The Association Between Physical Activity, Sitting Time, Sleep Duration, and Sleep Quality as Correlates of Presenteeism

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Objective: This study aims to examine the relationship of lifestyle behaviors (physical activity, work and non-work sitting time, sleep quality, and sleep duration) with presenteeism while controlling for sociodemographics, work- and health-related variables. **Methods:** Data were collected from 710 workers (aged 20 to 76 years; 47.9% women) from randomly selected Australian adults who completed an online survey. Linear regression was used to examine the relationship between lifestyle behaviors and presenteeism. **Results:** Poorer sleep quality (standardized regression coefficients [B] = 0.112; $P < 0.05$), suboptimal duration (B = 0.081; $P < 0.05$), and lower work sitting time (B = −0.086; $P < 0.05$) were significantly associated with higher presenteeism when controlling for all lifestyle behaviors. Engaging in three risky lifestyle behaviors was associated with higher presenteeism (B = 0.150; $P < 0.01$) compared with engaging in none or one. **Conclusions:** The results of this study highlight the importance of sleep behaviors for presenteeism and call for behavioral interventions that simultaneously address sleep in conjunction with other activity-related behaviors.

Presenteeism is an individual's loss of productivity at work because of physical and psychosocial conditions and illness.[1,2] The economic cost of lost productivity because of presenteeism is higher than the cost of absenteeism, that is, being not at work because of illness.[3,4] Furthermore, longitudinal research suggests that presenteeism may increase the likelihood of future absenteeism.[5] To reduce presenteeism in the workplace, the associated economic and social burden effective interventions are required. To inform this process, a greater understanding of the factors that affect presenteeism is needed.

There is some evidence that poor lifestyle behaviors may adversely affect presenteeism.[1,6,7] For example, studies have shown that low levels of physical activity,[6,8–10] higher sitting time before and after work,[6] sleep disorders[11–13] and poor sleep quality[7] are associated with higher presenteeism. Nevertheless, the extent to which these behaviors affect presenteeism is still relatively unclear. This is because of the paucity of studies conducted, inconsistent findings reported (in the case of physical activity[14,15]), important aspects of behavior not examined (eg, examining sleep disorders[11–13] and sleep quality[7] but not sleep duration), the tendency to examine these behaviors in isolation, as well as lack of control for other important factors, such as health issues.[1,6–13]

Strong evidence shows that sleep duration and sleep quality are important for maintaining good physical and mental health.[16–18] Compared with the prevalence of sleep disorders (insomnia, obstructive sleep apnea, and restless leg syndrome), which affects 8.9% of the population, suboptimal sleep duration (sleeping less than 7 hours and more than 8 hours) affects 35% to 60% of the population and poor sleep quality (difficulty falling asleep or remaining asleep[19]) affects 23% of the population.[20–24] Yet, previous studies[7,11–13] examining sleep behavior and presenteeism have predominantly focused on sleep disorders and rarely considered less severe sleep issues (such as too little or not enough sleep and difficulty falling asleep) that also affect on health and well-being and are more prevalent in the population.

The lack of studies examining the effect of these behaviors in conjunction with each other is particularly concerning, given that 58.5% of the population report having at least two unhealthy lifestyle behaviors simultaneously.[25] It may be that lifestyle behaviors have a greater effect on presenteeism than what is shown in the current literature focusing on single behaviors as having several unhealthy lifestyle behaviors increases the risk of poor health, chronic disease, and mortality.[16,26–28] The association of physical activity, sitting behavior, and sleep with presenteeism is of particular importance. Nonoccupational sitting time is increasing,[29,30] and changes to work environments and job requirements are influencing workers' sleep behaviors[31] and have resulted in reduced levels of occupational physical activity while increasing the proportion of occupational sitting.[32] This is illustrated by studies reporting that office workers spend approximately 66% of their workday sitting.[33]

Furthermore, when examining the effect of lifestyle behaviors on presenteeism, it is important to take into account other factors that may influence this association. Particularly, health-related factors such as self-rated health should be considered given the strong interrelationships between lifestyle behaviors, self-rated health, and health outcomes.[20,34,35]

Therefore, this study aims to examine associations of physical activity, sitting time, sleep duration, and sleep quality with presenteeism when adjusting for self-rated health, as well as examine the association between having multiple unhealthy lifestyle behaviors simultaneously and presenteeism.

METHODS

The Human Ethics Research Review Panel at the Central Queensland University provided ethical approval for the project (Project H12/06–126).

Participant Recruitment

Participants were members of the Australian Health and Social Science Panel study funded by the Institute for Health and Social Science Research at the Central Queensland University, Australia. Panel members were recruited between 2009 and 2012

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Disclosure of funding: Dr Duncan is supported by a Future Leader Fellowship (ID 100029) from the National Heart Foundation of Australia.

There are no further funding sources to disclose.

Conflict of interest: The authors report no conflicts of interest.

Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site (www.joem.org).

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DOI: 10.1097/JOM.0000000000000355

using computer-assisted telephone interviewing. Panel members were randomly selected adults (aged 18 years and older) contactable via telephone across all states and territories of Australia. Further details on the recruitment methods for the Australian Health and Social Science Panel are available elsewhere.[36]

In 2012, all panel members ($n = 3932$) were invited to a Web-based survey via e-mail with up to four reminders. A total of 1843 (46.9%) respondents completed the survey. Only respondents who were employed in any type of paid work ($n = 1073$) were included in analyses. Respondents were excluded if their body mass index (BMI) exceeded 50 ($n = 10$), if they reported any health condition that prevented them from increasing physical activity or decreasing sitting time ($n = 41$), or if they had missing data for any variables included in the analyses conducted for this study ($n = 312$).

MEASURES

Sociodemographic, Work-Related, and Health-Related Variables

Participants provided information on their sex, age, marital status, employment, educational level, and household income. Highest level of education was categorized into lower education (high school or less, TAFE—a provider of vocational nonbachelor education up to level of advanced diploma) or higher education (technical college and higher education including university bachelor degree or higher). Household income was dichotomized into less than $1500 per week and $1500 or more per week. Respondents were asked to report employment status (full-time, part-time, or casual worker) and primary working time (during the day, during the night, or during the day and night). Occupation was classified using standardized measures[37] into the following three categories similar to other research[38]: professionals (managers and administrators, professionals, and associate professionals); white-collar workers (elementary, intermediate, and advanced clerical, sales, and service workers); and blue-collar workers (tradespersons, intermediate production, and transport workers, laborers, and related workers). Self-rated health was assessed with one question "Would you say that in general your health is excellent, very good, good, fair, poor?" from an existing measure of health-related quality of life—HRQOL-4.[39] Participants BMI was calculated from their self-reported height and weight (weight in kg/[height in m]^2). The presence of a chronic health condition was assessed by asking respondents if they have at least one of the following diseases: coronary heart disease, hypertension, hypercholesterolemia, diabetes, chronic bronchitis, cancer, osteoporosis, osteoarthritis, rheumatoid arthritis, irritable bowel syndrome, celiac disease, food allergy/intolerance, Alzheimer disease, and dementia. Mental health was assessed with one question "Have you ever been diagnosed with or treated for any kind of mental health condition including depression or anxiety?" (response options "yes" or "no").

Presenteeism

Presenteeism was quantified as reduced performance while at work using a question of the World Health Organization's validated Health and Work Performance Questionnaire (HPQ).[40,41] Participants were asked to rate their overall job performance on working days during the past 4 weeks from 0 (worst job performance) to 10 (performance of a top worker). Response options were inversely coded and expressed as percentage to ease interpretation resulting in a score ranging from 0 (no presenteeism) to 100 (maximal presenteeism).

Physical Activity

The Active Australia Survey (AAQ)[42] was used to measure frequency and time spent performing walking, moderate and vigorous physical activity in the last week. In this study, two measures of physical activity were examined. The first was a continuous measure of total minutes of physical activity, calculated as the sum of time participating in walking, moderate and vigorous physical activity (multiplied by two); this is consistent with guidelines for analysis and reporting of AAQ items.[42] A second measure of activity defined as the accumulation of at least 150 minutes of activity in five or more sessions was also used to classify participants as insufficiently or sufficiently active. Agreement of the AAQ with other questionnaires regarding the proportion of participants categorized as sufficiently active (150 minutes per week including at least five sessions) was between 59.2% and 74.3%,[43] and reliability for total minutes of physical activity was also high (intraclass correlation coefficient = 0.59).[44]

Sitting Behavior

Daily sitting time in the last week was assessed using the Workforce Sitting Questionnaire (WSQ).[45] The WSQ assesses sitting time (on weekdays and weekend days) separately for traveling to and from places, being at work, watching TV, using a computer at home, and doing other leisure activities. The WSQ was found to have a good test-retest reliability (intraclass correlation coefficient = 0.46 to 0.90) and criterion validity against accelerometry ($r = 0.18$ to 0.46).[45] Average daily sitting time at work was calculated by ([time spent sitting while at work on workdays * the number of workdays] + [time spent sitting while at work on non-workdays * the number of non-workdays]/7). Average daily non–work-related sitting time was calculated by ([time spent sitting while traveling, watching TV, using a computer, and other leisure activities on workdays * the number of workdays] + [time spent sitting while traveling, watching TV, using a computer, and other leisure activities on non-workdays * the number of non-workdays]/7).

Sleep Duration and Quality

Sleep duration was assessed using one question "During the past month, how many hours of sleep did you usually get each night? This may be quite different to the number of hours you spent in bed. (Enter total number of hours sleep per night)." Sleep quality during the past month was assessed with a four-point rating scale (1 = very good, 2 = fairly good, 3 = fairly bad, and 4 = very bad). These items were adopted from the Pittsburgh Sleep Quality Index, which has demonstrated good psychometric properties (Cronbach $\alpha = 0.83$; test-retest reliability = 0.85).[46]

Statistical Analysis

Descriptive statistics (means, standard deviation, and/or proportions) were calculated for all variables. Univariate linear regression analyses including sociodemographic, work- and health-related variables from Table 2 as predictors and presenteeism as the outcome variable were performed to identify possible confounders for the relationship between lifestyle behaviors and presenteeism. The associations of physical activity, work and non-work sitting time, sleep quality, and sleep duration with presenteeism were examined using linear regression analyses for each separate lifestyle behavior adjusted for significant sociodemographic, work- and health-related confounders identified in step one (models 1a to 1e). The lifestyle behaviors were included as continuous predictor variables in the described models. Furthermore, because lifestyle behaviors are likely to influence each other, a linear regression analysis including *all* lifestyle behaviors in a single model and adjusted for all significant sociodemographic, work- and health-related confounders was performed (model 2).

For lifestyle behaviors that are significantly associated with presenteeism graphs were produced in Excel showing the predicted presenteeism scores for the different levels of the lifestyle behavior. Predicted presenteeism scores were derived from the regression equation using unstandardized regression coefficients and sample

TABLE 1. Description of Sociodemographics, Work- and Health-Related Variables, Lifestyle Behaviors, and Presenteeism ($n = 710$)

Variables		*n* (%), If Not Otherwise Stated
Sociodemographics		
Sex		
Men		340 (47.9)
Women		370 (52.1)
Age, yrs		
Mean (SD), range		51.0 (10.8), 20–76
Educational level		
Low		232 (32.7)
High		478 (67.3)
Marital status		
Single		64 (9.0)
Divorced, separated, widowed		75 (10.6)
Married, de facto		571 (80.4)
Income		
< $1,500 per week		222 (31.3)
≥$1,500 per week		488 (68.7)
Work-related factors		
Employment status		
Full-time worker		445 (62.7)
Part-time worker		208 (29.3)
Casual worker		57 (8.0)
Occupation		
Professional		502 (70.7)
White collar		131 (18.5)
Blue collar		77 (10.9)
Working time		
During the day		606 (85.4)
During the night, or day and night		104 (14.7)
Health-related variables		
Body mass index		
Mean (SD), range		27.2 (5.0), 17–48
Normal (<25 kg/m^2)		257 (36.2)
Overweight/obese (≥25 kg/m^2)		453 (63.8)
General health		
Poor		3 (0.4)
Fair		68 (9.6)
Good		254 (35.8)
Very good		301 (42.4)
Excellent		84 (11.8)
Chronic diseases		
Yes		447 (63.0)
No		263 (37.0)
Mental health issue		
Yes		161 (22.7)
No		549 (77.3)
Lifestyle behaviors		
Physical activity		
Minutes mean (SD), median		364.0 (375.2), 240.0
Sufficient*		415 (58.5)
Insufficient		254 (35.8)
No activity		41 (5.8)
Sitting time		
Work-related mean (SD)		232.3 (141.1)
Non–work-related mean (SD)		388.1 (197.0)
<8 h		224 (31.5)
≥8 h		486 (68.5)
Sleep quality		
Very good		125 (17.6)
Fairly good		430 (60.6)
Fairly bad		137 (19.3)
Very bad		18 (2.5)
Sleep duration		
Mean (SD), range		6.9 (1.0), 3–12
<7 h		240 (33.8)
≥7 to <8 h		266 (37.5)
≥8 h		204 (28.7)
Number of risky lifestyle behaviors respondents engage in		
0 or 1 behaviors		97 (13.7)
2 behaviors		230 (32.4)
3 behaviors		265 (37.3)
4 behaviors		118 (16.6)
Presenteeism		
Loss of productivity in %	Mean (SD)	19.8 (14.9)

*The accumulation of at least 150 minutes of activity per week including at least five sessions.

means for covariates to control for sociodemographic, work- and health-related variables, as well as other lifestyle behaviors.

Since research suggested that both shorter and longer sleep duration may have adverse effects on health,[47] it was examined whether the relationship between sleep duration and presenteeism was nonlinear. First, an augmented partial residuals plot[48] was produced to identify nonlinearity in the data. Second, to test for a nonlinear relationship, a squared term of sleep duration (after centering by the mean) was added to the regression model 1e, and change in model fit was explored using likelihood ratio test. Because the squared term was significant (Standardized regression coefficients [B] = 0.105; $P < 0.005$) and model fit was improved (likelihood ratio $\chi^2(1) = 8.54$; $P < .005$) compared with the model including only a linear association, we only report on results for models 1e and 2 while including the squared term in addition to the linear term of sleep duration. Variance inflation factors for model 2 were less than 1.6 for all lifestyle behaviors indicating no multicollinearity.

To examine the effect of multiple lifestyle behaviors on presenteeism, an index was created where each participant was allocated a single point for each of the following risky lifestyle behaviors they engaged in—insufficient physical activity (not accumulating at least 150 minutes of physical activity with at least five sessions of activity over 1 week[42]), reporting sitting time of 8 or more hours a day,[49] reporting not very good sleep quality,[18] and a sleep duration less than 7 hours or 8 or more hours.[25] Overall sitting time was included in the index because there are no separate recommendations for work and non-work sitting time. Behaviors were categorized according to established guidelines for the behavior (physical activity) or evidence that risk of poor health outcomes (eg, overall mortality) was increased based on that pattern of behavior. Because of the low number of participants engaging in none risky lifestyle behavior (2.0%), we collapsed participants reporting to engage in none

or one risky lifestyle behavior (13.7%) into one category. Linear regression analysis with the number of risky lifestyle behaviors as the dummy coded predictor and significant sociodemographics, work- and health-related variables as covariates (from univariate analysis) was performed to examine the association of multiple lifestyle behaviors and presenteeism. Standardized regression coefficients and standard errors were calculated. Statistical analysis was performed with Stata version 12 (StataCorp LP, College Station, TX). All models were evaluated using a significance level of $P < 0.05$.

RESULTS

Respondents

A description of the sample ($n = 710$) regarding sociodemographics, work- and health-related variables, as well lifestyle behaviors, and presenteeism is presented in Table 1.

Associations of Lifestyle Behaviors With Presenteeism

Results of univariate regression analyses on the association of sociodemographic, work- and health-related factors with presenteeism are presented in Table 2. There was a significant association between the following sociodemographic, work- and health-related factors and presenteeism: sex, marital status, employment status, occupation class, general health status, and mental health. Therefore, all the following analyses were adjusted for these factors.

Individual regression analyses with adjustment for the significant sociodemographic, work- and health-related variables (Table 3, models 1a to 1e) revealed a significant association of presenteeism with poor sleep quality (B = 0.132; $P < 0.001$). For sleep duration, both the linear (B = −0.076; $P < 0.05$) and the squared term (B = 0.105; $P < 0.01$) were significantly associated with presenteeism. Physical activity (B = −0.054; $P = 0.156$), work-related (B = −0.057; $P = 0.149$), and non–work-related sitting time (B = 0.060; $P = 0.106$) were not associated with presenteeism.

After controlling for all lifestyle behaviors and sociodemographic, work- and health-related variables (Table 3, model 2), poor sleep quality (B = 0.112; $P < 0.05$) and the squared term of sleep duration (B = 0.081; $P < 0.05$) remained significantly associated with presenteeism, whereas the linear term of sleep duration was no longer significant (B = −0.023; $P = 0.582$). Furthermore, work-related sitting was significantly associated with presenteeism in this model (B = −0.086; $P < 0.05$), whereas physical activity (B = −0.057; $P = 0.132$) and non–work-related sitting time (B = 0.060; $P = .116$) remained not associated with presenteeism. Figures 1 and 2 display the association of sleep quality and sleep duration with

TABLE 2. Univariate Associations of Sociodemographics, Work- and Health-Related Variables With Presenteeism

Variables	Presenteeism B (SE)
Sociodemographics	
Sex (0 male; 1 female)	−0.180 (1.100)***
Age, yrs (continuous)	−0.060 (0.052)
Educational level (0 no tertiary; 1 tertiary)	0.024 (1.191)
Marital status (0 single, divorced, widowed; 1 married, de facto)	−0.103 (1.401)**
Income (0 <1500$; 1 ≥ 1500$ per week)	0.068 (1.203)
Work-related factors	
Employment status	
Full-time	Reference
Part-time	−0.080 (1.248)*
Casual	−0.008 (2.090)
Occupation	
Professional	Reference
White collar	−0.090 (1.455)*
Blue collar	−0.060 (1.815)
Working time (0 night, night and day; 1 day)	−0.018 (1.580)
Health-related variables	
BMI (continuous)	0.044 (0.112)
General health (continuous; 1 excellent to 5 poor)	0.187 (0.656)***
Chronic diseases (0 none; 1 yes)	0.007 (1.157)
Mental health issue (0 none; 1 yes)	−0.099 (1.328)**

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.
B, standardized regression coefficients; BMI, body mass index; SE, standard error.

TABLE 3. Association of Lifestyle Behaviors With Presenteeism

	Presenteeism	
Variables	Models 1a–1e[a] B (SE)	Model 2[b] B (SE)
Physical activity	− 0.054 (0.002)	− 0.057 (0.001)
Work sitting time	− 0.057 (0.004)	− 0.086 (0.004)*
Non-work sitting time	0.060 (0.003)	0.060 (0.003)
Sleep quality[c]	0.132 (0.833)***	0.112 (0.065)*
Sleep duration[d]		
Sleep duration	− 0.076 (0.525)*	− 0.023 (0.601)
Sleep duration^2	0.105 (0.296)**	0.081 (0.301)*

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.
[a]Model 1, adjusted for sex, marital status, employment status, occupation, general health, and mental health.
[b]Model 2, same as model 1 but additionally adjusted for all other lifestyle behaviors.
[c]Coded from 1 "very good" to 4 "very bad."
[d]The effect of sleep duration on presenteeism is represented by a linear and a squared term as adding the squared term was shown to improve model fit.
B, standardized regression coefficients; SE, standard error.

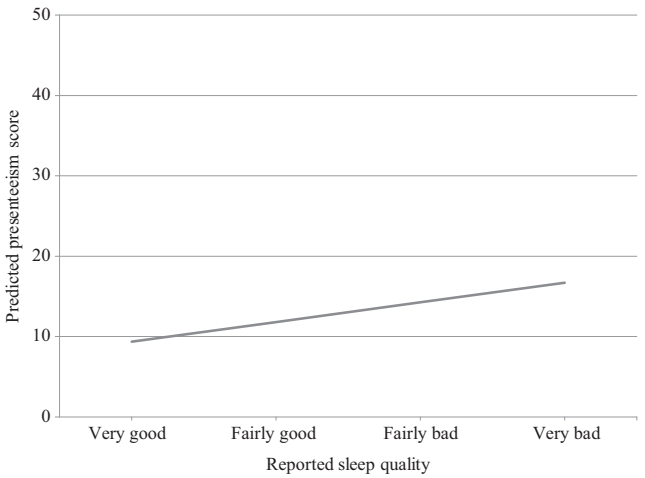

FIGURE 1. Association between reported sleep quality and presenteeism. Note: Predicted values based on model 2 adjusted for sex, marital status, employment status, occupation, general health and mental health, physical activity, work-related sitting time, non–work-related sitting time, and sleep duration.

presenteeism on the basis of model 2; the pattern of association in these models is similar to that of models 1d and 1e. Figure 3 illustrates the association of work-related sitting time with presenteeism on the basis of model 2.

Table 4 shows the association between presenteeism and the number of risky lifestyle behaviors participants engage in. Engaging in three risky lifestyle behaviors was associated with a significantly higher presenteeism score (B = 0.150; $P < 0.01$) compared with engaging in none or one risky lifestyle behavior. There were no significant associations with presenteeism scores when engaging in two (B = 0.050; $P = 0.368$) or four (B = 0.067; $P = 0.188$) risky lifestyle behaviors compared with engaging in none or one risky behavior.

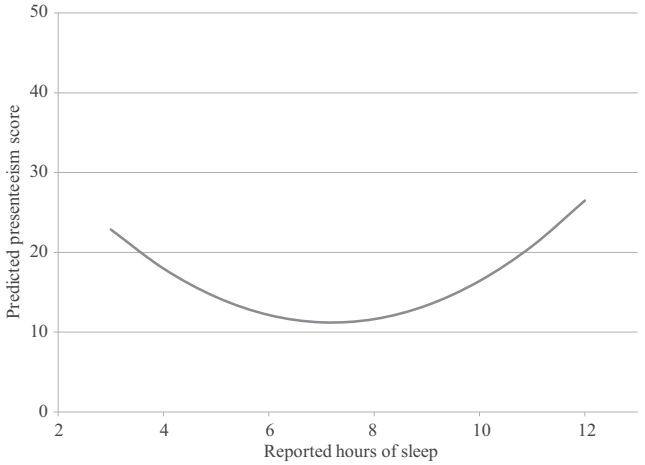

FIGURE 2. Association between reported hours of sleep and presenteeism. Note: Predicted values based on model 2 including both sleep duration and sleep duration^2, and adjusted for sex, marital status, employment status, occupation, general health and mental health, physical activity, work-related sitting time, non–work-related sitting time, and sleep quality.

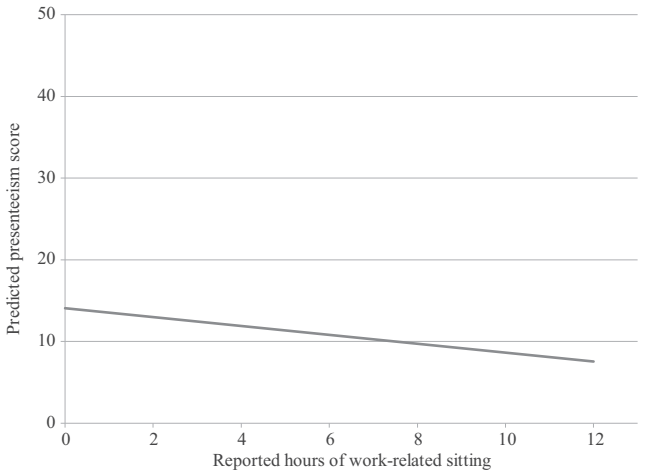

FIGURE 3. Association between reported work-related sitting time and presenteeism. Note: Predicted values based on model 2, adjusted for sex, marital status, employment status, occupation, general health, mental health, physical activity, non–work-related sitting time, sleep quality, and sleep duration.

TABLE 4. Association Between Number of Risky Lifestyle Behaviors Respondents Engage in and Presenteeism[a]

Number of Risky Lifestyle Behaviors[b] Respondents Engage in	Presenteeism B (SE)
0 or 1	Reference
2	0.050 (1.743)
3	0.150 (1.725)*
4	0.067 (2.036)

*$P < 0.01$.
[a]Adjusted for sex, marital status, employment status, occupation, general health, and mental health.
[b]Including physical activity, sitting time, sleep quality, and a sleep duration.
B, standardized regression coefficients; SE, standard error.

DISCUSSION

Results of this study demonstrate that poor sleep quality and suboptimal sleep duration are associated with higher presenteeism in workers when accounting for sociodemographics, work- and health-related variables, as well as for other lifestyle behaviors. Furthermore, presenteeism was heightened when respondents engaged in three risky lifestyle behaviors compared with engaging in none or only one risky behavior.

This study extends previous studies on the association of presenteeism and sleep disorders[16–18] by concurrently examining the role of sleep quality and sleep duration and by controlling for a broad range of factors. As depression and chronic disease presence are related to both presenteeism and suboptimal sleep durations,[50,51] depression, chronic diseases, and sleep quality were adjusted for in our analysis. This allowed us to more clearly examine the relationship between sleep duration, sleep quality, and presenteeism. Analyses also adjusted for physical activity, which is important as physical activity and sleep behaviors are interrelated.[52] In line with previous studies,[7,53] this study showed that poorer sleep quality was associated with higher presenteeism, and that this relationship remains when accounting for sociodemographics, work- and health-related variables, and other lifestyle behaviors. Furthermore, the squared term of sleep duration was significantly associated with presenteeism. This indicates that medium sleep duration is associated with lower presenteeism compared with shorter and longer sleep duration. In this study, this medium sleep duration was broadly comparable with the sleep duration suggested by several health agencies.[54] This is in line with previous studies showing adverse health effects of both shorter and longer sleep durations.[16,23] These findings are important, given that 22% of the employees in this study reported fairly bad or very bad sleep quality, and further 62.5% reported sleep durations less than 7 hours or 8 or more hours. Other potential reasons for these associations may be due to impaired cognitive performance associated with shorter or longer sleep durations; however, this was not assessed in this study.[55,56] Further research examining this issue is needed including the use of study designs that can limit the effect of any potential bidirectional relationships.

To date, workplace health promotion programs have typically focused on improving physical activity, smoking, and nutrition. Although these have had some success reducing presenteeism,[53] results from this study suggest that the inclusion of sleep behaviors may further enhance intervention outcomes. Notwithstanding that brief educational interventions in sleep hygiene have been found to be effective in enhancing sleep quality,[57,58] sleep hygiene has rarely been included in health promotion programs. This may be due to the fact that sleep disturbances were traditionally treated pharmacological, and only recently studies started to focus on the benefits of nonpharmacological treatment.[59]

When examining the combined effect of lifestyle behaviors on presenteeism, this study showed that engaging in three risky lifestyle behaviors is associated with higher presenteeism compared with engaging in none or one risky behavior. Thus, interventions targeting multiple lifestyle behaviors simultaneously are likely to be more useful for reducing presenteeism compared with interventions that focus on single health behaviors, as many previous interventions have done.[60] Therefore, employers should encourage their workers to a healthier lifestyle, including being physically active, reducing sitting time, and enhancing sleep behaviors. This is of particular importance as a supportive work environment was found to be associated with lower presenteeism.[10]

When adjusting for sociodemographic, work- and health-related factors, there was no association between physical activity and sitting time with presenteeism in this study. Previous studies[6,8–10] have reported a relationship of physical activity and sitting time with presenteeism. Nevertheless, these studies have not controlled for health-related variables, which are known to influence presenteeism. This may suggest that the association between these lifestyle behaviors and presenteeism is partially mediated through health variables. This is supported by subsequent analysis in this study (see Supplemental Digital Content Table 1, http://links.lww.com/JOM/A182), which demonstrated that low physical activity and higher non-work sitting time were indeed associated with presenteeism when only controlling for sociodemographic variables. This analysis was not reported because we deemed it important to account for health-related variables in the association between lifestyle behaviors and presenteeism. Nevertheless, this is in line with studies showing that both high physical activity and low sitting time are associated with better health.[27,28,61]

In relation to sitting time, two aspects should be considered when evaluating the results of this study. First, as there is a relatively high proportion of casual and part-time workers in our sample, this may have affected the results because casual and part-time workers are likely to differ from the full-time workers in their sitting time.[62] Second, after controlling for other lifestyle behaviors (model 2), higher work-related sitting was significantly associated with lower presenteeism. Given previous studies demonstrating higher sedentary time was related to heightened presenteeism,[6] this is unexpected and may be due to several factors. Differences in the behaviors being measured, sedentary behavior versus sitting time, and the methods used to quantify them may contribute to differences between studies. The high number of professional and white-collar employees in the sample (89%), many of whom are required to be seated to conduct their work[63,64] regardless of their presenteeism, may have confounded this relationship. Study design prohibited exploring this association in depth; however, when examining this association separately by occupation (data not shown), high work-related sitting time was associated with lower presenteeism only in professionals. Thus, it may be useful to examine this in future studies to better understand this association.

Some methodological limitations have been focused in this study. First, as we used cross-sectional data, we cannot provide information on the causality of the observed associations. Even though it seems reasonable to assume that lifestyle behaviors lead to differences in presenteeism, there is evidence from prospective studies suggesting that presenteeism predicts future health as well.[65] Second, even though we found that engaging in three risky lifestyle behaviors is associated with higher presenteeism, there was no heightened presenteeism for engaging in four risky lifestyle behaviors compared with engaging in none or one. This may be due to a lack of power to detect differences between groups because only 118 respondents (16.6%) reported engaging in four risky health behaviors. Third, we assessed presenteeism using a self-report measure (the HPQ), which may have led to bias from memory effects or social desirability. Nevertheless, respondents' reported score on the HPQ is in line with previous studies, showing a similar score for general workers[66] and a lower score for workers with medical conditions[67–69] indicating this sample is comparable with other published data. Finally, the HPQ did not assess productivity loss because of health problems, so we may have assessed productivity loss because of other reasons as well. Although computer-based tracking systems, for work productivity, exist, the objective measurement of work productivity remains challenging when looking at measurement of work quality and in occupations where discrete endpoints (eg, produced pieces, finished calls) are lacking.[70] Strengths of this study include examining the association of a range of lifestyle behaviors and presenteeism while taking into account health-related variables and the effect of multiple lifestyle behaviors.

CONCLUSIONS

This study demonstrated that higher presenteeism is associated with poor sleep quality and suboptimal sleep duration even after controlling for health-related variables and other lifestyle behaviors. Presenteeism was heightened for employees engaging in three risky lifestyle behaviors compared with engaging in none or one. Hence, the outcomes of this study suggest that encouraging employees to be more physically active, reducing sitting time, and enhancing sleep behavior can reduce effects of presenteeism. To reduce presenteeism associated costs, employers should consider implementing workplace programs to improve multiple health behaviors in employees.

ACKNOWLEDGMENTS

The authors thank the Australian Health and Social Science (AHSS) Panel study founded by the Institute for Health and Social Science Research (IHSSR) at the Central Queensland University, Australia, for providing data used in this study.

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