HHS Public Access

Author manuscript

Policing. Author manuscript; available in PMC 2021 June 15.

Published in final edited form as:

Policing. 2020 April 30; 43(3): 483–494. doi:10.1108/pijpsm-10-2019-0165.

Fatigue and short-term unplanned absences among police officers

Samantha Riedy

Sleep and Performance Research Center, Washington State University, Spokane, Washington, USA

Elson S. Floyd College of Medicine, Washington State University, Spokane, Washington, USA

Drew Dawson

Appleton Institute, Central Queensland University, Wayville, Australia

Desta Fekedulegn, **Michael Andrew**

Bioanalytics Branch, Health Effects Laboratory Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia, USA

Bryan Vila*

Department of Criminal Justice and Criminology, Washington State University, Spokane, Washington, USA

Sleep and Performance Research Center, Washington State University, Spokane, Washington, USA,

John M. Violanti*

Department of Epidemiology and Environmental Health, School of Public Health and Health Professions, University at Buffalo, State University of New York, Buffalo, New York, USA

Abstract

Purpose ——The purpose of this paper is to assess whether shift work, sleep loss and fatigue are related to short-term unplanned absences in policing.

Design/methodology/approach ——*N* = 367 police officers from the Buffalo Police Department were studied. Day-by-day work and sick leave data were obtained from the payroll. Absenteeism was defined as taking a single sick day on a regularly scheduled workday. Biomathematical models of fatigue (BMMF) predicted officers' sleep–wake behaviors and on-duty fatigue and sleepiness. Prior sleep, fatigue and sleepiness were tested as predictors of absenteeism during the next shift.

Corresponding author: Samantha Riedy can be contacted at: samantha.riedy@pennmedicine.upenn.edu.

*Shared senior authorship.

Disclosure statement: Drew Dawson, PhD derives income from royalties associated with the use of FAID Quantum. The remaining authors do not have any disclosures to report. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

Findings ——A total of 513,666 shifts and 4,868 cases of absenteeism were studied. The odds of absenteeism increased as on-duty fatigue and sleepiness increased and prior sleep decreased. This was particularly evident for swing shift officers and night shift officers who were predicted by BMMF to obtain less sleep and have greater fatigue and sleepiness than day shift officers. The odds of absenteeism were higher for female officers than male officers; this finding was not due to a differential response to sleep loss, fatigue or sleepiness.

Practical implications ——Absenteeism may represent a self-management strategy for fatigue or compensatory behavior to reduced sleep opportunity. Long and irregular work hours that reduce sleep opportunity may be administratively controllable culprits of absenteeism.

Originality/value ——Police fatigue has consequences for police officers, departments and communities. BMMF provide a potential tool for predicting and mitigating police fatigue. BMMF were used to investigate the effects of sleep and fatigue on absenteeism.

Keywords

Shift work; Police; Fatigue; Sleep; Absenteeism; Biomathematical model

1. Introduction

Policing is a 24/7 operation. Police departments use shift work to schedule officers around-the-clock, and understaffed police departments also rely on overtime. Policies governing officers' work schedules are set at the local government level, often in negotiation with local police unions or collective bargaining units. As a result, policies regulating officers' work schedules can be highly variable across departments. Nearly all general-purpose law enforcement agencies permit overtime hours without restrictions and secondary employment generally with restrictions (Reaves, 2012). Furthermore, court systems have the authority to require officers to appear in court via subpoena, which increases police departments' reliance on overtime to staff officers.

Shift work and long work hours have consequences for police officers' sleep opportunities. Shift work displaces sleep to the daytime hours when the pressure for wakefulness is high and it is often difficult to initiate or sustain sleep. Shift work also displaces work to the nighttime hours when the pressure for wakefulness is low and sleepiness is high. Long work hours resulting from overtime, secondary employment and off-duty court hours further complicate the problem by reducing police officers' sleep opportunities. Shift work and sleep loss are major sources of fatigue for police officers (Åkerstedt and Wright, 2009). These sources of fatigue have been linked to degraded operational performance (Violanti *et al.*, 2013; Waggoner *et al.*, 2012), damaged police–community relationships (Vila, 2006; James *et al.*, 2018; Riedy *et al.*, 2019) and long-term health consequences for police officers (Violanti *et al.*, 2009; Charles *et al.*, 2011). Night shift work has also been linked to higher injury risk in policing (Violanti *et al.*, 2012), with findings suggesting that fatigue may be involved in the increased injury risk during night shift work when compared with day shift work.

Recent cross-sectional research has also shown that shift work and long work hours increase absenteeism in policing (Fekedulegn *et al.*, 2013a, 2013b) – findings consistent with research conducted in other operational settings (e.g. Ropponen *et al.*, 2019). Furthermore, research has demonstrated that workers with sleep disorders and/or sleep disturbances have greater absenteeism incidence rates than workers without sleep disorders and/or sleep disturbances (Rajaratnam *et al.*, 2011; Azor Hui and Grandner, 2016). Absenteeism previously associated with shift work, long work hours and sleep disorders may be related to absenteeism indirectly through the sleep loss and fatigue these officers likely experience. Indeed, there is some evidence from research with hospital nurses that occasional absenteeism provides a coping mechanism and way of reducing exposure to various types of stressors, including tiredness and sleep disturbances (Hackett and Bycio, 1996). In policing, this coping mechanism involving short-term absences has been referred to as a "safety valve" used at times of excessive stress (Gabarino *et al.*, 2012).

Compensatory time off and sick leave provide two routes for absenteeism in policing. Depending on the police department, officers may earn compensatory time off rather than paid overtime as overtime compensation. Officers can use compensatory time off on any date(s) requested as long as it would not "unduly disrupt" the operation (Fair Labor Standards Act, 2011). Indeed, Vila and Riedy (2019) stated that compensatory time off provides a route for police to recover from the effects of shift work and long work hours and is an important safety measure that enables police to meet their responsibilities to be fit for duty. On the other hand, sick leave is a guaranteed benefit in officers' compensation packages. And, often when sick leave is discussed in the context of unplanned absences, it is in terms of the costs to police departments and/or the need to control abuse of sick leave (Jones, 2008). It is not as often discussed in terms of what is driving the unplanned absences – factors that may or may not be administratively controllable.

This research provides a longitudinal assessment of the relationships between police officers' work–rest schedules, sleep–wake behaviors, on-duty fatigue and absenteeism. The results are used to assess whether absenteeism in policing may actually represent a self-management strategy for fatigue and/or a compensatory behavior to reduced sleep opportunity. That is, whether police officers may volitionally or unintentionally use absenteeism to cope with and reduce the amount of sleep loss and fatigue they experience during difficult work schedules that often include shift work and long and erratic work hours.

2. Methods

2.1 Buffalo Cardio-Metabolic Occupational Police Stress (BCOPS) study

Participants included 367 sworn police officers enrolled in the Buffalo Cardio-metabolic Occupational Police Stress (BCOPS) study. All officers were employed by the Buffalo, New York Police Department. Electronic day-by-day work history records and sick leave data, from 1994 to 2015, were obtained from the Buffalo, New York, Payroll department. The payroll data included the start time and duration of work periods and sick leave. Officers were paid for their overtime hours; the department does not use compensatory time off *in lieu* of paid overtime.

2.2 Biomathematical models of fatigue

Biomathematical models of fatigue are methodological tools for predicting fatigue, sleepiness and/or performance impairment using sleep–wake data and/or work–rest schedules (Dawson *et al.*, 2011). These tools incorporate our scientific understanding of sleep timing and sleep duration and their relationships with fatigue, sleepiness and performance. In operational settings, the model predictions are used to (1) construct work–rest schedules with adequate sleep opportunities (Dawson and McCulloch, 2005), (2) evaluate the likelihood of on-duty fatigue to determine the extent to which fatigue mitigation strategies are needed (Dawson *et al.*, 2012), (3) develop safety cases (Lamp *et al.*, 2018) and (4) investigate the likelihood of fatigue in post-accident investigations (Price and Coury, 2015). In operational research, biomathematical models of fatigue are useful tools for studying sleep–wake behaviors, on-duty fatigue and job performance during different work–rest schedules (Riedy *et al.*, 2019; Hursh *et al.*, 2006; Åkerstedt *et al.*, 2008; Morris *et al.*, 2018; Sagherian *et al.*, 2018).

In the current operational research, we used two biomathematical models of fatigue – Fatigue Audit InterDyne (FAID) and Three-Process Model of Alertness (TPM) – incorporated into the analytical software FAID Quantum (Roach *et al.*, 2004; Åkerstedt and Folkard, 1995; FAID Quantum User Guide v1.0, 2017). FAID predicted officers' on-duty fatigue (i.e. FAID scores) directly from their work–rest schedules. FAID scores ranged from 0 to 100+, with higher FAID scores indicating greater likelihood of fatigue. The default threshold for a high likelihood of fatigue is a peak FAID score of 80, which is equivalent to fatigue-related impairment after approximately 21 h of total sleep deprivation (FAID Quantum User Guide v1.0, 2017; Dawson and Reid, 1997). For each shift, a peak FAID score was calculated. The peak FAID score represented the greatest fatigue (i.e. the highest FAID score) predicted during that shift.

FAID Quantum predicted officers' sleep–wake behaviors directly from their work–rest schedules. TPM predicted on-duty sleepiness (i.e. Karolinska Sleepiness Scale (KSS) ratings) from officers' predicted sleep–wake behaviors. KSS ratings ranged from 1 to 9, with higher KSS ratings indicating greater likelihood of sleepiness. The default threshold for a high likelihood of sleepiness is a peak KSS rating of 7 (FAID Quantum User Guide v1.0, 2017). Previous research has demonstrated that physiological signs of sleepiness (e.g. heavy eyelids, long eye blinks and slow eye movements) and behavioral signs of sleepiness (e.g. lane deviation and unintentional line crossings) begin to be seen at KSS ratings of 7 (see Åkerstedt *et al.*, 2014 for a review). For each shift, a peak KSS rating was calculated. The peak KSS rating represented the greatest sleepiness (i.e. the highest KSS rating) predicted during that shift.

2.3 Data analyses

Data analyses focused on sworn police officers regularly working 10-h shifts. Detectives, lieutenants, sergeants, chief commissioners and other police department personnel were excluded from the data analyses. Sworn police officers regularly working 8-h shifts were also excluded from the data analyses because the 8-h shifts were usually day shifts and were rarely swing shifts or night shifts. Payroll data collected during a suspension or an injury

were excluded from all data analyses. All data analyses were conducted using SAS 9.4 (Cary, North Carolina, USA).

Absenteeism was analyzed as a dichotomous dependent variable (two levels: at work, absent from work). To be included as an outcome in the analyses, the shift or absence had to occur on a regularly scheduled workday and had to be preceded by at least one shift in the prior 24 h. The following continuous variables were tested as the main predictors of absenteeism in separate mixed-effects logistic regression models with a logit link function and a random intercept over subjects (PROC GLIMMIX, SAS 9.4): peak FAID scores during the prior shift, sleep in the 24 h prior to the shift and peak KSS ratings during the prior shift. Officers' sex (categorical: male, female) was included as a main effect in each model. Two-way interactions between the main continuous predictor variables and shift type (categorical: day, swing, night) and the continuous variables and officers' sex were included. The two-way interactions examined whether the effects of prior fatigue, sleep and/or sleepiness on absenteeism varied as a function of shift type and/or officers' sex. Continuous predictors were group-mean centered by shift type. As such, the odds ratios are interpreted as deviations from the group (i.e. day, swing or night) averages for prior sleep, on-duty fatigue and on-duty sleepiness.

3. Results

In total, 367 sworn police officers (101 females) were studied. Between 1994 and 2015, a total of 743,292 shifts were studied, with each officer contributing 2,025.3 ± 1,034.0 shifts to the data set (range: 17–4,805 shifts). A total of 513,666 shifts and 4,868 cases of absenteeism occurred on regularly scheduled workdays, were preceded by at least one shift in the prior 24 h and ultimately were included in the data analyses. On average, each officer's contribution to the analyses included 1,399.6 ± 736.0 shifts (range: 8–3,697 shifts) and 13.3 ± 16.3 absenteeism cases (range: 0–105 cases).

Across officers and shift types, the average peak FAID score was 49.4 ± 22.0, and the average peak KSS rating was 6.1 ± 1.3. On average, 7.1 ± 1.5 h of sleep were predicted in the 24 h prior to a shift. As expected, peak FAID scores, peak KSS ratings and hours of sleep predicted in the 24 h prior to a shift significantly differed by shift type ($F_{2,52E4} \geq 111{,}033$, $p < 0.001$). On-duty fatigue and sleepiness predictions were higher on night shifts than swing shifts and day shifts. And, less sleep was predicted prior to a night shift than prior to a swing shift or day shift (Figure 1).

Overall, officers' peak FAID scores, peak KSS ratings and prior sleep were significant predictors of absenteeism ($F_{1,518E3} \geq 15.3$, $p < 0.001$). The odds of absenteeism during the next shift increased as prior fatigue increased, sleep decreased, sleepiness increased. The effects of prior sleep did not vary significantly by shift type – obtaining less sleep consistently increased the odds of absenteeism across shift types ($F_{2,518E3} = 1.4$, $p = 0.26$). The effects of prior fatigue and sleepiness on absenteeism did significantly vary by shift type ($F_{2,518E3} \geq 14.2$, $p < 0.001$). See Table 1. The odds of absenteeism increased for the swing shift officers and night shift officers, as prior fatigue and sleepiness increased, but not for the day shift officers who were predicted to be relatively well-rested. See Table 1. These results

were particularly evident with the sleepiness data. A one-unit shift on the KSS, particularly at the higher end of the scale, is a bigger shift than a ten-unit shift in FAID scores. As FAID scores continued to deviate from the group-mean, the odds ratios continued to increase.

Consistent with prior research, the odds of absenteeism were consistently higher for females than males (OR = 1.7; $F_{1,365} \geq 10.0$, $p < 0.01$). However, the interactions between officers' sex and prior fatigue and officers' sex and sleepiness were not significant ($F_{1,518E3} \leq 3.6$, $p \geq 0.06$). Thus, the odds of absenteeism did not change disproportionately for females versus males as prior fatigue or sleepiness changed (Table 2). The interaction between officers' sex and prior sleep was significant ($F_{1,518E3} = 15.2$, $p < 0.001$). However, this appears to be a negligible difference, and the significance was likely driven by the low variability in sleep predictions. On average, males obtained 7.1 ± 1.5h of sleep in the prior 24 h and females obtained 7.2 ± 1.3h of sleep in the prior 24 h. The odds ratios for a 1-h change for both males and females were 0.6 (Table 2).

4. Discussion

This operational research provided a longitudinal assessment of the relationships between police officers' work–rest schedules, sleep–wake behaviors, on-duty fatigue and absenteeism. The research used work data and sick leave data collected during the BCOPS study and fatigue, sleep and sleepiness estimates from biomathematical models of fatigue. The findings from this operational research suggest that sleep loss and fatigue increase the likelihood of absenteeism in policing. Absenteeism may represent a self-management strategy for police fatigue or a compensatory behavior to reduced sleep opportunity. Future discussions of unplanned absences in policing should include a conversation on how these unplanned absences may be driven by sleep loss and police fatigue resulting from long and irregular work hours.

4.1 Absenteeism in policing

Absenteeism places an enormous economic burden on employers. The nature of absenteeism in the workplace is likely multifactorial and complex. However, the World Economic Forum has previously reported that the costs of sleep loss-related absenteeism, presenteeism and other negative occupational outcomes total over US$150bn each year in the USA (Azor Hui and Grandner, 2016; World Economic Forum, 2010). In US policing, specifically, absenteeism is, in part, an administrative problem. Absenteeism requires police departments to reassign duties (Violanti *et al.*, 2015) or requires other officers to work overtime to fill in for their absent colleagues. As such, absenteeism aggravates the officer shortage problem at understaffed police departments, and it strains departmental budgets.

The conversation of unplanned absences in policing is thus often focused around the costs to police department budgets and the need to control the abuse of sick leave. However, absenteeism is not strictly an administrative problem. The current research suggests that short-term unplanned absences may represent a response to reduced sleep opportunity. That is, the results suggest that police officers may use absenteeism to cope with and reduce the amount of sleep loss and fatigue they experience. This could be a self-management strategy for fatigue, or it could be unintentional compensatory response to reduced sleep opportunity.

Sleep loss and police fatigue resulting from long and irregular work hours may be administratively controllable culprits of unplanned absences in policing. It remains to be determined whether regulating and/or restricting use of sick leave increases police fatigue and fatigue-related risks.

4.2 Shift work, sleep loss and police fatigue

Cross-sectional research conducted in policing and other operational settings has previously suggested that shift work, long work hours, sleep disturbances and sleep disorders increase workplace absenteeism. The longitudinal research presented here suggests that these factors may be related to absenteeism indirectly through sleep loss, fatigue and sleepiness. Officers predicted to obtain less sleep and have greater on-duty fatigue and on-duty sleepiness were more likely to call in sick from work during their next shift. This relationship was particularly evident for the swing shift workers and night shift workers who were predicted to obtain less sleep prior to a shift and have greater on-duty fatigue and sleepiness than day shift workers. On average, officers working night shifts had high levels of sleepiness – sleepiness levels that have previously been associated with increased lane deviation, unintentional lane crossing, slow rolling eye movements and other behavioral and physiological signs of sleepiness (Åkerstedt *et al.*, 2014).

Furthermore, female officers had a greater likelihood of absenteeism than male officers. This is a common finding in previous research, and it is often explained by childcare and family responsibilities (Patton and Johns, 2007). In the policing literature specifically, however, there have been inconsistent findings. In 2009, a systematic review was conducted on all scientific studies on absenteeism among male and female police officers (Körlin *et al.*, 2009). It was concluded that research on sex differences in absenteeism rates among police officers was scarce, and there was an obvious need for additional studies (Körlin *et al.*, 2009). Since this systematic review was published, additional studies have found that female officers tend to have a greater likelihood of absenteeism than male officers (e.g. Fekedulegn *et al.*, 2013b; Svedberg and Alexanderson, 2012). The results presented here add to this growing literature. These results could not be explained by a differential response to prior sleep loss, on-duty fatigue or on-duty sleepiness. The fatigue and sleepiness predictions did not significantly differ for female officers versus male officers. The sleep predictions did significantly differ for female officers versus male officers; however, the difference was negligible, and the significance was likely driven by the low variability in sleep predictions. Violanti *et al.* (2018) reported similar findings using BCOPS study data and actual self-reported fatigue ratings, i.e. fatigue ratings did not differ by officers' sex after controlling for shift type.

Officers' age and years of experience were intentionally not controlled for in the analyses for two reasons. The primary reason is that officers' age and years of experience significantly differ by shift type. Younger officers tend to work more night shifts, while the older officers tend to work more day shifts. The secondary reason is that biomathematical models' predictions are derived from workers' work–rest schedules and/or sleep–wake behaviors. The model estimates do not differ by age or years of experience.

4.3 Managing fatigue in policing

Fatigue in shift work is inevitable; however, mitigating and managing fatigue in policing is critical. Police fatigue has been associated with degraded operational performance, increased risk of injuries and accidents, changes in police–community relationships, long-term health consequences and now workplace absenteeism. Approaches for mitigating and managing fatigue in the operation should be considered. Such an approach should also provide police departments with the operational flexibility needed to schedule officers around-the-clock and meet demands for service.

In policing, a one-size-fits-all approach such as federal hours-of-service regulations that specify duty time limitations and minimum rest break requirements are likely impractical. There is considerable variability from one police department to the next on various environmental, social, economic and labor factors. Many police departments are also chronically understaffed and need scheduling flexibility to meet demands for service. Furthermore, the efficacy of hours-of-service regulations to manage fatigue and improve safety in an operation is continuously being challenged (McDonald, 1981; Jones *et al.*, 2005; Gander *et al.*, 2015; Honn *et al.*, 2019). Operations such as aviation and rail have developed fatigue risk management systems as an alternative, more comprehensive risk management approach for addressing fatigue in the operation while also increasing scheduling flexibility. In fatigue risk management systems, managing fatigue is viewed as a shared responsibility between employees and employers because fatigue is driven by both work demands and other waking activities (Gander *et al.*, 2011; Zaslona *et al.*, 2018).

In 2019, the Working Time Society published a series of consensus statements and best practices with the aim of providing stakeholders with the best information available when developing working time policies and regulations in different operational settings (Popkin and Fischer, 2019). Within the consensus statements, it was stated that the purpose of fatigue risk management systems is, in part, to develop procedures and processes for mitigating and managing fatigue predictively, proactively and reactively (Honn *et al.*, 2019). Examples of such procedures and processes include identifying fatigue hazards in an operation; use of predictive fatigue modeling (i.e. biomathematical models) in work scheduling; implementation of proactive fatigue monitoring; and development of education and training programs, non-punitive fatigue reporting systems and reactive procedures for investigating possible fatigue-related incidents or accidents (Balkin *et al.*, 2011; Satterfield and Van Dongen, 2013; Dawson *et al.*, 2016; Honn *et al.*, 2019).

In policing, there will be situations where the consequences of not doing the job outweigh the consequences of sleep loss and fatigue. In these situations, police and first responders will be at the forefront, and overtime and long and irregular work hours will be inevitable. In everyday policing, however, fatigue should be mitigated and managed. The research presented here suggests that absenteeism may being used as a self-management strategy for fatigue and/or may represent a compensatory response to sleep loss and fatigue.

4.4 Limitations

Limitations of this study include: (1) shifts and absences had to be preceded by a shift in the prior 24 h to be included in the analyses. As a result, the first shift in a work week is not included, and the absenteeism rate is lower than previously reported. Approximately 0.9 percent of the outcomes were absences. The Bureau of Labor Statistics (2020) reported that the absence rate of police and other protective service personnel is closer to 2.5; however, this absence rate includes more than sick leave. (2) Commute times were not accounted for. The FAID Quantum User Guide suggests adjusting shift start and end times for commutes longer than 45 min. Commute data were unavailable between 1994 and 2004. (3) Sleep, fatigue and sleepiness were predicted by a biomathematical model of fatigue. As such, some research questions could not be addressed, such as determining whether there were age effects independent of shift type. (4) Sleep timing, sleep duration, fatigue and sleepiness are predicted at the group level (i.e. for the average individual). Biomathematical models of fatigue do not account for untreated sleep disorders; workplace stress; family demands; and other physiological, non-physiological and psychosocial factors that impact sleep–wake behaviors and on-duty fatigue and sleepiness.

5. Conclusions

Shift work and long work hours are prevalent in policing. Fatigue during shift work is inevitable. Mitigating and managing fatigue in policing is critical for sustaining around-the-clock performance. The results from this longitudinal research study suggest that short-term unplanned absences may represent a self-management strategy for fatigue and/or a compensatory response to reduced sleep opportunity. It remains to be determined whether regulating and/or restricting sick leave increases police fatigue. Future discussions of unplanned absences in policing should include a discussion on approaches for mitigating and managing fatigue in the operation and whether there are administratively controllable drivers of absenteeism.

Support:

The Buffalo Cardio-Metabolic Occupational Police Stress study was funded by CDC/NIOSH grant 1R01OH009640-01A1 and NIJ grant 2005-FS-BX-0004.

We thank InterDynamics for providing the first-author with a FAID Quantum Research License.

Nomenclature

#	Number
BCOPS	Buffalo Cardio-metabolic Occupational Police Stress study
CI	Confidence interval
FAID	Fatigue Audit InterDyne
KSS	Karolinska Sleepiness Scale
SD	Standard Deviation

TPM Three-Process Model of Alertness

References

Åkerstedt T and Folkard S (1995), "Validation of the S and C components of the three-process model of alertness regulation", Sleep, Vol. 18 No. 1, pp. 1–6. [PubMed: 7761737]

Åkerstedt T and Wright KP Jr (2009), "Sleep loss and fatigue in shift work and shift work disorder", Sleep Medicine Clinics, Vol. 4 No. 2, pp. 257–271. [PubMed: 20640236]

Åkerstedt T, Connor J, Gray A and Kecklund G (2008), "Predicting road crashes from a mathematical model of alertness regulation – the Sleep/Wake Predictor", Accident Analysis and Prevention, Vol. 40 No. 4, pp. 1480–1485. [PubMed: 18606281]

Åkerstedt T, Anund A, Axelsson J and Kecklund G (2014), "Subjective sleepiness is a sensitive indicator of insufficient sleep and impaired waking function", Journal of Sleep Research, Vol. 23 No. 3, pp. 240–252. [PubMed: 24750198]

Azor Hui S and Grandner MA (2016), "Trouble sleeping associated with lower work performance and greater healthcare costs: longitudinal data from Kansas State Employee Wellness Program", Journal of Occupational and Environmental Medicine, Vol. 57 No. 10, pp. 1031–1038.

Balkin TJ, Horrey WJ, Graeber RC, Czeisler CA and Dinges Dvd.F. (2011), "The challenged and opportunities of technological approaches to fatigue management", Accident Analysis and Prevention, Vol. 43 No. 2, pp. 565–572. [PubMed: 21130217]

Bureau of Labor Statistics (2020), Department of Labor, Labor Force Statistics from the Current Population Survey, available at: https://www.bls.gov/cps/cpsaat47.htm (accessed 23 April 2020).

Charles L, Gu J, Andrew M, Violanti JM, Fekedulegn D and Burchfiel C (2011), "Sleep duration and biomarkers of metabolic function among police officers", Journal of Occupational and Environmental Medicine, Vol. 53 No. 8, pp. 831–837. [PubMed: 21785371]

Dawson D and McCulloch K (2005), "Managing fatigue: it's about sleep", Sleep Medicine Reviews, Vol. 9 No. 5, pp. 365–380. [PubMed: 16099184]

Dawson D and Reid K (1997), "Fatigue, alcohol and performance impairment", Nature, Vol. 388 No. 6639, p. 235. [PubMed: 9230429]

Dawson D, Noy YI, Härma M, Åkerstedt T and Belenky G (2011), "Modelling fatigue and the use of fatigue models in work settings", Accident Analysis and Prevention, Vol. 43 No. 2, pp. 549–564. [PubMed: 21130216]

Dawson D, Chapman J and Thomas MJW (2012), "Fatigue-proofing: a new approach to reducing fatigue-related risk using the principles of error management", Sleep Medicine Reviews, Vol. 16 No. 2, pp. 167–175. [PubMed: 21784677]

Dawson D, Darwent D and Roach GD (2016), "How should a bio-mathematical model be used within a fatigue risk management system to determine whether or not a working time arrangement is safe?", Accident Analysis and Prevention, Vol. 99, pp. 469–473. [PubMed: 27040118]

FAID Quantum Version 1.0 (2017), User Guide, InterDynamics PTY, Brisbane, Queensland.

Fair Labor Standards Act (2011), Fact Sheet #7: State and Local Governments under the Fair Labor Standards Act (FLSA), March 2011, U.S. Department of Labor Wage and Hour Division, Washington, D.C.

Fekedulegn D, Burchfiel CM, Hartley TA, Andrew ME, Charles LE, Tinney-Zara CA and Violanti JM (2013a), "Shiftwork and sickness absence among police officers: the BCOPS study", Chronobiology International, Vol. 30 No. 7, pp. 930–941. [PubMed: 23808812]

Fekedulegn D, Burchfield CM, Hartley TA, Baughman P, Charles LE, Andrew ME and Violanti JM (2013b), "Work hours and absenteeism among police officers", International Journal of Emergency Mental Health and Human Resilience, Vol. 15 No. 4, pp. 267–276. [PubMed: 24707589]

Gabarino S, Magnavita N, Chiorri C, Brisinda D, Cuomo G, Venuti A and Fenici R (2012), "Evaluation of operational stress in riot and crowd control police units: a global challenge for prevention and management of police task-related stress", Journal of Police and Criminal Psychology, Vol. 27 No. 2, pp. 111–122.

Gander P, Hartley L, Powell D, Cabon P, Hitchcock E, Mills A and Popkin S (2011), "Fatigue risk management: organizational factors at the regulatory and industry/company level", Accident Analysis and Prevention, Vol. 43 No. 2, pp. 573–590. [PubMed: 21130218]

Gander PH (2015), "Evolving regulatory approaches for managing fatigue risk in transport operations", Reviews of Human and Ergonomics, Vol. 10 No. 1, pp. 253–271.

Hackett RD and Peter P (1996), "An evaluation of employee absenteeism as a coping mechanism among hospital nurses", Journal of Occupational and Organizational Psychology, Vol. 69, pp. 327–338.

Honn KA, Van Dongen HPA and Dawson D (2019), "Working Time Society consensus statements: prescriptive rule sets and risk management-base approaches for the management of fatigue-related risk in working time arrangements", Industrial Health, Vol. 57 No. 2, pp. 264–280. [PubMed: 30700674]

Hursh SR, Raslear TG, Kaye AS and Fanzone JF (2006), "Validation and calibration of a fatigue assessment tool for railroad work schedules, summary report", Report No. DOT/FRA/ORD-06/21, Federal Railroad Administration, Washington, DC.

James L, James S and Vila B (2018), "The impact of work shift and fatigue on police officer response in simulated interactions with citizens", Journal of Experimental Criminology, Vol. 14 No. 1, pp. 111–120.

Jones CB, Dorrian J, Rajaratnam SMW and Dawson D (2005), "Working hours regulations and fatigue in transportation: a comparative analysis", Safety Science, Vol. 43 No. 4, pp. 225–252.

Jones DE (2008), Trapped: Judicial Review of Municipal Agencies' Sick Leave Policies, The University of Chicago Law Review, pp. 1717–1748, available at: https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=5433&context=uclrev (accessed 10 May 2019).

Körlin J, Alexanderson K and Svedberg P (2009), "Sickness absence among women and men in the police: a systematic literature review", Scandinavian Journal of Public Health, Vol. 37, pp. 310–319. [PubMed: 19124595]

Lamp A, Chen JMC, McCullough D and Belenky G (2018), "Equal to or better than: the application of statistical non-inferiority to fatigue risk management", Accident Analysis and Prevention, Vol. 126, pp. 184–190. [PubMed: 29428150]

McDonald N (1981), "Safety and regulations restricting the hours of driving of goods vehicle drivers", Ergonomics, Vol. 24 No. 6, pp. 475–485.

Morris MB, Wiedbusch MD and Gunzelmann G (2018), "Fatigue incident antecedents, consequences, and aviation operational risk management resources", Aerospace Medicine and Human Performance, Vol. 89 No. 8, pp. 708–716. [PubMed: 30020055]

Patton E and Johns G (2007), "Women's absenteeism in the popular press: evidence for a gender-specific absence culture", Human Relations, Vol. 60 No. 11, pp. 1579–1612.

Popkin S and Fischer FM (2019), "Foreward", Industrial Health, Vol. 57 No. 2, pp. 133–134.

Price J and Coury BG (2015), "A method for applying fatigue science to accident investigation", Review of Human Factors and Ergonomics, Vol. 10 No. 1, pp. 79–114.

Rajaratnam SMW, Barger LK, Lockley SW, Shea SA, Wang W, Landrigan CP, O'Brien CS, Qadri S, Sullivan JP, Cade BE, Epstein LJ, White DP and Czeisler CA (2011), "Sleep disorders, health, and safety in police officers", Journal of the American Medical Association, Vol. 306 No. 23, pp. 2567–2578. [PubMed: 22187276]

Reaves BA (2012), "Hiring and retention of State and Local Law Enforcement Officers, 2008 – Statistical Tables", October 2012, Bureau of Justice Statistics, Washington, DC, NCJ238251, available at: https://www.bjs.gov/content/pub/pdf/hrslleo08st.pdf.

Riedy SM, Dawson D and Vila B (2019), "U.S. police rosters: fatigue and public complaints", Sleep, Vol. 42 No. 3, pp. 1–10.

Roach GD, Fletcher A and Dawson D (2004), "A model to predict work-related fatigue based on hours of work", Aviation Space & Environmental Medicine, Vol. 75 No. 3, Suppl., pp. A61–9.

Ropponen A, Koskinen A, Puttonen S and Härma M (2019), "Exposure to working-hour characteristics and short sickness absence in hospital workers: a case-crossover study using objective data", International Journal of Nursing Studies, Vol. 91, pp. 14–21. [PubMed: 30665013]

Sagherian K, Zhu S, Storr C, Hinds PS, Derickson D and Geiger-Brown J (2018), "Bio-mathematical fatigue models predict sickness absence in hospital nurses: an 18 months retrospective cohort study", Applied Ergonomics, Vol. 73, pp. 42–47. [PubMed: 30098641]

Satterfield BC and Van Dongen HPA (2013), "Occupational fatigue, underlying sleep and circadian mechanisms, and approaches to fatigue risk management", Fatigue: Biomedicine, Health AND Behavior, Vol. 1 No. 3, pp. 118–136.

Svedberg P and Alexanderson K (2012), "Associations between sickness absence and harassment, threats, violence, or discrimination: a cross-sectional study of the Swedish Police", Work, Vol. 42, pp. 83–92. [PubMed: 22635152]

Vila B and Riedy SM (2019), "Predictive analysis of deputy fatigue under current and proposed work schedules and mandatory overtime", Expert Report Prepared for the San Francisco Deputy Sheriff's Association.

Vila B (2006), "Impact of long work hours on police officers and the communities they serve", American Journal of Industrial Medicine, Vol. 49 No. 11, pp. 972–980. [PubMed: 17006951]

Violanti JM, Burchfiel CM, Hartley TA, Mnatsakanova A, Fekedulegn D, Andrew ME, Charles LE and Vila BJ (2009), "Atypical work hours and metabolic syndrome among police officers", Archives of Environmental AND Occupational Health, Vol. 64 No. 3, pp. 194–201. [PubMed: 19864222]

Violanti JM, Fekedulegn D, Andrew ME, Charles LE, Hartley TA, Vila B and Burchfield CM (2012), "Shift work and the incidence of injury among police officers", American Journal of Industrial Medicine, Vol. 55 No. 3, pp. 217–227. [PubMed: 22228219]

Violanti JM, Fekedulegn D, Andrew ME, Charles LE, Hartley TA, Vila B and Burchfield CM (2013), "Shift work and long-term injury among police officers", Scandinavian Journal of Work, Environment, and Health, Vol. 39 No. 4, pp. 361–368.

Violanti JM, Fekedulegn D, Hartley TA, Andrew ME, Charles L, Tinney-Zara CA and Burchfield CM (2015), "Police work absence: an analysis of stress and resiliency", Journal of Law Enforcement Leadership and Ethics, Vol. 1 No. 1, pp. 49–67.

Violanti JM, Owens SL, Fekedulegn D, Ma CC, Charles LE and Andrew ME (2018), "An exploration of shift work, fatigue, and gender among police officers: the BCOPS study", Workplace Health and Safety, Vol. 66 No. 11, pp. 530–537. [PubMed: 29480763]

Waggoner LB, Grant DA, Van Dongen HPA, Belenky G and Vila B (2012), "A combined field and laboratory design for assessing the impact of night shift work on police officer operational performance", Sleep, Vol. 35 No. 11, pp. 1575–1577. [PubMed: 23115407]

World Economic Forum (2010), The New Discipline of Workforce Wellness: Enhancing Corporate Performance by Tackling Chronic Disease, Geneva.

Zaslona JL, O'Keeffe KM, Signal TL and Gander PH (2018), "Shared responsibility for managing fatigue: hearing the pilots", PLoS ONE, Vol. 13 No. 5, pp. 1–11.

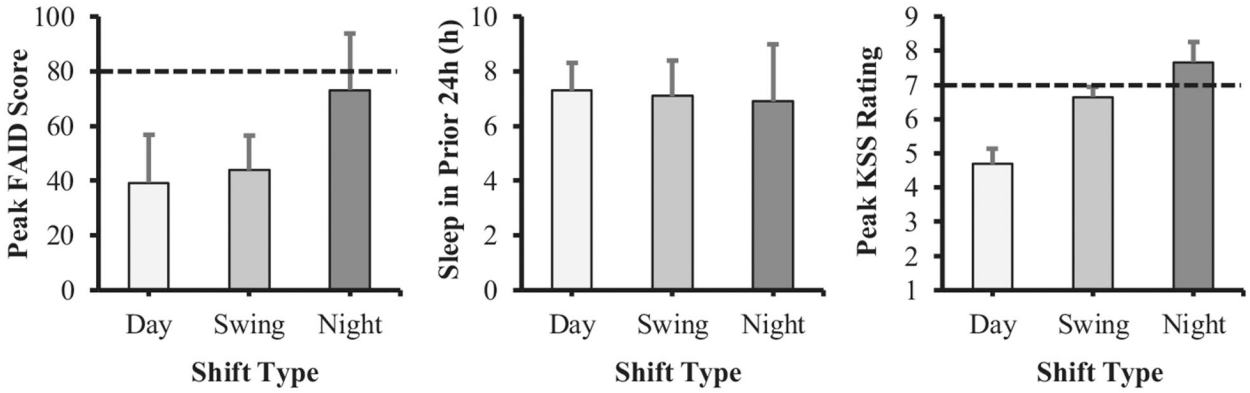

Figure 1.

Average peak FAID scores (±SD; left), average number of hours of sleep in the 24 h preceding a shift (±SD; middle) and average peak KSS ratings (±SD; right) for day shifts (white), swing shifts (light gray) and night shifts (dark gray). The dotted reference lines represent the default thresholds for high levels of fatigue (i.e. a peak FAID score of 80) and sleepiness (i.e. a peak KSS rating of 7)

Table 1.

Odds ratios for the relationships between absenteeism and prior fatigue, sleep and sleepiness for police officers working day shifts, swing shifts and night shifts

Shift type	# of shifts‡	# of absences‡	Mean (±SD)	Odds ratio†	95% CI‡
Peak FAID scores					
Day shift	205,049	2,003	39.2 ± 17.5	1.0	0.9–1.0
Swing shift	178,413	1,564	43.9 ± 12.7	1.1	1.0–1.1
Night shift	130,204	1,301	73.1 ± 20.8	1.1	1.1–1.1
Sleep in prior 24 h					
Day shift	205,049	2,003	7.3 ± 1.0	0.6	0.6–0.6
Swing shift	178,413	1,564	7.1 ± 1.3	0.6	0.6–0.6
Night shift	130,204	1,301	6.9 ± 2.1	0.6	0.6–0.6
Peak KSS ratings					
Day shift	205,049	2,003	4.7 ± 0.5	1.0	0.9–1.1
Swing shift	178,413	1,564	6.6 ± 0.3	1.2	0.9–1.5
Night shift	130,204	1,301	7.7 ± 0.6	1.6	1.4–1.8

Note(s):

‡Abbreviations: Number (#), Confidence interval (CI)

†Peak KSS ratings and peak FAID scores are continuous variables group-mean centered by shift type. The odds ratios for the peak KSS ratings are for a one-unit shift from the group mean. The odds ratios for the peak FAID scores are for a ten-unit shift from the group mean. The odds ratios for hours of sleep in the 24 h prior to a shift are for a 1-h shift from the group-mean

Table 2.

Odds ratios for relationships between absenteeism and officers' sex

Shift type	# Of shifts‡	# Of absences‡	Odds ratio†	95% CI†
Peak FAID scores				
Male	383,222	3,254	1.0	1.0–1.0
Female	130,444	1,614	1.1	1.0–1.1
Sleep in prior 24 h				
Male	383,222	3,254	0.6	0.6–0.6
Female	130,444	1,614	0.6	0.5–0.6
Peak KSS ratings				
Male	383,222	3,254	1.2	1.1–1.4
Female	130,444	1,614	1.2	1.0–1.4

Note(s):

‡Abbreviations: Number (#), Confidence Interval (CI)

†Peak KSS ratings and peak FAID scores are continuous variables group-mean centered by shift type. The odds ratios for the peak KSS ratings are for a one-unit shift from the group mean. The odds ratios for the peak FAID scores are for a ten-unit shift from the group mean. The odds ratios for hours of sleep in the twenty-four hours prior to a shift are for a one-hour shift from the group-mean