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Original Article

Associations between Sleep and Work-Related Cognitive and Emotional Functioning in Police Employees

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ABSTRACT

Aim: We aimed to examine the cross-sectional and longitudinal associations between sleep and work-related impaired cognitive and emotional functioning in police employees.
Methods: This study included 410 participants (52% men) employed in a police district in Norway at baseline, of which 50% also participated in the study at 6 months later follow-up. The questionnaires included items measuring work schedule, sleep length, insomnia, as well as impaired cognitive and emotional functioning at work.
Results: The results showed that insomnia was related to impaired work-related emotional functioning measured at baseline, and to impaired cognitive functioning measured at both baseline and follow-up. Sleep length and rotating shift work were not associated with future decline in cognitive or emotional functioning.
Conclusion: Our study indicates that the relationship between insomnia and emotional functioning at work may be transient, whereas insomnia can be related to both immediate and future impaired cognitive functioning. Replication of the findings in larger samples is advised. The findings call for an emphasis on the prevention and treatment of sleep problems among police employees as a mean of maintaining and improving cognitive and emotional functioning at work, and thereby reducing the risk for impaired performance and negative health and safety outcomes.

Sleep is a fundamental need and affects numerous vital functions, including cognitive performance and emotional regulation [1–3]. Various aspects of sleep, for example, duration and quality, are crucial for cognitive functioning and for regulating emotional experiences and responses [4–6]. However, we lack a clear understanding of the effects of sleep on cognitive and emotional functioning in highly robust workers, especially police employees. The majority of police employees in Norway are thoroughly selected into the occupation and have undergone extensive professional training, but they are still at risk for experiencing sleep problems that contribute to poorer cognitive and emotional functioning. Police employees often have irregular working hours and resting time [7]. Shift work, that is, fixed or rotating shifts that include working hours between 6 PM and 7 AM [8], renders employees susceptible to shorter and more disturbed sleep, reduced sleep quality, and a higher prevalence of sleep problems compared to day work [9,10].

According to recommendations, adults aged 26–64 years should sleep 7–9 h/d, as sleep duration under 6 hours and over 10 hours is unfavorable for daily functioning [11]. Short sleep, that is, sleeping less than 6 h/night, can weaken a wide specter of cognitive functions; including information processing, sustained attention, and working memory [12]. Short sleep also has adverse effects on decision making [13] and recognition of emotions [14], as well as reduces impulse control, empathy toward others and positive thinking [15]. Interactions between sleep and emotional regulation have received increased attention [3]. Palmer and Alfano [16] highlight the need for distinction between different emotional

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processes when examining the effects of sleep, as well as the need for longitudinal studies in sleep and emotion-focused research. The present study investigates impaired emotional functioning specifically related to work, for example, regulation of emotions during the workday.

Insomnia is a sleep disorder characterized by persistent difficulties with initiating or maintaining sleep that reduce sleep quality and sleep duration, increase sleepiness and impairs daily functioning (5th ed.; DSM-5, [17]). Previous research has shown that insomnia is related to deficits in attention and episodic memory [18], which in turn can affect performance and safety [19]. Employees with symptoms of insomnia are less likely to engage in safety behaviors, which in turn can be a consequence of cognitive failures related to poor sleep [20]. Insomnia is also related to increased feelings of hostility and decreased job satisfaction, attentiveness, and joviality among employees [21], making insomnia potentially harmful for interpersonal skills at work. Lastly, insomnia contributes to excessive daytime sleepiness, which has been shown to negatively affect sustained attention and response speed [22].

Complex tasks, emotional work, fast decision making, and interaction with the public are daily occurrences in the police profession, and high cognitive and emotional functioning are crucial for their work. Police employees are dependent on optimal cognitive functioning to detect details and make rational and informed decisions in a limited time [23]. This is important for many occupations, and it is of particular relevance in the police profession where many of the work tasks come with a higher health and safety risk compared to other occupations, for example, responding to crime, violence, and accidents. Reduced cognitive functioning at work due to poor sleep may thus be a serious hazard in this occupation. Well-functioning emotion regulation is important for several critical aspects at the workplace, including collaboration skills, coping, creativity, and work engagement [24,25]. Police employees are expected to remain calm and in control of their emotions, even when their work can be emotionally challenging [26,27]. Sleep-deprived individuals may have a lower threshold for stressful events and experience an increase in negative emotions, for example, anger and anxiety, compared to those who are not deprived of sleep [28].

The potentially harmful effects of poor sleep represent a risk factor for safety, reduced performance, as well as mental and physical health at work [29]. However, we lack knowledge about the longitudinal effects of sleep problems on cognitive and emotional performance in real-life police settings. This study aims to examine the effects of sleep on work-related cognitive and emotional functioning among police employees. We also evaluate how these factors vary across time, that is, if sleep is merely associated with transient state-like changes in cognitive and emotional functioning, or if inadequate sleep also predicts a future decline in cognitive and emotional functioning at work.

1. Methods

1.1. Design and procedure

The study used data from the longitudinal study “Sleep, activity, psychosocial work environment and police health” (SAPPH). The project was approved by the Regional Committee for Medical Research Ethics (REK) of Central Norway in 2018 (2018/299/REK-Central), and performed according to the Declaration of Helsinki [30] and European general data protection regulations. Data were collected through an online survey distributed by e-mail to all employees in a police district in Norway at two separate time points 6 months apart. The baseline data collection (Time 1) was conducted in October 2018 and the follow-up data collection (Time 2) took place in May 2019.

1.2. Sample

A total of 410 police employees participated in the study at baseline (response rate = 40%). The dropout rate was 50% between the first and second round of data collection, resulting in 206 police employees who answered the full or parts of the questionnaire at both baseline and follow-up. An overview of the sample characteristics is presented in Table 1. Owing to missing values on individual variables (affecting 8% of the cases at baseline and 11% at follow-up), the final sample in the regression analyses consisted of 377 participants at baseline and 184 at follow-up.

1.3. Measures

The questionnaires included items measuring, among others, demographic variables, work schedule, impaired cognitive, and emotional functioning at work, sleep length on workdays, and insomnia.

Background variables. We included three selected background variables in the analyses: age, gender, and rotating shift work. Age and gender were selected as control variables because of their relation to cognitive and emotional functioning in previous research [31–34]. The work schedule was in the questionnaire measured with the following categories: daytime shifts only, equal amounts of evening and daytime shifts, and rotating shifts including night shifts. The variable was for the present study dichotomized into (0) not enrolled in work schedules that include night work and (1) enrolled in rotating shifts that include night work. The final variable was labeled “rotating shift work” and resulted in 50% of the employees being categorized as not enrolled in work schedules that included nighttime work (i.e. 43% daytime only workers and 7% workers with equal amounts of daytime and evening work) and 50% being categorized enrolled rotating shifts including nights (i.e. workers who had a rotating schedule with both daytime, evening, and night work).

Table 1
Sample characteristics

	Baseline (n = 410)	Follow-up (n = 206)
Gender (%)		
Female	199 (48%)	100 (48%)
Male	211 (52%)	106 (52%)
Age (y)		
Mean (SD)	40.93 (11.18)	42.48 (10.71)
Min–max	20–68	22–65
Median	41.00	43.00
Work schedule (%)		
Nonrotating shift (day/evening)	204 (50%)	110 (53%)
Rotating shift (day/evening/nights)	206 (50%)	96 (47%)
Time in police profession		
Mean (SD)	14.20 (11.15)	16.32 (11.47)
Min–max	0–47	0–41
Median	10.00	15.00
Time in current position		
Mean (SD)	5.10 (5.96)	4.78 (5.77)
Min–max	0–40	0–34
Median	3.00	2.00
Assignments (%)		
Operational	198 (48%)	82 (40%)
Investigation	149 (34%)	71 (35%)
Administrative	87 (21%)	56 (27%)
Civil justice	42 (10%)	18 (9%)
Prosecution	18 (4%)	6 (3%)

SD, standard deviation

Table 2
Descriptive statistics and correlations for variables measured at baseline and 6-months follow-up ($N = 184–410$)

	1	2	3	4	5	6	7	8	9	10	11
1.Gender[a]	–										
2. Age	−.03	–									
3. Rotating shift work[b]	−.20**	−.44**	–								
4. Sleep length[b]	−.13**	−.03	.03	–							
5. Sleep length[c]	−.17*	.01	−.08	.60**	–						
6. Insomnia[b]	.13**	−.02	−.03	−.38**	−.28**	–					
7. Insomnia[c]	.17*	−.04	.01	−.42**	−.37**	.73**	–				
8. Impaired cognitive functioning[b]	.12*	.07	−.22**	−.12*	−.12	.28**	.19**	–			
9. Impaired cognitive functioning[c]	.13	−.10	−.18*	−.13	−.13	.39**	.41**	.57**	–		
10. Impaired emotional functioning[b]	.15**	-.01	−.09	−.09	−.17*	.28**	.19*	.57**	.35**	–	
11. Impaired emotional functioning[c]	.20**	−.02	−.12	−.15*	−.22**	.24**	.21**	.45**	.48**	.62**	–
Mean (SD)	.49 (.50)	40.93 (11.17)	.50 (.50)	6.58 (.82)	6.53 (.83)	11.60 (8.67)	10.63 (8.51)	1.75 (.62)	2.07 (.59)	1.46 (.49)	1.59 (.50)

*$p < .05$; **$p < .01$; [a]0 = male, 1 = female; [b]=baseline; [c]=follow-up.
SD, standard deviation.

Insomnia. The Bergen Insomnia Scale [35] assesses symptoms of insomnia through six items based on the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders-IV (4th ed.; DSM-4). The instrument is considered a solid measure of insomnia, and has in previous studies shown good convergent and discriminative validity as well as satisfying psychometric properties [35]. The participants were asked to indicate how many days a week (ranging from 0 to 7) during the last month they have struggled with six specific symptoms of insomnia: sleep initiation, sleep maintenance, early awakenings, excessive sleepiness, sleep satisfaction, and adequate rest. The present study used the continuous form of the scale with sum scores ranging from 0 to 42. The internal consistency for insomnia was high at both Time 1 and Time 2 ($\alpha = .85$).

Work-related impaired cognitive and emotional functioning. Impaired cognitive and emotional functioning at work was measured with two subscales from the Burnout Assessment Tool, which measures self-reported cognitive and emotional regulation and functioning specific to work [36]. Impaired cognitive functioning was measured with the following items: *"At work, I have trouble staying focused," "At work I struggle to think clearly," "I'm forgetful and distracted at work," "When I'm working, I have trouble concentrating,"* and *"I make mistakes in my work because I have my mind on other things."* Impaired emotional functioning was measured with the following items: *"At work, I feel unable to control my emotions," " I do not recognize myself in the way I react emotionally at work," "During my work I become irritable when things don't go my way," "I get upset or sad at work without knowing why,"* and *"At work, I may overreact unintentionally."* The participants were instructed to indicate how often each statement applied to them in their current work situation on a five-point Likert frequency scale ranging from 1 (never) to 5 (always), which were then used to calculate mean scores for each scale. Higher scores indicates greater cognitive and emotional impairment at work. In the present study, the internal consistency was satisfying for both impaired cognitive functioning ($\alpha = .90$, $\alpha = .88$) and impaired emotional functioning ($\alpha = .81$, $\alpha = .79$), measured at baseline and follow-up, respectively.

1.4. Statistical analyses

All analyses were performed using the Statistical Package for Social Sciences 27.0. Pearson correlation analysis was applied to examine the correlations between variables measured at baseline and follow-up. Drop-out analysis (t tests) was performed to explore potential differences between employees who participated in the study only at baseline and employees who participated at both

Table 3
Hierarchical regression analysis on the relationships between variables measures at baseline and impaired cognitive functioning at work

		Impaired cognitive functioning							
		Baseline ($n = 377$)				Follow-up ($n = 184$)			
		β	SE B	P	R^2	β	SE B	p	R^2
Model 1					.06				.09
	Gender[a]	.08	.07	.138		.11	.09	.151	
	Age	-.03	.03	.646		-.21	.04	.009	
	Rotating shift work	-.22	.07	.000		-.26	.10	.001	
Model 2					.13				.23
	Gender[a]	.03	.06	.498		.02	.08	.789	
	Age	-.02	.03	.740		-.20	.04	.007	
	Rotating shift work	-.22	.07	.000		-.24	.09	.001	
	Insomnia	.27	.04	.000		.41	.05	.000	
	Sleep length	.00	.04	.978		.07	.05	.376	
Model 3									.41
	Gender[a]					-.01	.07	.835	
	Age					-.14	.04	.026	
	Rotating shift work					-.11	.08	.100	
	Insomnia					.31	.04	.000	
	Sleep length					.10	.05	.119	
	Impaired cognitive functioning[b]					.47	.06	.000	

[a]0 = male, 1 = female; [b]=baseline.
SE, standard error.

baseline and follow-up. Multiple hierarchical regression analyses were conducted in two and three steps for impaired cognitive and emotional functioning measured at baseline and follow-up as separate outcomes. Step 1 in the regression analyses included age, gender, and rotating shift work. Step 2 included age, gender, rotating shift work, sleep length on workdays, and insomnia. In the longitudinal analyses, the final Step 3 adjusted for previous symptoms of either impaired cognitive or emotional functioning measured at baseline. Lastly, we performed cross-lagged analyses to test for directional influence and reciprocal relationships [37,38], that is, if impaired cognitive and emotional functioning measured at baseline could predict changes in symptoms of insomnia or sleep length at follow-up. Gender, age, and rotating shift work were included as control variables and the analyses were adjusted for insomnia and sleep length measured at baseline.

2. Results

The demographic characteristics of the sample are shown in Table 1. Descriptive statistics and correlations between all included variables measured at baseline and 6-months follow-up are shown in Table 2. The level of impaired cognitive and emotional functioning was low, indicating overall high cognitive and emotional functioning. There were no significant differences in impaired emotional and cognitive functioning between employees who only participated at baseline compared to those who participated in the study at both baseline and follow-up. Regarding age differences, employees who participated in the study at both times were slightly older ($M = 42.48$, $SD = 10.71$) than those who *only* participated at baseline ($M = 39.37$, $SD = 11.45$), $t\ (408) = 2.84$, $p < .01$, $d = .28$). Insomnia measured at baseline was positively correlated to both current and future impaired cognitive and emotional functioning measured at baseline and follow-up. Baseline sleep length had negative associations to impaired emotional functioning at baseline and follow-up, and with impaired cognitive functioning at baseline. Rotating shift work was negatively associated with impaired cognitive functioning measured at baseline and follow-up.

Tables 3 and 4 show cross-sectional and longitudinal relationships between variables measured at Time 1 on work-related impaired cognitive and emotional functioning measured at baseline and 6-months follow-up.

Work-related impaired cognitive functioning. The model including age, gender, rotating shift work, sleep length, and insomnia explained 13% of the variance in baseline impaired cognitive functioning ($F\ (5, 371) = 10.87$, $p < .001$) and 23% of the variance in impaired cognitive functioning measured at follow-up ($F\ (5, 178) = 10.50$, $p < .001$). After adjusting the final model for baseline impaired cognitive functioning, the explained variance rose to 41% ($F\ (6, 177) = 20.71$, $p < .001$). Insomnia measured at Time 1 had positive relations to both current and future impaired cognitive functioning, also when adjusting for previous symptoms of impaired cognitive functioning. Baseline sleep length on workdays had no significant relation to impaired cognitive functioning at either time. Rotating shift work was negatively related to impaired cognitive functioning measured at baseline and follow-up. Age was negatively associated with impaired cognitive functioning at follow-up, but not when measured simultaneously at baseline. There was no significant relation between gender and impaired cognitive functioning at neither baseline nor follow-up.

Work-related impaired emotional functioning. The model including age, gender, rotating shift work, sleep length, and insomnia explained 10% of the variance in baseline impaired emotional functioning ($F\ (5, 371) = 7.93$, $p < .001$) and 9% of the variance in impaired emotional functioning measured at follow-up ($F\ (5, 178) = 3.70$, $p < .01$). After adjusting the final model for baseline emotional functioning, the explained variance rose to 40% ($F\ (6, 177) = 19.45$, $p < .001$). Insomnia measured at Time 1 was positively related to impaired emotional functioning at both baseline and follow-up, but the relation to future impaired emotional functioning was no longer significant in the fully adjusted model including baseline emotional functioning. Gender had a positive relation to impaired emotional functioning at baseline and follow-up before the model was adjusted for insomnia, sleep length, and earlier symptoms of impaired emotional functioning. Age, rotating shift work, and sleep length had no association to impaired emotional functioning measured at baseline or follow-up.

Results from the cross-lagged analysis. The cross-lagged regression analyses showed that the baseline impaired cognitive functioning ($\beta = -.02$, $p = .727$) and impaired emotional functioning T1 ($\beta = -.03$, $p = .534$) did not predict changes in symptoms of insomnia 6 months later. Impaired cognitive functioning ($\beta = -.02$, $p = .761$) and impaired emotional functioning ($\beta = -.04$, $p = .499$) measured at baseline did not predict sleep length 6 months later.

Table 4
Hierarchical regression analysis on the relationships between variables measured at baseline and impaired emotional functioning at work

		Impaired emotional functioning							
		Baseline ($n = 377$)				Follow-up ($n = 184$)			
		B	*SE B*	*p*	R^2	*β*	*SE B*	*p*	R^2
Model 1					.03				.06
	Gender[a]	.13	.05	.012		.18	.08	.014	
	Age	-.05	.03	.423		-.07	.04	.413	
	Rotating shift work	-.08	.06	.165		-.13	.08	.124	
Model 2					.10				.09
	Gender[a]	.10	.05	.065		.13	.08	.090	
	Age	-.04	.02	.499		-.06	.04	.468	
	Rotating shift work	-.08	.06	.180		-.12	.08	.139	
	Insomnia	.28	.03	.000		.19	.05	.018	
	Sleep length	.04	.03	.431		-.03	.05	.729	
Model 3									.40
	Gender[a]					.02	.06	.810	
	Age					-.05	.03	.467	
	Rotating shift work					-.06	.07	.378	
	Insomnia					.08	.04	.269	
	Sleep length					.03	.04	.699	
	Impaired emotional functioning[b]					.60	.06	.000	

[a]0 = male, 1 = female; [b]=baseline.
SE, standard error.

3. Discussion

The present study examined cross-sectional and longitudinal associations between sleep and work-related impaired cognitive and emotional functioning among Norwegian police employees. The level of impaired cognitive and emotional functioning was low, indicating overall high cognitive and emotional functioning at work. Insomnia had a positive relationship to both impaired emotional functioning and impaired cognitive functioning at work, but only the latter association remained significant after 6 months when adjusting for baseline levels of the constructs. Subjective sleep length and rotating shift work were not associated with a decline in future emotional and cognitive functioning. Lastly, impaired cognitive and emotional functioning did not predict insomnia or sleep length 6 months later, providing support for the directional effect between sleep and cognitive and emotional functioning in the present study. The results demonstrate that the association between insomnia and emotional functioning can be more transient than the effect of insomnia on cognitive functioning. The study underlines the negative effects of insomnia on police employees' cognitive and emotional functioning at work. A stronger focus on the prevention and treatment of insomnia among police employees is warranted, and the possible accumulating effect insufficient and poor-quality sleep has on cognitive functioning should receive more attention in future research.

Insomnia had both cross-sectional and longitudinal relations to impaired cognitive and emotional functioning at work. However, the longitudinal association between insomnia and reduced emotional functioning at work was no longer significant after adjusting for baseline symptoms of impaired emotional functioning, whereas the relationship between insomnia and impaired cognitive functioning was slightly strengthened after 6 months. This finding is in line with previous studies that have shown an accumulating effect of chronic short and shallow sleep that may hinder performance in acute situations and execution of essential tasks like driving and operating equipment [39]. Previous research has shown that sleep disorders are common among police officers and increases the risk of poor performance and negative safety outcomes [40]. Insomnia can impair cognitive performance and functioning, especially attention, problem-solving, as well as episodic and working memory [2,18]. Persistent problems with concentration and decision-making due to sleep problems among police employees may lead to fatal outcomes for the individual employee, their colleagues, and the public.

Police employees are often faced with emotionally challenging events during their workday and need to be able to control their emotions and act rationally to perform their work safely and effectively [41]. Although the present study only found a temporary association between insomnia and impaired emotional functioning, healthy regulation of emotions is fundamentally important for mental health, social relations, and general well-being [42,43]. Overall, our findings are in line with previous studies that have identified impaired cognition and emotional distress as consequences of sleep deprivation and low quality sleep [18,44], and provides new insight into how sleep affects cognitive and emotional function in a work setting. In their line of work, police employees are dependent on optimal cognitive and emotional functioning. This highlights the necessity of ensuring that employees in the police occupation focus on getting enough high-quality sleep, as well as providing support and treatment to those who suffer from mild to serious symptoms of insomnia.

Sleep length had no association to impaired cognitive and emotional functioning at work at neither baseline nor 6 months later. Our study demonstrates that the individual experience of having trouble sleeping, lower sleep quality, and reduced daily functioning (i.e. insomnia) have a stronger relationship to cognitive and emotional functioning than average sleep length alone. Previous research has shown that the necessary amount of sleep is highly individual [11], and that good quality sleep can be more important for daily functioning than overall sleep length [45,46]. In addition to providing employees with sufficient rest time between shifts [47], the organization should also focus on their workers' sleep quality. Sleep leadership refers to the supervisors' concern, care and actions directed at improving employees' quality and quantity of sleep, and the presence of high sleep leadership may lead to less sleep disturbances and improved sleep hygiene among employees [48].

This study follows a longitudinal design and provides new knowledge about the relationship between sleep and work-related cognitive and emotional functioning across time. A minimum of 3 months between measurements can be regarded as sufficient to study longitudinal changes in this context [49]. Furthermore, the use of cross-lagged analyses in the present study provides more information about directional influence between insomnia and impaired cognitive functioning than ordinary regression analysis alone [37,38,50]. Although the dropout rate was 50% between the first and second time of measurement, there were no significant mean differences in the included variables, except a small age difference. Furthermore, participants in sleep studies tend to overestimate how long they sleep compared to objectively measured sleep length [51], and the use of self-reported sleep length in the present study may have contributed to an imprecise estimate of sleep duration. The results in the present study might also have been influenced by common method and self-report bias related to the use of questionnaires [52,53]. However, questionnaires have the advantage of being able to capture information that is only available to the individual [54]. The scales used to measure cognitive and emotional impairment were work-specific, making it possible to generalize the finding to other working populations dependent on high cognitive and emotional functioning to perform their work effectively and safely. Owing to the small to moderate sample size at follow-up, we recommend that the findings are replicated in larger samples. Lastly, the present study did not account for past accidents or trauma, psychosocial work factors, or mental or physical illnesses that could have influenced the results. For example, head trauma or anxiety can contribute to sleep disturbances as well as cognitive and emotional impairment [55,56]. However, a serious degree of any illness or trauma would have made the police employees ineligible to perform most tasks in this occupation. Furthermore, employees with extended periods of sickness absence did not participate in the study. This is also reflected in the samples' level of general health, of which 93% of the participants reported as good or very good and merely 7% classified as poor.

Our study demonstrates that poor sleep can influence cognitive and emotional functioning in work settings. This finding highlight why organizations should care about their employees' sleep, especially in high-risk occupations such as the police, fire and rescue services, as well as the military. Enough sleep, in terms of both quantity and quality, is important for the individual's well-being as well as for the safety of the public they serve. Organizations should accentuate the importance of sleep and have a low threshold for offering personalized measures aimed at preventing, reducing, and treating sleep problems among their employees. Investing time and resources in ensuring better sleep among employees is an investment in their performance and productivity. Future research is encouraged to replicate the findings in larger samples, other high-risk occupations, and over longer periods with multiple measurement points.

4. Conclusion

Our results demonstrate that insomnia can be more harmful to cognitive and emotional functioning at work than the individuals' work schedule and sleep length are. However, the association between insomnia and impaired emotional functioning was transient and limited to cross-sectional findings. Lastly, the longitudinal relationship between insomnia and impaired cognitive functioning was slightly stronger than the cross-sectional association, indicating that the negative impact of sleep problems on cognition may accumulate over time. Replication of the findings in larger samples is advised.

Conflicts of interest

All authors have no conflicts of interest to declare.

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