

Review Article

Impact of Shift Policies and Non-Shift Interventions on Wellness of Police Officers - A Systematic Review

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Received: August 28, 2024

Accepted: September 09, 2024

Published: September 17, 2024

Introduction

Shiftwork is common in modern policing, necessitated by the need for round-the-clock law enforcement and public safety [1]. These shift schedules are usually rotating, may be irregular, and typically involves a combination of day, afternoon, and night shifts. Such shiftwork interferes with normal sleep patterns and compel officers to work at times of the day when their

Abstract

Introduction: Shiftwork in policing is essential in maintaining public safety among the community. Such non-standard work schedules negatively impact health and well-being of police officers. This systematic review studies effectiveness of interventions that reduce the adverse impact of shiftwork on police officers in domains of Quality of Sleep (QoS), Quality of Life (QoL), and Shift-Alertness (SA).

Methods: We searched electronic databases (PubMed, Web of Science and PsycInfo) from inception of database to October 2023 on original studies examining the effect of shiftwork on QoS, QoL and SA. The search term: ((“police” OR “enforcement”) AND (“shift” OR “night”)) was used. The quality of studies was assessed using the Cochrane Risk of Bias in Nonrandomised Studies- of Interventions (ROBINS-I) tool and version 2 of the Cochrane Risk of Bias tool for randomised trials (RoB 2).

Results: 10h shifts and permanent shifts of 6 months duration significantly improved the quality of officer’s sleep compared to traditional forward rotating cycles of 8h and 12h durations. Compressed work week schedules reduced social and work disruption, providing positive impact on QoL. 10h shifts and 4 consecutive night shifts showed improvements in SA. 5mg Melatonin supplementation showed improvements in QoS and SA. Fatigue management courses showed improvement in QoS.

Conclusions: Compressed work weeks, 4 consecutive night shifts, and permanent shifts improved QoS, QoL and SA among police officers. Such change in work schedule may be the first step towards advancing wellness among police officers.

Keywords: Shiftwork; Police; Intervention; Sleep; Quality of Life; Alertness

Abbreviations: QoS: Quality of Sleep; QoL: Quality of Life; SA: Shift Alertness; CFF: Critical Flicker Fusion; WHOQOL: World Health Organisation Quality of Life; GHQ-12: 12 Item General Health Questionnaire; PSQI: Pittsburgh Sleep Quality Index; QWL: Quality of Work Life; CWW: Compressed Work Week; RCT: Randomised Control Trial; WHO: World Health Organization.

bodies are programmed to sleep. The ill effects of shiftwork on police officers have gained recognition in recent years. Irregular and non-standardized work schedules have been shown to be associated with a plethora of health concerns that include disrupted sleep patterns, increased fatigue and increased risk of medical conditions such as cardiovascular diseases and meta-

bolic disorders [2,3]. Shiftwork has also been associated with elevated levels of stress, anxiety, and depression [4]. Many of these ill effects were attributed to shiftwork related disruption of circadian rhythm [5]. Shiftwork has also been reported to increase work family conflict and stress leading to burnout in police officers [6].

The World Health Organization (WHO) defines wellness as the optimal state of health and is indicated by a positive approach to living. Wellness is determined by six pillars of physical wellness, occupational wellness, social wellness, mental and emotion wellness, and financial wellness [7]. Based off this definition, the lifestyle associated with shiftwork has significant impacts on the wellness of police officers. Several interventions have been studied to mitigate the negative impact of shiftwork on wellness. These include policy-related interventions such as modifications of shiftwork schedules, education-related interventions (e.g. sleep hygiene practices) and pharmacological interventions (e.g. melatonin).

To date, there has been no systematic review performed to study the impact of shift schedule policies and other shift optimization interventions on wellness of police officers. This study reviews physical wellness (QoS), occupational wellness (SA) and social wellness (QoL) as indicators for overall wellness of police officers with shift schedules. In this study, QoS encompasses metrics such as sleep duration, subjective fatigue post sleep and subjective sleep experience.

The knowledge gained from this review may be useful to optimize shiftwork schedules and introduce practice recommendation in an evidence-informed manner to mitigate the negative impacts of shiftwork on sleep to improve the wellbeing of police officers and achieve higher standards of performance among police officers.

Methodology

Article Search Strategy

A search was conducted via PubMed, Web of Science, and PsycInfo for publications up to October 18, 2023, examining the effects of shiftwork or optimal shiftwork characteristics within police forces. Our search term was as follows: ("police" OR "enforcement") AND ("shift" OR "night"). We searched title-abstract-keywords for PubMed, all fields for Web of Science and keywords for PsycInfo.

Article Selection

The article selection process involved three steps: eliminating irrelevant titles, abstracts, and full texts. Two investigators (JFSJY and OK) independently conducted the article selection. Non-English articles, case reports, case series, review articles, animal studies, articles unrelated to the topic, articles with poor data analysis, non-peer reviewed articles, and non-interventional studies were excluded. Where there were differences in article selection, both investigators convened to resolve differences. Where there were challenges in resolving differences, a third investigator (AAS) was involved to decide if the study should be included.

Qualitative Assessments of Included Articles

Quality assessments of included articles were conducted through an evaluation using Cochrane Risk of Bias In Non randomised Studies- of Interventions (ROBINS-I) tool and version 2 of the Cochrane Risk of Bias tool for randomised trials (RoB

2). Using the ROBINS-I system, studies were reviewed for bias across 7 aspects: presence of confounders, selection of participants, classification of interventions, deviations from intervention, missing data, measurement of outcome, and selection of reported results. Using the RoB 2 system, the 1 Randomised Control Trial (RCT) was evaluated for bias across 5 aspects: Randomisation, deviation from intended intervention, missing data, measurement of outcome, and selection of reported results.

Studies that used objective measures, such as sleep tracking with wrist actinography and fatigue levels with Critical Flicker Fusion (CFF), were rated above studies that utilized subjective questionnaires as the latter was more predisposed to reporting bias. Although most included studies relied on questionnaires to assess the impact of intervention, many of these studies did use validated questionnaires such as the World Health Organisation Quality of Life (WHOQOL) and 12 Item General Health Questionnaire (GHQ-12). Studies which took measures to reduce confounders and bias, such as the presence of a control group or the use of crossover design for internal validity, were also rated higher in overall quality.

Treatment of Data from Included Articles

The characteristics of included studies, including their study design, country of origin, number of participants for analysis, duration of study, intervention and comparator, outcomes, and results were consolidated and displayed in a table.

Results

5055 articles were extracted from the databases. Upon removing duplicate articles, 3851 titles were screened with 3646 titles removed based on the exclusion criteria. On review of the remaining 205 abstracts, 93 abstracts had met the exclusion criteria leaving 112 full texts for review. 95 full texts had met our exclusion criteria hence leaving 16 articles for inclusion in our systematic review. A summary of the process of article selection has been illustrated in Figure 1. Characteristics of the 16 included studies has been summarized in Table 1.

Of the 16 studies, 12 were related to shiftwork schedules and 4 were related other types of interventions. The latter included pharmacological (n= 1) and educational interventions (n= 3).

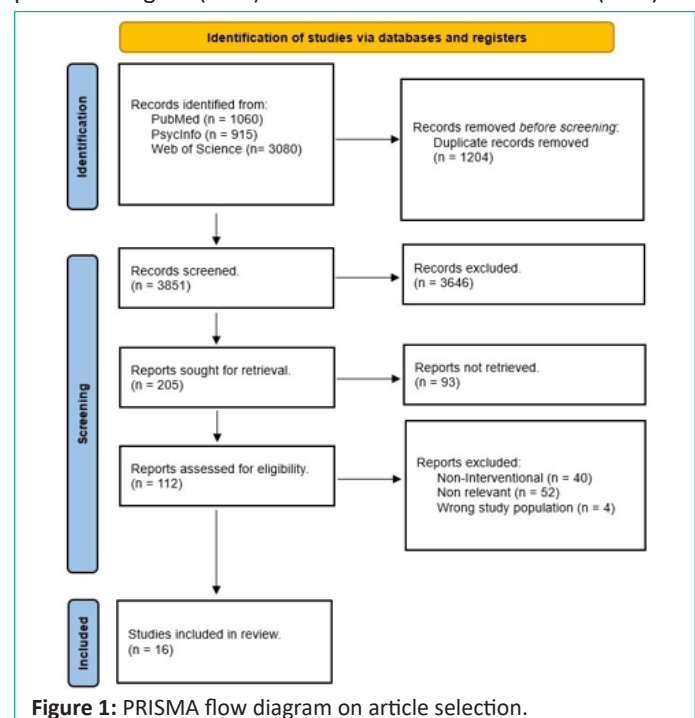


Figure 1: PRISMA flow diagram on article selection.

Table 1: Characteristics of studies included.

S/N	Author /Year Country	Study Design	Sample Size (N)	Duration	Intervention	Comparator	Outcome Effect measure	Results
1	Totterdell et al [1] / 1992 United Kingdom	Quasi experimental	71	6 months	Ottawa shift system (10h morning, 10h afternoon and 8h night shifts)	Control shift (8h shifts)	<ul style="list-style-type: none"> Sleep duration (self-reported) Sleep quality (unipolar analogue scale) Alertness rating (unipolar analogue scale) Psychological wellbeing (GHQ-12) Social and work disruption (unipolar analogue scale) 	<ul style="list-style-type: none"> Increase in sleep duration in intervention compared to control ($p < 0.05$). Increased alertness rating in intervention compared to control ($p < 0.05$). Improvement in GHQ-12 scores for those on intervention compared to control ($p < 0.001$). Improvements in social and work disruption for those on intervention compared to control ($p < 0.05$).
2	Smith et al [2] / 1998 United Kingdom	Quasi experimental	92	6 months	12h morning and night shifts	Control shift (8h shifts)	<ul style="list-style-type: none"> Sleep quality (self-reported) Sleep duration (self-reported) Chronic fatigue scale (self-reported) Alertness scale (self-reported) Social/domestic interference (self-reported) Physical health questionnaire (self-reported) Psychological wellbeing (GHQ-12) 	<ul style="list-style-type: none"> No differences in outcomes between control and intervention group after accounting for potential confounders.
3	Amendola et al [3] 2007 USA	Quasi experimental	226	6 months	10h shifts 12h shifts	Control Shift (8h shifts)	<ul style="list-style-type: none"> Work performance and safety (laboratory simulation) <ul style="list-style-type: none"> Fitness for duty impairment screener Behavioural Personnel Assessment Device STISIM Driving Simulator Psychomotor vigilance test MILO shooting simulator Health and stress (Law enforcement officer survey) Quality of life (law enforcement officer survey) Sleep duration/quality (self-reported: Sleep diary) Overtime and off-duty workload (law enforcement officer survey) 	<ul style="list-style-type: none"> Average duration of sleep was associated with length of shift ($p = 0.043$). Longest sleep duration associated with 10h shift. No association between shift length and average quality of sleep. Increased sleepiness in 12h shift compared to 8h shift ($p = 0.003$). Reduced alertness levels in 12h shift compared to 8h shift ($p = 0.012$); No drop in alertness from between 8h and 10h shifts. No differences between shift length and any measures of performance and safety. Quality of work life (QWL) was associated with shift length ($p = 0.021$). Highest QWL on 10h shift > 12h shift > 8h shift. No associations between shift length and measures of health and stress Higher amount of overtime among officers in the 8h shift compared to 10h shift ($p = 0.00$) and 12h shift ($p = 0.00$).

4	Folkard et al [4] / 1993 England	Randomized Control Trial	15	3 months	Melatonin	Placebo and baseline	<ul style="list-style-type: none"> • Sleep duration (sleep diary) • Sleep quality (sleep diary) • Mood checklist (unipolar analogue scale) • Alertness rating (self-rated scale) • Mid-shift performance <ul style="list-style-type: none"> ○ Memory scanning ability ○ Visual intercept speed • Workload rating (self-reported) 	<ul style="list-style-type: none"> • Increase in rated sleep quality between treatment and control groups ($p=0.003$). • Increase in sleep duration between treatment and control groups ($p=0.026$). • No significant associations between treatment with melatonin and increased alertness on shift • No significant associations between treatment with melatonin and mid-shift performance • No significant associations between treatment with melatonin and subjects' ability to cope with workload
5	James et al [5] / 2021 United Kingdom	Quasi experimental	50	7 weeks	Post fatigue management course	Baseline	<ul style="list-style-type: none"> • Sleep duration and quality (wrist actinography) • Health and well-being (Self-reported) <ul style="list-style-type: none"> ○ WHOQOL ○ Epworth Sleepiness Scale (ESS) ○ PTSD checklist (PCL-5) 	<ul style="list-style-type: none"> • Improvement in sleep duration ($p=0.003$) and sleep quality ($p=0.001$) post intervention • No significant associations with improvement in self-rated well-being post intervention
6	Velasco-Garrido et al [6] / 2022 Germany	Quasi experimental	583	5 years	Compressed work week (increased 12h shifts)	Former shift model (increased 8h shifts)	<ul style="list-style-type: none"> • Quality of life (WHO-QOL) • Work ability (Work Ability Index- WAI) • Self-rated health (self-reported) 	<ul style="list-style-type: none"> • Increase in WAI scores post intervention ($p=0.021$). • Higher quality of life scores posts intervention ($p<0.0001$). • Higher self-rated health status post intervention ($p<0.0001$) • Decrease in quality-of-life scores ($p=0.002$) and self-rated health ($p=0.006$) over time spent in intervention
7	Holbrook et al [7] / 1994 USA	Quasi experimental	38	1 month	Post sleep hygiene course	Baseline	<ul style="list-style-type: none"> • Sleep Hygiene (Sleep Hygiene awareness and practice scale) • Sleep quality (post sleep inventory) 	<ul style="list-style-type: none"> • Increase in pre- to post-test awareness of sleep hygiene ($p<0.001$) and in knowledge about nicotine ($p<0.001$), hypnotics ($p<0.001$), and caffeine ($p<0.001$). • No improvement in sleep quality post intervention.
8	Peacock et al [8] / 1983 USA	Quasi experimental	75	6 months	12h shifts	8h shifts	<ul style="list-style-type: none"> • Sleep duration/quality (Sleep diary) • Alertness rating <ul style="list-style-type: none"> ○ Critical Flicker Fusion -CFF ○ Baddeley test of grammatical reasoning ○ Self-reported alertness 	<ul style="list-style-type: none"> • Improvement in sleep quality post intervention. • No increase in sleep duration post intervention. • No impact on CFF and subjective alertness scores post intervention. • No significant association on grammatical reasoning post intervention.
9	Rohwer et al [9] / 2022 Germany	Quasi experimental	116	5.5 years	Alternating shift schedule (increased 12h shift)	Former shift model (reduced 12h shifts)	<ul style="list-style-type: none"> • Work-life balance (Questionnaire from previous police survey) • Job satisfaction (Copenhagen Psychosocial Questionnaire-COPSOQ) • Quality of life (WHO-QOL) 	<ul style="list-style-type: none"> • Increase in police officers' work-life balance ($p=0.014$) and job satisfaction ($p=0.002$) post intervention. • No improvement in quality-of-life scores post intervention. • Overall increase in mean scores for work-life balance, job satisfaction and quality of life post intervention.

10	Smith & Mason [10] / 2001 United Kingdom	Quasi experimental	76	7 months	3-4 consecutive night shift	7 consecutive night shift	<ul style="list-style-type: none"> Subjective fatigue (visual analogue scales) Objective measure of fatigue (CFF) 	<ul style="list-style-type: none"> Increase in CFF score (reduced objective fatigue) with intervention ($p < 0.05$). Increased subjective fatigue and sleepiness with intervention ($p < 0.01$). Younger shift workers reported greater levels of adjustment to the night shift compared to older workers ($p < 0.05$).
11	Nabe-Nielsen et al [11]/ 2016 Denmark	Quasi experimental	68	6 months	2 and 7 consecutive night shifts	4 consecutive night shifts	<ul style="list-style-type: none"> Impact on sleep, alertness, and work performance (qualitative questionnaire) 	<ul style="list-style-type: none"> Majority (57%) of participants preferred the 4 consecutive night shift system, citing improvements in sleep alertness, and work performance. Good sleep flexibility was positively associated with the number of night shifts in the preferred intervention ($p = 0.019$). Evening chronotype participants preferred intervention with longer spells of night work ($p = 0.002$).
12	Bell et al [12] / 2015 USA	Quasi experimental	343	9 months	13h 20min shifts	10h shifts	<ul style="list-style-type: none"> Sleep duration, quality, latency, and effectiveness (Pittsburgh Sleep Quality Index- PSQI) Attention and reaction (Psychomotor Vigilance Test- PVT) Cognitive processing and attention (STROOP Colour Word Test) Cognitive abilities Work performance and safety. <ul style="list-style-type: none"> Shooting qualification Professional Standards Bureau complaints Self- report of field activities Quality of life (Quality of Life Inventory -QOLI) Overtime hours (self-reported) Shift preference (self-reported) 	<ul style="list-style-type: none"> Intervention negatively associated with sleep duration ($p = 0.02$) and sleep quality ($p = 0.002$) compared to control. Increase in daytime dysfunction in intervention group ($p < 0.001$). Slower reaction time in intervention group compared to control ($p = 0.004$). More lapses in concentration ($p = 0.008$) in intervention compared to control. Reduced cognitive processing in last hour of shift among intervention group ($p = 0.022$). Intervention group had significant increase in complaints ($p = 0.47$) compared to control. Intervention negatively associated with quality of life compared to control ($p < 0.05$). Control group worked significantly more overtime compared to intervention group ($p = 0.001$). Significant preference for 10h shifts from both control and intervention groups ($p < 0.001$).
13	Jensen et al [13] / 2013 Denmark	Quasi experimental	73	6 months	2 and 7 consecutive night shifts	4 consecutive night shifts	<ul style="list-style-type: none"> Sleepiness (Karolinska Sleepiness Scale-KSS) Sleep duration/quality (Wrist actinography, sleep diary) 	<ul style="list-style-type: none"> No association in reported sleepiness after two, four, and seven consecutive night shifts. No association in total sleep duration across two, four, and seven consecutive night shifts.
14	James et al [14] / 2018 United Kingdom	Quasi experimental	61	4 weeks	Post fatigue management training	Baseline	<ul style="list-style-type: none"> Sleep duration/quality <ul style="list-style-type: none"> PSQI WHOQOL Psychological distress symptoms checklist 90 (SCL-90) 	<ul style="list-style-type: none"> Decrease in number of participants reporting insomnia ($p = 0.02$) and headaches ($p = 0.01$) post intervention. Increase in number of participants reporting being satisfied with their sleep ($p = 0.03$) post intervention.

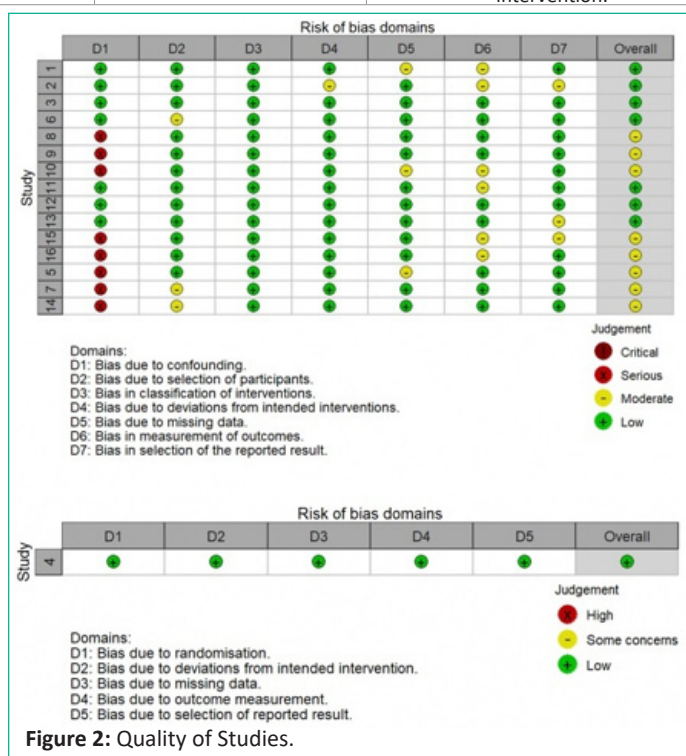
15	Philips et al [15] / 1991 United Kingdom	Quasi experimental	63	4 months	Permanent shift	Rotating shift	<ul style="list-style-type: none"> Sleep quality and hygiene (Florida Sleep Questionnaire-FSQ) Self-rated health (SCL-90) 	<ul style="list-style-type: none"> Officers required fewer hours of sleep ($p < 0.01$) and felt well with less sleep time ($p < 0.03$) post intervention. Increase in the adequacy of sleep ($p < 0.01$) and quality of sleep ($p < 0.03$) post intervention. Officers felt more rested upon awakening and had less daytime sleepiness ($p < 0.02$) post intervention. Post intervention there was improved regularity of bedtime ($p < 0.05$); participants noted fewer episodes of awakening an hour earlier or later than usual ($p < 0.02$) Improvement in psychological well-being post intervention. Reduced absentee rates from 1400 hours to 883 hours post intervention.
16	Pierce & Dunham [16] / 1992 United Kingdom	Quasi experimental	50	1 year	12h shifts	8h shifts	<ul style="list-style-type: none"> Social and work disruption (scales from previously validated reports) Work-life satisfaction (Index of Organisational Reaction) Stress/ fatigue levels (scales from previously validated reports) Organizational effectiveness (scales from previously validated reports) 	<ul style="list-style-type: none"> Decrease in work schedule interference for family and friends ($p < 0.01$). Increase in overall set of work schedule attitudes ($p < 0.01$). Increase in life, job, and leisure time satisfaction post intervention ($p < 0.01$). Decrease in physiological and psychological stress symptoms ($p < 0.01$). Improvement in work coordination and service noted ($p < 0.01$). No association between employee attitude, organizational commitment, job involvement and intrinsic motivation with outcome measures post intervention.

The impact of the interventions on different outcome measures (QoS, QoL, and SA) are discussed below. Many of the studies selected investigated the impact of intervention on a combination of the primary outcomes. 12 studies evaluated the impact of interventions on QoS, 10 studies evaluated the impact of interventions on QoL, and 8 studies evaluated the impact of interventions on SA.

Validated questionnaires and tools were used in many of the studies to help to measure various outcomes. GHQ-12 is a validated tool used for assessing psychological distress and short-term changes in mental health. Items within the questionnaire include questions on levels of social dysfunction, and the presence of anxiety and depression [8]. PSQI is a validated self-rated questionnaire that is used to assess sleep quality and disturbances. It contains questions regarding sleep latency, sleep duration and the presence of daytime dysfunction to assess overall sleep quality [9]. The WHOQOL is another validated tool that is widely used for the assessment of QoL across different cultures and nationalities. It contains questions spanning 4 domains: physical health, psychological health, social relationships, and environmental health [10].

Quality of Sleep

Non shift related interventions such as melatonin supplementation prior to sleeping showed improvement in sleep duration ($p = 0.026$) and quality ($p = 0.003$) of officers. Sleep duration was shown to increase from an average of 6.91h to 7.42h



(7.38%) while on melatonin supplementation compared to 6.98 (1.01%) on placebo [11]. The melatonin regime described in the study was 5 mg per night for 3 months, here was no known side effects reported in the 15 participants. Educational intervention

had mixed results on their impact on sleep duration and quality. Fatigue management courses (n=2) showed significant improvement in sleep quantity (p=0.003) and sleep quality (p=0.001) post intervention [21] as well as an increase in number of participants being satisfied with their sleep (p=0.03) [12]. Sleep hygiene course however by Holbrook showed no improvement in sleep satisfaction despite increase in sleep hygiene knowledge [14].

Shift schedule with 10h durations and permanent shifts were shown to be the most effective. Totterdell [8] showed that 10h shifts resulted in significant increases in sleep duration compared to control (8h shifts) following 6 months post intervention (p<0.05). In another study [10], there was a significant effect on duration of sleep with respect to length of shift, (p= 0.043), with 10h shifts experiencing longest sleep duration (mean = 7.86) compared to 8h and 12h shifts (means of 7.35 and 7.55. respectively). The Phoenix Police Department initiated a study on working 3 consecutive shifts of 13h20min per week in response to a union request. Officers would work a 40-hour workweek, divided into 3 workdays of 13h 20min. Compared to the existing 10 hours shift, the extended 13h20min shifts led to reduced sleep duration(p=0.02) and sleep quality (p=0.002) [19]. Permanent shifts where officers stick to either a morning, evening or night shift were also shown to lead to improvement in both the adequacy of sleep (p<0.01) and QoS (p<0.03) compared to forward rotating shifts where an officer would rotate sequentially through morning, evening, and night shifts [22].

Quality of Life

Shift-related interventions with increased shift duration were positively associated with increased QoL for officers with no further benefit beyond 12 hours shift. One study by Totterdell [8] compared the Ottawa Shift (10h morning shift, a 10h evening shift and an 8.5h night shift) to control shift of 8h and showed a significant increase in GHQ 12 score (p<0.001) and significant reduction in personal social and work disruption after 6 months (p<0.05).

Another study by Amendola [10] showed that shift length had significant effect on the Quality of Work Life (QWL), with highest QWL experienced on 10h shifts followed by 12h shifts and lastly 8h shifts. Of note was that benefits reaped from 10h shifts did not extend to shifts beyond 12h with one study by Bell [19] showing that 13h20min shifts led to lower QoL compared to 10h control shifts (p<0.05).

Overall, the presence of longer shift durations present in Compressed Work Week (CWW) showed significant benefits on QoL compared to 8h shifts. CWW is defined as an alternative work schedule where the hours worked per day were increased and the days worked were decreased to enable the standard number of weekly hours to be fitted into less than five days [11]. One study showed higher QoL scores (p<0.0001) post implementation of CWW with increased number of 12h shifts [13]. Another by Pierce & Dunham showed decrease in work-social disruption (p<0.01), increase in life, job, and leisure time satisfaction (p<0.01), and decrease in physiological and psychological symptoms of stress (P<0.01) with change from 8h shifts to 12h shifts [23]. Another study showed that CWW with increase in number of 12h shifts led to significant increase in police officer's work life balance (p=0.014) and job satisfaction (p=0.002) [16].

Shift-Alertness

Significant findings from shift related interventions showed that 10h shifts were the most beneficial to alertness and concentration for officers on shift compared to the common shift duration of 8h. Totterdell showed an increased alertness rating for the intervention group utilizing 10h shifts compared to 8h shift durations (p<0.05) [8]. 10h shifts were also shown to have improved daytime function, reaction time and concentration and cognitive processing compared to shifts of 13h20min duration [19]. In a study comparing 8h, 10h and 12h shifts, reduced alertness levels were identified among police officers undertaking the 12h shifts compared to 8h shifts (p=0.012). However, there was no difference in alertness levels when comparing the 10h shifts with the 8h shifts [10]. However, of note, the difference in alertness levels between the 12h and 8h shifts contrasted with the findings by Smith et al [9] and Peacock et al [15] (1983) which identified no differences in alertness levels between the two shift schedules.

Separately, 3-4 consecutive night shifts were the ideal number of night shifts to have as part of fatigue management. A study by Smith & Mason showed that shorter periods of 3-4 consecutive night shifts contributed to reductions in objective fatigue (p<0.05) when compared to 7 consecutive night shifts, when assessed using CFF [17]. This was supported by a study by Nabe-Nielson which assessed shift preferences based off impacts on sleep, alertness, and work performance. 57% of participants preferred the 4 consecutive night shift system, compared to 2 and 7 consecutive night shifts, citing ease of adjusting their circadian rhythm [18].

Quality of Studies

Among the studies included in the review, 15 were quasi-experimental with variation in assessment tools used to measure various outcomes. Only one study was designed as a RCT. Due to this variation in assessment tools among the quasi-experimental studies, quality of the individual studies was evaluated using the ROBINS-I tool and the RCT was evaluated using the RoB 2 tool.

The differences in assessment tools across studies in this review underscores the need for careful consideration when interpreting the findings and drawing conclusions about the interventions and their true level of impact on police officers. Further details on quality assessment of the included studies are further detailed in Figure 2.

Discussion

This systematic review synthesized evidence from 16 studies investigating the effectiveness of shift-related interventions and other interventions such as pharmacological- and education-based interventions. Shift related interventions such as compressed work weeks with 10h to 12h shifts, 4 consecutive night shifts, and permanent shifts were most beneficial for shiftwork-related outcomes such as sleep duration and quality, alertness during shift and QoL.

These 3 outcomes were selected as they were intricately linked to the wellbeing of police officers. Adequate sleep plays a pivotal role in mitigating the risk of cardiovascular health issues, especially among police officers where poor sleep and chronic sleep debt is a known risk factor for cardiovascular diseases and chronic conditions such as diabetes [12,13]. Inadequate sleep leads to increased fatigue which also is associated

with impaired vigilance, decision-making and cognitive reasoning. This increases the risk of workplace errors and accidents including road traffic collisions [14]. Studies have shown that shiftwork leads to reduction in alertness and cognitive concentration across shifts particularly the evening or overnight shifts [15]. The cognitive performance impairment following 24h of wakefulness is equivalent to that at blood alcohol concentration of 0.1%, above the legal limit for driving [16]. This loss of focus can be dangerous or even fatal for a police officer in the line of duty. QoL is a multi-faceted domain that is influenced by delicate interplay between occupational stressors, work-life balance, mental health, and social support systems [17]. Shiftwork has been reported to increase work family conflict and stress leading to burnout in police officers [6]. Such emotional and psychological stress manifest as absenteeism or thoughts of resignation [18]. Negative burnout coping strategies such as substance abuse (alcohol and tobacco products) and in extreme cases, suicide [19] can also result from excessive emotional and psychological stress and are key reasons for maintaining the QoL of police officers. Overall, shiftwork affects the wellness and performance of police officers with important implications extending from individual health and safety to public safety and law enforcement effectiveness. It is therefore important to evaluate interventions that had been effective to improve this aspect of shiftwork. Historically, continuous shiftwork divided the 24h day into 8h blocks of day, afternoon, and night shift due to ease of administration [20]. Further research and studies have also supported a forward rotating shift pattern of morning followed by afternoon and night due to the improved ability to adapt circadian rhythm by delaying sleep rather than advancing it [21]. These principles form the framework for the modern-day police officer's shift, however there might be merits to moving away from this incumbent system.

Shift related interventions such as longer shift hours, particularly in the form of CWW, showed significant impact on reducing the less desirable aspects of shiftwork particularly in the aspects of sleep, alertness, and QoL. CWW has been gaining traction as an alternative to traditional working hours not just among policing and emergency services but also in the commercial sector driven by demand for flexible work arrangements following the COVID-19 pandemic [22]. From the various studies reviewed in this paper, there was strong evidence to support CWW with shift durations of 10h and 12h for police officers.

Our review identified that 10-hour shifts were consistently superior to both 8 hour and 12-hour shift cycles [8,10]. The benefits gained were not linearly associated to increases in shift length, with one study showing significant reduction in sleep and alertness on shift when comparing 13h20min shifts to 10h shifts [19]. This was corroborated by other studies in the healthcare sector which showed that shifts among nurses with greater than 13h were linked to patient dissatisfaction and doubled the risk for burnout and job dissatisfaction [23].

Interestingly, one study in our review comparing 8h 10h and 12h shifts showed that there were no significant differences between shift length and any measures of performance and safety [10]. This is in contrast with a review by Salminen which reported that 10h and 12h shifts increased occupational injury by 15% and 38% respectively when compared to 8h shifts [24]. In Salminen review, the studies used, were all involving participants from the manufacturing industry which might explaining the significant increase in injury rates with longer shifts, due to risk with operating heavy machinery. More research is required

to identify if routine longer shifts of 10- 12h duration among police officers is safe and sustainable.

CWW also had the largest impact on work-life balance, life, job and leisure time satisfaction, physical fitness, as well as QoL. Six out of seven (85%) of the studies that introduced CWW showed significant improvement in QoL mainly in the areas of reduction in work and social interference. With CWW, many of the officers felt that they had increased time to spend with their family or on leisure. This led to an overall improvement in QoL which often translated into higher job satisfaction. These findings were not only limited to policing as other studies among public servants also found that CWW was highly favoured due to this perception of increase in QoL [25].

Reducing the number of consecutive night shifts, with 4 consecutive night shifts in a block, was also an effective shiftwork intervention in reducing objective fatigue and allowing best adjustment to circadian rhythm. These findings are in line with another study that show that 4 consecutive night shifts had the lowest odds ratio for insomnia among shift workers [26]. It was previously believed that an ideal shift system should have as few consecutive night shifts as possible to maximize physiological adjustment and wellbeing [27]. However, our findings stand in contrast and suggests that there is a nonlinear relation between consecutive night shifts and overall worker wellbeing due to the need for adjustment of the circadian rhythm.

Lastly permanent shifts were also shown to contribute to the least circadian rhythm disruption to personnel, reduced psychological distress and reduced absenteeism rates compared to a standard forward rotating shift [22]. Officers in this study were given a questionnaire to rank their preference for specific shift of morning, evening, or night. Out of the 163 officers taking part in the study, 144 (88%) received their first choice, 18 (11%) received their second choice and 2 (1%) received their third choice. These officers then stayed in the allocated shift for 6 months and showed significant improvement in sleep and distress symptoms post intervention. While there are benefits from permanent shifts, scheduling police officers to permanent evening or night shifts would significantly impact work life and social life and should only be considered under special circumstances until more evidence supports the long term. A study conducted among healthcare workers on shift had affirmed that social components of life were adversely affected among night shift workers compared to day shift workers [28].

Pharmacologically, melatonin supplementation at a dose of 5mg once daily significantly improved sleep duration and sleep quality during shiftwork [11]. The use of melatonin to initiate sleep and improve sleep efficacy for the general population is supported by literature [29]. In fact, melatonin supplement consumption has increased in countries such as the US [30]. However, there have been no recommendations supporting the use of melatonin supplementation in shift workers [31]. Moreover, melatonin content varies across different types of melatonin supplements and even across different batches of the same supplement, with some supplements containing controlled substances such as serotonin [32]. Further data on the effects of long-term use and high doses is also required [33]. While melatonin supplementation has been shown to mitigate the negative effects of shiftwork in police officers, it should be used with caution. Melatonin regime in the study included was short term and not sufficient to inform on longer term side effects or negative impact of melatonin supplement consumption.

Fatigue management courses were also shown to have a positive effect on the sleep quality and quantity of police officers. However, both studies were relatively short term compared to the other studies, with no long-term tracking of benefits. It has also been shown that there is a complex relationship between health communication and long-term behaviour change which might limit the impact of education intervention [34]. Therefore, the efficacy of education-based interventions in producing sustained long-term benefits remains uncertain and should be used with caution in mitigating the impacts of shiftwork. Evidence so far supports the use of shiftwork related interventions to improve QoL and sleep as well as performance of police officers. However, implementation of such shiftwork related interventions require organization change management and maybe challenged by manpower and resource constraints, logistics limitations and resistance to change.

There were limitations to this systematic review. Firstly, the study design of most studies was quasi-experimental. There were inherent selection biases in such articles. Furthermore, the way confounders were dealt with was not clear in many of the included articles. The inability to blind participants to many of the included interventions and the use of survey-based tools to assess outcomes could have also contributed to reporting biases. Furthermore, the variability in interventions and outcomes measures across studies posed a challenge in synthesizing the evidence quantitatively in the form of a meta-analysis. Separately, there was potential publication bias as most studies were from higher income countries such as the United States and United Kingdom. Consequently, the results from this review may not be generalizable to all police forces. Nevertheless, as the first systematic review on this topic, the authors believe that these findings do provide a foundation for future research. This review highlights the paucity of high-quality studies in this critical topic. Higher quality studies are required to draw definitive conclusions on the efficacy of the interventions to mitigate the negative impacts of shiftwork. The authors also hope that this review serves as a consolidated view of key findings of studies within this field for policy makers who have influence on managing shiftwork policies within police forces.

Conclusions

Alternative shift schedules such as compressed work weeks incorporating 10h to 12h shifts, 4 consecutive night shifts, and permanent shifts improve QoS, QoL and SA. Such change in work schedule may be the first step towards advancing wellness among police officers.

Author Statements

Declaration of Financial Support

This review was conducted without any financial support. The work presented here is the result of independent efforts and resources.

Declaration of Conflicting Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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