SHIFTWORK AND FIRE FIGHTERS

The International Association of Fire Fighters (IAFF) does not take an official position regarding shiftwork and considers shift length to be something determined at the local level.

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OVERVIEW

Shiftwork is an integral part of the fire service, enabling continuous operational readiness and emergency response. Broadly speaking, shiftwork can be defined as any schedule outside the period of 7 or 8am through 5 or 6pm as currently identified by the National Institute for Occupational Safety and Health (NIOSH). Fire fighters commonly work extended shifts, with 24-hour schedules being the most prevalent across departments. These shifts are designed to accommodate the unpredictable nature of calls, and can vary based on staffing, resources, and department decisions. Some common shift schedules can be seen in Table 1 below.

Shiftwork, in relation to extended hours, can pose unique challenges including disruptions to sleep, circadian rhythms, adverse impacts on cardiovascular health, and impact social factors. The health risks can have subsequent effects, such as increased cancer risks and decreases in cognitive and physical performances.[1] Understanding these factors is critical for evaluating the occupational impacts of shiftwork on fire fighter health, safety, and overall well-being. This document provides a summary review of existing research about shiftwork in the fire service, examining associated considerations on health, social well-being, physical and emotional impacts.

Table 1. Common Shift Schedules	
24-hour on/48-hour off	Workers are on duty for 24 consecutive hours, followed by 48 hours off duty.
48-hour on/96-hour off	Workers are on duty for 48 consecutive hours, followed by 96 hours off duty.
Kelly Schedule	24 hours on, 24 hours off, 24 hours on, 24 hours off, 24 hours on, followed by 96 hours off.
Forward Rotating Shift Schedule	Shifts rotate in a forward direction, typically morning to afternoon to night.
6-Day Schedule	2-day shifts, 2-night shifts, followed by 2 days off.
9-Day Schedule	3-day shifts, 3-night shifts, followed by 3 days off.
21-Day Schedule	4 consecutive days on, followed by 3 consecutive days off. This cycle repeats itself every 21 days and teams rotate between day, swing, and night shifts.
10-hour on/14-hour off	7 10-hour shifts and 7 14-hour night shifts in a 28-day period.
12-hour Shifts	4 consecutive 12-hour shifts, followed by 4 days off.
California Swing Shift	24 hours on, 24 hours off for 5 consecutive days, followed by 96 hours off.

HEALTH IMPLICATIONS

Recent research has demonstrated that shiftwork is associated with adverse health outcomes, including metabolic syndrome, digestive troubles, poor mental health and wellbeing, cancer, and sleep problems. It is important to also acknowledge that shiftwork impacts more than physical health, it can impact cognitive function, performance, family dynamics and off-shift habits. In 2021, reports by the National Toxicology Program (NTP) and the International Agency for Research on Cancer (IARC) suggested that night shift work is probably carcinogenic. Relatedly, recent literature has seen trends with increased cardiovascular issues, negative psychological and social impacts, and physiological concerns.[2,3] These health concerns should be considered when identifying the best shift schedule for your department.

Cardiovascular & Metabolic Health

A significant body of research has demonstrated that irregular work hours can lead to increased risks of cardiovascular disease. For example, studies show that those who work irregular shifts have higher blood pressure and elevated levels of inflammatory markers such as C-reactive protein and interleukin-6. These markers are risk factors for cardiovascular diseases. Circadian misalignment, or the body's inability to synchronize physiological activities with the actual time of day, is another consequence of shiftwork and is related to heart health.[4]

Nutrition is also a concern as fire fighters often eat irregularly and can struggle to maintain a balanced diet due to job duties. Recent studies find associations between shiftwork and individuals who experienced gastrointestinal issues such as acid reflux, due to eating large meals late at night or skipping meals during shifts. These irregular patterns contribute to an increased risk of metabolic syndrome, a condition characterized by high blood pressure, high blood sugar, and abnormal cholesterol levels.[5,6]

Cancer Risk

Cancer is one of the leading causes of fire fighter fatalities, and shiftwork may increase this risk further. As mentioned, the NTP and IARC classified night shift work as 2A "*probably carcinogenic to humans*." This means that there is limited evidence (positive associations have been observed between exposures to the agent and cancers, but that other explanations for the observations could not be ruled out) of carcinogenicity in humans and either sufficient evidence of carcinogenicity in experimental animals or strong mechanistic evidence, showing that the agent exhibits key characteristics of human carcinogens. Thus, in IARC's context, the term "limited" should not be discounted, as it represents a "positive association" factor in their determination and classification of carcinogens. The scientific evidence established associations between

night shiftwork and cancers of the breast, prostate, colon, and rectum[7]. Evidence also supported several mechanisms by which night shiftwork could promote cancer, including immunosuppression, chronic inflammation, increased cell proliferation, and disrupted estrogen levels in female shift workers.

The combination of interrupted sleep, exposure to carcinogens during fires, and circadian misalignment compounds risks of shiftwork. For example, research has suggested that those predominantly on night shifts have higher incidence of prostate cancer. In a study by Barul and colleagues (2019), it was found that circadian disruption affects hormone regulation and can increase the vulnerability to hormone-related cancers.[8]

Sleep and Fatigue

Sleep disturbances are often a result of extended shiftwork, affecting both the quality and duration of fire fighters' sleep. Fire fighters frequently report difficulties achieving adequate sleep during 24-hour shifts due to interruptions from emergency calls, stress, and the challenges of resting in environments like the firehouse. Sleep fragmentation during shifts can also result in cumulative sleep debt, which impairs cognitive performance and decision-making. A survey of firefighters found that 60% experienced sleep fragmentation during their shifts, and 45% reported feeling excessively fatigued at least twice a week.[9] Fatigue impairs reaction time and may increase the likelihood of accidents on the job.

Sleep issues and fatigue do not end when the shift is over. Many fire fighters find it challenging to adapt back to a regular sleep schedule when off-shift, which can contribute to chronic sleep deprivation. Sleep impacts mental, psychological, and emotional aspects for an individual and it’s important to adopt healthy sleep practices, when possible, for both on and off-shift.

LITERATURE ON SHIFTWORK

There is limited research on EMS and fire fighters when it comes to shiftwork. A significant portion of this current research primarily utilizes populations within the healthcare sector population, particularly on resident physicians, nurses, and other healthcare providers. Typically, research will explore the effects of shiftwork on patient care quality and medical errors, and how the providers themselves are managing the impacts. This does offer valuable intel since these individuals have similar shifts to fire fighters and ultimately will aid in helping gain a better understanding of job performance and health impacts of sleep deprivation. However, there can be limitations since the occupations are not directly comparable and the existing literature is divided on which

shift is more beneficial for fire fighters. Ultimately, continued research regarding shiftwork is necessary to gain a better understanding of the overall impact.

A study conducted in 2016 assessed sleep quality between 109 male fire fighters across six fire departments in three states in the southwestern United States. Using a sleep quality index measure derived from questionnaires, results indicated the 24on/48off schedule, 48on/96off schedule, and the Kelly Schedule all disrupted circadian rhythms to varying degrees. The 24on/48off shift was reported by participants to have the best sleep quality and the Kelly schedule was associated with the worst sleep quality. The 24on/ 48off was reported to produced similar sleep quality to the 48hr on/96hr off shift schedules. One limitation of the study was that it did not evaluate fire fighter performance between different types of shift schedules.[10]

In 2013, researchers assessed whether sleepiness was a potential effect of sleep deprivation. They examined the prevalence and severity of sleep deprivation in a random sample of 458 career fire fighters across the U.S. and found fire fighters did not have high rates of daytime sleepiness, despite working extended shift lengths.[11] Sleepiness for this study was measured using the Epworth Sleepiness Scale questionnaire. When compared to the general population, rates of daytime sleepiness among fire fighters in the study were similar to or lower than that in other shift workers. This was including medical residents and long-haul truck drivers. 73% of the fire fighters in this study worked 24-hour shifts. The authors reported that fire fighters were not at an increased risk for excessive daytime sleepiness (EDS). It is worth noting that the study did find fire fighters who were on a 48-hour shift had significantly higher rates of on-duty EDS compared with those on a 24-hour shift.[11]

A 2020 study conducted in South Korea assessed the association between shiftwork and neurocognitive function.[12] This was a prospective before-and-after study on 352 fire fighters using neurocognitive function testing. The measures were based on central nervous system vital sign measurement, which measures physiological parameters in the brain. The study examined the effects of shiftwork on neurocognitive function in fire fighters before and after night shifts. The design of the study attempted to account for potential confounding factors, such as insomnia and depression. Findings revealed that in all types of shift rotations studied, whether the 3-day, 6-day, 9-day, or 21-day schedules, neurocognitive function significantly decreased in six areas. These performance areas consisted of composite memory, verbal memory, visual memory, complex attention, psychomotor speed, and motor speed.

Recently, in 2024, a study investigated the shiftwork sleep disorder (SWSD). This is classified as a prevalent condition among shift workers that disrupts their circadian rhythms and sleep patterns. This disorder has significant psychological consequences

like depression, anxiety, and cognitive impairments. The article reviewed research on SWSD and the relationships between mental health from neurobiological, sociological, and psychological perspectives. The study also identified risk factors such as backward-rotating schedules and quick returns between shifts. SWSD was found to be associated with circadian disruption, sleep reactivity, depressive symptoms, and anxiety. However, it should be considered that the measures used for the sleep and circadian rhythms only factored in experiences not influenced by perceptions or opinions of the participants. While it is valuable to include the impacts of individual self-perceptions and experiences, it is also valuable to have studies that account for those variables.[13]

Further on published research, a pair of programs titled “Operation Stay Alert”, and “Operation Fight Fatigue” were conducted by Harvard Medical School’s Division of Sleep Medicine.[14] These studies showed the effects sleep disorders can have on health and safety outcomes and showed many fire fighters may have untreated sleep disorders. As sleep management programs become more widespread, the ongoing research will be critical in assessing the effectiveness and aid in implementing them into departments.

Ultimately, while not covering all published articles, these study summaries demonstrate the widespread impact of shiftwork and the importance of ongoing research to ensure comprehensive understanding and awareness when it comes to this topic.

Research Limitations

There are limitations in any research study. One of these may be confounding factors. These are external variables (behaviors or metrics) that impact exposures, outcomes, and may be unrelated to what the study is evaluating.[15] When it comes to shiftwork, some confounding factors may include alcohol, tobacco use, and home environments which have impacts on sleep, and mental well-being outside of occupational exposures. Additionally, individual differences in fire fighters should be considered as there are different levels of adaptability to shiftwork and not all studies are able to represent those differences.

When reviewing studies and literature, it’s important to consider other elements such as biases and limitations. Biases may arise from timing of measurement and the metrics used or from the scientists and institutions themselves. When it comes to limitations, it is valuable to also consider whether the study acknowledged the latency period for a disease to develop, whether there are acute or chronic exposures, and/or impacts of learned behaviors. Efforts are continuing to address these biases and limitations, and researchers are utilizing tools like biometric watches and products to better observe shiftwork on health and performance. While there is ongoing research on the health

effects of shiftwork and sleep deprivation in fire fighters. However, no research to date demonstrates that one shift schedule to be more beneficial for fire fighters than another.

MANAGEMENT CONSIDERATIONS

There remains debate over which shift schedule is preferable, partly because multiple factors must be considered beyond health effects. Staffing availability, response times, and budget are critical, along with handoff risks, fatigue, the inclusion of 'sleep time,' and flexibility to adjust crews for different shifts during peak periods. Some concerns commonly raised include whether the 24-hour shift restricts productivity. However, other factors must be considered as well. For example, operationally, 24-hour shifts require only one shift change per day, whereas 10-hour/14-hour shifts require two, and eight-hour shifts require three. This impacts staffing requirements and makes scheduling details easier under a 24-hour shift, as fewer shift changes reduce disruptions. These considerations are also relevant when examining how different shift schedules affect leave usage.

Leave Usage

The 24-hour shift may be a disincentive to use sick leave for several reasons. One is that the employee loses twenty-four hours of sick time for each absence, so staff are more likely to only use sick days when they are truly sick. Medical appointments are easier to schedule on off days, therefore, fewer sick time hours are used for that purpose.

Generally speaking, the probability of an employee becoming sick on a workday is significantly lower on the 24-hour shift.

- Fire fighter A: Works a 42-hour week on a 10–14-hour shift work approximately 182 days out of the year (not counting vacation days) and therefore, if an illness does occur during a one-year period, there is a 182/365 or 50% chance of it occurring on a workday.

- Fire fighter B: Works a 42-hour week on a 24-hour shift schedule works approximately 91 days out of the year and under the same circumstances has a 91/365 or 25% chance of the illness occurring on a workday.

Both fire fighter A and fire fighter B work 42 hours per week, which means they are scheduled to work the same number of hours per year. However, the odds of a one-day illness falling on a workday is far less likely to on a 24-hour shift. Additionally, the 24-hour shift schedule would allow the employee an extra day off to recuperate or to recover from an illness.

Mental Health Support

The effects of shiftwork extend beyond individual firefighters, impacting their families and social lives. The demands of irregular shifts can strain relationships and affect quality of life. Fire fighters working 24-hour shifts often miss family events or struggle to maintain consistent involvement in household responsibilities, leading to tension and feelings of guilt.

The non-traditional hours associated with shiftwork can also lead to social isolation, as fire fighters' schedules often conflict with those of their friends and family. To mitigate these effects, some fire departments have introduced family support initiatives, including workshops and family-oriented events to foster community among firefighters' families.

Operational Efficiency and Mitigation Strategies

Shiftwork is essential to the fire service's operational efficiency, ensuring continuous emergency response. However, it is important to balance these operational needs with the health and well-being of fire fighters. Exploring alternative scheduling models can help reduce the negative health impacts of shiftwork.

Additionally, incorporating structured rest periods during long shifts can significantly mitigate the effects of fatigue. Allowing for naps during downtimes has been shown to improve cognitive performance and reduce errors. Evidence suggests that even short naps (20-30 minutes) can significantly improve alertness and reduce fatigue-related errors.[16]

When it comes to ensuring fire fighters understand the potential health concerns around shiftwork, it is important to provide education on the importance of sleep, nutrition, and stress management. These efforts will encourage fire fighters to take proactive steps in maintaining their health and performance both on and off shift. Additionally, promoting sleep hygiene practices, such as using blackout curtains and avoiding caffeine before bedtime, can help fire fighters maximize their sleep quality at home.

CONCLUSION

Shiftwork is an essential part of fire service operations, ensuring that emergency services are available around the clock. However, as demonstrated by the research and experience of those on the frontline, the extended and irregular nature of shifts can significantly impact fire fighter health, sleep quality, mental well-being, and family life. Addressing these issues requires a multifaceted approach, including education, support programs, resources.

The evidence presents a mixed picture when it comes to health and safety risks associated with fire fighters working different types of shifts. There has been no clear evidence that 24-hour shifts are any better or worse for the health of fire fighters and EMS as compared with shorter shift rotation schedules.

There are additional considerations unique to the circumstances for each local fire department that should be acknowledged when determining which shift schedule are most appropriate and these can change over time. The IAFF has resources available to support and assist departments as they navigate shift schedules and best practices to address associated health concerns.

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