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Uncovering energetic mechanisms that link work stressors to sleep

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ABSTRACT

In this study we examine whether and why daily work stressors are associated with sleep quality and sleep quantity. We draw on the effort-recovery model to test daily relationships between challenge and hindrance work stressors and sleep through physical and psychological fatigue, and vigor. We analyze daily diary data from 98 working sole mothers collected over seven days. The within-person daily hypotheses linking challenge and hindrance stressors to sleep via energetic mediators in our model were not supported. Exploratory analysis revealed several of our hypotheses were supported at the between-person level. Challenge and hindrance stressors were differentially related to psychological fatigue *and* physical fatigue such that hindrance stressors were positively associated, and challenge stressors were negatively associated. Challenge and hindrance stressors were differentially related to vigor such that hindrance stressors were negatively associated, and challenge stressors were positively associated. Across individuals, challenge and hindrance stressors were indirectly related to sleep quantity through these energetic mediators. This study answers calls for more investigations into mechanisms linking work stressors and sleep, and emphasises the importance of examining phenomena at multiple levels of analysis. Theoretical and practical implications for the challenge-hindrance framework and effort-recovery model, including the appropriate timeframe for study, are discussed.

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Challenge and hindrance stressors; sleep; energy; fatigue; effort-recovery

Getting enough sleep has crucial implications for employee health and performance. Sleep is an important and necessary part of the recovery process for employees after encountering daily stressors (Buysse, 2014; Meijman & Mulder, 1998; Porkka-Heiskanen et al., 2003), and achieving restful sleep of adequate duration makes us feel happier, more alert, and more energetic, as well as helps our body to heal and to defend against immune system threats (Buysse et al., 1989; Cappuccio et al., 2010; Kuppermann et al., 1995). Poor sleep is associated with reduced well-being and increased illness (Colten & Altevogt,

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2006), as well as decreased work engagement, job satisfaction, and performance (e.g. Barnes, 2012; Litwiller et al., 2017).

Work stressors are one barrier to achieving sufficient and restful sleep. Meta-analyses show work stressors are associated with impaired sleep quality and quantity (Litwiller et al., 2017), as well as sleep disturbances (Nixon et al., 2011). This is thought to occur because work stress exposure leads to psychological and physiological activation that is incompatible with undisturbed sleep (Åkerstedt, 2006). However, the literature on work stressors and sleep is largely cross-sectional and between-persons. Consequently, we lack empirical tests of the day-to-day explanatory processes that link stressor exposure and sleep (Crain et al., 2018; French et al., 2019a; Litwiller et al., 2017). Further, reviews suggest that the relationships between work stressors and sleep are of varying magnitudes and somewhat inconsistent (Litwiller et al., 2017; Nixon et al., 2011). Distinguishing work stressors that are challenging (motivating and goal relevant; Cavanaugh et al., 2000) versus hindering (frustrating or overwhelming; Cavanaugh et al., 2000) may be one way to clarify when and how work stressors impact sleep on a daily basis (French et al., 2019a).

The present study furthers the work stress and sleep literature by examining energetic mediators that explain *why* challenge and hindrance work stressors have differential associations with daily sleep. We combine the challenge-hindrance model (Cavanaugh et al., 2000) with the effort-recovery model (Meijman & Mulder, 1998) to suggest challenges and hindrances differentially relate to daily sleep quantity and quality due to distinct patterns of fluctuation in three energetic states: psychological fatigue, physical fatigue, and vigor.

Our paper makes several contributions. First, we expand knowledge of *why* work stressors affect sleep. Specifically, we test energetic states as key mediators that are often theorised as a logical link between work stress and sleep outcomes (e.g. Åkerstedt, 2006; Berset et al., 2011; Crain et al., 2018; Linton, 2004). Second, we focus on *within-day* fluctuations, allowing us to better understand daily lived experiences of workers and to test work stressor implications for sleep in a way that allows us to capture short-term changes in a theoretically appropriate time frame (Crain et al., 2018; Meijman & Mulder, 1998; Porkka-Heiskanen et al., 2003; Sonnentag et al., 2008). Third, we replicate and extend previous studies that suggest the *type of work stressor* has implications for sleep by distinguishing challenge and hindrance stressors (French et al., 2019a). Specifically, we test the idea that challenges and hindrances are differentially associated with sleep, rather than treating stress as a unidimensional construct. Last, by additionally examining our hypotheses at the between-person level as supplementary analysis, we demonstrate the importance of simultaneously considering phenomena at multiple levels of analysis (Gabriel et al., 2019) and highlight contrasting within- and between-person results.

Hypothesis development

Our hypothesis development first reviews and posits direct relationships between daily work stressors and sleep within the framework of the challenge-hindrance model. We then incorporate energetic mediating mechanisms (psychological fatigue, physical fatigue, and vigor) that explain why challenge and hindrance stressors have differing relationships with sleep on a daily basis.

Work stressors and sleep

Sleep quantity and sleep quality are both important aspects of sleep health (Buysse, 2014). Sleep quantity is defined as the duration of sleep during the major sleep period overnight. Sleep quality is defined as the perception that one's sleep was generally good and restful (e.g. Krystal & Edinger, 2008). Measuring both sleep quantity and quality maintains a holistic representation of sleep health (Buysse, 2014), and allows us to determine whether challenge and hindrance work stressors are differentially associated with each aspect of sleep health (e.g. Åkerstadt et al., 2002; French et al., 2019a).

Although work stressors are known to have negative implications for psychological well-being (e.g. Podsakoff et al., 2023), work stressor implications for sleep remain more uncertain. Some studies find work stressors, when defined at a general level as high psychological or physical demands, are associated with poor sleep quality (Åkerstedt, 2006; Linton et al., 2015). Work stressors are also associated with worsening sleep health problems and sleep complaints (Lallukka et al., 2010; Rella et al., 2009), as well as shortened sleep duration (Åkerstedt, 2006). However, multiple past reviews conclude the associations between work stressors and sleep outcomes are weak or unclear (e.g. Litwiller et al., 2017; Nixon et al., 2011).

Some of this ambiguity may be resolved by taking into account the type of work stressor. The challenge-hindrance stressor framework was first developed by Cavanaugh et al. (2000) to explain why some work stressors have differing relationships with job attitudes and performance. Challenge stressors are posited to be depleting, but come with opportunities for growth, learning, and completion of work goals that promote positive attitudes and states like satisfaction (Cavanaugh et al., 2000). Examples of challenge stressors at work include workload, time pressure, and increased job responsibility. Hindrance stressors are also posited to be depleting, but instead thwart growth and learning, producing negative attitudes and states like frustration (Crawford et al., 2010). Examples of hindrance stressors include work interruptions, poor supervision, and organisational politics (e.g. Crawford et al., 2010; O'Brien & Beehr, 2019).

Despite some speculation about whether stressors can be objectively categorised as a challenge or a hindrance (e.g. Rosen et al., 2020; Widmer et al., 2012), several studies find support for hypothesised challenge-hindrance differences in workplace outcomes (e.g. Crawford et al., 2010; LePine et al., 2005; Podsakoff et al., 2023). Further, while both challenges and hindrances are depleting, challenge-strain relationships are often weaker than hindrance-strain relationships (e.g. Edwards et al., 2014; French et al., 2019b; Podsakoff et al., 2023; Rodell & Judge, 2009; Webster et al., 2011; Wood & Michaelides, 2016). This is because hindrances are relatively more negative, frustrating, and distressing compared to challenges, which have a motivational and energising silver lining. Prior sleep research similarly shows stressors that can be classified as hindrances have been associated with poor sleep quality or reduced sleep quantity, while stressors that can be classified as challenges are weakly or not associated with these outcomes (e.g. Åkerstadt et al., 2004; Eriksen et al., 2008; Slopen & Williams, 2014). French et al. (2019a) directly compared the two and found that hindrance stressors were more strongly associated with prospective sleep quantity than challenge stressors. Thus, we posit:

> Hypothesis 1: Hindrance stressors are negatively associated with (a) sleep quantity and (b) sleep quality.

Hypothesis 2: Challenge stressors are negatively associated with (a) sleep quantity and (b) sleep quality.

Hypothesis 3: Hindrance stressors have stronger negative associations with (a) sleep quantity and (b) sleep quality, compared to challenge stressors.

Energy as a mechanism for challenge-hindrance differences

To illuminate *why* these direct, differential relationships between stressors and sleep may exist, we next examine challenge and hindrance stressors and sleep through the lens of the effort-recovery model. Meijman and Mulder's (1998) effort-recovery model provides rationale for energetic changes in response to workplace stressors. When encountering work stressors, employees mobilise mental and physical effort to cope with or eliminate the stressor (e.g. Clark et al., 2014). The effort-recovery model posits that these effortful behaviours result in energy expenditure and produce short-term energetic changes like mental and physical fatigue, as well as dispositions like excitement (Meijman & Mulder, 1998). To capture a range of these energetic changes, we examine state measures of physical fatigue (physical tiredness and reduced capacity to perform physical activity, Frone & Tidwell, 2015), psychological fatigue (mental tiredness and reduced capacity to engage in cognitive activity, Frone & Tidwell, 2015), and vigor (high levels of energy, mental resilience, investment, and persistence in work, Schaufeli & Bakker, 2004). In doing so, we include both the theorised potential depletion and invigoration associated with challenge and hindrance stressors (e.g. Cavanaugh et al., 2000), as well as incorporate measures of physical energy and energetic activation that are theorised to link work and sleep (Crain et al., 2018).

The challenge-hindrance stressor framework acknowledges that both challenges and hindrances are taxing (Cavanaugh et al., 2000). Hindrance stressors, however, are thought to be particularly energetically exhausting because expending effort does not necessarily lead to desired outcomes (Cavanaugh et al., 2000; Lazarus & Folkman, 1984). Challenge stressors, while effortful, produce eagerness at the thought of and accomplishment of potential gains (e.g. learning, progress). These challenges are more likely to act as a "call to action" and activate a search for solutions (Cavanaugh et al., 2000; Lazarus & Folkman, 1984). As such, we expect hindrances to be more strongly, positively related to both physical and psychological fatigue, and we expect challenges to be more strongly, positively related to vigor. In line with this rationale, previous research shows challenges and hindrances are associated with exhaustion and fatigue, but hindrance associations are relatively stronger (LePine et al., 2004; LePine et al., 2005; Stiglbauer & Zuber, 2018). Challenges have been positively related to vigor and similar constructs like motivation and engagement, while hindrances are not (Crawford et al., 2010; LePine et al., 2005; Lin et al., 2009). Following our theoretical rationale and considering prior empirical results, we posit:

Hypothesis 4a: Hindrances are positively associated with psychological fatigue.

Hypothesis 4b: Challenges are positively associated with psychological fatigue.

Hypothesis 4c: Hindrances are more strongly positively associated with psychological fatigue compared to challenges.

Hypothesis 5a: Hindrances are positively associated with physical fatigue.

Hypothesis 5b: Challenges are positively associated with physical fatigue.

Hypothesis 5c: Hindrances are more strongly positively associated with physical fatigue compared to challenges.

Hypothesis 6a: Hindrances are negatively associated with vigor.

Hypothesis 6b: Challenges are positively associated with vigor.

Hypothesis 6c: Challenges are more positively associated with vigor, compared to hindrances.

According to the effort-recovery model, as employees encounter stressors, psychological and physiological systems become engaged and aroused as effort is expended (Meijman & Mulder, 1998). After energy expenditure, these systems need quantitatively and qualitatively sufficient rest to return to baseline levels of arousal. Employees who experience fatigue, which reflects a state of depletion, require sufficient sleep to restore energetic resources (Crain et al., 2018; Frone & Tidwell, 2015). Employees who feel invigorated, which reflects a state of activation, experience psycho-physiological arousal that could impair sleep (Crain et al., 2018).

As hypothesised above, we expect both types of work stressors to be positively related to psychological and physical fatigue, and we expect these relationships are stronger for hindrances compared to challenges. Psychological and physical fatigue are characterised by feeling a lack of energy, extreme tiredness, and reduced functional capacity as a result of depletion from regulatory effort at work (Frone & Tidwell, 2015). As per the effort-recovery model, workers who become fatigued during the workday require sleep to return their energetic resources to baseline levels, and being in a depleted energetic state may facilitate falling and staying asleep. Thus, we expect a stronger, *positive* indirect relationship between hindrance stressors and sleep quantity and quality through psychological and physical fatigue compared to challenges. We predict:

Hypothesis 7: Psychological fatigue partially mediates the relationship between hindrances and sleep such that hindrances are positively associated with (a) sleep quantity and (b) sleep quality through psychological fatigue.

Hypothesis 8: Psychological fatigue partially mediates the relationship between challenges and sleep such that challenges are positively associated with (a) sleep quantity and (b) sleep quality through psychological fatigue.

Hypothesis 9: Psychological fatigue partially mediates the relationship between hindrances and sleep such that hindrances are more strongly positively associated with (a) sleep quantity and (b) sleep quality through psychological fatigue, compared to challenges.

Hypothesis 10: Physical fatigue partially mediates the relationship between hindrances and sleep such that hindrances are positively associated with (a) sleep quantity and (b) sleep quality through physical fatigue.

Hypothesis 11: Physical fatigue partially mediates the relationship between challenges and sleep such that challenges are positively associated with (a) sleep quantity and (b) sleep quality through physical fatigue.

Hypothesis 12: Physical fatigue partially mediates the relationship between hindrances and sleep such that hindrances are more strongly positively associated with (a) sleep quantity and (b) sleep quality through physical fatigue, compared to challenges.

Daily changes in vigor also reflect the recruitment and usage of resources when encountering work stressors. However, vigor reflects feeling energised and a willingness to invest effort, as well as high engagement and involvement in work throughout the day (Schaufeli & Bakker, 2004). As hypothesised, we expect challenges to be more strongly related to vigor compared to hindrances. The increased arousal and activation of feeling invigorated may disturb sleep or prolong sleep onset (Crain et al., 2018; Linton, 2004; Partinen, 1994). Thus, we expect a stronger, *negative* indirect relationship between challenge stressors and sleep quantity and quality through vigor compared to hindrances. We thus predict that:

Hypothesis 13: Vigor partially mediates the relationship between hindrances and sleep such that hindrances are positively associated with (a) sleep quantity and (b) sleep quality through vigor.

Hypothesis 14: Vigor partially mediates the relationship between challenges and sleep such that challenges are negatively associated with (a) sleep quantity and (b) sleep quality through vigor.

Hypothesis 15: Vigor partially mediates the relationship between challenges and sleep such that challenges are more negatively associated with (a) sleep quantity and (b) sleep quality through vigor, compared to hindrances.

Method

Participants and procedure

Participants in this study were working sole mothers (i.e. non-partnered women who work) who were recruited online (e.g. social media, online advertising), in local newspaper ads, and via word-of-mouth in Fall 2018 to participate in a daily diary study over 7 days. Sole mothers encounter significant challenges as they attempt to balance work and nonwork demands with limited support at home and increased financial hardship compared to their partnered counterparts (Baxter & Renda, 2011; Robinson et al., 2018). Sole mother status is also associated with known health disparities (Artazcoz et al., 2004; Dziak et al., 2010; Shattuck & Kreider, 2013). Sleep is an especially prominent concern for sole mothers as they face considerable obstacles to maintaining their health and engaging in adequate recovery (e.g. Dziak et al., 2010; Robinson et al., 2018).

To be eligible, participants were required to identify as a woman, work at least 32 paid hours per week, have at least one dependent child, live without a partner, and work non-night-shift hours. Eligible participants first filled out a baseline survey including demographics and individual differences. The following Monday, participants began a seven-day daily diary that included a morning survey (completed upon waking, sent at 6:00 AM) and an evening survey (completed when going to bed, sent at 9:00 PM) each day. Daily diary methodology allowed us to measure energetic responses that occur on a short-term reactionary basis and is appropriate because these energetic processes are theorised to reset each day, often after achieving sufficient sleep (Crain et al., 2018; Meijman & Mulder, 1998; Porkka-Heiskanen et al., 2003; Sonnentag et al., 2008).

Participants had up to four hours to complete each survey. After limiting our sample to working days only, we retained 380 daily surveys from 98 mothers. This study was approved by two co-author institutions (Virginia Tech IRB # 18-571 and Georgia Tech H18222).

The final sample of women were 36.51 years of age on average ($SD = 8.50$) and had an average of 2.52 dependent children ($SD = .74$). Participants worked an average of 41.36 h per week ($SD = 6.30$) and worked an average of 1.19 jobs ($SD = .55$). Participants were predominantly White (64%), followed by Black (27%), Hispanic (8%), and not listed among available options (1%). Most respondents had a bachelor's degree (32%), followed by some college (31%), a master's degree (15%), or a high school diploma (12%). Job titles reflected a wide variety of jobs, such as administrative assistant, manager, cashier, director, sales representative, teacher and licensed clinical social worker. Participants earned on average between $40,000 and $50,000 per year.

Measures

Challenge stressors (evening survey)

Challenge stressors were measured with three items from Rodell and Judge (2009) (average daily $\alpha = .59$, $SD = .12$). (We computed alpha values for each day, then averaged the alpha values across the seven days. This reliability coefficient includes a low outlier day, minimum $\alpha = .02$, maximum $\alpha = .80$, median $\alpha = .75$). Challenges were assessed in the evening survey before bedtime. Participants responded using a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item includes: "Today, my job has required me to use a number of complex or high-level skills."

Hindrance stressors (evening survey)

Hindrance stressors were measured with four items from Rodell and Judge (2009) (average daily $\alpha = .74$, $SD = .10$), and assessed in the evening survey. Participants responded using a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item includes: "Today, I have had to go through a lot of red tape to get my job done."

Psychological fatigue (morning and evening surveys)

Psychological fatigue was measured using five items from Lanaj et al. (2014) and was assessed in both the morning (average daily $\alpha = .85$, $SD = .07$) and evening surveys (average daily $\alpha = .87$, $SD = .05$). Participants indicated the extent they were experiencing each item "right now" using a 5-point scale ranging from 1 (*not at all*) to 5 (*very much*). A sample item includes: "I feel mentally drained."

Physical fatigue (morning and evening surveys)

Physical fatigue was measured using four items from Frone and Tidwell (2015), and was assessed in both the morning (average daily $\alpha = .96$, $SD = .01$) and evening surveys (average daily $\alpha = .95$, $SD = .02$). Participants indicated the extent to which they were experiencing each item "right now" using a 5-point scale ranging from 1 (*not at all*) to 5 (*very much*). A sample item includes: "I feel physically worn out."

Vigor (morning and evening surveys)

Vigor was measured using three items from Schaufeli and Bakker (2004), and assessed in both the morning (average daily α = .80, *SD* = .15) and evening surveys (average daily α = .59, *SD* = .29). (This reliability coefficient includes a low outlier day, minimum $\alpha = .02$, maximum $\alpha = .80$, median $\alpha = .75$). Participants indicated the extent to which they were experiencing each item "right now" using a 5-point scale ranging from 1 (*not at all*) to 5 (*very much*). A sample item includes: "I feel strong and vigorous."

Sleep quantity (morning survey)

Sleep quantity was assessed in the morning survey of the next day (following each night of sleep) using a single self-report item from Buysse et al. (1989): "How many hours of actual sleep did you get last night? This may be different than the number of hours you spent in bed."

Sleep quality (morning survey)

Sleep quality was assessed in the morning survey of the next day (following each night of sleep) using a single self-report item from Buysse et al. (1989). Participants were instructed to answer the question: "How would you rate your sleep quality last night?" using a 4-point scale ranging from 1 (*very bad*) to 4 (*very good*).

Results

Preliminary analyses

Descriptive statistics, ICCs, within-person correlations, and between-person correlations are presented in Table 1. ICCs indicated 34% - 78% of the variance in the measured variables resides at the between (person) level, and LL difference tests compared to general linear models were all statistically significant at $p < .05$ (Bliese & Ployhart, 2002). Thus, statistics indicate the data should be treated as nested (days nested within persons). We evaluated a measurement model for all predictors and mediators measured in the evening, as well as for all mediators measured in the morning using multilevel confirmatory factor analysis. All items were specified to load onto their intended constructs and identical models were specified at the between- and within-person level. Each model fit demonstrated adequate fit (evening model $\chi^2(284) = 577.94$, $p < .01$, CFI = .92, TLI = .90, RMSEA = .05, within SRMR = .05, between SRMR = .12; morning model $\chi^2(102) = 247.37$, $p < .01$, CFI = .96, TLI = .95, RMSEA = .06, within SRMR = .04, between SRMR = .09), providing evidence that items tapped into each respective construct and did not cross-load onto other constructs (Hu & Bentler, 1999). To confirm psychological and physical fatigue items measure distinct constructs, we compared our measurement models to alternative models that combined psychological and physical fatigue items onto one factor. The alternative models fit worse, suggesting psychological and physical fatigue variables are distinct (evening model: $\Delta\chi^2$ (4) = 95, $p < .01$, ΔCFI = −0.03, ΔRMSEA = 0.01; morning model: $\Delta\chi^2$ (4) = 120, $p < .01$, ΔCFI = −0.03, ΔRMSEA = 0.02; Chen, 2007; Meade et al., 2008).

Table 1. Means, standard deviations, ICCs, and bivariate correlations.

	M	*SD*	*ICC*	1	2	3	4	5	6	7	8	9	10	11	12
1. Challenge stressors	3.70	0.78	0.60		0.35**	−0.14	−0.08	−0.20*	−0.06	0.18	0.25*	0.06	0.14	0.08	0.18
2. Hindrance stressors	2.16	0.77	0.78	0.32**		0.23*	0.47**	0.26*	0.46**	−0.45**	−0.39**	−0.18	−0.35**	0.59**	0.22*
3. Morning psychological fatigue	1.95	0.90	0.59	0.09	0.07		0.73**	0.88**	0.69**	−0.59**	−0.33**	−0.26*	−0.40**	0.33**	0.02
4. Evening psychological fatigue	2.28	0.99	0.66	0.15**	0.10	0.24**		0.69**	0.89**	−0.57**	−0.49**	−0.23*	−0.42**	0.50**	0.11
5. Morning physical fatigue	2.08	1.14	0.60	0.05	0.07	0.76**	0.22**		0.71**	−0.68**	−0.39**	−0.33**	−0.50**	0.35**	0.06
6. Evening physical fatigue	2.64	1.25	0.54	0.15**	0.11*	0.27**	0.73**	0.26**		−0.59**	−0.58**	−0.35**	−0.48**	0.60**	0.17
7. Morning vigor	2.86	1.19	0.71	−0.02	−0.01	−0.52**	−0.25**	−0.58**	−0.25**		0.74**	0.23*	0.49**	−0.51**	−0.20
8. Evening vigor	2.40	1.01	0.64	−0.09	−0.10	−0.11*	−0.44**	−0.13*	−0.53**	0.14*		0.09	0.37**	−0.52**	−0.13
9. Sleep quantity	6.62	1.19	0.64	−0.09	0.02	−0.35**	−0.13*	−0.32**	−0.18**	0.32**	0.03		0.44**	−0.25*	−0.06
10. Sleep quality	3.04	0.70	0.31	0.00	0.04	−0.40**	−0.14**	−0.42*	−0.19**	0.37**	0.08	0.49**		−0.36**	−0.15
11. Affective rumination	2.73	1.06													
12. Problem-solving pondering	2.92	0.76													

*$p < .05$; **$p < .01$. *M*: Mean; *SD*: Standard deviation; *ICC*: between subjects variance/(within + between subjects variance). Between subjects correlations above the diagonal ($N = 98$). Within subjects correlations below the diagonal ($N = 356–380$).

Hypothesis testing

Hypotheses were tested using multilevel structural equation modeling (MSEM) in Mplus (Muthén & Muthén, 2018) using Bayesian estimation (Asparouhov & Muthén, 2021). As such, any missing values are estimated within the analysis (Asparouhov & Muthén, 2021). We estimated the within- and between-level models according to the mediation model depicted in Figure 1. At the within level, we regressed the evening-assessed mediators on morning-assessed levels to evaluate change in energy after accounting for morning levels. Paths were estimated as fixed effects, with intercepts allowed to vary randomly. We compared challenge and hindrance paths using model constraints in Mplus in this core mediation model. Unstandardised path estimates and posterior standard deviations are shown in Table 2.

Hypothesis 1 stated that hindrance stressors will be negatively associated with (a) sleep quantity and (b) sleep quality. Neither Hypothesis 1a (*estimate* = .02, 95% *CI* = [−.26, .28]) nor 1b (*estimate* = −.02, 95% *CI* = [−.19, .20]) were supported. Hypothesis 2 stated that challenge stressors will be negatively associated with (a) sleep quantity and (b) sleep quality. We found no support for Hypothesis 2a (*estimate* = −.06, 95% *CI* = [−.26, .14]) nor 2b (*estimate* = −.11, 95% *CI* = [-.28, .04]). Hypothesis 3 stated that hindrance stressors will have stronger, negative associations with (a) sleep quantity and (b) sleep quality compared to challenge stressors. Neither Hypothesis 3a (*estimate* = .07, 95% *CI* = [−.29, .44]) nor 3b (*estimate* = .12, 95% *CI* = [−.16, .38]) were supported (Table 3).

We found no evidence that hindrances are positively associated with psychological fatigue (*estimate* = .11, 95% *CI* = [−.05, .27]), and no evidence that challenges are positively associated with psychological fatigue (*estimate* = .08, 95% *CI* = [−.05, .22]), yielding no support for Hypotheses 4a or 4b. Similarly, we had no evidence to suggest that hindrances are more strongly, positively related to psychological fatigue (*estimate* = .04, 95% *CI* = [−.19, .26]), yielding no support for Hypothesis 4c. We found no evidence that hindrances are positively associated with physical fatigue (*estimate* = .08, 95% *CI* = [−.13, .29]), and no evidence that challenges are positively associated with physical fatigue (*estimate* = .09, 95% *CI* = [−.11, .30]), yielding no support for Hypotheses 5a or 5b. We also had no evidence to suggest that hindrances are more strongly, positively related to physical fatigue (*estimate* = -.01, 95% *CI* = [−.37, .31]), yielding no support for Hypothesis 5c.

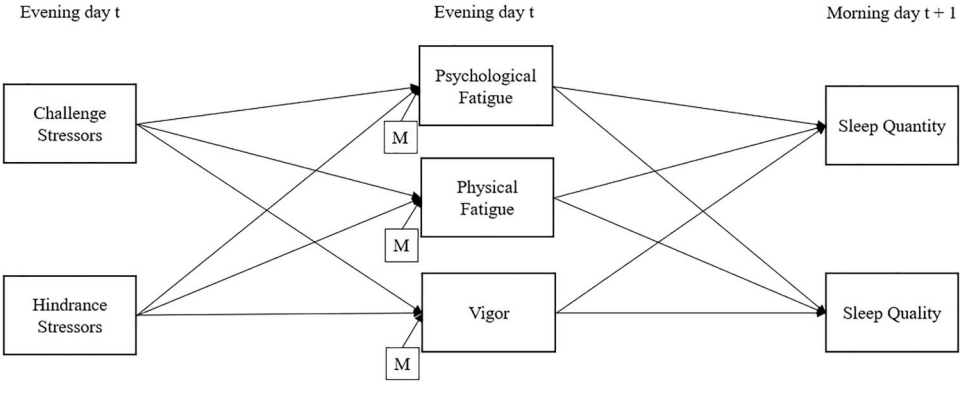

Figure 1. Hypothesised within-person model.

Note: M = Morning day control for each respective variable.

Table 2. Hypothesised mediation model unstandardised path coefficients.

	Evening psychological fatigue		Evening physical fatigue		Evening vigor		Sleep quantity		Sleep quality	
Variables	Estimate	*SD*[1]	Estimate	*SD*	Estimate	*SD*	Estimate	*SD*	Estimate	*SD*
Within										
Challenge stressors	0.08	0.07	0.09	0.10	0.05	0.08	−0.06	0.11	−0.11	0.08
Hindrance stressors	0.11	0.09	0.08	0.11	−0.29**	0.09	0.02	0.14	0.02	0.10
Evening psychological atigue							−0.11	0.12	−0.17	0.09
Evening physical fatigue							0.10	0.09	0.15*	0.07
Evening vigor							0.06	0.08	−0.04	0.07
Morning psychological fatigue	0.25**	0.06								
Morning physical fatigue			0.28**	0.06						
Morning vigor					0.16*	0.06				
Residual variance	0.33**	.0.03	0.51**	0.04	0.35**	0.03	0.58**	0.05	0.33**	0.03
Between										
Challenge stressors	−0.67*	0.14	−0.76*	0.18	0.83**	0.13	0.78*	0.38	0.18	0.15
Hindrance stressors	0.80**	0.11	1.00**	0.14	−0.75**	0.11	−0.42	0.33	−0.11	0.14
Evening psychological fatigue							1.19**	0.31	0.04	0.14
Evening physical fatigue							−1.35**	0.26	−0.17	0.12
Evening vigor							−0.62**	0.23	0.09	0.12
Residual variance	0.29**	0.07	0.44**	0.12	0.28**	0.07	0.38**	0.17	0.07*	0.03

Note: *SD* here refers to posterior standard deviation. Consistent with Preacher et al. (2010) unconflated model, all predictors are person-mean centered and estimated only at the within person level.

*$p < .05$; **$p < .01$.

Table 3. Challenge vs. hindrance within-person and between-person contrast estimates.

Level	Outcome	Relationship	*Estimate*	*Post. SD*	*95% CI LL*	*95% CI UL*
Within	Evening psychological fatigue	Direct effect	0.04	0.12	−0.19	0.26
	Evening physical fatigue	Direct effect	−0.01	0.16	−0.37	0.31
	Evening vigor	Direct effect	−0.34*	0.13	−0.57	−0.09
	Sleep quantity	Direct effect	0.07	0.19	−0.29	0.44
		Indirect effect through evening psychological fatigue	0.00	0.02	−0.05	0.04
		Indirect effect through evening physical fatigue	0.00	0.02	−0.05	0.04
		Indirect effect through evening vigor	−0.02	0.03	−0.08	0.03
	Sleep quality	Direct effect	0.12	0.14	−0.16	0.38
		Indirect effect through evening psychological fatigue	−0.01	0.02	−0.06	0.04
		Indirect effect through evening physical fatigue	0.00	0.03	−0.07	0.05
		Indirect effect through evening vigor	0.01	0.03	−0.04	0.08
Between	Evening psychological fatigue	Direct effect	1.45**	0.21	1.03	1.83
	Evening physical fatigue	Direct effect	1.75**	0.26	1.28	2.30
	Evening vigor	Direct effect	−1.58**	0.19	−1.97	−1.20
	Sleep quantity	Direct effect	−1.19	0.66	−2.45	0.07
		Indirect effect through evening psychological fatigue	1.72**	0.57	0.76	3.04
		Indirect effect through evening physical fatigue	−2.36**	0.65	−3.93	−1.34
		Indirect effect through evening vigor	0.96*	0.39	0.25	1.78
	Sleep quality	Direct effect	−0.29	0.27	−0.77	0.27
		Indirect effect through evening psychological fatigue	0.06	0.21	−0.35	0.50
		Indirect effect through evening physical fatigue	−0.30	0.22	−0.73	0.08
		Indirect effect through evening vigor	−0.14	0.19	−0.53	0.29

*$p < .05$; **$p < .01$. *SE*: Standard error; *95% CI LL*: 95% credibility interval lower limit; *95% CI UL*: 95% confidence interval upper limit.

Hindrances were negatively associated with vigor (*estimate* = −.29, 95% *CI* = [−.47, −.32]), yielding support for Hypothesis 6a. Challenges were not positively associated with vigor (*estimate* = .05, 95% *CI* = [−.12, .18]), yielding no support for Hypothesis 6b. Hypothesis 6c stated challenges are more strongly, positively associated with vigor compared to hindrances. The contrast was statistically significant (*estimate* = −.34, 95% *CI* = [−.57, −.09]). However, hindrances were negatively associated with vigor (*estimate* = -.29, 95% *CI* = [−.47, −.32]), whereas challenges were not (*estimate* = .05, 95% *CI* = [−.12, .18]).

Regarding indirect effects, we found no evidence that psychological fatigue mediates the relationship between hindrances and sleep quantity (*estimate* = −.01, 95% *CI* = [−.06, .02]) nor quality (*estimate* = -.02, 95% *CI* = [−.07, .01]), and no evidence that psychological fatigue mediates the relationship between challenges and sleep quantity (*estimate* = −.01, 95% *CI* = [−.04, .01]) nor quality (*estimate* = −.01, 95% *CI* = [−.05, .01]), providing no support for Hypotheses 7a, 7b, 8a, or 8b. Hindrances were not more strongly, positively associated with sleep quantity (*estimate* = .00, 95% *CI* = [−.05, .04]) nor sleep quality (*estimate* =−.01, 95% *CI* = [−.06, .04]) through psychological fatigue compared to challenges, yielding no support for Hypotheses 9a or 9b.

We also found no evidence that physical fatigue mediates the relationship between hindrances and sleep quantity (*estimate* = .00, 95% *CI* = [−.02, .05]) nor quality (*estimate* = .01, 95% *CI* = [−.02, .05]), and no evidence that physical fatigue mediates the relationship between challenges and sleep quantity (*estimate* = .01, 95% *CI* = [−.02, .04]) nor quality (*estimate* = .01, 95% *CI* = [−.02, .06]), providing no support for Hypotheses 10a, 10b, 11a, or 11b. Hindrances were not more strongly, positively associated with sleep quantity (*estimate* = .00, 95% *CI* = [−.05, .04]) nor sleep quality (*estimate* = −.00, 95% *CI* = [−.07, .05]) through physical fatigue compared to challenges, yielding no support for Hypotheses 12a or 12b.

Last, we found no evidence that vigor mediates the relationship between hindrances and sleep quantity (*estimate* = -.02, 95% *CI* = [−.07, .03]) nor quality (*estimate* = .01, 95% *CI* = [−.03, .06]), and no evidence that vigor mediates the relationship between challenges and sleep quantity (*estimate* = .00, 95% *CI* = [−.01, .02]) nor quality (*estimate* = .00, 95% *CI* = [−.02, .01]), providing no support for Hypotheses 13a, 13b, 14a, or 14b. Challenges were not more negatively associated with sleep quantity (*estimate* = -.02, 95% *CI* = [−.08, .03]) nor sleep quality (*estimate* = .01, 95% *CI* = [−.04, .08]) through vigor compared to hindrances, yielding no support for Hypotheses 15a or 15b.

Between person supplementary analyses

We additionally examined our hypotheses at the between-person level to determine whether mechanisms are supported when looking across individuals. Hindrance stressors were not associated with sleep quantity (*estimate* = −.42, 95% *CI* = [−1.09, .17]) nor sleep quality, (*estimate* = -.11, 95% *CI* = [−.37, .18]), yielding no support for Hypothesis 1a and 1b. Challenge stressors were positively associated with sleep quantity (*estimate* = .78, 95% *CI* = [.03, 1.47]), and not associated sleep quality (*estimate* = .18, 95% *CI* = [-.11, .43]), yielding no support for Hypothesis 2a and 2b. Hypothesis 3, which stated hindrance stressors will have stronger negative associations with (a) sleep quantity and (b) sleep quality compared to challenge stressors, was also not supported at the between-person level (sleep quantity: *estimate* = −1.19, 95% *CI* = [−2.45, .07]; quality: *estimate* = −0.29, 95% *CI* = [−0.77, 0.27]).

In support of Hypothesis 4a, hindrances were positively associated with psychological fatigue (*estimate* = .80, 95% *CI* = [.55, .99]). Challenges were negatively associated with psychological fatigue (*estimate* = -.67, 95% *CI* = [−.93, −.36]), yielding no support for Hypothesis 4b. Challenge and hindrance stressors were differentially related to psychological fatigue (*estimate* = 1.45, 95% *CI* = [1.03, 1.83]), providing support for Hypothesis 4c. Next, hindrances were positively associated with physical fatigue (*estimate* = 1.00, 95% *CI* = [.74, 1.31]), and challenges were negatively associated with physical fatigue (*estimate* = -.76, 95% *CI* = [−1.12, −.41]), yielding support for Hypothesis 5a, and no support for 5b. Challenge and hindrance stressors were differentially related to physical fatigue (*estimate* = 1.75, 95% *CI* = [1.28, 2.30]). In both cases, the hindrance path was positive and statistically significant, whereas challenge path was negative and statistically significant, providing support for Hypothesis 5c at the between-person level. Hindrance stressors were negatively related to vigor (*estimate* = −.75, 95% *CI* = [−.98, −.54]) while challenge stressors were positively related to vigor (*estimate* = .83, 95% *CI* = [.56, 1.09]), providing support for Hypotheses 6a and 6b. Challenge and hindrance stressors were also

differentially related to vigor (*estimate* = −1.58, 95% *CI* = [−1.97, −1.20]). The challenge path was positive and statistically significant, whereas the hindrance path was negative and statistically significant, yielding support for Hypothesis 6c at the between-person level.

In support of Hypothesis 7a, hindrances were indirectly associated with greater sleep quantity through psychological fatigue (*indirect effect estimate* = .91, 95% *CI* = [.40, 1.64]). Hindrances were not indirectly associated with sleep quality through psychological fatigue (*indirect effect estimate* = .03, 95% *CI* = [−.20, .26]), yielding no support for Hypothesis 7b. Challenges were indirectly associated with less sleep quantity through psychological fatigue (*indirect effect estimate* = −.77, 95% *CI* = [−1.45, −.31]), and were not indirectly associated with sleep quality through psychological fatigue (*indirect effect estimate* = −.03, 95% *CI* = [−.24, .16]), yielding no support for Hypotheses 8a or 8b. In support of Hypothesis 9a, hindrances were more strongly, positively associated with sleep quantity (*estimate* = 1.72, 95% *CI* = [0.76, 3.04]) through psychological fatigue compared to challenges, but not sleep quality (*estimate* = .06, 95% *CI* = [−.35, .50]), yielding no support for Hypothesis 9b.

Physical fatigue partially mediated the relationship between hindrances and sleep quantity (*indirect effect estimate* = −1.34, 95% *CI* = [−2.14, −.75]), but this finding was opposite our Hypothesis 10a. Physical fatigue did not mediate the relationship between hindrances and sleep quality (*indirect effect estimate* = −.17, 95% *CI* = [−.42, .05]), yielding no support for Hypothesis 10b. In support of Hypothesis 11a, challenges were indirectly associated with sleep quantity (*indirect effect estimate* = 1.01, 95% *CI* = [.50, 1.91]) through physical fatigue. Challenges were not indirectly associated with sleep quality (*indirect effect estimate* = .13, 95% *CI* = [−.03, .35]) through physical fatigue, yielding no support for Hypothesis 11b. For Hypothesis 12a, the indirect effect contrast was significant (*estimate* = −2.36, 95% *CI* = [−3.93, −1.34]), but the pattern was opposite our Hypothesis. As stated above, hindrances were indirectly, negatively related to sleep quantity through physical fatigue (*indirect effect estimate* = −1.34, 95% *CI* = [−2.14, −.75]), and challenges were indirectly, positively related to sleep quantity through physical fatigue (*indirect effect estimate* = 1.01, 95% *CI* = [.50, 1.91]). Hindrances were not more strongly, positively associated with sleep quality (*estimate* = −.30, 95% *CI* = [−.73, .08]) through psychological fatigue compared to challenges, yielding no support for Hypothesis 12b.

In support of Hypothesis 13a, hindrances were indirectly, positively associated with sleep quantity through vigor (*indirect effect estimate* = 0.45, 95% *CI* = [.13, .85]). Hindrances were not indirectly associated with sleep quality through vigor (*indirect effect estimate* = -.07, 95% *CI* = [−.26, .14]), yielding no support for Hypothesis 13b. In support of Hypothesis 14a, challenges were indirectly related to less sleep quantity through vigor (*indirect effect estimate* = −0.50, 95% *CI* = [−.94, −.12]). Challenges were not indirectly related to sleep quality through vigor (*indirect effect estimate* = .07, 95% *CI* = [−.15, .27]), yielding no support for Hypothesis 14b. Challenges were more negatively associated with sleep quantity (*estimate* = 0.96, 95% *CI* = [0.25, 1.78]) through vigor compared to hindrances, supporting Hypothesis 15a. Challenges were not more negatively associated with sleep quality (*estimate* = -.14, 95% *CI* = [−.53, .29]) through vigor compared to hindrances, yielding no support for Hypothesis 15b.

Discussion

The central aims of this study were to use the challenge-hindrance framework (Cavanaugh et al., 2000) and effort-recovery model (Meijman & Mulder, 1998) to help explain why inconsistent effects have been observed in prior work connecting stress and sleep, and to uncover theoretically-grounded energetic mediators that help explain why challenge and hindrance work stressors have differential associations with sleep health indicators. Overall, we found sparse evidence that hindrances are more strongly associated with fatigue or sleep outcomes relative to challenges on a daily basis. Only one significant daily contrast emerged, such that daily hindrances were negatively associated with evening vigor, while challenges were not observed to associate with evening vigor. Energetic states also did not explain the daily relationship between work stressors and sleep.

However, we found support for numerous hypotheses at the between-person level, such that hindrance stressors were more strongly associated with greater psychological and physical fatigue compared to challenges, while challenge stressors were associated with greater levels of vigor compared to hindrances. Energetic mediators also explained the relationships between challenges and hindrances and sleep quantity; indirect relationships predicting sleep quality were not significant. Indirect effects had interesting and countervailing effects. Specifically, hindrances were indirectly associated with *greater* sleep hours through increased psychological fatigue and decreased vigor while challenges were indirectly associated with *fewer* sleep hours through decreased psychological fatigue and increased vigor. Hindrances were also indirectly associated with *fewer* sleep hours through increased physical fatigue, while challenges were associated with *greater* sleep hours through physical fatigue. Together, these findings highlight the importance of considering multiple levels of analysis, as well as specific energetic mechanisms, in interpreting recovery-related effects of work stress.

Theoretical implications

Our research expands understanding of within- and between-person challenge-hindrance relationships by outlining differential results when associations are simultaneously tested at both levels (Gabriel et al., 2019). Traditionally, the effort-recovery model emphasises "short-term" (p. 8) psychological and physiological reactions to work demands (Meijman & Mulder, 1998). Fatigue, in particular, is considered an end-of-day phenomenon (Frone & Tidwell, 2015). As "short term" is a vague phrase, the fact that our proposed stressor-to-health relationships were not observed at the daily level (with the exception of hindrances and vigor) may suggest effort-recovery model relationships dealing with work-related challenge and hindrance stressors tend to manifest across longer time frames than each day. Daily sleep could be dependent on the frequency and persistence of work stressors across time, and long-term stability of energetic changes. One theory that complements this long-term perspective is the allostatic load model (McEwen, 1998), which suggests that chronic, repeated exposure to stressors may over-tax one's physiological systems and result in negative downstream outcomes (e.g. Juster et al., 2010; McEwen, 1998). Our findings extend prior literature by suggesting that an appropriate time frame for studying the effects of work stressors

on sleep *may not solely be at the daily level of analysis*, and that cumulative effects of work stressors, à la the allostatic load model, may be relevant for examining the relationships between challenge and hindrance stressors, energy, and sleep.

Our statistically significant between-person indirect effects (and contrasts) predicting sleep quantity also help to illuminate several important distinctions that might explain previous contradictory or null findings. First, the type of energetic mediator matters. Consistent with the idea that low psychological activation is ideal for attaining a full night of restful sleep (e.g. Crain et al., 2018), we found increased hindrances (and decreased challenges) were associated with greater sleep hours via increased psychological fatigue and decreased vigor. *However*, the opposite pattern was found for physical fatigue mediated effects. Thus, physical and mental forms of energy appear to be differentially associated with sleep. Physical and psychological fatigue are thought to be distinct mechanisms reflecting depletion of two separate energy sources (Frone & Tidwell, 2015), and the relationship between physical fatigue and sleep is complex. Prior reviews suggest work stressors may deplete physical energy, which promotes a need for sleep, but intense physical fatigue may actually impair sleep (Crain et al., 2018). For example, physical work demands have been shown to increase risk of insufficient sleep (Trinkoff et al., 2001), and findings from the exercise literature suggest moderate physical depletion is ideal for achieving adequate sleep quantity and quality, while low and high physical depletion may impair sleep behaviour (e.g. Driver & Taylor, 2000). It may also be that physical fatigue is accompanied by physical pains that make it difficult to sleep (e.g. Onen et al., 2005). So, while the effort-recovery model proposes physiological and psychological reactions to stressors, which necessitate recovery, the specific mechanism of physical fatigue may operate in a more complex manner than psychological fatigue and vigor.

Next, our data offer support for the theorised challenge-hindrance pattern at the between-persons level. We find hindrances are more energetically depleting than challenges, consistent with the theoretical distinction of hindrances as sources of strain and frustration and challenges as energising and motivating (e.g. Podsakoff et al., 2023). We similarly find hindrances are more strongly associated with less sleep via physical fatigue compared to challenges, in line with challenge-hindrance rationale (French et al., 2019b). However, we also find that hindrances are associated with *greater* sleep hours than challenges, because they facilitate low energy states that facilitate sleep. These findings are in opposition with the direct relationships implied by the challenge-hindrance framework which suggest that hindrances are more strongly, negatively related to sleep health (French et al., 2019b). Our results suggest that when accounting for energetic mechanisms, hindrances could benefit sleep health, and challenges may impair sleep health. This is a fundamental shift in our understanding of how challenge and hindrance stressors produce strain, and further emphasises the importance of accounting for mediating pathways. Perhaps previous negative bivariate relationships between hindrance stressors and sleep may have been driven by unmeasured physical fatigue.

Finally, despite prominence of energetic states as mediating mechanisms between stressors and sleep in prior work (e.g. Berset et al., 2011; Crain et al., 2018; Linton, 2004), we found no evidence that day-to-day fluctuations in energy explain why work stressors are associated with evening sleep quantity or quality. Our results do, however, suggest fatigue and vigor may explain why chronic exposure to work stressors

relates to individual differences in sleep hours. Our study answered calls for investigations into theoretically-guided explanatory mechanisms linking challenge and hindrance stressors to health behaviours like sleep (Chen et al., 2021; French et al., 2019a), as well as a call to simultaneously examine multiple types of human energy in relation to sleep (Crain et al., 2018).

Practical implications

Chronic exposure to hindrances was more energetically depleting compared to exposure to challenges. These findings suggest that workers may need to engage in more resource management (e.g. recuperation and protection; Hobfoll et al., 2018) during hindering periods to prevent negative cumulative health consequences. For example, engaging in "low-duty" (p. 3) leisure-time recovery activities like socialising with friends and watching TV aid in replenishing depleted resources (Sonnentag et al., 2008), and have the benefit of being able to be performed with or in the presence of dependent children.

Organisations may consider proactively addressing hindrance stressors, as their potential harm for the health of the workforce has been illustrated (e.g. French et al., 2019b; Mazzola & Disselhorst, 2019; Nixon et al., 2011; O'Brien & Beehr, 2019). This harm may be particularly salient within vulnerable populations. For example, schedule control, or the extent to which employees can decide when and how much they work, is associated with greater sleep quality and sleep quality in lower-wage workers (Brossoit et al., 2020). Experimental research has demonstrated that workplace interventions designed to increase employee schedule control result in increased employee sleep quality and quantity (Olson et al., 2015). Additionally, job crafting is a behaviour employees can engage in to shape their jobs and address or remove stressors (e.g. Bakker et al., 2014). Importantly, mothers of young children have been specifically identified as a type of worker who would benefit from bottom-up job crafting opportunities (schedule flexibility, increased autonomy, etc.) due to high family demands that are often unpredictable (Demerouti, 2014). Job crafting interventions have been identified as powerful and effective tools to support employee well-being (Demerouti et al., 2019). Additional studies (e.g. Dowling, 2017; Kim, 2020) have highlighted cost-effective, accessible, and useful ways that organisations can better support working parents (e.g. work flexibility and fostering peer-to-peer learning).

Limitations and directions for future research

This study has limitations which can be addressed in future research. First, it may be that there is difficulty in objectively categorising stressors as either a "challenge" or "hindrance" (e.g. Rosen et al., 2020; Webster et al., 2011; Widmer et al., 2012). Although the challenge-hindrance framework is a well-established typology (e.g. Podsakoff et al., 2023), some recent research has critiqued its usefulness and robustness (Mazzola & Disselhorst, 2019; Rosen et al., 2020). Future research could benefit by blending relevant models like the transactional model of stress (Lazarus & Folkman, 1984) with the challenge-hindrance framework by assessing both primary challenge-hindrance appraisals and secondary evaluations of available resources. Our stressor measures also failed to capture intensity and duration of challenge and hindrance stressor exposure (Mazzola

& Disselhorst, 2019). Future studies could examine intensity and duration of work stressors as moderators of the relationships between challenge and hindrance stressors and health and well-being outcomes. Alternatively, studies might assess challenge and hindrance "pile-up" over time (e.g. Smyth et al., 2023) to determine at what point the cumulative effects of daily challenge and hindrance stressors produce changes in energy and sleep.

Given strong theoretical precedence for energy as a mediating mechanism (e.g. Crain et al., 2018; Meijman & Mulder, 1998), we would suggest further research continue to explore its potential for explaining why work impacts sleep. Perhaps there are certain conditions under which energy affects sleep. For example, if vigor were combined with negative affect or rumination it might be particularly difficult to fall asleep. Expectations and future stressor appraisals might also exacerbate the effects of work stressors (e.g. DiStaso & Shoss, 2020), such that worry or anxiety about the next day increases the potency of work stressors and aroused states. The effort-recovery model also conceptualises energy physiologically (Meijman & Mulder, 1998). Thus, cortisol (an energy mobilising hormone) and glucose (blood sugar that provides energy) may be alternative ways to measure energy that are relevant for achieving physiologically rested states needed for sufficient sleep quantity and high sleep quality (Crain et al., 2018; Dahlgren et al., 2009). Future research might extend our work by looking into these physiological energy pathways.

Methodologically, our daily challenge and hindrance measures had some low internal consistency reliability estimates, which may have limited our ability to find within-person effects. Although a strength of our study was focusing on a specific understudied population (working sole mothers), this also limited our sample size due to eligibility restrictions and difficulty accessing mothers who had the time and capacity to participate in our study. The mothers in our sample were primarily white and college-educated. The generalizability of our findings to men, partnered workers, or workers without children is reduced. As mentioned, the high level of work and family demands faced by sole mothers (Robinson et al., 2018; Roman, 2019; Rose, 2017) may have influenced the detectability of daily changes in challenge and hindrance stressors and energy. There is also some evidence that women have more rigid family boundaries than men (Matthews & Barnes-Farrell, 2010), which may have reduced the potential for daily work stressors to affect daily sleep. Future work with larger and more diverse samples can also model the role of intersecting stigmatised identities held by sole working mothers and other groups, considering the stressors that come with holding such identities, in understanding health effects (e.g. race, socio-economic status; occupational hierarchy status; see Cole, 2008; Crenshaw, 1991).

Finally, we chose to study sleep quantity and quality as outcomes due to their relevance to health and importance for recovery (e.g. Colten & Altevogt, 2006). Our supplementary analyses demonstrated some significant associations with sleep quantity, but not quality. Theory suggests energetic mechanisms linking work to sleep may be uniquely or differentially related to sleep quantity and quality (Crain et al., 2018). While our results could indicate that measures of energetic depletion and activation are more directly relevant to hours of sleep, future daily research should consider using a more holistic measure of sleep quality, such as the brief form of the Pittsburgh Sleep Quality Index (B-PSQI; Sancho-Domingo et al., 2021). Further, other health

behaviours may be related to challenge and hindrance stressors. Particularly relevant to the current work, research has shown that sole mothers are more likely to report daily smoking behaviour and problem (alcoholic) drinking than their married counterparts (Wang, 2004). Future research could consider multiple, alternate health behaviour outcomes (e.g. physical activity, eating behaviours) to capture a holistic representation of health and wellbeing in sole mothers balancing work and home stressors.

Conclusion

This daily diary study used the challenge-hindrance framework (Cavanaugh et al., 2000) and the effort-recovery model (Meijman & Mulder, 1998) to examine energetic states as mediators of daily relationships between challenge and hindrance workplace stressors and sleep. At the within-person level, we found little support for relationships among hindrance and challenge stressors, energetic states, and sleep. However, when aggregated to the between-person level, we found exposure to hindrances is associated with greater psychological and physical fatigue than exposure to challenges. Exposure to challenges was associated with greater vigor than exposure to hindrances. We also found countervailing indirect effects on sleep quantity, such that hindrances were associated with *more* sleep hours due to depleted psychological energy, compared to challenges. Interestingly, hindrances were associated with *fewer* sleep hours due to depleted physical energy compared to challenges, suggesting that physical and mental forms of energy appear to be differentially associated with sleep. Overall, our study points to time frame, stressor, and mediator type as important theoretical and practical considerations when understanding and addressing how work affects sleep.

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