in this field.

METHODS

Study Population

Data were collected in October 2014 from employees of a Swedish municipality. All employees of the municipality ($n = 2765$) were invited by E-mail to complete a web-based survey. A total of 2460 ($n = 88.97\%$) respondents completed the survey. Respondents were excluded if they had missing data for any variables included in the analyses conducted for this study ($n = 129$ excluded), resulting in a total study population of 2331. For the purpose of this study only data of respondents with good or poor sleep quality were included ($n = 1973$). By filling in the questionnaire, employees automatically gave informed consent that data could be used for scientific research purposes. The Stockholm Ethical Board, Sweden, provided ethical approval for the project (Dnr. 00-012). There were no conflicts of interest in the municipality.

Variables

Sleep Quality

Sleep quality was assessed with the question ''How do you rate the overall quality of your sleep?'' on a five-point scale, ranging

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Author contribution: L.K., S.K., and N.L. participated in the design of the study. C.B. was responsible for the collection of the data. N.L. and L.K. were responsible for analysis and interpretation of the data, and for drafting the manuscript and revising it critically for important intellectual content. S.K. and C.B. helped to draft the manuscript. J.H. contributed to the statistical analyses and interpretation of the data. All authors read an approved the final version of the manuscript.

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Clinical significance: Future intervention studies should test the effectiveness of using exercise as a prescriptive to improve sleep quality among those with high work stress. If exercise is effective in improving sleep quality among those with high work stress it can be prescribed in clinical practice.

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from ''very good'' (1) to ''very bad'' (5). The question has previously been validated.[18] For the purpose of the present study two categories were created by combining the scales ''1'' and ''2'' as ''good sleep quality'' and ''4'' to ''5'' as ''poor sleep quality.''

Job-Strain

Demands and control at work were assessed with items of the General Nordic Questionnaire for Psychosocial and Social factors at work (QPS Nordic[19]). Demands at work were assessed using seven items on a five-point scale ranging from ''very seldom or never'' (1) to ''very often or always'' (5). Items were related to quantitative demands (four items) and decision making (three items). Control at work was assessed with eight items on a five-point scale ranging from ''very seldom or never'' (1) to ''very often or always'' (5). Items were related work pacing (3) (three items) and control of decision (five items). The variable job-strain was calculated by combining the variables demands and control at work. A median was calculated for demands and control, in order to divide into the suggested categories.[9] For the present study two categories of job-strain were calculated: high job-strain (a combination of high demand and low control at work) and low job-strain, which includes active, passive, and low-strain jobs (any other combination of demand and control at work).

Physical Activity Levels

Physical activity levels were assessed with the short version of the validated International Physical Activity Questionnaire (IPAQ-short).[20] The IPAQ-short assesses physical activity undertaken across the following domains: leisure time, domestic and gardening (yard) activities, work-related and transport-related activity. The instrument assesses walking, moderate-intensity activities and vigorous intensity activities; frequency (measured in days per week), and duration (time per day) for each of these three domains. Categories for low physical activity (LPA) and moderate to vigorous physical activity (MVPA) were created according to the ''Guidelines for Data Processing and Analysis of the IPAQ''.[20]

Covariates

Self-rated health was measured with the item ''How do you assess your general state of health'' on a five-point scale, which ranged from ''very good'' (1) to ''very poor'' (5). The item was adapted from the general health questionnaire (GHQ).[21] Two categories were created by combining the scales ''1'' and ''2'' as ''good self-reported health'' and the scales ''3 to 5'' as ''poor self-reported health.''

Support from coworkers and from superior were measured by two (coworkers) and three items (superior) on a five-point scale, ranging from ''very seldom or never'' (1) to ''very often or always'' (5). The items originated from the QPS Nordic Questionnaire.[19] Sum-scores were calculated for both variables and were recoded to values between ''0'' and ''4''; with ''0'' representing the highest level of support and ''4'' the lowest level.

Smoking was measured with one item (are you a smoker?) with four answering categories (yes; no, I quit smoking in the last 12 months; no, I have not smoked in more than 12 months; no, I have never smoked). Smoking was dichotomized into ''1'' for smoker and ''2'' for non-smoker.

Socio-demographics included age (continuous), sex, BMI (kg/m^2), and educational background. BMI was calculated based on self-reported weight and height. Educational background was measured with four categories (high school or equivalent; secondary school; university; higher academic degree). Due to the small number in the highest educational category (doctoral degree) categories three and four were combined.

Statistical Methods

Firstly, descriptive analyses were run to explore sample characteristics. Secondly, in order to test the association between job-strain, physical activity levels and sleep quality prevalence ratios (PR) were estimated using a modified Poisson regression analyses. We used modified Poisson regression, a Poisson regression model with robust variance estimation, as this is a useful analysis for estimating relative risks or prevalence ratios.[22,23] The PRs quantify the strength of the association. The association was adjusted for age, sex, educational status, self-rated health, smoking, body mass index (BMI), support from coworkers and support from superior. In the analyses possible interactions between job-strain and other included variables were tested. A significant interaction was observed between job-strain and self-reported health. Consequently, interaction (job strain × self-rated health) adjusted PRs were calculated. To find the best model of fit a combination of forward and backward stepwise regression was used. The akaike information criterion (AIC) of the model presented in this paper is 2219.074, the AIC of the model without the interaction term job strain × self-rated health is 2224.516. The best model of fit, the one with the lower AIC, was therefore the model with the interaction term job strain × self-rated health. In the final model the association between job-strain, physical activity levels, and sleep quality, was adjusted for social support from superior and social support from coworkers. Estimated marginal means, representing the estimated percentages of poor sleep for different combinations of job strain, self-rated health, and physical activity levels, were calculated. All analyses were conducted with IBM SPSS version 22.0 (IBM Corp, Armonk, NY).

RESULTS

Participants

A description of the study participants is presented in Table 1. The study population consisted of mainly women (83.1%) and the average age of the population was 45.1 years. Around 73% of the study population reported to have good sleep quality; moreover, nearly 74% of the study population reported good self-reported health and approximately 74% of the study population responded to have moderate-to-vigorous levels of physical activity. The respondents that reported poor sleep quality were slightly older ($P < 0.001$) than those who reported good sleep quality. Moreover, significantly more respondents with poor sleep quality reported poor self-rated health ($P < 0.001$), low levels of physical activity ($P < 0.01$), high job strain ($P < 0.001$), and low support from superior ($P < 0.001$) and coworkers ($P < 0.001$) compared with respondents with good sleep quality.

Associations Between Job Strain, Physical Activity Levels, and Sleep Quality

The results of the modified Poisson regression analyses are presented in Table 2. The interaction adjusted PRs for high job strain were 1.986 (95% CI 1.58 to 2.49) and 1.220 (95% CI 1.04 to 1.44) compared with the reference groups low job-strain × good self-rated health and low job-strain × bad self-rated health, respectively. This result indicates that the prevalence of poor sleep quality is nearly two times as high among those with high job strain compared with those with low job strain and good self-rated health. The PR of moderate-to-vigorous physical activity was 0.841 (95% CI 0.727 to 0.973) compared with the reference group, indicating a lower prevalence of poor sleep quality with higher levels of PA. For bad self-rated health interaction adjusted PRs were respectively 3.273 (95% CI 2.676 to 4.003) and 2.010 (95% CI 1.644 to 2.458) compared with the reference groups. The PR of social support from superior was 1.129 (95% CI 1.057 to 1.206) and of social support from coworkers 1.101 (95% CI 1.020 to 1.189). This result indicates

TABLE 1. General Sample Characteristics

Variables	Total ($n = 1973$)		Good Sleep Quality ($n = 1457$)		Poor Sleep Quality ($n = 516$)	
	N	%	*n*	%	*N*	%
Gender						
Women	1639	83.1	1202	82.5	437	84.7
Men	334	16.9	255	17.5	79	15.3
Age, yrs						
Mean, SD	45.5		45.0	10.9	46.8**	10.5
Education						
High school or equivalent	115	5.8	78	5.4	37	7.2
Secondary school/vocational school	907	46.0	691	47.4	216	41.9
University/higher academic degree	951	48.2	688	47.2	263	51.0
BMI						
Mean (SD)	25.6	4.4	25.7	4.5	25.5	4.3
Self-rated health						
Good	1439	72.9	1200	82.4	239***	46.3
Poor	534	27.1	257	17.6	277	53.7
Sleep quality						
Good	1457	73.8	-	-	-	-
Poor	516	26.2	-	-	-	-
Smoking status						
Smoker	264	13.4	194	13.2	71	13.8
Non-smoker	1709	86.6	1264	86.8	445	86.2
Physical activity						
Low levels	519	26.3	356	24.4	163*	31.6
Moderate-to-vigorous level	1454	73.7	1101	75.6	353	68.4
Job strain						
High job strain	630	31.9	386	26.5	244***	47.3
Low job strain	1343	68.1	1071	73.5	272	52.7
Support superior						
High	690	35.0	559	38.4	131***	25.4
Moderate	994	50.4	727	49.9	267	51.7
Low	289	14.6	171	11.7	118	22.9
Support coworkers						
High	1155	58.5	892	61.2	263***	51.0
Moderate	741	37.6	523	35.9	218	42.2
Low	77	3.9	42	2.9	35	6.8

BMI, body mass index.
***$P < 0.000$.
**$P < 0.001$.
*$P < 0.01$.

TABLE 2. Interaction Adjusted Prevalence Ratios (95% CI) for Job Strain, Physical Activity Levels on Sleep Quality

Variables	Prevalence Ratio	95% CI
High job strain	1.986**	1.58–2.49
Low job strain × good self-rated health	Reference	Reference
High job strain	1.220*	1.04–1.44
Low job strain × bad self-rated health	Reference	Reference
Moderate-to-vigorous physical activity	0.841*	0.727–0.973
Low physical activity	Reference	Reference
Poor self-rated health	3.273**	2.676–4.003
Good self-rated health × low job strain	Reference	Reference
Poor self-rated health	2.010**	1.644–2.458
Good self-rated health × high job strain	Reference	Reference
Social support from superior	1.129**	1.057–1.206
Social support from coworker	1.101*	1.020–1.189

Final model included the variables job strain, physical activity levels, self-rated health, social support from superior, and social support coworkers. CI, confidence interval.
**$P < 0.01$.
*$P < 0.05$.

that the prevalence of poor sleep quality is slightly higher among those with lower social support from superior and coworkers.

Estimated Percentages of Sleep Quality in Combination With Job Strain, Self-Rated Health, and Physical Activity

The estimated marginal means for job strain combined with physical activity levels are presented in Table 3. The estimated marginal means for poor sleep quality were highest for those individuals who reported high job strain and low levels of physical activity (mean 0.42; 95% CI 0.37 to 0.49) and lowest for those who reported low job strain and moderate-to-vigorous physical activity (mean 0.23; 95% CI 0.20 to 0.26). This result indicates that 42% of individuals who reported high job strain and low levels of physical activity reported poor sleep quality compared with 23% of individuals who reported low job strain and moderate-to-vigorous physical activity.

Table 4 shows the estimated marginal means for job strain combined with self-rated health and physical activity levels. The highest estimated marginal mean for poor sleep quality was

TABLE 3. Estimated Marginal Means for Percentage of Poor Sleep Quality Combined With Job Strain and Physical Activity Levels

Job Strain	Physical Activity	Mean	SE	95% CI
Low job strain	Moderate-to-vigorous	0.23	0.013	0.20–0.26
	Low	0.27	0.019	0.24–0.31
High job strain	Moderate-to-vigorous	0.36	0.020	0.32–0.40
	Low	0.42	0.031	0.37–0.49

CI, confidence interval; SE, standard error.

observed for those participants with high job-strain, poor self-rated health, and low levels of physical activity (mean 0.60; 95% CI 0.52 to 0.69), indicating that 60% of those participants who reported high job-strain in combination with poor self-rated health and low levels of physical activity also reported poor sleep quality. The lowest estimated marginal mean was observed for those individuals with low job strain, good self-rated health, and moderate-to-vigorous physical activity (mean 0.13; 0.11 to 0.15).

DISCUSSION

The aim of the present study was to examine the associations between work stress defined as high job strain (low control and high demands) and physical activity with sleep quality while controlling for relevant covariates. In a large sample of Swedish municipality workers, we found that the prevalence ratio of poor sleep quality was higher among those who report high job strain and low physical activity levels, while controlling for self-rated health and social support. We are unaware of any previous studies that have simultaneously examined associations between job strain, physical activity, and sleep quality. The observed associations between work stress and sleep quality are consistent with findings of other studies, which have shown that work stressors have a negative impact on sleep quality,[10,24] including difficulty initiating sleep, difficulty maintaining sleep, and early-morning awakening.[25] However, in the present study the strength of the association between job strain and sleep quality differs depending on the level of self-reported health. Furthermore, the strongest associations were observed between self-rated health and sleep quality, indicating that self-rated health may play a greater role in sleep quality than job strain. There is to date no consensus as to whether the relationship between job strain and sleep quality is attributable to health status. A longitudinal study conducted by Gosling and colleagues (2014) observed that health status, both physical and mental, significantly increased the likelihood of experiencing sleep disturbances, including difficulty falling asleep and waking early. Gosling et al[26] suggested that the effects of work stress on sleep disturbances may be mediated by effects of work stress on health. Due to the cross-sectional nature of the present study, we are not able to establish any causal-effect relationship however the results underscore the importance of self-reported health in the association between work-stress and sleep quality.

Physical activity was independently associated sleep quality. Higher levels of physical activity were related to better sleep quality. The marginal means additionally suggest that physical activity levels may have a moderating role in the relationship between job strain, self-rated health, and sleep quality as they were consistently lower for those respondents who reported moderate-to-vigorous physical activity levels among all levels of job strain and self-rated health. Previous studies examining associations between physical activity and job strain have observed that sustained participation in physical activity contributes to reduced job strain and suggest that physical activity may improve functional capacity and cardiorespiratory fitness to cope with work-related stress.[27,28] Due to the cross-sectional nature of the study we are not able to establish any causal-effect relationship. This potential beneficial effect of physical activity on sleep quality should therefore further be studied with longitudinal study designs. This would provide valuable information regarding the use of exercise as a prescriptive to improve sleep quality among those with high work stress.

The following methodological issues need to be discussed. Firstly, an important limitation of the present study is its cross-sectional nature, which does not permit to draw causal relationships between observed associations. Future longitudinal studies should further explore the moderating and dynamic role of physical activity in the relationship between work stressors and sleep problems, especially as previous studies have observed that job stressors can inhibit physical activity levels, that is, job stressors hinder individuals from being physically active. A second limitation is related to the use of self-reported data. Even though validated questions were used there remains a risk of reporting bias, for

TABLE 4. Estimated Marginal Means for Percentage of Poor Sleep Quality Combined With Job Strain, Self-Rated Health and Physical Activity Levels

Job Strain	Self-Rated Health	Physical Activity	Mean	SE	95% CI
Low job strain	Good	Moderate-to-vigorous	0.13	0.010	0.11–0.15
		Low	0.15	0.015	0.12–0.18
	Moderate/bad	Moderate-to-vigorous	0.41	0.030	0.36–0.48
		Low	0.49	0.037	0.42–0.57
High job strain	Good	Moderate-to-vigorous	0.25	0.022	0.21–0.30
		Low	0.30	0.030	0.24–0.36
	Moderate/bad	Moderate-to-vigorous	0.50	0.033	0.44–0.57
		Low	0.60	0.045	0.52–0.69

CI, confidence interval; SE, standard error.

example, among those individuals with poor sleep quality that are more likely to report bad self-reported health and lower-levels of physical activity. Future research should use more objective measures such as accelerometers with regard to assessment of physical activity and collect in-depth information on when physical activity was performed during the day. This will provide valuable insight into the potential beneficial effect of domain-specific physical activity. A third limitation is that no data were collected on participants' medication and/or alcohol usage, or whether they had sleep apnea syndrome. We were, therefore, unable to eliminate any potential biases of these factors. A final limitation is related to the generalizability of the results. Participants were recruited from one Swedish municipality consisting of mainly women; however, a large sample was recruited representing different occupational and educational groups. Future studies should, therefore, be conducted in a sample, which has a more equal distribution of men and women.

CONCLUSION

Our findings show that high job strain and low physical activity are both associated with poor sleep quality, and we observed that self-rated health plays an important role in the association between job strain and sleep quality. Future longitudinal studies should examine the potential beneficial effect of physical activity on sleep quality among employees with high work-stress, while considering individual health status.

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