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Associations of Chronotype, Work Schedule, and Sleep Problems With Work Engagement Experiences in Middle Age—The Northern Finland Birth Cohort 1966

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Objective: The aim of the study is to investigate the role of chronotype for work engagement in middle age. **Methods:** We used data from the Northern Finland Birth Cohort 1966 study (N = 5341) to analyze associations of self-reported chronotype (morning, intermediate, and evening type) with work engagement and its dimensions (vigor, dedication, absorption). We conducted multivariate analyses of variance to examine whether work schedule or sleep problems moderate these associations. **Results:** Evening types showed lower scores in work engagement and its dimensions than intermediate and morning types, even when work schedule and sleep problems were controlled. Sleep problems emphasized the chronotype-work engagement and chronotype-dedication linkages. **Conclusions:** Chronotype may play a role in employees' work engagement. In addition, sleep problems seem relevant in terms of chronotype-work engagement linkage.

Keywords: work engagement, chronotype, work schedule, sleep problems, well-being at work

CME Learning Objectives

After completing this enduring educational activity, the learner will be better able to:

- Understand how individual chronotype is linked to work engagement experiences.
- Outline the role of sleep problems for chronotype-work engagement linkage.
- Investigate the role of chronotype for work engagement in middle-age.

The concept of work engagement, a positive emotional and motivational state at work characterized by vigor, dedication, and absorption,[1] has attracted scholars because of its many positive outcomes both for employees and organizations. Engaged employees tend to be psychologically more resilient, more satisfied with their jobs, and physically healthier.[2–5] In addition to individual benefits, there are organizational and economic reasons to promote work engagement,[6,7] as it enhances job performance[2] and decreases absences due to illness[8] and disability pensions.[9] However, global estimates have shown that only 20% of employees are engaged at work,[10] indicating a clear need for improvement.

According to the job demands-resources model, job resources, including organizational, psychological, social, and physical aspects of a job, can promote and predict work engagement.[11,12] These resources can be further divided into work-related and individual factors.[13] One individual factor that potentially affects work engagement is chronotype, the individual biological timing of the circadian rhythm.[14] Chronotype is often defined as "morningness-eveningness," and it indicates an individual's preference of timing daily activities such as sleep, waking hours, and eating according to one's own internal clock.[15,16] The circadian rhythm influences the daily regulation of body temperature, hormone excretion, physical performance, and cognition.[16,17] Indeed, chronotype also influences the timing of an individual's best cognitive functioning performance[18] and in this way might be associated with work engagement.[19]

So far, the relationship between chronotype and work engagement has not been much examined, but in the existing two studies, chronotype was linked to work engagement by sleep quality and quantity in an experimental study[20] as well as in a small-scale survey at the time of transition to daylight saving time.[21] Overall, evening chronotype has been linked to poorer work ability,[22] whereas morningness has been shown to be associated with better job performance[23,24] at least partly due to strong organizational social norms that favor morning-type work schedules[25] and therefore likely have an impact on evening-type individuals' work engagement. There are also several health-related outcomes that lead us to believe that chronotype may be related to engagement. For instance, some studies have indicated that later chronotype is associated with poorer mental health outcomes, such as mood and general mental health,[26,27] as well as poorer physical health and health behavior.[28–31]

Sleep-related factors are possible moderators of the chronotype-work engagement relationship. Prior literature has emphasized the role of sleep quality for mental health in general[32] and at work.[33] Other studies have indicated that sleep quality plays an important role specifically in the experience of work engagement,[34,35] wherein individuals with poor sleep hygiene are less engaged at work.[36] Insomnia has also been linked to reduced work engagement.[37] Importantly, evening types tend to have poorer sleep quality and duration than intermediate and morning types.[38,29]

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Data availability statement: The data that support the findings of this study are available from the Northern Finland Birth Cohort (NFBC) for researchers who meet the criteria to access confidential data. Please contact the NFBC Project Center (NFBCprojectcenter@oulu.fi) and visit the cohort website (Northern Finland Cohorts http://www.oulu.fi/nfbc/) for more information.

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Misalignment between one's internal clock and external time requirements is likely an important factor in the chronotype-work engagement relationship. Evening-type employees often struggle with misalignment with their internal clock and externally controlled work time, which influences their health, well-being,[39] work ability, and job performance.[20,22] During the work week, going to bed early is linked to higher work productivity with morning types, and late wake-up with evening types.[40] In addition, it is well documented that shift work has a negative impact on health and well-being mainly due to circadian misalignment.[41] When working a night shift, employees must be awake and alert when their circadian drive for alertness is naturally very low and then sleep during the intermediate when their biological alertness is high.[42] One study also implied that shift work is related to lower work engagement and increased risk for job burnout.[43] Working night shifts is not likely appropriate for any employee despite chronotype, but working in the early morning or late evening has a different effect on morning and evening types.[44] Because daytime work is the most common work schedule,[45] evening types must adjust themselves to a work schedule that conflicts with their inner clock. It is harder for the evening types to fall asleep early enough to get enough sleep before the workday starts, challenging opportunities to sufficient sleep. Thus, work schedule (and therefore sleep) may moderate the relationship between chronotype and work engagement.

The aim of this study is to examine this relationship between chronotype and work engagement and its subdimensions, which has not been done previously. In addition, we aim to investigate whether work schedule and sleep problems moderate these potential associations. We derived no hypothesis for this study due to the scarcity of adequate prior literature on the topic.

METHODS

Participants

This study analyzed questionnaire-based data from the 46-year follow-up study of the Northern Finland Birth Cohort 1966.[46] The study originally included 12,058 children in the two northernmost Finnish provinces with expected date of birth in 1966, more than 95% of births in the region in 1966 (Nordström et al,[47] 2021). In 2012, at the age of 46 years, Northern Finland Birth Cohort 1966's target population (living in Finland, $N = 10{,}331$) received postal questionnaires, to which 69% ($N = 7146$) responded.[47] Analyses were conducted only with participants who were currently working full time ($N = 5483$) and whose questionnaires were complete. The final analyses included 5341 participants. The study was approved by the ethical committee of the Northern Ostrobothnia Hospital District in Oulu, Finland (94/2011), and abided by the Declaration of Helsinki. Reporting of this cohort study was done according to Strengthening the reporting of observational studies in epidemiology (STROBE) guidelines (Supplemental Digital Content, http://links.lww.com/JOM/B522).

Measures

Morningness-Eveningness Questionnaire

Chronotype was measured with the Morningness-Eveningness Questionnaire (MEQ),[48] which was developed for epidemiological purposes. The MEQ questionnaire has been shown to be linked to body temperature measures that have strong validity for indicating chronotype.[49] A shortened Finnish version of the original MEQ questionnaire containing six items was used in this study. Items 1–4 were measured on a four-point Likert scale (eg, "Assuming adequate environmental conditions, how easy do you find it to get up in the morning?"), and item 5 was measured on a five-point Likert scale ("Suppose that you can choose your own work hours. Assume that you worked a 5-hour day and that your job was interesting and paid by results. Which five consecutive hours would you select?"). Item 6 ("One hears about 'morning' and 'evening' types of people. Which one of these types do you consider yourself to be?") was measured by points (0, 2, 4, or 6), with higher values indicating morningness and lower ones indicating eveningness. The respondents were classified into morning (M), intermediate (I), and evening (E) chronotypes according to total questionnaire score (M: 19–27, I: 13–18, and E: 5–12) based on the cutoff points validated in a Finnish general population study.[29]

Work Engagement

We used the Utrecht Work Engagement Scale to measure the participants' work engagement.[1] The scale consists of the following three dimensions: vigor (eg, "In my job, I feel strong and vigorous"), dedication (eg, "I am enthusiastic about my job"), and absorption (eg, "I feel happy when I am working intensely"). The survey includes nine items (Cronbach $\alpha = 0.9$) rated on a six-point Likert scale ranging from 0 (never) to 6 (always). We calculated work engagement ($\alpha = 0.9$), vigor ($\alpha = 0.9$), dedication ($\alpha = 0.9$), and absorption ($\alpha = 0.9$) as the average of the items of work engagement and its subdimensions. A previous study has confirmed the validity and reliability of the Utrecht Work Engagement Scale in its wide and frequent use to measure work engagement.[50]

Work Schedule

Work schedule was classified into daytime work (between 6:00 am and 6:00 pm), shift work with evening shifts, and shift work including night shifts (at least 3 hours between 11:00 pm and 6:00 am).

Sleep Problems

Sleep problems were measured using the Athens Insomnia Scale (AIS-5), which consists of five items that assess participants' sleep problems over the previous month. The five items cover sleep induction, awakening during the night, early morning awakening, total sleep time, and overall sleep quality, all rated on a four-point Likert scale (0 = no problem at all, 3 = very serious problem). The participants were divided into low, intermediate, and high levels of sleep problems for the final analyses of the summed score. The cutoff value for insomnia in the AIS-5 is estimated at 4 or more points.[51] Prior studies have shown that the AIS-5 has good reliability and validity for assessing insomnia.[52]

TABLE 1. Descriptive Statistics

Variable (Range)	*n*	Frequency	%	Mean	(SD)
Gender	5,429				
Women		2,852	52.5		
Educational level	5,216				
Basic		333	6.4		
Intermediate		3,334	61.4		
Academic level		1,594	28.5		
Occupational status	5,429				
Manual		2,470	46.3		
Lower nonmanual		1,579	29.6		
Upper nonmanual		1,284	24.1		
Work schedule	5,286				
Daytime		4,273	78.7		
Shift work (also evenings)		616	11.7		
Shift work (also nights)		397	7.3		
Sleep problems*	5,171				
Yes		1,754	33.9		
No		3,417	66.1		
Chronotype groups	5,233				
Morning types		1,396	25.7		
Intermediate types		3,291	60.6		
Evening types		545	10.4		
Work engagement (0–6)	5,317			4.59	1.18
Vigor				4.71	1.18
Dedication				4.62	1.32
Absorption				4.43	1.40

*Athens Insomnia Scale (1–15), 4–15 = yes, 0–3.99 = no.

TABLE 2. Bivariate Correlations Between the Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Gender[a]	1								
2. Education	−0.120**								
3. Occupational status	0.041**	0.533**							
4. Work schedule[b]	−0.009	−0.180**	−0.317**						
5. Sleep problems[c]	−0.020	−0.080**	−0.082**	0.086**					
6. Chronotype[d]	−0.033*	0.064**	0.037**	−0.072**	0.176**				
7. Vigor	−0.114**	0.026	0.064**	−0.040**	−0.230**	−0.224**			
8. Dedication	−0.107**	0.073**	0.128**	−0.047	−0.177**	−0.165**	0.826**		
9. Absorption	−0.104**	0.095**	0.175**	−0.099**	−0.114**	−0.104**	0.661**	0.753**	
10. Work engagement	−0.118**	0.073**	0.138**	−0.070**	−0.187**	−0.177**	0.900**	0.942**	0.892**

[a]1 = male, 0 = female.
[b]1 = only daytime shifts, 2 = shift work including evening shifts, 3 = shift work including night shifts.
[c]0= no problem at all, 3 = very serious problem.
[d]1 = morning type, 2 = intermediate type, 3 = evening type.

Confounding Variables

Gender was coded as 1 for male or 0 for female. *Occupational status* was coded as manual, lower nonmanual, or higher nonmanual. *Education level* was classified into three classes (1 = comprehensive school, 2 = high/vocational school, and 3 = university-level education).

Statistical Analyses

We first checked whether gender modified the association between chronotype and work engagement and its dimensions. As all the interactions of gender with chronotype on work engagement, vigor, dedication, and absorption were nonsignificant (work engagement: $P = 0.752$; vigor: $P = 0.411$; dedication: $P = 0.902$; absorption: $P = 0.791$), we ran our analyses for the total sample, including both men and women. Pearson's correlation coefficients were calculated to evaluate bivariate correlations between the study variables.

As such, total sample multivariate analyses of variance with Bonferroni-corrected post hoc comparisons were used to examine the associations between chronotype (morning, intermediate, and evening types) and work engagement and its dimensions.

We also wanted to examine whether work schedule (daytime, shift work with evening shifts, and shift work with night shifts) and sleep problems moderate the association between chronotype and work engagement. We also ran multivariate analysis of variance to test any interaction between work schedule-chronotype and sleep problems-chronotype with work engagement. The main effects of chronotype and work schedule or sleep problems were adjusted for in the analyses. Furthermore, we divided the sleep problems into tertiles and ran analyses for chronotype-work engagement associations among participants with low, intermediate, and high levels of sleep problems. We additionally drew a figure for sleep problems according to chronotype with work engagement. We divided sleep problems for the figure according to standard deviation (lowest tertile: −1 SD from mean; highest tertile: +1 SD from mean).

All models and analyses were adjusted for gender, education, and occupational status.

RESULTS

The descriptive statistics for the study variables are presented in Table 1. Of the participants, a quarter were morning types, and a tenth were evening types.

Table 2 shows that eveningness was negatively linked to work engagement ($r = -0.177$, $P < 0.001$), vigor ($r = -0.224$, $P < 0.001$), dedication ($r = -0.165$, $P < 0.001$), and absorption ($r = -0.104$, $P < 001$). Work engagement was positively correlated with daytime work schedule ($r = 0.070$, $P < 0.001$). Sleep problems were positively

TABLE 3. Multivariate Analyses of Variance for Chronotype in Relation to Work Engagement, Vigor, Dedication, and Absorption

Dependent Variable	Morning Type Mean (SD)	Day Type Mean (SD)	Evening Type Mean (SD)	$F(2.4941)$	P	η^{2a}
Model 1						
Work engagement	4.88 (0.03)	4.52 (0.02)	4.18 (0.05)	91.887	<0.001	0.036
Vigor	5.07 (0.03)	4.65 (0.02)	4.12 (0.05)	140.621	<0.001	0.054
Dedication	4.93 (0.04)	4.56 (0.02)	4.12 (0.05)	80.608	<0.001	0.032
Absorption	4.67 (0.04)	4.35 (0.02)	4.17 (0.06)	35.345	<0.001	0.014
Model 2						
Work engagement	4.89 (0.05)	4.53 (0.02)	4.14 (0.05)	89.260	<0.001	0.035
Vigor	5.07 (0.03)	4.65 (0.02)	4.12 (0.05)	137.085	<0.001	0.053
Dedication	4.93 (0.03)	4.56 (0.02)	4.12 (0.05)	80.007	<0.001	0.032
Absorption	4.67 (0.04)	4.36 (0.03)	4.18 (0.06)	33.311	<0.001	0.013
Model 3						
Work engagement	4.85 (0.03)	4.53 (0.02)	4.19 (0.05)	68.130	<0.001	0.028
Vigor	5.02 (0.02)	4.66 (0.02)	4.23 (0.05)	103.193	<0.001	0.041
Dedication	4.88 (0.05)	4.57 (0.02)	4.88 (0.04)	60.582	<0.001	0.025
Absorption	4.65 (0.04)	4.36 (0.03)	4.22 (0.06)	26.676	<0.001	0.011

Model 1: Adjusted for gender, education, and occupational status.
Model 2: Adjusted for gender, education, occupational status, and work schedule.
Model 3: Adjusted for gender, education, occupational status, and sleep problems.
[a]Partial eta squared.

TABLE 4. Post Hoc Comparison of Work Engagement, Vigor, Dedication, and Absorption between Morning, Intermediate, and Evening Types

	Work Engagement			Vigor			Dedication			Absorption		
	Mean Difference	SD	*P*	Mean Difference	SD	*P*	Mean Difference	SD	*P*	Mean Difference	SD	*P*
Morning–Intermediate	0.36	0.05	<0.001	0.43	0.04	<0.001	0.35	0.04	<0.001	0.31	0.05	<0.001
Morning–evening	0.70	0.06	<0.001	0.91	0.06	<0.001	0.75	0.07	<0.001	0.44	0.07	<0.001
Intermediate–Evening	0.34	0.04	<0.001	0.49	0.05	<0.001	0.40	0.06	<0.001	0.13	0.07	0.126

associated with shift-related work schedule ($r = 0.083$, $P < 0.001$), but negatively correlated with work engagement ($r = -0.200$, $P < 0.001$), vigor ($r = -0.245$, $P < 0.001$), dedication ($r = -0.183$, $P < 0.001$), and absorption ($r = -0.129$, $P < 0.001$).

Multivariate analysis of variance (Table 3) revealed significant differences between chronotypes in work engagement ($F(2.4941) = 91.887$, $P < 0.001$, $\eta^2 = 0.036$), vigor ($F(2.4947) = 140.621$, $P < 0.001$, $\eta^2 = 0.054$), dedication ($F(2.4941) = 80.608$, $P < 0.001$, $\eta^2 = 0.032$), and absorption ($F(2.4941i) = 35.345$, $P < 0.001$, $\eta^2 = 0.014$). Evening types showed lower scores in work engagement and its subdimensions vigor and dedication than morning types ($P < 0.001$) and intermediate types ($P < 0.001$). For absorption, evening types showed lower scores than morning types ($P < 0.001$), but the difference compared with intermediate types was not statistically significant ($P = 0.126$; Table 4).

Table 5 shows that sleep problems moderated the association between chronotype and work engagement ($F(27.4761) = 1.586$, $P = 0.028$) and dedication ($F(27.4761) = 1.807$, $P = 0.007$; Figure 1), but not chronotype's association with absorption ($F(27.4761) = 1.430$, $P = 0.069$) or vigor ($F(27.4761) = 1.445$, $P = 0.064$). Chronotype was associated with work engagement among participants with low-level sleep problems (work engagement: $F(2.844) = 12.755$, $P < 0.001$; dedication: $F(2.844) = 8.294$, $P < 0.001$), intermediate-level sleep problems (work engagement: $F(2.2318) = 34.987$, $P < 0.001$; dedication: $F(2.2317) = 34.955$, $P < 0.001$), and high-level sleep problems (work engagement: $F(2.1630) = 21.083$, $P < 0.001$; dedication: $F(2.1630) = 18.527$, $P < 0.001$). As shown in Figure 1, the more there were sleep problems the poorer was the level of work engagement. This association was even more pronounced among morning and intermediate types than evening types.

Work schedule did not moderate the association between chronotype and work engagement and its subdimensions (work engagement: $F(4.4889) = 0.830$, $P = 0.506$; vigor: $F(4.4889) = 0.811$, $P = 0.518$; dedication: $F(4.4889) = 0.521$, $P = 0.720$; absorption: $F(4.4889) = 0.164$, $P = 0.164$).

DISCUSSION

This large population-based study showed that individuals with different chronotypes (morning, intermediate, and evening) differ in their work engagement and its subdimensions vigor, dedication, and absorption. Evening types showed lower scores in work engagement and its subdimensions compared with morning and intermediate types. These associations remained even when work schedule, sleep problems, and other covariates were adjusted for. In particular, sleep problems moderated the chronotype-work engagement and chronotype-dedication linkages, but work schedule did not.

Our results on the role of chronotype in the experience of work engagement and its subdimensions provide new contributions to the literature. Overall, evening types have lower work engagement compared with intermediate and morning types. Prior studies have linked eveningness to lower work productivity,[40] but not specifically to work engagement. However, work engagement is strongly related to work productivity, as engaged employees are highly productive and generate great work performance.[53] Evening types experience stress due to the mismatch between their own circadian timing and work schedule, which can eventually influence their mental health.[20,39] In addition, prior studies have proposed that this mismatch may reduce cognitive performance among evening types, as they are not able to work during their most innovative time.[20,40,24] Indeed, circadian variations influence cognitive performance, including memory, reaction time, and attention,[24,54] which all relate back to innovative thinking and work engagement.

We also showed that morning types, in turn, exhibit the highest work engagement and vigor. Prior studies have found that morningness is linked to better subjective well-being,[55] as morning types are privileged to work during their most innovative times.[20] This may help understanding our results, as work engagement is strongly related to subjective and employee well-being.[56] Earlier studies provide further background to the observed linkage between chronotype and vigor as well, indicating that especially morning types tend to have higher levels of energy and arousal during the working day and they find this work schedule preferable.[40] Indeed, the concept of vigor as a dimension of work engagement reflects a high level of energy.[12] A recent study among university students also reported that individuals with the morning chronotype show more positive moods in terms of vigor and well-being.[27]

Work schedule did not moderate the relationship between chronotype and work engagement nor its subdimensions in this study. However, considering the diversity of work schedules, our measure of

TABLE 5. Multivariate Analyses of Variance for Chronotype in Relation to Work Engagement and Dedication Among Participants With Low, Intermediate, and High Level of Sleep Problems

Level of Experienced Sleep Problems During Last Month	Dependent Variable	Morning Type Mean (SD)	Day Type Mean (SD)	Evening Type Mean (SD)	*F*(2.844)	*P*	η^{2a}	*n*
Low	Work engagement	5.10 (0.06)	4.81 (0.05)	4.51 (0.17)	12.755	<0.001	0.024	850
	Dedication	5.11 (0.06)	4.89 (0.05)	4.58 (0.19)	8.294	<0.001	0.014	850
					F(2.2318)			
Intermediate	Work engagement	4.91 (0.04)	4.57 (0.03)	4.32 (0.07)	34.987	<0.001	0.025	2,323
	Dedication	4.97 (0.05)	4.60 (0.03)	4.31 (0.08)	34.955	<0.001	0.026	2,323
					F(2.1630)			
High	Work engagement	4.62 (0.07)	4.33 (0.04)	3.98 (0.08)	21.083	<0.001	0.021	1,636
	Dedication	4.61 (0.08)	4.37 (0.04)	3.94 (0.09)	18.527	<0.001	0.019	1,636

Adjusted for gender, education, and occupational status.

[a]Partial eta squared.

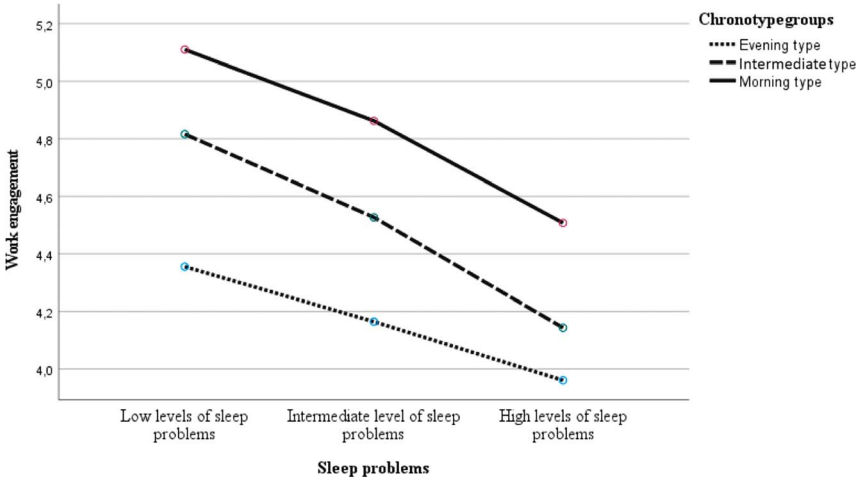

FIGURE 1. The level of sleep problems according to chronotype with work engagement. Adjusted for gender, education, and occupational status.

work schedule was rather rough. Moreover, we emphasize that regardless of employees' own work schedules, evening types might have to wake up earlier than preferred because of their family members' schedules, such as the school or work schedules of their children and spouse, which might also imply a mismatch between the timing of family activities and an individual's own chronotype.[43] Indeed, the mismatch may not always stem from working times but may also be caused by an individual's general pace of life.[14]

Sleep problems moderated chronotype's association with work engagement and dedication, but not with absorption or vigor. Sleep problems interacted with chronotype as follows: sleep problems reduced the level of work engagement among all chronotypes, even more among morning and intermediate types than evening types. As evening types may already have problems with sleep and mismatches between circadian preference and work schedule,[38,39] sleep problems might not affect their level of work engagement that much. However, sleep problems moderated especially the dedication-chronotype linkage. Dedication reflects being highly involved and enthusiastic at work.[1] Sleep quality playing a significant role in emotional regulation and mood at work[64] might therefore explain the effect of sleep quality especially on dedication. Previous sleep research has provided indirect support for our interpretation that sleep quality might moderate the linkage between chronotype and work engagement. For instance, good sleep quality promotes self-regulatory skills,[36] which are essential in terms of work engagement and job productivity, as they refer to the ability to set goals and monitor control to achieve those goals and other standards.[57]

Extant research has presented sleep-related factors as possible mediators of chronotype-work engagement linkage, not moderators. Importantly, evening chronotype has been linked to poor sleep quality, sleep-wake disorders, and insomnia symptoms.[58,29,37] A recent experimental study on inducing darkness to promote sleep has shown to promote work engagement especially among later chronotypes by sleep quality[20] and that chronotype plays an important role in alertness and mood during the day,[15] indicating that sleep-related factors might mediate chronotype-work engagement linkage. However, our results showed that sleep-related factors did not present with mediating effect because even when adjusted for sleep problems, the linkage between chronotype and work engagement remained significant.

Limitations, Strengths, Future Directions, and Practical Implications

The main limitation of this study is its cross-sectional design, which does not allow the examination of causal relations. Using only self-reported measures induces the risk of common method bias as well.[59] Another limitation is our rather crude measure of work schedule, through which we were unable to fully illustrate employees working in different time patterns. More specific measurements of work schedule are thus needed in future studies.

This study's greatest strength is most notably its large population-based cohort sample. The data also covered all branches of working life in both the public and private sectors. Furthermore, we were able to use well-validated measures of work engagement[50] and chronotype.[48]

Future studies should examine the chronotype-work engagement linkage longitudinally and further examine the potential mediating and moderating factors in the association of chronotype and work engagement, such as sleep quality[36,35] and cognitive functioning performance.[19]

CONCLUSIONS

We conclude that evening types experience lower levels of work engagement and its subdimensions vigor, dedication, and absorption than do intermediate and morning types. Work schedule (regular daytime or shift work) did not moderate the linkage between chronotype and work engagement, whereas sleep problems did. The same was true for the dedication subdimension, but sleep problems did not moderate the associations of chronotype with vigor or absorption. Future developmental studies are needed to alleviate the negative effects of poorer sleep and later chronotype for work engagement.

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