Sleep Coaching for Uniformed Firefighters

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Abstract

Sleep deprivation is linked to poor mental and physical health outcomes for professional firefighters. The importance of sleep hygiene practices and health promotional activities may increase the amount of quality sleep firefighters get on their days off. As the adverse outcomes of circadian misalignment due to sleep deprivation becomes more apparent in firefighter wellbeing, the need for a sleep health program becomes more evident. The purpose of this paper is to examine and assess the effects of a sleep health program for firefighter wellness. Research emphasizing the relevance of poor health outcomes related to sleep disturbances is prevalent in the literature. The findings have prompted the development of an evidence-based sleep coaching program for firefighters in a local fire department guided by The Cognitive Behavioral Therapy Model (Brewin, C.R., 1996). and a Knowledge-to-Action process framework for evidence-based-practice (Graham et al., 2006).

Keywords: firefighters, sleep, mental health, and sleep deprivation

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Background and Significance

Sleep Deprivation in Firefighters

The role of proper sleep health has become an important factor in health maintenance and longevity. Most firefighters are not meeting the recommended national sleep health initiatives due to work interruptions throughout the night and demanding schedules. Typical shift schedules for firefighters include 24 hours on followed by 48 off or 48 hours on and 96 hours off; and other variations. This schedule makes firefighters more vulnerable to sleep-related physical and mental health conditions (CDC, 2018). The physical and mental demands of a firefighting career require a focus on holistic health to increase longevity and quality of life, especially on days off when recovery time is crucial.

The firefighter population is at risk for specific health ailments; both different from, and comparable to other careers in public safety. For example, sudden cardiac death (SCD) is the leading cause of on-duty deaths for firefighters, and those with preexisting conditions such as coronary artery disease, elevated blood pressure, and high cholesterol have an increased risk (CDC, 2018). Firefighters work challenging jobs due to the frequent use of heavy machinery equipment, exposure to harmful materials, and performing live saving maneuvers in dangerous situations. This increase in stress may impact blood pressure, thus facilitating cardiac problems in the future (CDC, 2018).

The impact of fatigue on cognitive and motor function mimics those impacted by alcohol intoxication. Therefore, injuries, motor vehicle accidents, reduced response time, and reduction in critical thinking skills may impact both firefighters and public safety in similar ways that alcohol does (CDC, 2018). Firefighters who experience shiftwork fatigue they are at higher risk for work injuries; especially those who work longer than 24-hour shifts (CDC, 2018).

Although the firefighting career consists of both male and female employees, it is highly dominated by the male population. Specific concern of an imbalanced circadian rhythm in men includes low testosterone levels, which may increase adversities related to fatigue, mood, personal intimacy, and work performance, especially when physical demand is crucial (Pacheo, 2020). In essence, optimal physical and mental health are vital in a career where much physical demand and resiliency is required.

Aside from physical health concerns, the mental health aspect of firefighters is equally important. The effects of shiftwork fatigue in addition to frequent exposure of occupational hazards, dangerous situations, physical demand, and human suffering may exacerbate the effects of posttraumatic stress symptoms, alcohol use, sleep disturbances and suicidality (CDC, 2018). Mental health is a stigmatized subject within the firefighter community that is not openly discussed, and seeking help is avoided (APA, 2019). Many firefighters may face mental health challenges that can be exacerbated by sleep impairment or initiate further sleep disturbances.

Purpose and Rationale

Firefighters are susceptible to sleep deprivation and the negative outcomes associated with shift work disorders which impact both physical and mental health. The increased demand within the firefighting workplace environment remains a safety concern when fatigue exists. Injuries and poor health outcomes are facilitated by exhaustion and lack of sleep (Center of Disease Control, 2018). Chronic fatigue from shift work disorders may exacerbate existing mental health disorders or precipitate the development of them, and lead to poor physical health outcomes (AASM, 2021). The purpose of this paper is to establish an increased awareness in the firefighter community and promote healthy sleep habits through a sleep coaching intervention.

Problems with Shiftwork

The industrialized world will continue to require 24-hour shifts as a necessity for public safety and health, as well as commercial reasons. However, employees working these inevitable shifts are at risk for developing shift work disorder (SWD). Shift work disorder is common among healthcare professionals, truck drivers, military personnel, airline employees, and industrial jobs. Although night shift and long work hours are inevitable for public safety, it may disrupt normal sleep habits (CDC, 2018). Shift work schedules include early-morning shifts, night shifts, overnight shifts, and rotating shifts; all of which disrupt the natural human circadian rhythm leading to adverse mental and physical health outcomes (AASM, 2021). SWD is a condition defined by a circadian rhythm misalignment resulting in excessive daytime sleepiness at times when being tired is not desired. Along with multiple mental and physical health consequences, SWD is associated with a decrease in work performance, and an overall diminished quality of life (Wickwire et al., 2017). This disruption is often due to erratic sleep schedules, which obligates workers to realign their circadian rhythm during their days off.

The average adult requires 7-9 hours of sleep and the American Academy of Sleep Medicine (AASM) cautions adults who sleep less than 7 hours on a regular basis, and shift workers that are defined as those who work non-standard work schedules, or those who work permanent or intermittent night schedules. Those who do not meet sleep initiatives are at significant risk for poor health outcomes including impaired immune function, metabolic syndrome, cardiovascular disease, depression, anxiety, and increased risk of death (AASM, 2021). Practicing healthy sleep habits is important for mental health, physical recovery, and metabolic balances. According to the CDC (2018), nightshift workers are at increased risk for

cardiovascular disease, cancer, obesity, type 2 diabetes, a weakened immune system, depression, and anxiety due to consistent disruption in circadian rhythm.

Firefighter shifts may vary depending on each department need, call volume, distance from firefighter residences, and more. The days off in between shift schedules for example, are not always properly utilized by firefighters, and many of them tend to personal obligations or second jobs rather than sleep recovery. In addition, some firefighter schedules are harder to readjust circadian rhythm to, especially when the recovery day is also the day before next shift. This dilemma heights the need for adequate recovery time in between days off to ensure safety of both the firefighter and the public.

The Importance of Sleep Hygiene

Frequent night awakenings within the fire service are inevitable; however, management of personal sleep hygiene through educational programs may provide more opportunities for quality sleep and rest. According to Barger et al., (2016) sleep health programs and awareness programs are currently required in other shift work careers since as railroad workers, truckers, aviation employees and nurses. When firefighters were given the opportunity to participate, at least three-quarters joined and 46% reported behavioral changes that may have a lasting effect (Barger et al., 2016). Behavioral change is a lasting skill that firefighters can use to solve future problems. Some of the reported behavioral changes that firefighters reported included taking their blood pressure once a week after fires, drinking half the amount of normal coffee, and taking more naps (Barger et al., 2016). A sleep health program is shown to be effective and feasible to implement to increase knowledge of sleep health and improve sleep behaviors both on and off shift. These programs can easily be implemented in person or online leading to reduced sleep related morbidity and mortality among firefighters (Sullivan et al., 2017). Although sleep

health programs may be easily implemented, some firefighters report feeling overwhelmed by educational programs due to scheduled training and job duties. Peer leaders recommend making these sleep health programs part of a mandatory wellness program, or flexible around firefighter schedules to be most effective (Barger et al., 2016). Each fire department have unique challenges and opinions may differ among firefighter employees or department culture. The CDC (2018) recommends gathering existing knowledge within an organization to determine specific priorities to address. Health and safety concerns may be efficiently addressed through implementation of pilot testing survey materials, educational materials, safety training materials, and or other research-based methods tailored to the specific organizations' work environment (CDC, 2018).

Firefighters Without Sleep Coaching

Firefighters acknowledge unpredictable disruptions and adverse events to occur during a 24-hour period as part of expected duties of the job, including exposure to imminent danger. Firefighter culture promotes resiliency as part of the required strength and endurance needed to serve as public safety figures. Frequent service calls with hazardous situations may subject firefighters to sleep deprivation, physical exhaustion, and increased stress from repetitive exposure to human agony (CDC, 2018). Personal resiliency is subjective; yet resiliency impacts a firefighters' ability to recover from post-traumatic stress symptoms (PTSS) and cope with difficulties (Wickwire et al., 2017). Highly resilient individuals report increased positive emotions, a greater sense of control, and better physical and mental health; while those with lower resiliency experience an increase in posttraumatic stress symptoms (Wickwire et al., 2017). Since resiliency is dependent on the individual, proper coping skills tailored to each person are important to overcome hardships. Unfortunately, the firefighting culture limits

uniformed firefighters from seeking proper self-care and addressing mental health needs due to the stigma of expected resilience without help.

Posttraumatic stress severity (PTSS) is significantly, positively associated with alcohol use for coping with adverse events. Similarly, increased sleep disturbance was significantly, positively associated with alcohol use for coping reasons related to PTSS (Smith et al, 2018). Hence, stress and sleep may create a vicious cycle also known as insomnia. Since some people lack adequate coping skills to regulate stressful circumstances, they may internalize conflicts leading to emotional turmoil. Emotional unrest may result in hyperarousal and problems with sleep. Difficulties with sleeplessness may in turn intensify emotional arousal; thus, creating a vicious cycle between alcohol use and worsened sleep quality (Smith et al., 2019).

Although occupational stress, exposure to trauma, depression, and anxiety all correlate with sleep disturbance, the strongest correlation with sleep deprivation was an increased suicide risk (Serrano et al., 2020). Pre-employed firefighters reported less sleep disruption than their full-time employed counterparts, however, the strongest factors associated with sleep disruption included depression, anxiety, and social support (Lim et al., 2020). Firefighters may find relaxation challenging in an action-packed career and the importance of rest may be minimized.

Circadian disruptions are expected within the firefighting career due to the nature of frequent emergency action required throughout the night. Although daytime naps may provide short-term benefit, they are not substantial to replace long-duration sleeping (AASM, 2021). When normal cycles of the sleep-wake rhythm are often interrupted, it may take two days to restore a normal rhythm, and four to restore a severe dysrhythmia (Billings & Focht, 2016). For example, a 24on/48off shift allows for circadian rhythm to return to a normal pattern only if no further disruptions occur and sleep prioritization is utilized (Billings & Focht, 2016). The ability

to gain adequate sleep within 48 hours is subjective to the individual and their ability to sleep without unwanted impairment.

Barriers to Adequate Sleep on Days off

Although most people who are fatigued come home to sleep, some firefighters work second jobs or pick-up overtime for additional income during their days off. Other firefighters tend to members of their family, or children who need care during the days off. This can further impair firefighters from adequate recovery time when errands and family obligations take priority. A study shows firefighters who added an additional 24-hour shift as overtime increase the risk of furthering sleep deprivation and exhibited signs of high diastolic blood pressure (DBP); compared to those who reported their standard assigned schedule (Choi & Dobson, 2016). A cross-sectional study examined the association of obesity, hypertension, and sleep apnea in firefighters with increased left ventricular mass. According to the study, BMI is the strongest predictor of LV hypertrophy and increased cardiac mass. This is believed to be related to hypertension and sleep apnea resulting from metabolic disorders with weight gain (Korre et al., 2016). Sleep deprivation further precipitates the development of metabolic syndromes, cardiovascular risk, and weight gain (CDC, 2018). This vicious cycle of cardiac strain is a result of insufficient rest periods, continuous work-related stressors, or fulfilling obligations rather than using rest time.

Lack of Sleep Coaching or Wellness Programs

Currently, health management programs geared toward firefighters are limited. Health management programs and screening may be helpful for firefighter wellness. *Firestrong* provides basic online information regarding sleep and mental health for specific Arizona departments; yet it is uncertain if fire fighters regularly utilize these resources (FireStrong,

2021). A health clinic known as *Heart Fit for Duty* offers cardiovascular wellness screening, fitness, nutrition and health screenings to Firefighters, EMS, Police and Military patients. However, this website is lacking information about sleep hygiene or self-screening opportunities for sleep disorders (Heart Fit for Duty, 2021).

Firefighting training academies within the valley offer limited educational training while focusing on physical endurance. Current wellness programs and PTSD prevention programs are initiated briefly during firefighting academies for new hires. However, the lasting effects of these programs on behavioral change or sleep habits are currently unknown, and refresher courses are not provided (City of Glendale, 2019). The literature review mentions a general lack of intervention and health promotion in firefighters for sleep hygiene; and suggest more attention is given to this population of first responders (Barger et al., 2016).

Scottsdale Fire Department

The city of Scottsdale is known for its clubs, tourism activities, entertainment districts, and shopping. This busy commercial hub increases visitors and residential demand causing the frequent use of emergency services. A large Fire Department located in Scottsdale is the third largest and busiest department in the Valley. They report 275 sworn firefighter employees, with more than 20,000 incident calls for 2020 (City of Scottsdale, 2021). The number of emergency calls within busy stations further subjects' firefighters to frequent awakenings in the middle of the night; thus, triggering the negative effects of sleep disruption. The fire chief of this department changed the original 48/96 schedule (48 hours on shift, and 96 hours off) to a 24/48 (24 hours on shift, and 48 hours off) in 2014 due of concerns related to poor patient outcome, delayed response times, or error related to fatigue. The interest in this problem led to an examination of up-to-date evidence to determine the most effective interventions for sleep

hygiene. This literature review has initiated a clinically relevant PICOT question, “In firefighters (P), how does a sleep coaching program (I), compare to current education (C), impact sleep disturbance (O) over 30 days (T)”?

A Hopeful Future

The initiation of sleep wellness programs may have lasting impacts on firefighters’ behaviors. Firefighters who participated in a sleep health program (SHP) reported the important information to be helpful and lead them to initiate positive behavioral changes within the department after completion (Barger et al., 2016). Workplace wellness programs that provide firefighters with sleep health education and sleep disorder screenings may also reduce the amount of workplace injuries and disabilities (Sullivan, 2017). Firefighter education may include strategies for practice of better sleep routine, limiting alcohol use, prioritizing sleep, and time management for personal obligations. Other considerations may include mindfulness or relaxation techniques. Firefighters who practiced the act of mindfulness reduced their stress related sleep disturbances and overall risk for suicide (Serrano et al., 2020). Sleep coaching may have impact on long-term behavioral changes surrounding sleep practices.

Search Strategy

A thorough review of current evidence was conducted in a database search to answer the PICOT question “In firefighters (P), how does a sleep coaching program (I), compare to current education (C), impact sleep disturbance (O) over 30 days (T)”? Three databases were expansively searched for recent and relevant materials to the topic of fire fighters and sleep deprivation. These databases are known for their reliability and scientific contributions within the medical field; thus, yielding dependable results best suited for practice change. Three databases were utilized – PubMed, EBSCO Host, and ProQuest.

Databases were searched using key terms that addressed all components of the PICOT question; the combination of these terms included: *firefighters, sleep, health, mental health, wellness, sleep deprivation, and insomnia.* Key terms for the intervention *sleep health program* narrowed the search, so broad terms such as *health, wellness and sleep* yielded better results. Filters were applied for publications between 2012 to 2021 and full text articles. The Boolean phrase was used to broaden the search.

The initial search terms for PubMed included *firefighter, sleep habits, sleep deprivation,* and *quality sleep,* and only yielded 5 results. To widen the search results, these terms were narrowed down to *firefighters, sleep habits,* and *sleep deprivation*; this search yielded a total of 27 results. To further expand the results, the terms were limited to *firefighters, sleep,* and *health,* which generated 129 results without filters.

The initial search terms for EBSCO Host included *firefighters, mental health,* and *sleep* which generated 0 results. Search terms were narrowed down to *firefighter* and *sleep* produced 64 results. Filters added to these search terms included publication dates narrowed to 2012-2021, and full text, which further narrowed the results to 10.

Lastly, the initial search terms for ProQuest were *firefighter* and *sleep,* which produced 74 results. The search terms *firefighters* and *sleep deprivation* were added instead of *sleep*, which yielded 0 results. The search terms *firefighters* and *sleep deprivation* were then exchanged for *firefighters* and *insomnia*, which resulted in only 5 results. The best terms for this data base with the highest results were *firefighters* and *sleep,* with filters for full text and publications between 2012-2021 applied.

After reviewing titles and abstracts of articles based upon the inclusion criteria, 29 relevant articles were selected. Full text articles were retrieved for all 29 articles, which were

then evaluated with a rapid critical analysis checklist to narrow articles to the last 10 highest quality studies. These included two randomized control trials, five cross-sectionals, one systemic review, one meta-analysis, and one cohort study. Exclusion criteria included any articles unrelated to impacts of sleep deprivation, articles generalized to first responders and shift work, or any articles before 2016.

Critical Appraisal & Synthesis of Evidence

The quality and level of evidence was determined by use of the Melnyk and Fineout-Overholt's (2015) rapid critical appraisal tool. Cross-sectional studies are a lower level of evidence due to the inability to rule-out bias in self-reporting screening tools. However, this study design is favored for its ethical approach when studying the firefighter population, since certain interventions cannot be easily implemented within a fire department or home setting. A cross-sectional evaluation tool was used to determine the strength of cross-sectional evidence regarding sleep health, mental health, physical health, and the application of a health promotion program (Joanna Briggs Institute, 2017).

The study participants were predominantly male firefighters between the ages of 30-40 years old with previous work experience. The exception of one study that focused on the difference between newly employed firefighters vs. employed. Most of the studies were conducted in various settings such as the workplace, off-site health clinics, or online; and all the studies utilized screening tools. The studies were conducted both in the United States and other countries such as Thailand, Korea and Japan. Appropriate screening tools were used to measure self-reported sleep quality, mental health symptoms, demographic information, and determine observational relationships between variables. Less than half of the studies contained a sample size greater than 1000 people, and more than half of the others contained a smaller sample size

below 600 people. Additionally, 6 of the 10 studies focused on a health promotion intervention lasting between 15-160 minutes over the duration of a single session to 5 sessions. The other 4 studies were included for their significance in demonstrating the relationships between mental health, physical health, and sleep deprivation.

Conclusion

The importance of a sleep health promotion program for firefighter wellness is clear, and it may provide firefighters with tools to improve a holistic physical and mental wellbeing. The quality of life in firefighters is an important factor for health maintenance and longevity within a career that is physically and mentally demanding. Most importantly, firefighters who are well rested are less likely to experience workplace injury and improve patient outcomes with improved cognitive attention. Sleep health promotion programs grant firefighters the opportunity to receive evidence-based skills that enhance awareness of poor sleep hygiene and provides the tools for long-term behavioral change. Effective sleep health promotion programs should include a variety of sleep coaching methods with information that firefighters may modify to meet their unique needs.

The topic of sleep health for firefighters is lacking within the firefighter community, departments, and outreach programs. By providing firefighters a tailored sleep coaching program with resources, it may reduce adverse physical and mental health outcomes related to SWD. The included studies contain evidence that displays the ease of applying a health promotion program within various settings and is cost effective. However, mental health and related stigmas within the firefighter community should be considered, and any educational material should be designed with a communication style that firefighters are receptive to.

Theoretical Framework

Cognitive Behavioral Therapy (CBT) is considered an integrative theoretical framework which consists of interworking parts. This framework distinguishes therapy interventions which are targeted at specific disorders and contains interventions that modify conscious beliefs and representations from memory (Brewin, C.R., 1996). An individual's perception or spontaneous thoughts may influence their emotional and behavioral reactions to a certain circumstance. However, the theory of CBT is to assist patients to identify and correct their thinking, so it closely resembles reality to decrease distress and increase overall functioning (Beck Institute, 2021).

In the 1970's cognitive therapists argued with the theory that patients are entirely at the mercy of their conditioning history and conscious thoughts. Cognitive therapists have argued that techniques based upon a CBT approach have been successful in generalized problems such as Generalized Anxiety Disorder (GAD), depression, and personality disorders; since it is focuses on identifying unconscious representations, changing conscious beliefs, teaches coping skills, and modifies less-accessible underlying structures within the memory (Brewin, C.R., 1996). The 5 stages of this model include 1) Situation, 2) Automatic Thoughts and Images, 3) Reaction, 4) Emotional, 5) Behavioral, and 5) Physiological. Firefighters who experience sleep disruptions may unconsciously attribute them to certain psychological beliefs or reactions that may require restructuring through therapy. The CBT theoretical framework is used as guidance for behavior change which may positively impact sleep by decreasing disruptions, changing routine, and modifying beliefs surrounding sleep habits and routine.

Implementation Framework

Most individuals who hold internal motivation to contemplate a lifestyle change have likely considered the pros and cons of changing problem behaviors. Using information about sleep and providing a CBT-I intervention that is delivered in manageable sections from provider to individuals, is what makes the *Knowledge-to-Action* (KTA) *process framework* adaptable for firefighters who work hectic schedules (Graham et al.,2006). The model design includes informing and assessing for efficacy of the knowledge implemented, making it helpful to determine both efficacy and feasibility within the fire department among firefighters reported self-evaluation tools. The KTA model is flexible and encourages interventions to be tailored to suit the needs of specific audiences or current circumstances.

The CBT-I intervention will be tailored to meet the specific sleep impairments within each individual firefighter. This model correlates closely with the core of the intervention, which is a tailored sleep coaching program best suited for individual firefighters (Graham et al., 2006). The KTA model describes stages at which knowledge can be applied, evaluated for effectiveness, and reproduced, which is ideal for stakeholders who wish to utilize aspects of the project for long-term changes and maintenance of change (Graham et al., 2006). Firefighters will be asked to complete an end survey to determine feasibility of the program, which may help stakeholders make final decision in participation in future interventions, as well as what aspects of the program need improvement. It is important to consider that firefighters as individuals hold different health risks, and this variation may be dependent on age, lifestyle, years on the job, and current health status. Therefore, it is important to tailor the education of potential risks, threats, and solutions to resonate with the needs of an individual, rather than one mass generalized group.

An exchange of knowledge delivered in manageable sections from a healthcare provider to individuals, teams, or healthcare organizations, makes the *Knowledge-to-Action (KTA) process framework* (See Appendix G) adaptable for a variety of settings (Graham et al., 2006). This model is designed to inform and assess the efficacy of knowledge retained by the individual implementing it. The KTA model is flexible and encourages interventions that are tailored to suit the needs of current circumstances and specific audiences. Additionally, the model evaluates the appropriateness of the specific knowledge that is delivered for sustained use. The KTA model has a broad focus to ultimately enhance health status, which is suitable to meet the needs for the development and delivery of an evidence-based education to the firefighting community (Graham et al, 2006). This thorough research, and evaluation of evidence that has been examined, condensed, and refined, makes it useful for important stakeholders. The KTA model describes stages in which knowledge can be reproduced, applied, and evaluated for effectiveness (Graham et al., 2006). Using evidence to describe sleep deprivation and the negative effects associated with a lack of sleep, may be paired with sleep hygiene practices to promote wellness among the firefighter community.

Setting and Stakeholders

This large Fire Department in Scottsdale is a city funded organization that reports 275 sworn firefighters currently employed and reports over 20,000 service calls for 2020 (City of Scottsdale, 2021). The city of Scottsdale is known for its entertainment district which attracts a high volume of visitors and residents within the community; thus, increasing the need for emergency services. The current Fire Chief expressed concern for sleep deprivation among his firefighter counterparts. In the past, he has initiated two schedule changes to improve outcomes from the effects of firefighter fatigue on patient care, safety, firefighter health, and other work-

related outcomes. Despite these changes, the emphasis of sleep health is lacking within the firefighter community where excellence and safety is expected.

The Fire Chief agreed that an intervention to promote sleep health may be beneficial in multiple aspects and delegated the assistant fire chief to continue involvement with the project. The assistant Fire Chief oversees management of meeting times, project goals, and feasibility, and recruitment of other key stakeholders or members of interest. Recently, the assistant fire chief introduced a professional collogue involved in a similar intervention with this department. A professor of clinical psychology and researcher in sleep health at the University of Arizona, Dr. Patricia Haynes, plans to recruit firefighters to implement a long-term intervention with goals improve sleep quality. This intervention will not be implemented until 2022 and using this project as a small pilot will be useful for both the organization and the other stakeholder. The professional collaboration to ensure both interventions align will provide the department the most efficient, tailored, effective, and useful intervention for firefighters. Additionally, this project alignment will provide ideal outcomes for the agency, firefighters, and all stakeholders involved. Synchronized teamwork between two professionals can provide a better experience for firefighters who volunteer to participate and increase the likelihood of future engagement and completion rates.

Participants and Recruitment

Upon acceptance of the project proposal from the Fire Department and IRB approval, firefighters were recruited through word-of-mouth by the Fire Department Union President via their work e-mail. Those who were interested in sleep coaching sent a response e-mail as implied consent to participate. The inclusion criteria incorporated uniformed firefighters who reported a sleep disruption and a desire to improve their quality of sleep. Firefighters of any age or gender

were considered and all volunteers were asked to express interest in participation by a predetermined deadline. Exclusion criteria included firefighters who do not wish to participate, those who were not concerned about their sleep quality, those who were not literate in cellphone or telemedicine use, and those who do not complete the full intervention. Since the sample size was a total of 2 firefighters, no volunteers needed to be turned away.

Firefighters were provided the pre-survey screening tool to identify which problem area is likely the cause of poor sleep quality and obtain demographic data. A total of 6 firefighters completed the pre-survey, and only 2 scheduled the intake.

Planning and Intervention Methods

The American College of Physicians has strongly recommended CBT-I as the first-line treatment for insomnia disorders, regardless of the fundamental etiology (Quaseem et al., 2016). Additionally, a sleep coaching problem based upon CBT-I is useful and feasible over the phone. Upon receiving implied consent, 3 surveys were e-mailed to each firefighter using survey monkey to determine eligibility and obtain basic demographic data. Survey monkey was used to hold data. An individual participant ID number was created in the demographic survey to maintain privacy of all responses. Firefighters completed an initial screening tool to determine the presence of a sleep related impairment or disturbance using the Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance Assessment (SDA) and Sleep Related Impairment (SRI) screening tools, as well as a demographic data tool. A total of 6 firefighters completed the pre-surveys and only 2 of the 6 participants schedule an intake to move forward in the process. An intake meeting was scheduled via e-mail over the phone. An assessment sheet from the Veteran's Affair CBT-I Manual was used to gather information about sleep schedule, problem areas, sleep practices, and sleep hygiene. During the intake, firefighters

were instructed to download a user-friendly sleep diary app to gather sleep trend, then export via e-mail in excel format prior to the next session. The sleep diary was not a data tool, but rather a tool to assist in tailoring the intervention individually. The firefighters provided verbal consent to record sessions with an electronic recording device that was monitored by Dr. Patricia Haynes to provide professional feedback and assist in tailoring a plan.

During week 2 the intervention consisted of Cognitive Behavioral Therapy for Insomnia (CBT-I) sleep coaching session 1. The first sleep diary was reviewed via e-mail and shared with Dr. Haynes prior to session 1 to identify problem areas of the firefighter's sleep patterns, and to shape the session. Tailored sleep sessions will ensure firefighters are gaining specific skills to meet their individual sleep challenges.

Week 3 consisted of a follow-up of session 1, and to review the next sleep diary. The purpose of session 2 is to make any adjustments to the suggested intervention, answer questions from session 1, and review the sleep diary one last time. Recordings from the previous session were shared with Dr. Haynes, and adjustments were made as needed to the new sleep schedule. Any additional questions, concerns, or comments were considered at this time to enhance the retention of newly acquired skills. Upon completion of the intake, session 1, and session 2, firefighters then completed a post-survey via e-mail to measure sleep changes in the PROMIS SRI and SDA. Additionally, a feasibility was used to evaluate the opinion of the program, the likelihood of using the program again, and the likelihood of continuing to use the skills learned in the future.

Barriers include: 1) The fire community stigma of 'non-vulnerability' and honest self-disclosure, 2) Self-reporting scales are subjective to the patient and do not directly measure physiological data, 3) Firefighters may delay sessions or drop-out prematurely before adequate

data is collected due to hectic work-life balance and schedules, 4) Unexpected problems with technologies used for education, coaching sessions, and data collection, 5) Bias information may be given to assist the sleep coach in completing the project.

Budget

The nature of this project is to be as cost effective as possible. The entire intervention occurred online or over the phone which did not add any extra cost other than routine phone and internet bills. The design of this project will be used on an at home computer with Microsoft word and a PDF viewer, therefore, no materials or printed information were necessary. Zoom was be used for meetings for CBT-I training with Dr. Haynes, so in person sessions were not required. This eliminated the need for transportation or extra time allotted for driving and meeting arrangements. CBT-I training can range between $500-700 depending on the level of the training program and affiliations. However, basic training for CBT-I and sleep coaching methods training occurred for free directly from Dr. Patricia Haynes the VA CBT-I provider training manual.

Data Collection and Outcomes Measurement

Due to the barrier of hectic schedules, firefighters were more likely to drop-out prematurely due to time constraints and an overwhelming number of surveys or data collection that demand a timely response. Therefore, creating the simplest survey collection pre- and post-intervention may increase participation when working with this population, so a short form version was selected. The Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance (SD) and the Sleep-Related Impairment (SRI) both measure sleep quality and sleep-wake function with greater precision than the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS), which grants an advantage (Yu et al., 2011).

The PROMIS SD and SRI tool were developed using a rigorous and systematic methodology, which includes literature reviews, focus groups, review of qualitative items, and psychometric testing using methods from both item response theory (IRT) and classical test theory (CTT). The original form banks contain 27 and 16 items each. However, evidence supports that these question banks may be utilized to create 8-item short forms and are strongly correlated with similar outcomes as longer forms (Yu et al., 2011). Results from the PROMIS SD and SRI indicating decreased sleep disruption and increase in quality will determine if firefighters were able to successfully apply CBT-I coaching and sleep knowledge to improve their lifestyle.

The *CBT Theoretical model* will continue throughout the duration of the coaching sessions by providing the firefighters real time, personalized, feedback regarding their sleep habits, health concerns, and possible risks vs benefit. This feedback will ideally cue the firefighter to respond with cues to change behaviors that lead to distress. Whether or not firefighters experience a cue to action to utilize tools to make change will also be measured within the screening tools that report the level of sleep disruption.

Firefighters were informed of their right to privacy, and personal identification numbers will be made for each participant. Personal information was protected, and the survey of feasibility remained anonymous to the coach. This information was stored on a personal electronic device which did not contain any identifying data. Additionally, the information stored was only be kept until the duration of the project had been completed; in which it was the deleted and disposed of in a proper manner which resonates with the protection of confidential health information without the ability to trace back. The patient identification number list was shredded to comply with participant privacy.

Results

Descriptive Data

There were six firefighters who responded with interest via e-mail through word-of-mouth recruitment on behalf of the fire department union president. Five firefighters completed the PROMIS SRI and SDA pre-survey, as well as a demographic survey. Two of the five firefighters responded with a confirmed scheduled date to participate in the sleep coaching intake session. One firefighter completed the intake, session 1 and 2, and the post-survey. The second firefighter did not complete session 2 of the sleep coaching intervention but did complete the post-survey and feasibility measures.

Demographic Data

Summary statistics were calculated for percentages and frequencies of the demographic data (see Appendix H, Table 1). All project participants were male (*n=2,* 100%), white race (*n=2, 100%*), and both were between the ages of 30-44 (*n=2, 100%).* Half of the participants reported 10+ years on the job (*n= 2, 50%)*, and half reported 5-10 years (*n=2, 50%*).

PROMIS SDA and SRI Data

The average pre-SRI total score (PRESRITS) was 20.5 (*SD* = 13.44) and the scores ranged from 11-30 points. The average post-SRI total score (POSTSRITS) was 23 (*SD=18.38)* and the scores ranged from 10-36. The average pre-SDA total score (PRESDATS) score was 19.5 *(SD=2.12)* and the scores ranged from 18-21. The observations for post-SDA total score (PRESDATS) had an average of 19.00 (*SD* = 4.24) and the scores ranged from 3-6 (see Appendix H, Table 2).

Feasibility Measure Data

In order to assess the feasibility of the intervention, we looked at the following criteria: how logical sleep coaching seemed, likelihood of continued use, convenience of the phone method, overall experience, ease of using sleep coaching, how successful sleep coaching was to alleviating insomnia, if phone use would be recommended for the future, how helpful sleep coaching was, likelihood of repeating the program, and likelihood of recommending sleep coaching to other firefighters.

The observations for how *logical the program* was had an average of 4.00 (*SD* = 0.00) and the scores ranged from 0-4. The observations for *likelihood of continued use* had an average of 4.00 (*SD* = 0.00) and the scores ranged from 4-4. The observations for *convenience of the phone method* had an average of 4.50 (*SD* = 0.71) The observations for the *overall experience* had an average of 4.50 (*SD* = 0.71) and the scores ranged from 4-5. The observations for *ease of participation* had an average of 3.00 (*SD* = 2.83 and the scores ranged from 1-5. The observations for *how successful the program was in improving insomnia* had an average of 3.00 (*SD* = 0.00) and the scores ranged from 0-3.

The observations for *recommending phone use in the future* had an average of 4.50 (*SD* = 0.71 and the scores ranged from 4-5. The observations for *how helpful the program was to insomnia symptoms* had an average of 3.50 (*SD* = 0.71) and the scores ranged from 3-4. The observations for *willingness to repeat the program* had an average of 3.00 (*SD* = 1.41) and the scores ranged from 2-4. The observations for *likelihood to recommend to another firefighter* had an average of 4.00 (*SD* = 1.41) and the scores ranged from 3-5 (see Appendix H, Table 3).

Data Analysis

Summary statistics were calculated for pre-SRI total score (PRESRITS), Post-SRI total score (POSTSDATS), Pre-SDA total score (PRESDATS), and

Post-SRI total score (POSTSRITS_1) split by *years on the job* (see Table 4). Summary statistics were calculated for PRESRITS, POSTSDATS, PRESDATS, and POSTSRITS_1 split by *24-hour shift* see Table 5). Summary statistics were calculated for PRESRITS, POSTSDATS, PRESDATS, and POSTSRITS_1 split by *age* (see Table 6)

Discussion

Clinical significance

Although the statistical significance was inconclusive there was clinical significance. Due to the relatively small sample size of *n=2* and one firefighter who did not complete session 2, the statistical evidence shows an increase in sleep impairment and disturbance scores. Firefighter 1 was a Male between the ages of 45-49 with 10 years as a firefighter working 24-hour shifts with no history of sleep disorder or sleep treatment. Background information was obtained, and the firefighter denied use of nicotine or alcohol, and states caffeine consumption is typically in the morning. The firefighter stated he was recently ruled out for sleep apnea through occupational health and did not disclose symptoms of restless leg syndrome. The firefighter reported that his bed is only used for sleep and sex at night. Firefighter 1 scored a T-score of 51.2 on this pre-SDA and a 38.0 on the pre-SRI, indicating mild sleep disruption and impairment. Firefighter described his sleep disturbance as unprovoked middle of the night awakenings without cause, due to light noise, or thinking her heard a service call tone. Firefighter states he will walk laps around the house to calm himself before returning to sleep. Other times, it takes him over >40 minutes to fall back asleep if he chooses to stay in bed. Firefighter disclosed difficulty staying asleep the night before going back on shift, early wakening on days off, and poor naps when returning home. After completing the intake, and 2 sessions of sleep coaching,

firefighter reported less middle of the night awakenings, ease of initiating naps, and better quality of sleep during the night. Reports a post-SDA T-score of 45.5 and a post-SRI T-score of 35.9.

Firefighter 2, a male between the ages of 30-44 with 5-10 years as a firefighter working 24-hour shifts within a busy department, no history of sleep disorder or sleep treatment. Background information was obtained, and the firefighter discloses use of Nyquil as a sleep aid when needed and the last year when attending paramedic school. Firefighter states paramedic school with work demands increased his stress level and sleep became increasingly difficult. Firefighter denies use of nicotine and less than monthly use of alcohol, and caffeine consumption in the morning. Reports watching TV in bed with his fiancé at night, but the bedroom is mainly used for sex and sleep. Firefighter recorded pre-SDA T-score of 47.9 and pre-SRI T-score of 60.4. Firefighter disclosed severe challenges with personal time management and feelings of anxiety related to incomplete tasks on his to-do list both pre- and post-shift.

Per the documented sleep diary, firefighter recorded an erratic sleep schedule and bedtime/waketime (on his days off) which fluctuate from the original routine the firefighter initially disclosed during the intake session. Firefighter 2 was communicative during the recruitment process and pre-survey but became less engaged withs scheduling a time for an intake session and session 1. Firefighter rescheduled the session 1 time after missing the appointment and dropped out before session 2 could be completed (no response after 3 e-mails). Firefighter disclosed feeling extra stress during the PGA tour (golf tournament) and Barrett Jackson car show obligations assigned by his station; however, he agreed to finish the post-survey. The post score for this firefighter increased due to poor time management and an increase in workload related to special events. The post survey score for was SDA T-score of 52.2 and post SRI T-score of 67.5.

Limitations

There were several limitations to this intervention. First, time constraints and limited resources made it challenging to recruit more than 5 participants. The fire department assistant chief and union president recommended recruitment via word-of-mouth over mass work e-mail due to concern that too many firefighters would be turned away. A sample size of 2 was ultimately used out of 6 respondents. However, a larger sample size may have been obtained with larger recruitment effort. Second, firefighters seemed to respond better via text than work e-mail when scheduling sessions. Using text over e-mail for main communication may increase retention and participation rates in future research or interventions. Third, questions about department events, upcoming obligations, change in schedule, and other related personal time constraints may be important to inquire on prior to the firefighter making commitment to sleep coaching sessions. Certain life events or added work strain may impact the firefighter's ability to fully engage and adjust their sleep routine. Fourth, mental health diagnosis such as anxiety, post-traumatic stress disorder, depression, and other related disorders may be an important factor to consider when working with a participant with exhibiting insomnia. Although cognitive behavioral therapy is helpful, it may be more effective in conjunction with medication in certain circumstances and may depend on the level of impairment to assess severity. Lastly, the demographic data for age and years on the job was obtained in ranges, instead of an exact number; making it harder to assess the data.

Sustainability

Funding for fire department programs and activities is either provided through grants or city funding. Private organizations who choose to work with related stakeholders may consider additional funding outside of city funding in favor of promoting firefighter wellness. The

stakeholder in this project Dr. Patricia Haynes, will utilize some feedback information from this project to enhance future opportunities with other agencies, and tailor the next intervention based off firefighter feedback in the feasibility survey. This legacy project will continue into a larger intervention with a greater potential and resources for future sustainability. To continue CBT-I sleep coaching, the fire department will be required to create a sleep program and hire related trained professionals to implement these services. Some considerations for funding agencies may be organizations such as insurance companies and advocacy groups. Ultimately, sleep coaching wellness promotion and programs may increase firefighter longevity and wellness. Additionally, they may improve patient and public outcomes, decrease onsite related work-injuries, and decrease long-term health costs related to preventable illnesses exacerbated by a lack of sleep.

References

American Academy of Sleep Medicine (2021). *Shift work overview.* http://sleepeducation.org/essentials-in-sleep/shift-work

Barger, L. K., O'Brien, C. S., Rajaratnam, S. M., Qadri, S., Sullivan, J. P., Wang, W., Czeisler, C. A., & Lockley, S. W. (2016). Implementing a sleep health education and sleep disorders screening program in fire departments: A comparison of methodology. *Journal of occupational and environmental medicine*, *58*(6), 601–609. https://doi.org/10.1097/JOM.0000000000000709

Billings, Joel & Focht, Will. (2016). Firefighter shift schedules affect sleep quality. *Journal of occupational and environmental medicine: American College of Occupational and Environmental Medicine, 58*(3), 294-298. https://doi.org/10.1097/JOM.0000000000000624.

Center of Disease Control and Prevention (2018, August 8). *Sleep and chronic disease.* https://www.cdc.gov/sleep/about_sleep/chronic_disease.html

Choi, B., Schnall, P., & Dobson, M. (2016). Twenty-four-hour work shifts, increased job demands, and elevated blood pressure in professional firefighters. *International Archives of Occupational and Environmental Health*, *89*(7), 1111–1125. https://doi.org/10.1007/s00420-016-1151-5

City of Glendale (2019). *Glendale regional public safety training center. https://www.glendaleaz.com/live/city_services/public_safety/fire_department/glendale_regional_public_safety_training_center*

City of Scottsdale (2021). *Fire department calls for service.* https://data.scottsdaleaz.gov/datasets/187dd861ed1c4aecb392fce2ee901c05_20/data

City of Scottsdale (2021). *Fire services.* https://www.scottsdaleaz.gov/fire

FireStrong (2020). *Tools to build a stronger you.* https://www.firestrong.org/

Graham, I.D., Logan, J, Harrison, M.B., Straus, S.E., Tetroe, J., Caswell, W. & Robinson, N. (2006). Lost in knowledge translation: Time for a map? *Journal of Continuing Education in the Health Professions, 26*(1), 13-24. https://doi.org/10.1002/chp.47

HeartFit For Duty (2021). *Your health is our number one priority-it should be yours too.* https://www.heartfitforduty.org/

Intellectus Statistics Online computer software. (2021). Intellectus Statistics. Retrieved from https://analyze.intellectusstatistics.com/

Joanna Briggs Institute (2017). *Checklist for analytical cross-sectional studies.* https://jbi.global/sites/default/files/2019-05/JBI_Critical_Appraisal-Checklist_for_Analytical_Cross_Sectional_Studies2017_0.pdf

Jones, C. L., Jensen, J. D., Scherr, C. L., Brown, N. R., Christy, K., & Weaver, J. (2015). The Health Belief Model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. *Health communication, 30*(6), 566–576. https://doi.org/10.1080/10410236.2013.873363

Kim, J., Park, H., & Kim, J. (2018). Alcohol use disorders and insomnia mediate the association between PTSD symptoms and suicidal ideation in Korean firefighters. *Depression and Anxiety*, *35*(11), 1095–1103. https://doi.org/10.1002/da.22803

Korre, M., Porto, L., Farioli, A., Yang, J., Christiani, D., Christophi, C., Lombardi, D., Kovacs, R., Mastouri, R., Abbasi, S., Steigner, M., Moffatt, S., Smith, D., & Kales, S. (2016). Effect of body mass index on left ventricular mass in career male firefighters. *The*

American Journal of Cardiology, *118*(11), 1769–1773. https://doi.org/10.1016/j.amjcard.2016.08.058

Lim, M., Lee, S., Seo, K., Oh, H., Shin, J., Kim, S., Kang, H., Jeong, K., Oh, S., Koh, S., & Ahn, Y. (2020). Psychosocial factors affecting sleep quality of pre-employed firefighters: a cross-sectional study. *Annals of Occupational and Environmental Medicine*, *32*(1), e12–e12. https://doi.org/10.35371/aoem.2020.32.e12

Melnyk, B. M., Fineout-Overholt, E. (2015). Evidence-based practice in nursing and healthcare: A guide to best practice (3rd ed.). Philadelphia, PA: Wolters Kluwer. National Sleep Foundation (2021). *How much sleep do you really need?* https://www.thensf.org/how-many-hours-of-sleep-do-you-really-need/

Pacheco, D. (2020, October 16). *Shift work disorder.* Sleep Foundation. https://www.sleepfoundation.org/shift-work-disorder

Serrano, D., Rufino, K., Tran, J., & Vujanovic, A. (2020). Association between sleep disturbances and suicide risk among firefighters: moderating the role of mindfulness. *Mindfulness*, *11*(12), 2793–2803. https://doi.org/10.1007/s12671-020-01491-7

Smith, E., Velazquez-Pimentel, D., & Trockels, A. (2019). Posttraumatic stress disorder and sleep quality among urban firefighters in Thailand. *Nature and Science of Sleep*, *11*, 217–218. https://doi.org/10.2147/NSS.S229181

Smith, L., Gallagher, M., Tran, J., & Vujanovic, A. (2018). Posttraumatic stress, alcohol use, and alcohol use reasons in firefighters: The role of sleep disturbance. *Comprehensive Psychiatry*, *87*, 64–71. https://doi.org/10.1016/j.comppsych.2018.09.001

Smith, L., Bartlett, B., Tran, J., Gallagher, M., Alfano, C., & Vujanovic, A. (2019). Sleep disturbance among firefighters: understanding associations with alcohol use and distress

tolerance. *Cognitive Therapy and Research*, *43*(1), 66–77. https://doi.org/10.1007/s10608-018-9955-0

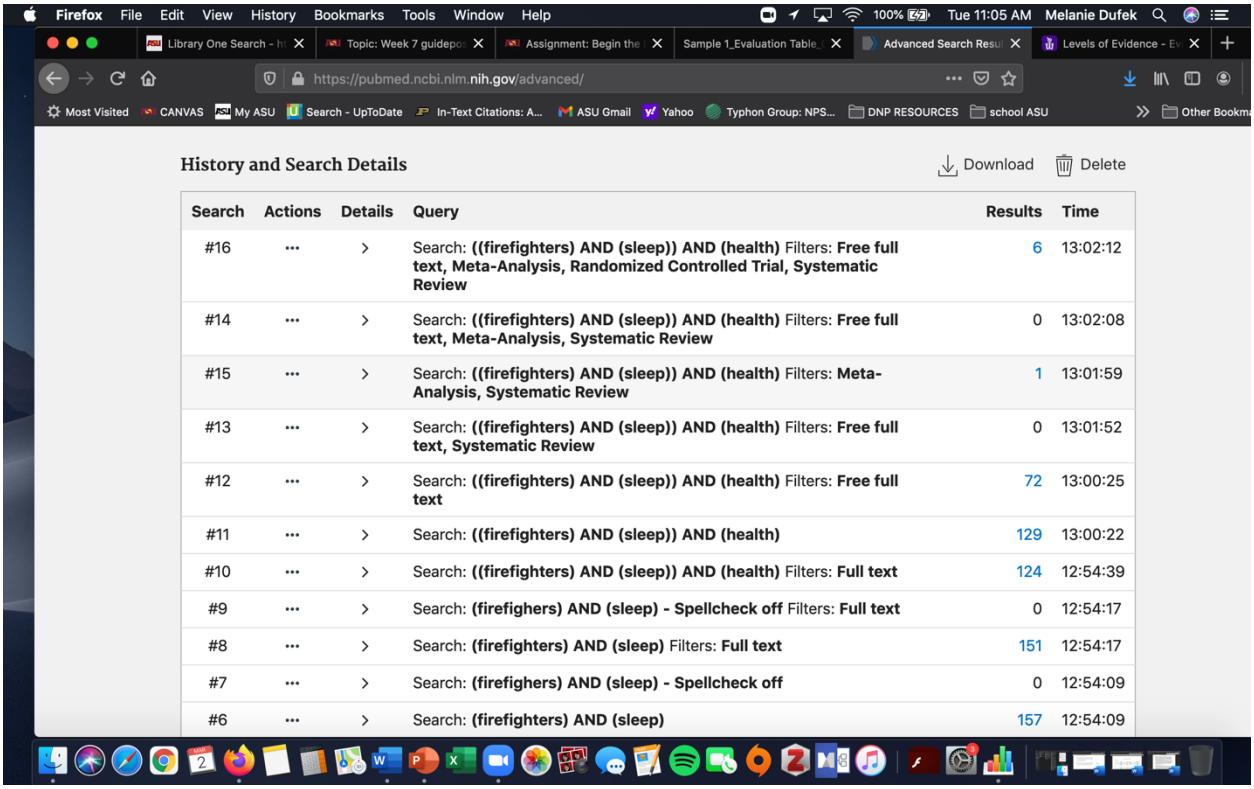
Sullivan, J. P., O'Brien, C. S., Barger, L. K., Rajaratnam, S. M., Czeisler, C. A., Lockley, S. W., & Harvard Work Hours, Health, and Safety Group (2017). Randomized, prospective study of the impact of a sleep health program on firefighter injury and disability. *Sleep*, *40*(1), 1-10. https://doi.org/10.1093/sleep/zsw001

U.S. Fire Administration (2021, February 12). *National fire department registry quick facts.* https://apps.usfa.fema.gov/registry/summary

Vargas de Barros, V., Martins, L., Saitz, R., Bastos, R., & Ronzani, T. (2013). Mental health conditions, individual and job characteristics, and sleep disturbances among firefighters. *Journal of Health Psychology*, *18*(3), 350–358. https://doi.org/10.1177/1359105312443402

Wickwire, E. M., Geiger-Brown, J., Scharf, S. M., & Drake, C. L. (2017). Shift work and shift work sleep disorder: Clinical and organizational perspectives. *Contemporary Reviews in Sleep Medicine*, *151*(5), 1156–1172. https://doi.org/10.1016/j.chest.2016.12.007

Appendix A PubMed



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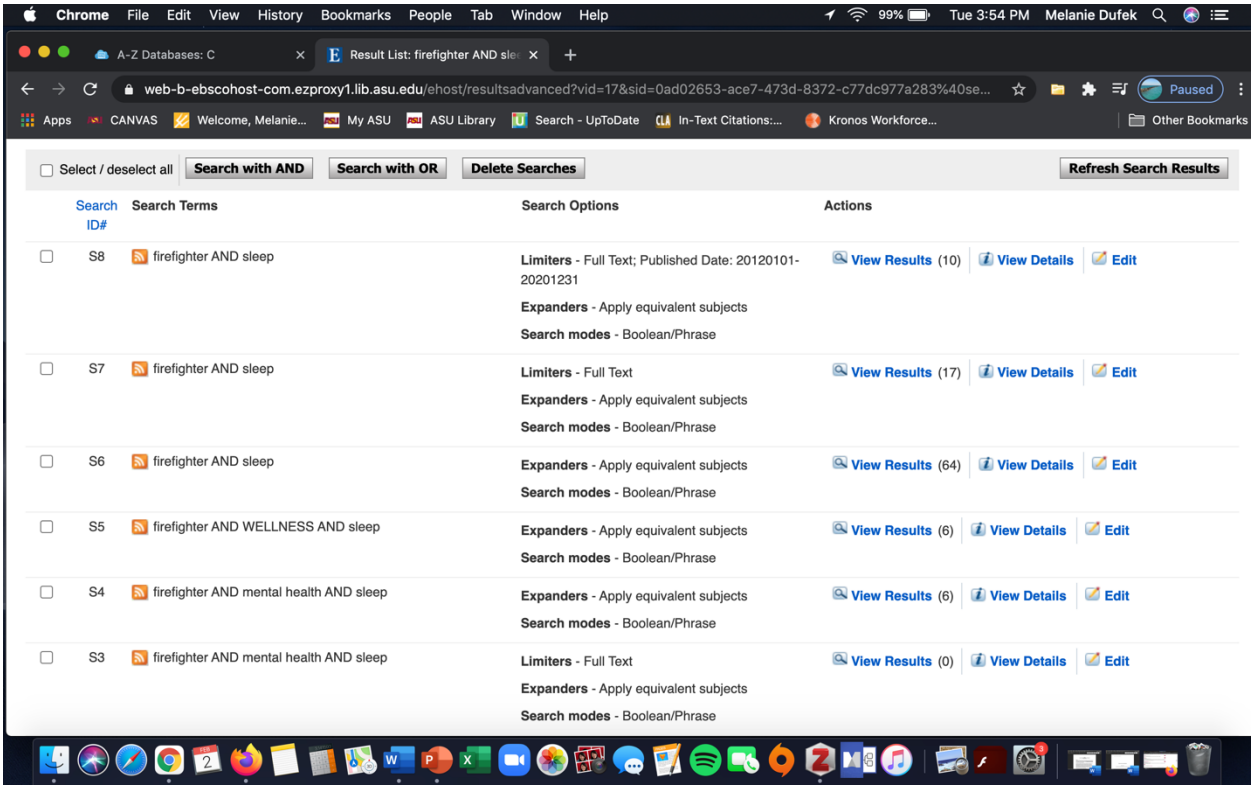
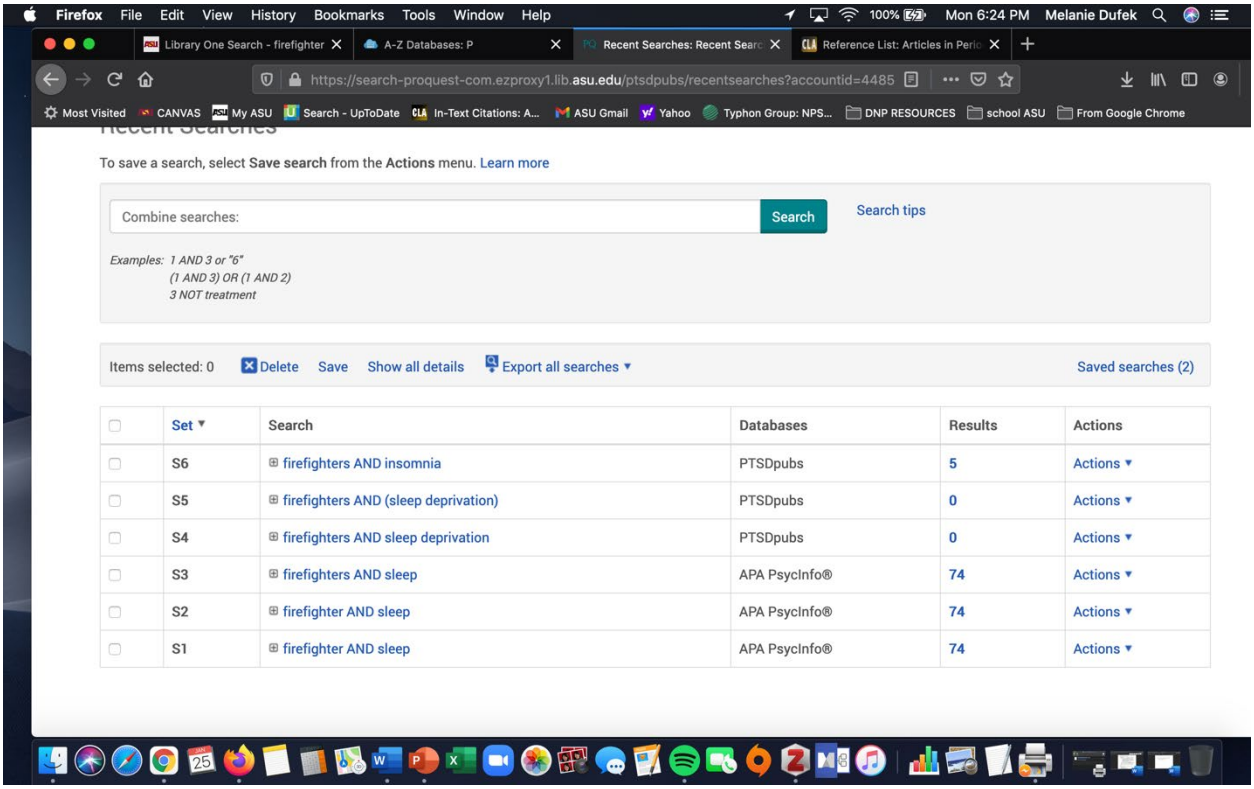
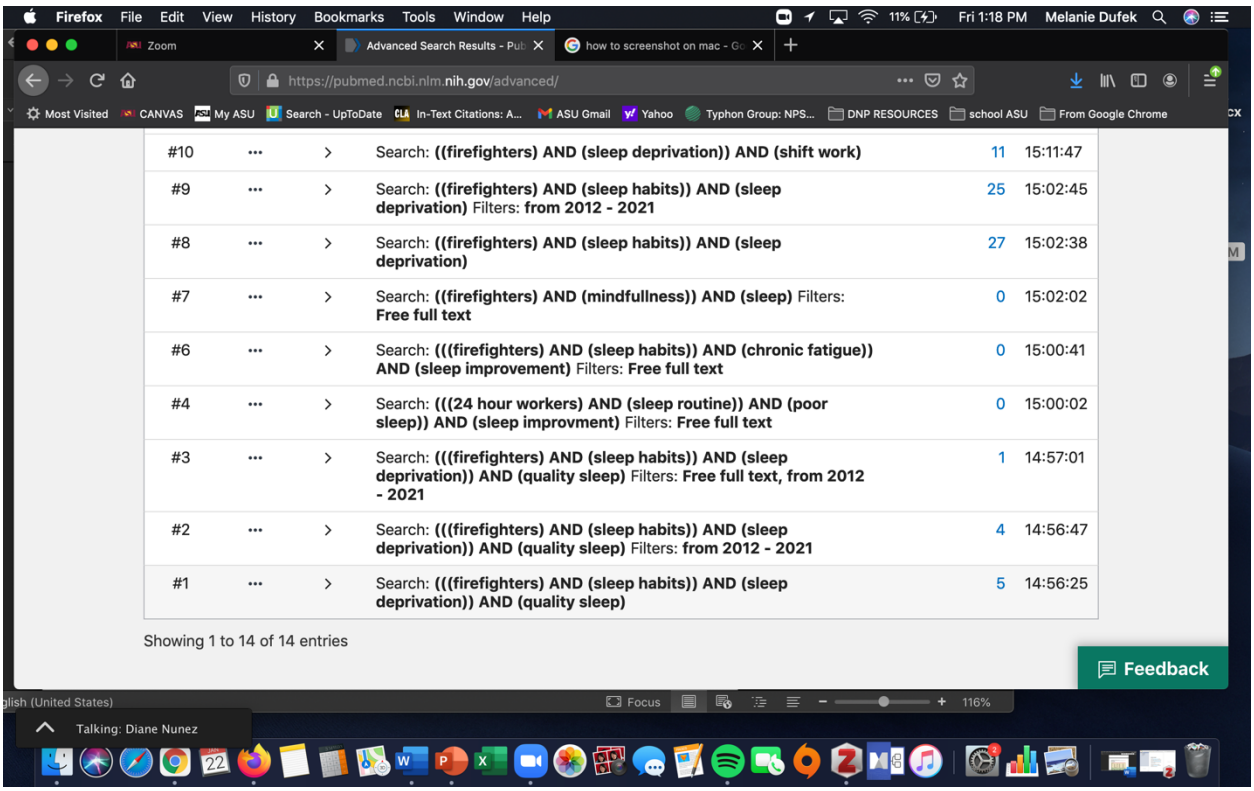


Appendix C ProQuest



Appendix D PubMed



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Showing 1 to 14 of 14 entries

Appendix E

Table 1 *Quantitative Evaluation Table*

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (statistics used)	Findings/ Results	Level/Quality of Evidence
Sullivan, J.P. et al. (2017). Randomized, Prospective Study of the Impact of a Sleep Health Program on Firefighter Injury and Disability. **Funding:** FEMA, NIOSH, NIH, NLI, and NBI grants. **Bias:** Funders had no role in study design, data collection or analysis. Authors report no conflict of interest. **Country:** United States	Behavioral change model	**Design:** Randomized field-based intervention **Purpose:** Examine effectiveness of sleep health program on firefighter disability and injury.	**N**=1189 **n**=601 (EG) **n**=588 (CG) **Setting:** mid-sized fire department in Columbus, OH **Sample demographics:** All personnel from the selected fire departments were instructed to attend information sessions. Mean age 43.6 years (EG) 44.4 years (IG). Female gender 1.3% (EG) 0.8% (IG), Male Gender 98.2%(EG), 99.2% (IG)	**IV-** Intervention station: mandatory 30-minute education session on firefighter mortality, fatigue-related health hazards, and physiological importance of sleep. Voluntary sleep screening post-education session. **DV-** Firefighter sleep quality	BQ-SR AIS ESTQ Created screening tool for shiftwork disorder based on International Classification of Sleep Disorders-2 diagnostic criteria and referred those who screened positive to American Academy of Sleep Medicine recommended clinics.	Chi-square Fisher's exact test to compare gender and race. Post hoc odd ratio to calculate risk of reported injuries. Student's *t*-tests were used to compare pre and post education session.	Of the 601 firefighters assigned to intervention stations, 90.2% attended 1 of the 52 educational sessions. **DV-** only 16% of firefighters responded to end-of-year study to report change in sleep quality. **DV2-**24% less likely to file at least one official injury report	**Strengths:** Sleep disorder screenings resulted in 46% fewer disability days on average. Sleep health program (SHP) is an effective way to increase knowledge of sleep health in firefighters. **Weaknesses:** Only 16.2% of those who screened positive sought medical treatment and not beneficial to long-term health. **Limitations:** Not RCT double-blind,

Key: **AIS-** Athens insomnia scale; **BQ-SR-**Berlin questionnaire self-report; **CG**-control group; **DV**-dependent variable; **EG**-experimental group; **ESTQ-**Epidemiology symptoms and Treatment questionnaire; **FEMA**-Federal Emergency Management Agency; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **NIH-**National Institute of Health; **NIOSH-**National Institute of Occupational Safety and Health; **NHI-**National Heart Institute; **NLI-**National Lung Institute; **NBI-**National Blood Institute; **SHP**- Sleep Health Program.

			Inclusion Criteria: All Firefighter personnel that work in Columbus, OH Fire Department were permitted and encouraged to attend informational session and join the study. **Exclusion Criteria:** None listed	**DV2**- firefighter injuries and disability **DV3-** sleep disorder diagnosis or positive screening			during the study duration than those who did not attend. **DV3-**42% of firefighters in this cohort screened positive for one more sleep disorder compared to 37% nationwide	re-assignments occurred, low response rate to end of year survey. **Bias:** may have occurred due to low response rates and underestimating the power of the project.

Key: **AIS-** Athens insomnia scale; **BQ-SR-**Berlin questionnaire self-report; **CG**-control group; **DV**-dependent variable; **EG**-experimental group; **ESTQ-**Epidemiology symptoms and Treatment questionnaire; **FEMA**-Federal Emergency Management Agency; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **NIH-**National Institute of Health; **NIOSH-**National Institute of Occupational Safety and Health; **NHI-**National Heart Institute; **NLI-**National Lung Institute; **NBI-**National Blood Institute; **SHP**- Sleep Health Program.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Barger L.K. et al. (2016). Implementing a sleep health education and sleep disorders screening program in fire departments: A comparison of methodology. **Funding:** FEMA, NIOSH, NIH, NIL, and NIB grants. **Bias:** Funders had no role in study design, data collection or analysis. Authors report they were supported by research grant through the Assistance to Firefighters Grant program. No conflicts of interest reported. **Country:** United States	Behavioral change model	**Design:** Cross-sectional design Sleep health program (SHP) and screening for common sleep disorders implemented in 8 fire departments with three approaches: 1) Expert led, 2) train the trainer, 3) online. **Purpose:** Examine and compare three methods of administering SHP in fire departments.	**N=2645** **n**=1002 (**EL**) **n**=892 (**TT**) **n**=751(**OL**) **Setting:** fire-department with "off-service" firefighters or online at fire department **Sample demographics:** All firefighters (**FF)** from the selected fire departments were instructed to attend information sessions. Total mean age 40.6 years (EL) 42.9 years (TT) 38.0 years, (OL) 40.8 years-Total Average	**IV-** Intervention station: 30-minute education session delivered with three different methodologies. Including firefighter testimonial videos of sleep disorder treatment, and screening for common sleep disorders. **DV-** Firefighter knowledge of educational program content before and after the educational session. **DV2**- Sleep disorder diagnosis or	7-point Likert scale and questionnaire based off the interventional Classification of Sleep Disorders-2 (ICSD-2). Created screening tool for sleep disorder screening and surveys to assess level of knowledge and SHP impact.	Chi-square used to compare participation rates, changes in assessment scores, firefighters' rating of the program, and rate evaluation and treatment of sleep disorders. Logistical regression used to account for interdepartmental variability.	42% of firefighters reported changing their sleep behaviors as a result from the program. **DV-** Overall firefighters showed 28.6% knowledge improvement rate. FF **DV2-**40.8% of FF screened positive for at least one sleep disorder. **DV3-** 52.0% of FF rated the importance of SHP program.	**Strengths:** Fire Departments were included with a phone interview to determine interest. **Weaknesses:** Challenging to schedule all firefighters for training, had to include firefighters on shift but "off-duty". Firefighters who completed the OL training were interrupted to service calls. **Limitations:** Group viewing of educational materials may have impacted participation rates, due to lack of individual post-evaluation tools. **Bias:** None listed

Key: **CG**-control group; **DV**-dependent variable; **EG**-experimental group; **EL**- Expert led; **FF**- Firefighters; **FEMA-**Federal Emergency Management Agency; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **NIH-**National Institute of Health; **NIOSH-**National Institute of Occupational Safety and Health; **NHI-**National Heart Institute; **NLI-**National Lung Institute; **NBI-**National Blood Institute; **OL**-Online; SHP- Sleep Health Program; **TT**-Train the Trainer

			Female gender (EL) 2.2% (TT) 7.3% (OL) 3.7% Total 4.3% Male Gender (EL) 95.3% (TT) 89.8% (OL) 93.9 Total 93.0% **Inclusion Criteria:** All Firefighter Personnel working for selected fire departments. **Exclusion Criteria:** None listed	positive screening. **DV3-** Program impact on firefighters.				

Key: **CG**-control group; **DV**-dependent variable; **EG**-experimental group; **EL**- Expert led; **FF**- Firefighters; **FEMA-**Federal Emergency Management Agency; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **NIH-**National Institute of Health; **NIOSH-**National Institute of Occupational Safety and Health; **NHI-**National Heart Institute; **NLI-**National Lung Institute; **NBI-**National Blood Institute; **OL**-Online; SHP- Sleep Health Program; **TT**-Train the Trainer

Citation	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables studied	Measurement/ Instrumentation	Data Analysis	Findings	Level/Quality of Evidence; Decision for practice/ application to practice
Choi, B., Schnall, P., & Dobson, M. (2016). Twenty-four-hour work shifts, increased job demands, and elevated blood pressure in professional firefighters. **Funding:** Supported by the CDC and NIOSH **Bias:** Authors declare they have no conflict of interest. **Country:** United States	Health Belief Model	**Design:** Cross-Sectional Firefighters used health questionnaires to report working conditions, and blood pressure was clinically assessed using standard classification. **Purpose:** To investigate whether working conditions (number of 24-hour shifts, number of calls, sedentary work, job strain, effort-reward imbalance, and physical demands) are associated with elevated blood pressure and hypertension among professional firefighters.	**N=330** **Setting:** survey conducted within health clinic when FF visited for wellness exam. **Sample demographics:** Professional firefighters, 321 males, mean age 42 years; and 9 females, mean age 37.8 years. Most firefighters were white, with some college or high school graduate. **Inclusion Criteria:** Professional firefighters who work at	**IV 1-** Sedentary vs. Strenuous work conditions **IV 2-** number of shifts/calls on shifts. **IV 3-** Job strain **DV-** SBP & DBP	FORWARD health questionnaire to measure health and firefighter specific work. JCQ ERIQ Blood pressures measured by experienced nurses with aneroid sphygmometer, twice consecutively. Hypertension defined as >140mmHg SBP and >90mmHg DBP	ANOVA and Chi-square used to example the whole sample of 330 firefighters.	**DV-** Compared to the standard work schedule group, SBP was 3.0 mmHg ($p = 0.20$) and 6.6 mmHg ($p = 0.10$) higher in the 12–21 shifts and 0–6 shifts groups, respectively DBP was also 2.6 mmHg ($p = 0.08$) and 4.6 mmHg ($p = 0.07$) higher in the 12–21 shifts and 0–6 shifts groups, respectively. the two subgroups (14 shifts and 16 shifts) had substantially higher SBP and DBP than the standard work schedule group: 4.3–4.4 mmHg ($p <$	**Strengths:** First Epidemiological study that examines multiple physical and psychosocial working conditions in relation to blood pressure and hypertension. Study suggests limiting the number of 24-hour shifts firefighters can work per year to improve cardiovascular health by limiting circadian rhythm disruption, and health promotion efforts may impact mild hypertension.

Key: **DBP**- diastolic Blood Pressure; **DV**-dependent variable; **FF**- Firefighters; **FORWARD Study-**Explore behavioral and occupational risk factors for obesity in firefighters; **ERIQ-**Effort-reward imbalance questionnaire; **JCQ-**Job content questionnaire; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **SBP-** systolic Blood Pressure

			fire stations and volunteered to participate **Exclusion Criteria:** Rookie firefighters with less than <1 year on the job; or with special training titles (i.e. medical director, training officer, investigator); or who did not have valid information on the other study variables in current study. Anyone taking current hypertensive medications were excluded from the multivariate model.				0.20) for SBP and 3.4–5.0 mm Hg ($p <$ 0.05) for DBP	**Weaknesses:** Cross-sectional study, unable to be sure of temporal relationships of the number of 24-hour shifts in the past month and increased job demand over the past years. **Limitations:** Self-reporting information may need test and retest over long term. Study was unable to assess whether noise exposure may impact SBP and DBP (i.e., Sirens) **Bias:** No bias reported.

Key: **DBP**- diastolic Blood Pressure; **DV**-dependent variable; **FF**- Firefighters; **FORWARD Study-**Explore behavioral and occupational risk factors for obesity in firefighters; **ERIQ-**Effort-reward imbalance questionnaire; **JCQ-**Job content questionnaire; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **SBP-** systolic Blood Pressure

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Billings, Joel & Focht, Will. (2016). Firefighter shift schedules affect sleep quality. **Funding:** No funding listed **Bias:** No bias reported **Country:** United States	Parallel multiple mediator model	**Design:** Cross-sectional design Sleep quality was assessed using a Pittsburgh Sleep Quality Index in a sample of 109 male career firefighters from six fire departments in three Southwestern US states and 26 different stations. **Purpose:** investigate the prevalence and severity	**N=109** **n= (24/48)**31 **n= (48/96)**38 **n=(Kelly)**40 **Setting:** 26 different fire-departments **Sample demographics:** All respondents are male, and most are married, have children living at home, work a second job, and worked in the fire service an average of nearly 13 years.	**IV 1-**Shift schedule worked; 24on/48off, 48on/96off, or Kelly. **IV 2-** Second jobs **DV 1-** Sleep quality **DV 2-** Dysrhythmia	PSQI	STATA software used to analyze data	**DV 1-** Based on a sample of 109 firefighters from the six fire departments, 80 of the 109 (73%) firefighters report poor sleep quality with a PSQI score of >5. **DV 2-** Differences in sleep quality between Kelly and the other two shift schedules show that the greater	**Strengths:** Current only peer-reviewed literature that explores firefighters working second jobs, and the impact on sleep. Shift schedules that disrupt normal circadian rhythms more result in poorer sleep quality, which can lead to less effective emergency response and increased risk to firefighter health and safety. **Weaknesses:** none listed **Limitations:** none listed

Key: **24/48-**24-hours on-duty and 48-hours off; **48/96-** 48-hours on-duty and 96-hours off; **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **Kelly-**24-hours on-duty, 24-hours off, 24-hours on-duty, 24-hours off, 24-hours on-duty, 96 hours off; **N**- number of studies; **n**- number of participants; **PSQI-**Pittsburg sleep quality index

		of firefighter sleep quality across department shift schedules	**Inclusion Criteria:** Only full-time firefighters with at least one month of current continuous shift-work experience were recruited to participate in interviews held at their fire stations. **Exclusion Criteria:** None listed				the dysrhythmia, the poorer the sleep quality. 70 of the 109 (64%) of firefighters work in jobs outside of the fire department. The results suggest that working second jobs during time off between work shifts may further adversely affect sleep quality	**Bias:** none listed

Key: **24/48-**24-hours on-duty and 48-hours off; **48/96-** 48-hours on-duty and 96-hours off; **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **Kelly-**24-hours on-duty, 24-hours off, 24-hours on-duty, 24-hours off, 24-hours on-duty, 96 hours off; **N**-number of studies; **n**- number of participants; **PSQI-**Pittsburg sleep quality index

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Smith, L.J., Bartlett, B.A., Tran, J.K. *et al.* Sleep disturbance among firefighters: understanding associations with alcohol use and distress tolerance. **Funding:** Study was unfunded **Bias:** No bias reported **Country:** United States	cross-sectional design	**Design-S**econdary analysis of data from a larger project examining stress and health-related behaviors among firefighters **Purpose-**To focus on better understanding relations among alcohol use, distress tolerance, and sleep disturbances among firefighters	**N=652** Firefighters **Setting:** All firefighters were recruited for participation in an online, survey-based study through a large urban fire department in the southern United States. **Sample demographics:** Male:611 Female: 36 Transgender: 5 Mean age: 38.4 **Inclusion Criteria:** 18 years of age or older, been a current firefighter, and consented	Bivariate correlations **IV 1:** Alcohol Use **IV 2:** Stress tolerance **DV 1:** Sleep Efficiency	AUDIT DTS PSQI SOOS-14	Hierarchical regression analysis was conducted	Descriptive statistics. Bivariate correlations. **IV 1:** Alcohol use increased with sleep disruption and poor distress tolerance. **IV 2:** Sleep efficiency was significantly and negatively correlated with poor stress tolerance. **DV 1:** Alcohol use severity was significantly associated with sleep disturbance, sleep efficiency,	**Strengths:** The current literature examined a large sample from a unique population that is highly understudied regarding substance use and health behaviors. Study was unfunded Interventions to improve sleep quality among firefighters may include programs include discussion of the health impact of sleep disturbance, education regarding associations between alcohol use and sleep disturbance, an emphasis on building distress tolerance skills to enhance emotional coping and thus improve sleep

Key: **AUDIT-** alcohol use identifications test; **DTS-**distress tolerance scale; **DV-**dependent variable; **FF-** Firefighters; **IV-** independent variable; **N-**number of studies; **n-** number of participants; **PSQI-**Pittsburgh sleep quality index; **SOOS-14-**sources of occupational stress

			to participation and completion of all online questionnaires. Furthermore, reported drinking alcohol on at least a "monthly or less" basis, which used to measure alcohol use. **Exclusion Criteria:** Unwilling to provide informed consent for the completion of the online questionnaire, or those who did not wish to participate.				perceived sleep quality, and daily disturbances. Years of service within the fire department was not significantly correlated with sleep quality, alcohol use or distress tolerance. Hierarchical regression analysis was conducted Post-hoc exploratory analyses	quality and reduce alcohol use, and screening (and appropriate referrals) for problematic alcohol use. **Weaknesses:** Cross sectional study **Limitations:** Possible under reporting due to job loss concerns among career firefighters **Bias:** none listed

Key: **AUDIT-** alcohol use identifications test; **DTS-**distress tolerance scale; **DV**-dependent variable; **FF-** Firefighters; **IV-** independent variable; **N-**number of studies; **n-** number of participants; **PSQI-**Pittsburgh sleep quality index; **SOOS-14-**sources of occupational stress

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Serrano, D.M., et al. (2020). Association between sleep disturbances and suicide risk among firefighters: the moderating role of mindfulness. **Funding:** None specified **Bias:** Authors declare they have no conflict of interest. **Country:** United States	cross-sectional design	**Design-** Cross-sectional design **S**econdary analysis of data from a larger project examining stress and health-related behaviors among firefighters **Purpose-**To focus on better understanding relations among alcohol use, distress tolerance, and sleep disturbances among firefighters	**N=865** Firefighters **Setting:** The fire department has an online continuing education portal where the participants were able to access the study and relevant documents if they chose to participate **Sample demographics:** Male:813 Female:46 Transgender: 6	**IV 1:** Mindfulness **DV 1:** Sleep Disturbance **DV 2:** Suicide Risk	LEC-5 IDAS SBQ-R FFMQ PSQI SOOS-14	Descriptive statistics and bivariate correlations among main variables.	**DV-1:** Suicide risk was statistically significantly and positively associated with occupational stress ($r = .35$, $p < .001$), life- time trauma load ($r = .16$, $p < .001$), depression and anxiety symptoms ($r = .32$, $p < .001$), and sleep disturbance ($r = .36$, $p < .001$). **DV 2:** Suicide risk was also statistically significantly but negatively associated with overall mindfulness ($r = -.13$, $p < .001$), the awareness mindfulness facet ($r = -.28$, $p < .001$), and the nonjudgmental mindfulness facet ($r = -.31$, $p < .001$), whereas the non-reactivity ($r = .09$, $p < .01$) and the observing facets (r =	**Strengths:** Mindfulness is a promising intervention for improving mental health in firefighters. **Weaknesses:** Cross sectional study **Limitations:** Majority of firefighters are white male, future studies should include transgender, and minorities. Assessment of prior level of experience in mindfulness or meditation was not measured. **Bias:** Potential bias since study relied on self-reporting measures. Other barriers could not be ruled out.

Key: **AUDIT-** alcohol use identifications test; **DTS-**distress tolerance scale; **DV-**dependent variable; **FF-** firefighters; **FFMQ-**five facet of mindfulness questionnaire; **IDAS-** inventory of depression and anxiety symptoms; **IV-** independent variable; **LEC-5-** life events checklist for DSM 5; **N-**number of studies; **n-** number of participants; **PSQI-**Pittsburgh sleep quality index; **SOOS-14-**sources of occupational stress

			Mean age: 38.50 **Inclusion Criteria:** All and any firefighters from the selected fire department. **Exclusion Criteria:** None listed				.20, $p < .001$) were positively associated with suicide risk.	

Key: **AUDIT-** alcohol use identifications test; **DTS-**distress tolerance scale; **DV-**dependent variable; **FF-** firefighters; **FFMQ-**five facet of mindfulness questionnaire; **IDAS-** inventory of depression and anxiety symptoms; **IV-** independent variable; **LEC-5-** life events checklist for DSM 5; **N-**number of studies; **n-** number of participants; **PSQI-**Pittsburgh sleep quality index; **SOOS-14-**sources of occupational stress

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Lim M., et al. (2020). Psychosocial factors affecting sleep quality of pre-employed firefighters: a cross-sectional study. **Funding:** Supported by the Field oriented Support of Fire Fighting Technology Research and Development Program funded by National Fire Agency **Bias:** Authors declare they have no conflict of interest. **Country:** Korea.	Cross-sectional design	**Design-** Cross-sectional design Brief lecture about sleep, followed by a self-report questionnaire survey. **Purpose-**To focus on sleep quality of pre-employed firefighters, and to examine sleep quality and psychosocial factors.	**N=602** Firefighters **Setting:** Fire academy **Sample demographics:** Male:480 Female:122 Mean age: 97.3% of sample between 20-30 years old **Inclusion Criteria:** Firefighters who completed a 15-week academy, required training course, and had passed	**IV:** Psychosocial factors **DV:** Sleep Quality	PHQ-9 GAD-7 ISI FSSQ PSQI	Independent 2 sample t-test to examine relationship between general characteristic, psychological factors, social support, and sleep quality. Logistic regression was used to evaluate effects of psychosocial factors on sleep quality	Sleep quality of pre-employed firefighters are like civilians than on-duty firefighters. Sleep disturbances were correlated with different circadian rhythms. Sleep is significantly correlated with psychological factors Higher social support correlated with higher quality sleep.	**Strengths:** First study to examine pre-employed firefighters. Included many psychosocial factors that may be useful for identifying patterns. **Weaknesses:** Cross sectional study **Limitations:** Presence of a child, child-care activities and history of sleep medication was not addressed. Only 1% of total subjects in the study reported taking a sleeping pill. **Bias:** Bias and non-bias responses on self-reporting questionnaires cannot be ruled out.

Key: **DBP**- diastolic blood pressure; **DV**-dependent variable; **GAD-7-**generalized anxiety disorder 7;**FF**- Firefighters; **FSSQ-** functional social support questionnaire; **ISI-**Insomnia severity index; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PSQI-**Pittsburgh sleep quality index; **SBP-** systolic blood pressure

			the fire officer test. **Exclusion Criteria:** 349 people did not respond to any of the survey questions.					

Key: **DBP**- diastolic blood pressure; **DV**-dependent variable; **GAD-7-**generalized anxiety disorder 7;**FF**- Firefighters; **FSSQ-**functional social support questionnaire; **ISI-**Insomnia severity index; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PSQI-**Pittsburgh sleep quality index; **SBP-** systolic blood pressure

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Nakada, Y., Sigumoto, A., Kadotani, H., & Yamada, N. (2018). Verification of effect of sleep health education program in workplace: a quasi-randomized controlled trial. **Funding:** None listed **Bias:** Authors declare they have no conflict of interest. **Country:** Japan	Quasi-randomized control trial	**Design-** Study divided into two groups, intervention, and control group. Sleep health education was provided to both subjects and employees for primary prevention in the workplace. **Purpose-** test the effectiveness of sleep health education in the workplace for about half a year in terms of primary prevention of mental health and then to investigate sleep changes both subjectively and objectively using	**N= 77** Firefighters **Setting:** Workplace setting **Sample demographics:** Male:42 Female:28 Mean age: 43.1 **Inclusion Criteria:** Employees within a pharmaceutical company **Exclusion Criteria:** 341 of 418 who denied	**IV 1:** Sleep Health Program (SHP) **DV 1:** Effectiveness of education	ESS AIS PHQ-9 SF-8 MTN-210	ANOVA- Used to assess the changes by intervention in the two groups *t*-tests used between the two groups for group comparison Category data measured with X2 test, McNemar test, and Fisher's Exact.	Weekday sleep duration increased significantly among the intervention group who used MTN-210 compared to the control group.	**Strengths:** Q-QCT study results indicate a significant increase in the weekday sleep duration in the intervention group using a sleep health educational program. Included 16 shift workers. **Weaknesses:** Small sample size **Limitations:** Used employee numbers to randomize instead of traditional means. Subjects could be health-minded since it was conducted at a pharmaceutical site. **Bias:** Bias and non-bias responses on self-reporting questionnaires cannot be ruled out.

Key: **AIS-**Athens insomnia scale; **AUDIT-** alcohol use disorders identification Test; **DV**-dependent variable; **ESS-**Epworth sleepiness scale; **FF**- Firefighters; **IV**- independent variable; **KOSS-SF-** Korean occupational stress scale; **PHQ-9-** patient health questionnaire; **MTN-210-**Self-administered questionnaires and activity monitor; **N**-number of studies; **n**- number of participants; **SF-8-** health-related QOL score-standard version

		self-administered questionnaires and activity monitor	inclusion of the study.					

Key: **AIS-**Athens insomnia scale; **AUDIT-** alcohol use disorders identification Test; **DV**-dependent variable; **ESS-**Epworth sleepiness scale; **FF**- Firefighters; **IV**- independent variable; **KOSS-SF-** Korean occupational stress scale; **PHQ-9-** patient health questionnaire; **MTN-210-**Self-administered questionnaires and activity monitor; **N**-number of studies; **n**- number of participants; **SF-8-** health-related QOL score-standard version

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Won, G. et al. (2020). The effect of a mental health promotion program on Korean firefighters. **Funding:** Authors received funding from NFARK **Bias:** Authors declare they have no conflict of interest. **Country:** Korea	Cross-Sectional	**Design-** 2-year program of mental health promotion: consisted of 60-minute general education, one 30-minute individualized counseling session, and four 30-minute counseling sessions for those deemed high risk, and BIC **Purpose-** Assess firefighter mental health and provide individualized support to local	**N= 1,859** Firefighters **Setting:** "Counseling Center for Firefighters" **Sample demographics:** Male:1,757 Female: 97 Mean age: 40.75 **Inclusion Criteria:** All firefighters who received notice of the study. **Exclusion:** None listed **Criteria:** Any active firefighter who visited the "Visiting Counseling	**IV 1:** Mental Assessment and Promotion Health Program **DV 1:** Mental Health	PCL BDI BAI BSS ISI AUDIT-K WHOQOL-BREF	Paired sample *t*-tests for parametric data or Wilcoxon for non-parametric data. Independent *t*-tests or the Mann-Whitney test to compare clinical characteristic. Qualitative variables including sociodemographic data compared	**IV-**Participants showed psychopathological improvement throughout the 2 years. The PCL (p=.001), BDI (p =.000), BAI (p =.000), BSS (p =.000), ISI (p =.000) and AUDIT-K (p =.000) scores all significantly improved.	**Strengths:** Large sample size, low selection bias due to systemic approach. Offered participants an opportunity for introspection and detect those in need of aid. **Weaknesses:** Only recruited participants from a Geyongsang-do providence in Korea **Limitations:** all changes were compared before and after the program without follow-up, and mental health assessments are self-administered so bias cannot be ruled out. **Bias:** Bias and non-bias responses on self-reporting questionnaires cannot be ruled out.

Key: **AUDIT-K-**Alcohol use disorder identification test-Korea; **BAI-** Beck's anxiety inventory; **BIC-**Brief intensive counseling; **BDI-** Beck's depression inventory; **BSS-** Beck scale for suicidal ideation; **DV**-dependent variable; **ISI-**Insomnia severity index; **IV**-independent variable; **N**-number of studies; **NFARK-**National Fire Agency Republic of Korea; **n**- number of participants; **PCL-**Post-traumatic checklist; **PSQI-**Pittsburgh sleep quality index; **WHOQOL-BREF-**World health organization quality of life

		firefighters through a mental health promotion program.	Center for Firefighters"			using chi-square test, Fisher's exact test and linear by linear associatio n.		

Key: **AUDIT-K-**Alcohol use disorder identification test-Korea; **BAI-** Beck's anxiety inventory; **BIC-**Brief intensive counseling; **BDI-** Beck's depression inventory; **BSS-** Beck scale for suicidal ideation; **DV**-dependent variable; **ISI-**Insomnia severity index; **IV**-independent variable; **N**-number of studies; **NFARK-**National Fire Agency Republic of Korea; **n**- number of participants; **PCL-**Post-traumatic checklist; **PSQI-**Pittsburgh sleep quality index; **WHOQOL-BREF-**World health organization quality of life

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Smith, E., Velazquez-Pimentel, D., & Trockels, A. (2019). Posttraumatic Stress Disorder and Sleep Quality Among Urban Firefighters In Thailand. **Funding:** 90th Anniversary of Chulalongkorn Nature and Science of Sleep 2019:11 University Fund, Office of Higher Education Commission and TRF. **Bias:** Authors declare they have no conflict of interest. **Country:** Thailand	Cross-sectional design	**Design-** Cross-sectional Analysis of 35 fire stations to determine effects of trauma on sleep quality. **Purpose-** To find an association between PTSD and sleep quality among firefighters.	**N=1215** Firefighters **Setting:** 35 Fire stations under Fire Brigade Division of Bangkok Metropolitan Administration. **Sample demographics:** Male:1215 Mean age: 39 years **Inclusion Criteria:** actively working as a firefighter for at least one year, age more than or equal 18 years old	**IV 1:** PTSD severity using PLC-C assessment **DV 1:** Sleep Quality	PCL-C-THAI PSQI-THAI	SPSS Bivariate analysis used Chi-square Fisher's exact test used if assumption was not met Continuous data sample *t*-tests were applied. If data was skewed, Mann-Whitney U test was used.	Of the 1215 firefighters, 78 were categorized into PTSD group using PCL-C scores. 88.5% of firefighters with PTSD reported poor sleep quality, compared to 46.4% without PTSD.	**Strengths:** Significant association between PTSD and sleep quality among firefighters. Current study suggests interventions and a policy related to psychological well-being among firefighters may enhance health. **Limitations:** Sleep quality was not differentiated for on-duty and off-duty it was within a 30-day timeframe. Call volumes were not considered. Cross-sectional studies cannot conclude the relationship between PTSD and sleep. Study cannot be generalized for wildfire firefighters. Different cut off

Key: **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PLC-C**-posttraumatic stress disorder checklist-civilian version; **PTSD**-posttraumatic stress disorder; **PSQI-THAI**-pittsburgh sleep quality index; **TRF**-Thailand research fund

			and male firefighters. **Exclusion Criteria:** None listed					point for questionnaire. **Bias:** Bias cannot be ruled out in self-reporting surveys.

Key: **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PLC-C-**posttraumatic stress disorder checklist-civilian version; **PTSD-**posttraumatic stress disorder; **PSQI-THAI-**pittsburgh sleep quality index; **TRF-**Thailand research fund

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
Kim, J., Park, H., & Kim, J. (2018). Alcohol use disorders and insomnia mediate the association between PTSD symptoms and suicidal ideation in Korean firefighters. **Funding:** None specified **Bias:** Authors declare they have no conflict of interest. **Country:** South Korea	Cross-sectional design	**Design-** Cross sectional Part of a self-report online survey administered in 34 fire-stations **Purpose-** Investigate the mediating role of AUDs (Alcohol use disorders) and insomnia in the relationship between PTSD (Posttraumatic stress disorder) symptoms and SI (suicidal ideation).	**N=7190** Firefighters **Setting:** 34 fire stations in South Korea, two headquarters and one academy. **Sample demographics:** Male: 6,521 Female:669 Mean age: 39.6 years old Average years of work:12.5 years **Inclusion Criteria:** All and any firefighters from the	**IV 1:** Alcohol Use **IV 2:** Insomnia **DV 1:** PTSD **DV 2:** Suicidal Ideation	AUDIT-KOREA AIS-KOREA PCL-KOREA PHQ-9-KOREA	Hierarchical multivariable linear regression analyses were performed to identify the relationship of AUDs and insomnia with suicidal ideation.	**DV 1-**377 Firefighters were found to have probable PTSD in the past month. **DV 2-**PTSD symptoms showed positive association with suicidal ideation, and the number of traumatic events were significantly associated with suicidal ideation The indirect effect of PTSD symptoms on suicidal ideation was mediated by AUDs and	**Strengths:** First study to investigate the role of AUDs and insomnia in the relationship between PTSD symptoms and suicidal ideation. Hypothesis can be made that after exposure to trauma, PTSD symptoms occur, leading to increased use of alcohol which increased insomnia and leads to sleep disturbances; ultimately leading to suicidal ideation. **Weaknesses:** Cross sectional study **Limitations:** Majority of firefighters are Korean male. Firefighters may underreport suicidal ideation or PTSD symptoms due to stigma of being

Key: **AIS-**Athens insomnia scale; **AUD-**Alcohol Use Disorder; **AUDIT-**Alcohol use disorder identification test; **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PCL-**PTSD symptom checklist; **PHQ-9-**Patient health questionnaire; **PTSD-**posttraumatic stress disorder; **SI-**suicidal ideation

			selected fire department. **Exclusion Criteria:** None listed				insomnia, PTSD symptoms were significantly associated with AUDs (β = 0.165, P < 0.001), AUDs were significantly associated with insomnia (β = 0.150, P < 0.001), and insomnia was significantly associated with suicidal ideation (β = 0.018, P < 0.001).	"weak" or "vulnerable". Did not obtain information on plan or actual attempt of suicide. Limited to Korean firefighters in one province. Socioeconomic status factors were not considered. **Bias:** Potential bias since study relied on self-reporting measures.

Key: **AIS-**Athens insomnia scale; **AUD-**Alcohol Use Disorder; **AUDIT-**Alcohol use disorder identification test; **DV**-dependent variable; **FF**- Firefighters; **IV**- independent variable; **N**-number of studies; **n**- number of participants; **PCL-**PTSD symptom checklist; **PHQ-9-**Patient health questionnaire; **PTSD-**posttraumatic stress disorder; **SI-**suicidal ideation

Appendix F

Table 2

Synthesis Table

Author	Sullivan	Barger	Choi	Billings	Smith	Serrano	Lim	Won	Nakada	Smith
Year	2017	2016	2016	2016	2017	2020	2020	2020	2018	2019
Design/Level of Evidence:	RCT/II	CS/V	CS/V	CS/V	CS/V	CS/V	CS/V	CS/V	QRCT/III	CS/V
Study Characteristics										
Demographics										
Age (Mean y.o.)	43.6	40.8	55-64	60	52.5	58.4	20-30	40.75	40-49	64.6
Males %	98.7	95.3	61.1	80	85.3	100	79.7	89	60	73
Female %	1.3	2.2	44.4	n/a	29.4	40	20.3	11	40	46
Unknown/Transgender		2.5	50	n/a	61.8	60	n/a	n/a	n/a	39.8
Setting:										
On-site Workplace	X	X		X	X	X			X	X
Fire Academy							X			
Off-Site Clinic			X					X		
Sample Size/ # of Studies Included	1189	2645	330	103	53	37 (NRNCT), 18 (DQ)	602	1859	77	1215
Measurement Tools	AIS, BQ-SR, ESTQ	LS, ICSD-2	JCQ ERIQ	PSQI	AUDIT DTS PSQI SOOS-14	LEC-5 IDAS SBQ-R FFMQ PSQI SOOS-14	PHQ-9 GAD-7 ISI FSSQ PSQI	PCL BDI BAI BSS ISI AUDIT-K WHOQOL-BREF	ESS AIS PHQ-9 SF-8 MTN-210	PCL-C-THAI PSQI-THAI

Key: AIS- Athens insomnia scale; **BDI -** Beck's depression inventory; **BQ-SR –** Berlin questionnaire self-report**; CS-**cross-sectional; **CG** - control group**; DV-** dependent variables; **EG** – experimental group; **ERIQ-** effort-reward imbalance questionnaire; **ESTQ-**epidemiology symptoms and treatment questionnaire; **FSSQ-**functional social support questionnaire **GAD-7-**generalized anxiety disorder screen; **ICSD-2** – classification of sleep disorders-2; **ISI-**insomnia severity index; **JCQ-**job content questionnaire; **IV-** independent variables; **LS** – Likert Scale**; MHPP-**mental health promotion program; **m –** months; **n/a –** not applicable; **PHQ-9** - patient health questionnaire -9; **PSQI-**Pittsburgh sleep quality index **RCT** – randomized control trial; **QRCT-**quasi-randomized control trial; **SHP** – sleep health program; **sx-**symptoms; **WHOQOL-BREF** – world health quality of life measure brief; **y/o-**years old; * - statistically significant with *p*-value ≤ 0.050; ↑ - increased; ↓ - decreased;

Duration of Intervention (minutes)	30	30	6	20	60	60	n/a	90-160	150	n/a
IV – Interventions										
Blood Pressure Measurement			X							
Expert Led SHP	X								X	
MHPP								X		
Mindfulness		X				X				
Online Module SHP		X					X			
Train-The-Teacher SHP		X								
SHP									X	
SHP Policy										
Screening Tools	X	X	X	X	X	X	X	X	X	X
DV-Dependent Variable										
Anxiety						↓				
Health Knowledge	↑		↑		↑	↑	↑	↑	↑	
Hypertension		↑	↑							
Injury/Disability	↓									
Psychopathological sx								↓		↓
PTSS						↓				
Sleep Deprivation									↓	
Sleep Knowledge	↑			↑		↑	↑		↑	↑
Suicidality						↓				

Key: AIS- Athens insomnia scale; **BDI -** Beck's depression inventory; **BQ-SR –** Berlin questionnaire self-report**; CS-**cross-sectional; **CG** - control group**; DV-**dependent variables; **EG** – experimental group; **ERIQ-** effort-reward imbalance questionnaire; **ESTQ-**epidemiology symptoms and treatment questionnaire; **FSSQ-**functional social support questionnaire **GAD-7-**generalized anxiety disorder screen; **ICSD-2** – classification of sleep disorders-2; **ISI-**insomnia severity index; **JCQ-**job content questionnaire; **IV-** independent variables; **LS** – Likert Scale**; MHPP-**mental health promotion program; **m –** months; **n/a –** not applicable; **PHQ-9** - patient health questionnaire -9; **PSQI-**Pittsburgh sleep quality index **RCT** – randomized control trial; **QRCT-**quasi-randomized control trial; **SHP** – sleep health program; **sx-**symptoms; **WHOQOL-BREF** – world health quality of life measure brief; **y/o-**years old; * - statistically significant with *p*-value ≤ 0.050; ↑ - increased; ↓ - decreased;

Appendix G

Models and Frameworks

Figure 1

The Cognitive Behavioral Therapy Model

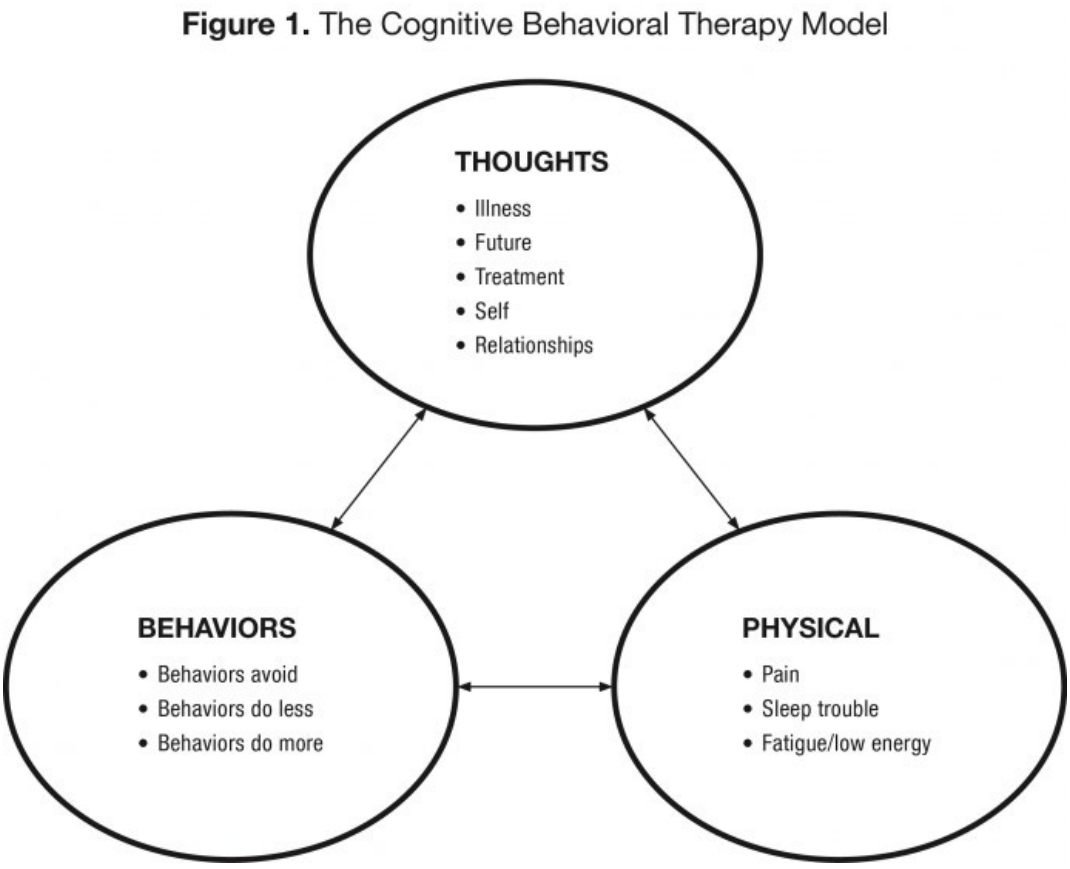
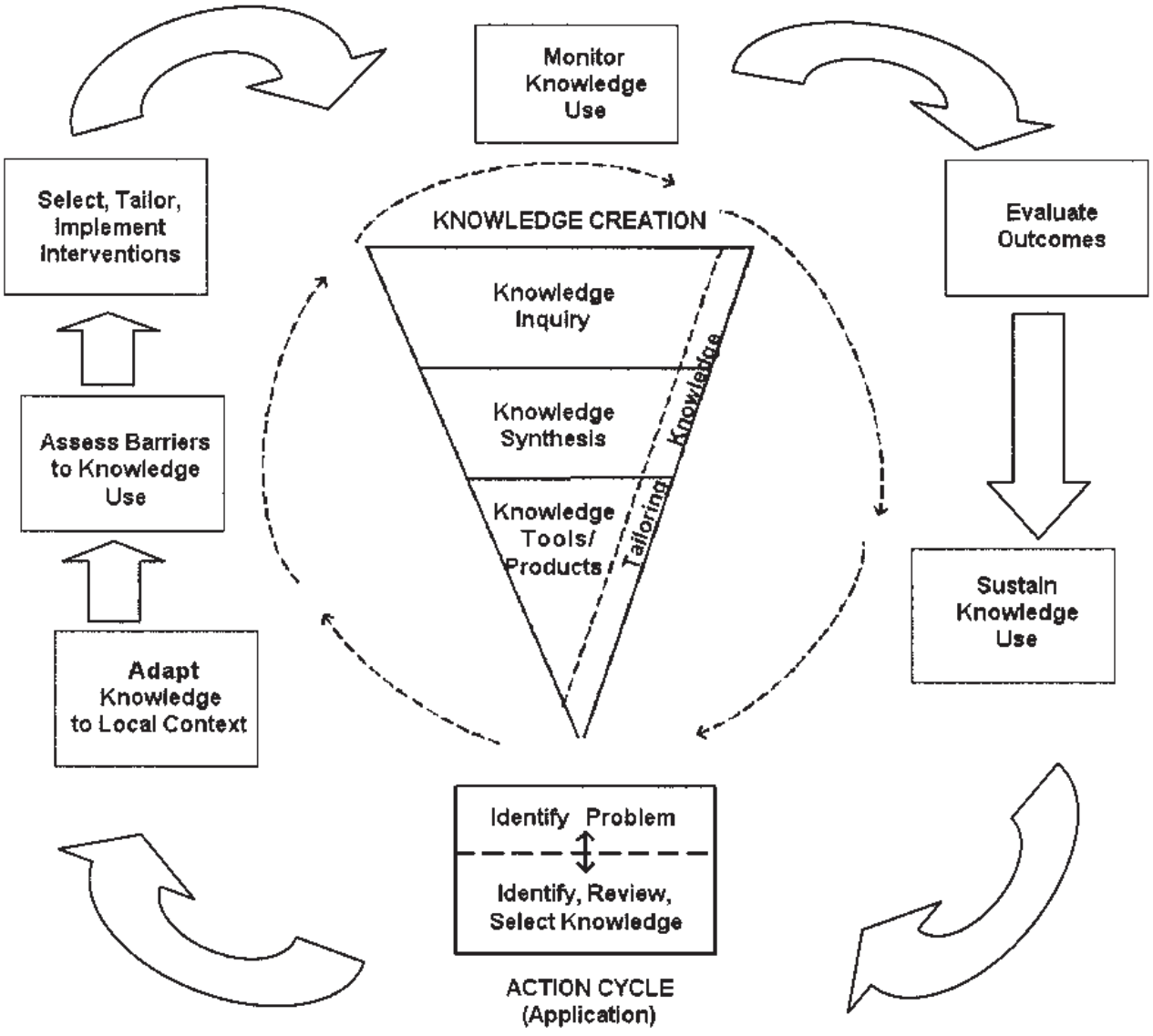


Figure 2

A Knowledge to Action Framework



Appendix H

Table 1

Demographics (n=2)

Variable	%
Race	
white	100
Age	
45-49	50
30-44	50
Years_on_Job	
10+	50
5-10	50
Gender	
male	100
X24_hour_shift	
yes	100
sleep_dx_or_tx	
no	100

Table 2

Sleep Related Impairment and Sleep Disturbance Assessment Descriptive Statistics (n=2)

Variables	*M*	*SD*	Min	Max
PRE-SRI Total Score	20.50	13.44	11.00	30.00
POST-SRI Total Score	23.00	18.38	10.00	36.00
POST-SDA Total Score	19.00	4.24	16.00	22.00
PRE-SDA Total Score	19.50	2.12	18.00	21.00

Table 3

Feasibility Measure (*n=2)*

Variables	*M*	SD	Min	Max
LOGICAL1	4.00	0.00	4.00	4.00
CONTINUED_USE4	4.00	0.00	4.00	4.00
CONVENIENCE_OF_PHONE7	4.50	0.71	4.00	5.00
OVERALL_EXPERIENCE10	4.50	0.71	4.00	5.00
EASE2	3.00	2.83	1.00	5.00
SUCCESSFUL5	3.00	0.00	3.00	3.00
RECOMMEND_PHONE8	4.50	0.71	4.00	5.00
HELPFUL3	3.50	0.71	3.00	4.00
REPEAT_PROGRAM6	3.00	1.41	2.00	4.00
RECOMMEND_TO_FIREFIGHTERS9	4.00	1.41	3.00	5.00

Table 4

Summary Statistics Table for Interval and Ratio Variables by Years_on_Job (n=2)

Variable	*M*	*SD*	Min	Max
PRESRITS				
10+	11.00	-	11.00	11.00
5-10	30.00	-	30.00	30.00
POSTSDATS				
10+	16.00	-	16.00	16.00
5-10	22.00	-	22.00	22.00
PRESDATS				
10+	21.00	-	21.00	21.00
5-10	18.00	-	18.00	18.00
POSTSRITS_1				
10+	10.00	-	10.00	10.00
5-10	36.00	-	36.00	36.00

Table 5

Summary Statistics Table for Interval and Ratio Variables by X24_hour_shift (n=2)

Variable	*M*	*SD*	Min	Max
PRE-SRI Total Score				
Yes 24-hour shift	20.50	13.44	11.00	30.00
POST-SDA Total Score				
Yes 24-hour shift	19.00	4.24	16.00	22.00
PRE-SDA Total Score				
Yes 24-hour shift	19.50	2.12	18.00	21.00
POST-SRI Total Score				
Yes 24-hour shift	23.00	18.38	10.00	36.00

Table 6

Summary Statistics Table for Interval and Ratio Variables by Age (n=2)

Variable	*M*	*SD*	Min	Max
PRESRITS				
45-49	11.00	-	11.00	11.00
30-44	30.00	-	30.00	30.00
POSTSDATS				
45-49	16.00	-	16.00	16.00
30-44	22.00	-	22.00	22.00
PRESDATS				
45-49	21.00	-	21.00	21.00
30-44	18.00	-	18.00	18.00
POSTSRITS_1				
45-49	10.00	-	10.00	10.00
30-44	36.00	-	36.00	36.00