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The impact of work time control on physicians' sleep and well-being

P. Tucker [a, b, *, 1], E. Bejerot [c], G. Kecklund [a, d], G. Aronsson [c], T. Åkerstedt [a]

[a] *Stress Research Institute, Stockholm University, 106 91 Stockholm, Sweden*
[b] *Department of Psychology, Swansea University, Swansea SA2 8PP, United Kingdom*
[c] *Department of Psychology, Stockholm University, 106 91 Stockholm, Sweden*
[d] *Behavioral Science Institute, Radboud University, 6500 HE Nijmegen, The Netherlands*

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ABSTRACT

Physicians' work schedules are an important determinant of their own wellbeing and that of their patients. This study considers whether allowing physicians control over their work hours ameliorates the effects of demanding work schedules. A questionnaire was completed by hospital physicians regarding their work hours (exposure to long shifts, short inter-shift intervals, weekend duties, night duties, unpaid overtime; and work time control), sleep (quantity and disturbance) and wellbeing (burnout, stress and fatigue). Work time control moderated the negative impact that frequent night working had upon sleep quantity and sleep disturbance. For participants who never worked long shifts, work time control was associated with fewer short sleeps, but this was not the case for those who did work long shifts. Optimizing the balance between schedule flexibility and patient needs could enhance physicians' sleep when working the night shift, thereby reducing their levels of fatigue and enhancing patient care.

1. Introduction

Physicians working in industrialised countries have traditionally worked long hours, particularly during the early stages of their career, with their schedules often featuring frequent overnight and on-call duties. Moreover, physicians face a particularly demanding combination of workplace stressors including high workload, demanding work hours, having to make critical judgements (including at times of heightened fatigue), emotional interactions, high cognitive demands and restricted autonomy (Wallace et al., 2009). Consequently, physicians tend to report higher levels of stress and emotional exhaustion and are more likely to report getting insufficient sleep, when compared to the general working population (Tucker et al., 2013).

Following concerns regarding the long hours worked by physicians and the potentially negative affects on both their own wellbeing and that of their patients, the last decade has seen moves towards the standardisation of physicians' working conditions (e.g. ACGME, 2011; European Parliament and Council, 1993; Philibert et al., 2002). These regulations stipulate limits such as maximum weekly work hours, maximum shift duration, maximum quantity of night work and minimum amount of rest opportunities (e.g. between shifts and days off per week). They reflect, at least in part, research findings that demonstrate the importance of appropriate work schedule design for the management of physicians' fatigue and wellbeing.

A recent systematic review reported that the reduction of shifts over 16 h was associated with improvements in patient safety, as well as physicians' quality of life, in most studies (Levine et al., 2010). For example, an intervention involving the total elimination of extended shifts (>24 h) resulted not only in physicians getting more sleep, but also experiencing fewer attentional failures (i.e. microsleeps) and committing fewer medical errors (Landrigan et al., 2004; Lockley et al., 2004). Another intervention study involved redesigning physicians' work schedules with shorter shifts, fewer consecutive night shifts, and a sequence of morning, evening and night shifts designed to facilitate circadian adaptation to night work. The intervention brought about a 33% reduction in medical errors (Cappuccio et al., 2009). Survey studies have also highlighted a range of factors, in addition to length of work hours, which are crucial to the management of physicians' fatigue, sleep and health. These include the prevalence of night work, the number of consecutive night shifts worked in a row, the number of rest days after working nights, the length of the interval between successive shifts, the regularity of the work schedule and being able to sleep

* Corresponding author. Department of Psychology, Swansea University, Swansea SA2 8PP, United Kingdom. Tel.: +44 (0)1792 295894; fax: + 44 (0)1792 295679.
E-mail address: p.t.tucker@swansea.ac.uk (P. Tucker).
[1] This work was conducted when the first author was a visiting researcher at the Stress Research Institute.

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during duty hours (Baldwin and Daugherty, 2004; Brown et al., 2010; Ferguson et al., 2010; Gander et al., 2007; Tucker et al., 2010). Physicians' work schedules can also impact on their health, with high levels of on-call work and working several consecutive nights both having been linked to impaired psychological well-being (Brown et al., 2010; Heponiemi et al., 2008; Smith et al., 2006; Tucker et al., 2010). High levels of on-call were also found to predict greater intention to quit (Heponiemi et al., 2008).

Control over work hours and schedule flexibility are important predictors of physicians' work-life balance, burnout (Keeton et al., 2007) and career satisfaction (Clem et al., 2008). These outcomes have, in turn, been linked to lower quality of care (Gundersen, 2001; Spickard et al., 2002) and are also likely to negatively impact on recruitment and retention. Our research has indicated that the proportion of shift working physicians (in Sweden) who lack any influence over their work hours is substantially higher than the equivalent statistic for all (Swedish) shift workers (Tucker et al., 2013). When comparing physicians in different medical specialties, we found physicians working in specialities where influence of work hours was low (ear, nose & throat, orthopaedics, cardiology, surgery and anaesthesia) tended to report the most negative attitudes towards their work hours in general.

The importance of work time control for employees is underlined by the findings of a recent systematic review which identified it as a predictor of several job related outcomes (i.e. attitudes, performance and turnover), work-nonwork balance and some indices of health, including burnout and sleep (Nijp et al., 2012). Work time control has also been shown to ameliorate some of the negative impacts of demanding work schedules. It has been shown to buffer the effects of long work hours on sickness absence (Ala-Mursula et al., 2006), physical ill-health symptom frequency (Tucker and Rutherford, 2005) and work-family interference (Geurts et al., 2009; Hughes and Parkes, 2007; Kandolin et al., 2001; Valcour, 2007). These beneficial effects may due in part to the alleviation of stress and fatigue, as follows.

Job autonomy – of which work time control is a specific sub dimension – has been identified in several influential occupational health theories as an important determinant of employee health (e.g. job characteristics model: Hackman and Oldham, 1975; demand-control model: Karasek and Theorell, 1990). Nijp et al. (2012) proposed two regulatory mechanisms that can explain favourable associations between work time control and indices of health. The first was a time-regulation mechanism, such that workers who have work time control are better able to align their work hours with their non-work commitments (c.f. Barnett et al., 1999). Hence work time control may help reduce work-home interference, which is a potential source of psychological strain among doctors (Tucker et al., 2010). The second was a recovery-regulation mechanism, and was based on effort-recovery theory (Meijman and Mulder, 1998). Workers who have work time control are better able to maintain a balance between effort and recovery, as they can stop working before they become too fatigued (Beckers et al., 2008) e.g. by taking rest pauses during work; having control over when they start and finish work; and by having control over leave days. Conversely, a lack of work time control is likely to result in insufficient recovery, which is a key factor underlying the association between stressful work and poor health (Geurts and Sonnentag, 2006).

Workers with higher work time control not only report better health but also fewer sleep problems and less fatigue (e.g. Takahashi et al., 2011, 2012). By enhancing time-regulation, work time control can help individuals to match their work hours with their own circadian rhythms (Baltes et al., 1999). Moreover, sleep may also be improved by the reduction of stressors (e.g. work-home interference; Geurts et al., 1999) and by enhanced opportunities for unwinding after work (c.f. Fritz and Sonnentag, 2006).

In summary, physicians' work schedules are an important determinant of their health, fatigue and sleep. While the majority of research in this area has focussed on the impact of particular work schedule parameters (e.g. the timing, duration and sequencing of shifts, and the distribution of rest opportunities), there is some limited evidence indicating the importance of providing physicians with control over their work hours. This accords with evidence from other occupational sectors showing that work time control is associated with enhancements of health, fatigue and sleep. A number of studies have also shown that work time control buffers (i.e. moderates) the impact of long work hours on health and wellbeing. However, it remains to be determined whether work time control can buffer the effects of other work schedule parameters, other than length of work hours, which are known to impact on fatigue, sleep and health. The current study addresses this gap in the literature by examining how the impacts of five key working time parameters (frequency of long shifts, frequency of short inter-shift intervals – "quick returns", frequency of weekend days that are worked, frequency of night duties and number hours of overtime worked per week) were moderated by work time control.

Our predictions were based on the premise that work time control buffers the negative effects of demanding work schedules. Hence we hypothesized that demanding work schedules (defined in terms of the five working time parameters listed above) would be less commonly associated with greater fatigue, impaired sleep and poorer health among physicians with work time control, as compared to physicians who lacked work time control.

2. Method

2.1. Participants

In 2007 a questionnaire was sent to 3000 Swedish physicians (almost 10% of all physicians in Sweden), selected at random from the membership of the Swedish Medical Association. We received 1534 responses. Analysis of non-responders indicated that 109 were not active physicians, giving a final response rate of 53.1%. Non-responders did not differ from respondents with regards to age, grade or geographical location. However, the response rate was higher for females (56.6%) than for males (49.8%).

The current analyses focussed on a sub-sample of the respondents, chosen to provide a relatively homogeneous sample and thereby exclude several potential confounds. The criteria for selection of the sub sample were based on job title (senior specialist/consultant or below), type of work place (hospital) and type of organization (regional public sector organization), with a resulting sample of $N = 799$. The number of participants who provided a full set of responses and could therefore be included in the analyses was $N = 545$ for the analyses of the sleep measures and $N = 542$ for the analyses of the wellbeing measures. Details of the included sample are provided in the results of the analyses that compared the included and excluded participants (see Results, below).

The regional ethics committee approved the questionnaire.

2.2. Materials

The questionnaire included six single item measures concerning working time arrangements. The first asked 'Can you influence how and when your work hours are scheduled?'. The response options were 1 – Yes; 2 – Yes, to some extent; 3 – No. Only 5% of respondents chose the first response option and so the item was recoded as: 0 – 'Some work time control' and 1 – 'No work time control', and is henceforth referred to as low work time control.

(Note that all variables were coded such that a higher score indicated what could generally be considered a less desirable situation.) The next four items ascertained the frequency of shifts longer than 12 h; the frequency of short inter-shift intervals (<11 h); the frequency of weekend days that are worked; and the frequency of night duties. The response options for these four items were 1 – Never; 2 – 1-2 times/month; 3 – 3-4 times/month; 4 – 5-6 times/month; 5 – More than 6 times per month. In view of the low numbers choosing the higher response options, the items referring to long shifts, short inter-shift intervals and night duties were recoded thus: 1 – Never; 2 – 1-2 times/month; 3 – 3-4 times/month; 4 – More than 4 times per month. The item referring to weekend work was recoded thus: 1 – Never; 2 – 1-2 times/month; 3 – More than 2 times per month). The sixth item asked respondents to state the number of hours worked per week without compensation i.e. unpaid overtime. This continuous variable was recoded into four response categories: 1 – Never; 2 – Up to 4 h; 3 – 5-9 h; 4 – >=10 h.

The measure of sleep disturbance was based on items from the Karolinska Sleep Questionnaire (Åkerstedt et al., 2008, 2002). It was calculated as the mean score of responses to four items which asked participants how often they had experienced each of the following sleep symptoms in the last three months: difficulty falling asleep, repeated awakenings with difficulty falling back to sleep, too early (final) awakening and interrupted/restless sleep (range of possible scores: 1 – Never; 2 – Rarely/occasionally; 3 – Sometimes/a few times per month; 4 – Often/1–2 times per week; 5 – Most of the time/3–4 times per week: 6 – Always/5 times or more per week. Cronbach's alpha = 0.87). An additional item asked how often they experienced short sleep (<6 h), with the same response format.

There were three measures related to wellbeing. Emotional exhaustion was based on 5 items from the Maslach Burnout Inventory (Maslach et al., 2001) asking how often respondents felt (i) emotionally drained by their work, (ii) completely exhausted when the work day was over, (iii) tired getting up in the morning to face a new day at work, (iv) that working a whole day was really trying and (v) run down by their work (1 – Never; 2 – A few times per year; 3 – Once per month; 4 – A few times per month; 5 – Once per week; 6 – A few times per week; 7 – Every day. Cronbach's alpha = 0.87). Stress was based on 3 items from the measure of long lasting stress described by Hasson et al. (2011), asking respondents how often in the last three months they had days when they (i) felt overactive all the time, (ii) felt very pressured, on the verge of what they were capable of, and (iii) found it hard to relax in their spare time (1 – Not at all; 2 – Sometimes; 3 – Rather often; 4 – Almost all of the time. Cronbach's alpha = 0.71). Fatigue after work was based on 3 items asking respondents how often they (i) felt physically tired after work, (ii) felt mentally tired after work and (iii) were so tired after work that they found it hard to do things such as working out, pursuing a hobby or meeting friends (1 – Almost never; 2 – No rarely; 3 – Yes, sometimes; 4 – Yes, rather often; 5 – Yes, often. Cronbach's alpha = .77).

2.3. Data analyses

In order to examine the effect of missing data on the representativeness of the final sample, comparisons were made between the included participants and those who were excluded, using Pearson Chi-Square analyses and an independent *t*-test.

For the main analyses, two multivariate analyses of variance (MANOVA) were conducted, one for the sleep-related dependent variables (sleep disturbance and frequency of short sleeps) and one for the dependent variables related to wellbeing (burnout, stress and fatigue). Each analysis incorporated the four control variables (age, gender, medical specialty and job grade); the six working time parameters (work time control, frequency of shifts longer than 12 h, frequency of inter-shift intervals <11 h, frequency of weekend days worked, frequency of night shifts and number of unpaid weekly hours); and the five terms representing the interactions (between low work time control and each of the other five working time parameters). Main effects and interactions for individual dependent variables were only interpreted if the overall multivariate test was significant. In the subsequent univariate tests, Bonferroni adjustments were applied in order to reduce the risk of Type I errors, such that the significance criteria were $P < 0.025$ for the sleep-related dependent variables and $P < 0.017$ for the dependent variables related to wellbeing.

3. Results

Comparisons of participants included in the analyses with those excluded on the basis of missing data indicated that the included participants were significantly younger by 2.8 years (mean age of included participants = 42.9 years (SD = 10.3), excluded participants = 45.7 years (SD = 11.2); $t(467) = -3.34$, $P < 0.01$) and were more likely to be male (53.5% of included were male, against 42.8% of excluded; χ^2 (1, $n = 799$) = 7.99, $P < 0.01$). The distribution of medical specialties differed between included and excluded participants (anaesthesia – 10.9% & 8.2%, respectively; paediatrics – 7.7% & 9.3%; internal medicine – 13.1% & 6.6%; surgery – 9.6% & 5.1%; orthopaedics – 6.3% & 7.8%; gynaecology – 4.6% & 6.2%; psychiatry – 6.8% & 9.7%; radiology – 9.0% & 7.4%; other specialties – 31.9% & 39.7%. χ^2 (8, $n = 799$) = 19.86, $P < 0.05$). There was no difference with respect to job grade between included and excluded participants (junior or specialty trainee – 27.5% & 23.3%, respectively; medical specialist or consultant – 72.5% & 76.7%. χ^2 (1, $n = 799$) = 1.55, $P > 0.05$).

Descriptive statistics (relating to the included sample) for the predictor and outcome variables and bivariate correlations between them are shown in Table 1 (note that when relatively demanding work schedules were associated with poorer sleep or wellbeing, this was reflected by a positive association). Low work time control and amount of unpaid overtime were both positively correlated with all five outcomes. All six working time parameters were positively associated with frequency of short sleeps. Frequency of short inter-shift intervals was positively associated with stress. There were weak to moderate positive correlations between the independent variables. The dependent variables were all moderately positively correlated with each other, with the highest inter-correlations observed between the measures of wellbeing.

In the analyses of sleep (see Table 2), higher amounts of unpaid overtime were significantly associated with greater sleep disturbance (mean score for participants who never work unpaid overtime = 2.47 (SE = 0.10); up to 4 h per week = 2.40 (SE = 0.11); 5–9 h = 2.72 (SE = 0.11); >10 h = 2.82 (SE = 0.12)) and more frequent short sleeps (never = 3.14 (SE = 0.12); up to 4 h = 3.16 (SE = 0.13); 5–9 h = 3.37 (SE = 0.13); >10 h = 3.66 (SE = 0.14)). There was a significant interaction between low work time control and frequency of long shifts in the analysis of frequency of short sleeps (see Fig. 1). Among participants who never worked long shifts, having work time control was associated with fewer short sleeps. There was no effect of work time control among those who worked long shifts. There were also significant interactions between low work time control and frequency of night shifts in the analyses of both sleep disturbance (see Fig. 2) and frequency of short sleeps (see Fig. 3). Among participants who worked nights more than 4 times per month, having work time control was associated with less disturbed sleep and fewer short sleeps. There were no effects of work time control among those who worked

Table 1
Means, standard deviations, inter-correlations of study variables.

Variable	Mean	SD	2	3	4	5	6	7	8	9	10	11
1. Low work time control[a]	0.44	0.50	.03	−0.02	0.06	0.05	0.12**	0.14**	0.10**	0.17**	0.11**	18**
2. Long shifts	2.62	0.97		0.53**	.43**	0.54**	0.06	0.01	0.16**	0.03	0.05	.03
3. Short inter-shift intervals	1.94	0.96			0.31**	0.26**	0.11**	0.05	0.22**	0.00	0.10*	0.07
4. Weekend duties	2.01	0.51				0.47**	0.03	−0.00	0.09*	−0.03	0.01	−0.01
5. Night duties	2.29	1.02					−0.07	−0.04	0.10*	−0.05	−0.03	−0.03
6. Unpaid overtime	2.22	1.11						0.18**	0.18**	0.12**	0.18**	0.12**
7. Sleep disturbance	2.54	1.09							0.48**	0.49**	0.53**	0.45**
8. Short sleep	3.09	1.25								0.31**	0.34**	0.28**
9. Burnout	3.79	1.33									0.67**	.72**
10. Stress	1.98	0.61										0.64**
11. Fatigue	3.35	0.89										

*$p < .05$, **$p < .01$.
[a] Work time control was coded so that a low score (0) indicated 'some work time control' and high score (1) indicated 'no work time control'. Likewise, all other variables were coded such that a higher score indicated what could generally be considered a less desirable situation.

nights up to 4 times per month (or among those who never worked nights).

In the analyses of wellbeing (see Table 3), participants who lacked work time control were more fatigued after work ($M = 3.73$ (SE = 0.08) than those who had work time control ($M = 3.32$ (SE = 0.09)). Higher levels of unpaid overtime were significantly associated with greater stress (mean score for participants who never work unpaid overtime = 1.92 (SE = 0.06); up to 4 h per week = 2.00 (SE = 0.06); 5–9 h = 2.16 (SE = 0.07); >10 h = 2.13 (SE = 0.07)) and greater fatigue after work (never = 3.34 (SE = 0.08); up to 4 h = 3.53 (SE = 0.09); 5–9 h = 3.68 (SE = 0.09); >10 h = 3.55 (SE = 0.10)).

4. Discussion

The results were only partially consistent with the premise that having work time control protects physicians from the negative effects of demanding schedules. Work time control moderated the negative impact that frequent night working had upon sleep quantity and sleep disturbance, in accordance with our predictions. The association between frequency of long shifts and frequency of short sleeps was moderated by work time control, although the interaction pattern was not consistent with our predictions. There were no moderating effects of work time control in the analyses of short inter-shift intervals, weekend working or unpaid overtime. In terms of main effects, having work time control was associated with less fatigue after work, but the associations between work time control and the other outcome measures failed to reach significance.

Among physicians who worked night shifts more than 4 times per month, those who lacked work time control reported more frequent short sleeps and more disturbed sleeps, as compared to those with some degree of work time control. There was no effect of work time control among physicians who worked night shifts less frequently. Given the well-established negative impact that night work has on sleep (Åkerstedt, 2003), it seems likely that those who work nights most often will gain the most benefit from being able to influence how and when their work hours are scheduled, in order to match their personal circumstances and their own circadian rhythms (c.f. Baltes et al., 1999). Influence on both night time and day time work hours is likely to be important, enabling individuals to optimize the fit between actual and preferred work hours at night, and also to maximize their opportunities for recovery during day time. The interactions may also partly reflect a selection effect. Some individuals with work time control may choose to work more night shifts because they are better able to adapt their sleep–wake cycle to a nocturnal routine. These individuals may be expected to experience less disrupted and curtailed sleep as a result of working night shifts, compared to those who are obliged to work them.

Work time control moderated the association between frequency of long (>12 h) shifts and frequency of short sleeps. Having work time control was associated with fewer short sleeps, but only among those who never worked long shifts. It is likely that physicians working at least some shifts that are longer than 12 h will work longer shifts on average, compared to those who work none. It may be that working longer shifts restricts physicians' ability to effectively utilize work time control to improve the fit between their preferred and actual work hours (e.g. by varying the start and finish times).

Under some circumstances flexible work schedules may foster a culture of overwork. In particular, when workloads are high and

Table 2
Results of the MANOVA examining the associations between working time parameters and sleep, controlling for age, gender, medical specialty and job grade[a] ($N = 545$).

	Multivariate tests				Univariate tests				
	Pillai's trace	*F*	Partial η^2	*df1,df2*	*F* sleep disturbance	Partial η^2	*F* short sleep	Partial η^2	*df1,df2*
Low work time control	.01	1.40	.006	2503	2.19	.004	1.92	0.004	1504
Long shifts	.01	0.51	.003	6,1008	0.23	.001	0.60	0.004	3504
Short inter-shift intervals	.02	.193	.011	6,1008	0.91	.005	2.02	0.012	3504
Weekend duties	.01	1.10	.004	4,1008	0.23	.001	1.16	0.005	2504
Night duties	.03	1.32	.008	6,1008	2.07	.012	1.30	0.008	3504
Unpaid overtime	.03	2.87**	.017	6,1008	4.01*	.023	4.11*	0.024	3504
WTC × Long shifts	.04	3.48**	.020	6,1008	2.60	.015	3.74*	0.022	3504
WTC × Short inter-shift intervals	.02	1.86	.011	6,1008	1.60	.009	2.89	0.017	3504
WTC × Weekend duties	.01	0.99	.004	4,1008	1.94	.008	0.59	0.002	2504
WTC × Night duties	.03	2.82*	.016	6,1008	3.84*	.022	3.96*	0.023	3504
WTC × Unpaid overtime	.02	1.40	.008	6,1008	1.99	.012	2.06	0.012	3504

*$=p < .05$ ($p < .025$ after Bonferroni adjustment in the univariate tests), **$=p < .01$ ($p < .005$ after Bonferroni adjustment in the univariate tests), WTC = Work time control.
[a] For the sake of parsimony, values for the control variables are not shown in the table, but are available on request from the first author.

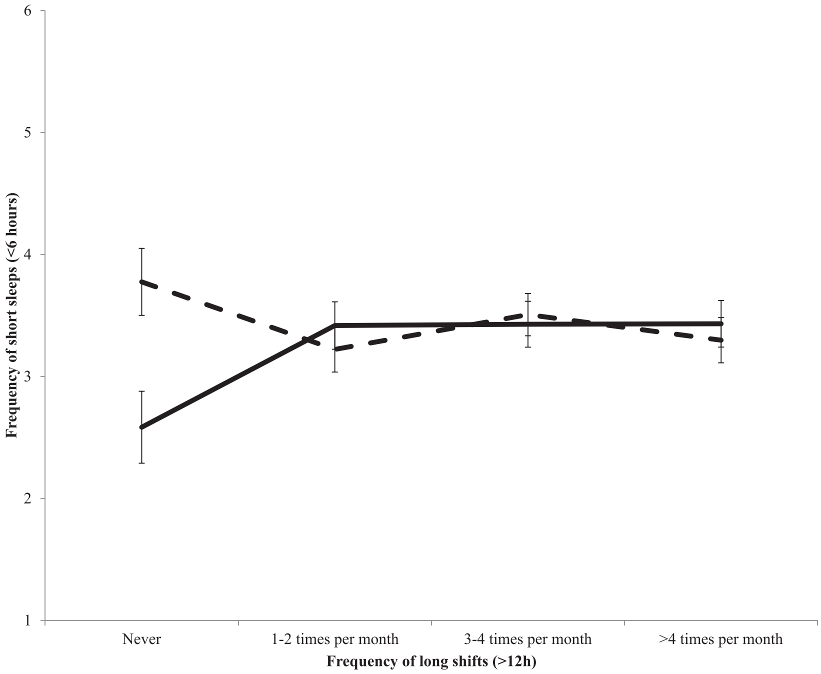

Fig. 1. Estimated marginal means (and their standard errors) for the interaction between work time control (WTC) and frequency of long shifts (>12 h) in the prediction of short sleeps (<6 h). Solid lines represent partcipants with some WTC, dashed lines represent partcipants with no WTC.

there are ambiguous norms about work hours, flexibility can be associated with the breakdown of work-nonwork boundaries. Consequently there is a risk that the employee may feel pressured to restructure their personal time to work, in order to work long hours (Kossek and Lee, 2008). The potentially negative impact of work time control under certain circumstances may go some way to explaining why there were few main effects of work time control and fewer than expected significant interaction effects involving work time control. Such negative influences may mask or counteract the otherwise positive influence of work time control.

Another possible explanation of why the impact of work time control was less than expected is that average levels of work time

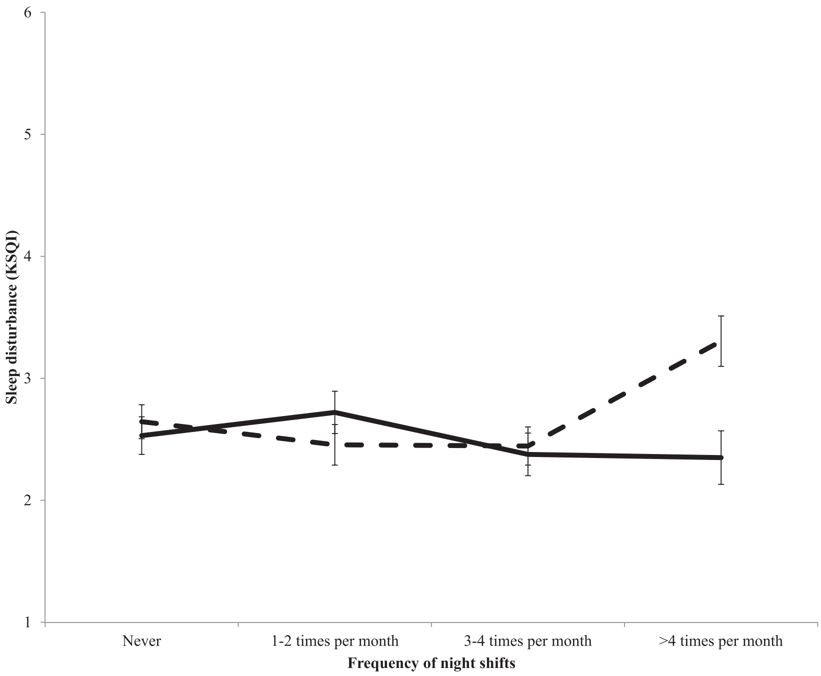

Fig. 2. Estimated marginal means (and their standard errors) for the interaction between work time control (WTC) and frequency of night shifts in the prediction sleep disturbance. Solid lines represent partcipants with some WTC, dashed lines represent partcipants with no WTC.

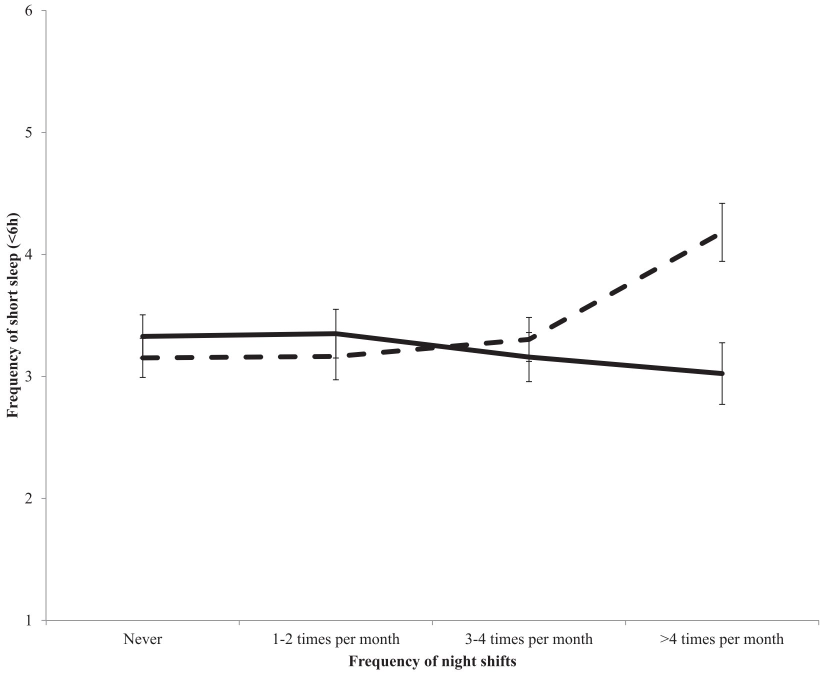

Fig. 3. Estimated marginal means (and their standard errors) for the interaction between work time control (WTC) and frequency of night shifts in the prediction of short sleeps (<6 h). Solid lines represent partcipants with some WTC, dashed lines represent partcipants with no WTC.

control were relatively low. As noted above, in response to the question asking whether respondents could influence their work hours, only a small number answered 'yes', while the vast majority of those classified as having some work time control answered 'yes, to some extent'.

From a theoretical perspective, the findings that lack of work time control was associated with greater fatigue after work is consistent with work time control being part of a recovery-regulation mechanism, as proposed by Nijp et al. (2012). A lack of work time control prevents employees adjusting their work and recuperation times to their current need for recovery, resulting in an accumulation of fatigue across the day. However, while it was previously suggested that the recovery-regulation mechanism could explain favourable associations between work time control and indices of health, there was limited evidence of work time control being associated with better health with respect to stress and burnout, possibly for the reasons noted above.

There were no significant associations between frequency of short inter-shift intervals (<11 h) and any of the outcome measures. In an earlier study of physicians, we used a different criteria for defining short inter-shift intervals (<10 h), and found significant associations between the frequency of short inter-shift intervals and both short sleeps and fatigue (Tucker et al., 2010). Thus it is possible that the shorter the length of the inter-shift interval, the more likely effects will observed in terms of restricted sleep and increased fatigue.

The lack of association between frequency of weekend working and any of the outcome measures is somewhat surprising, given our previous finding that weekend working by physicians was associated with greater work-family interference, which in turn can be a stressor (Tucker et al., 2010). One possible for reason for the absence of effects in the current analyses was the relatively restricted range of frequencies of weekend working (74% of the current sample worked weekends one or two times per month).

Higher amounts of unpaid overtime were associated with more sleep disturbance and more frequent short sleeps, as well as higher levels of stress and fatigue. It cannot be assumed that all those who worked a lot of unpaid overtime were necessarily working long

Table 3
Results of the MANOVA examining the associations between working time parameters and wellbeing, controlling for age, gender, medical specialty and job grade[a] ($N = 542$).

	Pillai's trace	*F*	Partial η^2	*df1,df2*	*F* burnout	Partial η^2	*F* stress	Partial η^2	*F* fatigue	Partial η^2	*df1,df2*
Low work time control	0.02	3.92**	0.023	3499	3.27	0.006	3.18	0.006	11.21**	.022	1501
Long shifts	0.02	1.42	0.008	9,1503	2.03	0.012	1.49	0.009	1.81	.011	3501
Short inter-shift intervals	0.03	1.48	0.009	9,1503	0.14	0.001	0.62	0.004	1.85	0.011	3501
Weekend duties	0.01	0.49	0.003	6,1000	0.40	0.002	0.15	0.001	0.99	0.004	2501
Night duties	0.03	1.61	0.010	9,1503	3.19	0.019	1.29	0.008	1.21	0.007	3501
Unpaid overtime	0.03	1.91*	0.011	9,1503	2.62	0.015	4.30*	0.025	3.55*	0.021	3501
WTC × Long shifts	0.04	2.03*	0.012	9,1503	2.33	0.014	3.45	0.020	2.15	0.013	3501
WTC × Short inter-shift intervals	0.03	1.46	0.009	9,1503	0.29	0.002	0.32	0.002	1.92	0.011	3501
WTC × Weekend duties	0.01	1.14	0.007	6,1000	0.94	0.004	2.23	0.009	0.29	0.001	2501
WTC × Night duties	0.02	1.28	0.008	9,1503	2.65	0.016	2.75	0.016	1.48	0.009	3501
WTC × Unpaid overtime	0.03	1.71	0.010	9,1503	2.29	0.014	2.09	.012	2.43	0.014	3501

*=$p < 0.05$ ($p < 0.017$ after Bonferroni adjustment in the univariate tests), **=$p < 0.01$ ($p < 0.003$ after Bonferroni adjustment in the univariate tests), WTC = Work time control.
[a] For the sake of parsimony, values for the control variables are not shown in the table, but are available on request from the first author.

weekly work hours, although it may be assumed that this was so in the majority of cases.[2] In so far as this assumption is correct, the findings are broadly consistent with previous studies that have highlighted the risks of physicians working long hours (Levine et al., 2010).

One of the main strengths of the current study is that was based on a relatively large sample of physicians working in public sector hospitals at or below the grade of senior specialist. While the analyses comparing the final sample with those who were excluded because of missing data indicated significant differences with respect to three out the four control variables examined, the differences were small and so the sample may be regarded as being reasonably representative. The questionnaire included a number of well-validated measures of health and wellbeing. However, it also included some single item measures, including that of work time control. The cross-sectional nature of the study limits the possibility for inferring causal mechanisms. Moreover, it relied entirely on self-report data, making it potentially subject to subjective biases and vulnerable to the problems of common method variance (Podsakoff et al., 2003).

5. Conclusions

The current findings show that work time control can buffer the impact that night work has upon sleep. This is in contrast to previous research that has tended to highlight the role of work time control as a moderator of effects on health. It was less clear that work time control mitigates the negative effects of other aspects of demanding work schedules (e.g. long shifts, short inter-shift intervals, weekend working, high levels of unpaid overtime). Indeed, in the analysis of long shifts, there was some suggestion that work time control is more beneficial for those working *less* demanding schedules. The relatively small magnitude of both the main effects of work time control and its interactions with other working time parameters reflect the complexity of the issues surrounding the relationships between work hours and sleep, fatigue and health. Thus, while working time control appears to be salient in the management of physicians' sleep when working night shifts, it should be acknowledged that it is but one of a large range of influential factors.

The results provide support for the practise of trying to match physician's night work hours to their individual needs and preferences. This will be challenging in the complex work environment where effective cover needs to be maintained at all times. Nevertheless, imaginative solutions that optimize the balance between flexibility and patient needs have the potential to enhance physicians' sleep, thereby reducing their levels of fatigue on the night shift and enhancing patient care.

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[2] The survey included an item asking about respondents' contracted weekly work hours. However, the range of responses to this item suggested that ambiguous phrasing of the question had led some participants to misinterpret it. Hence the item was not used in the current analysis.

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