Can subjective sleep problems detect latent sleep disorders among commercial drivers?

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ABSTRACT

Introduction: Long-haul truck drivers experience poor sleep health and heightened accident rates, and undiagnosed sleep disorders contribute to these negative outcomes. Subjective sleep disorder screening tools may aid in detecting drivers' sleep disorders. This study sought to evaluate the value of subjective screening methods for detecting latent sleep disorders and identifying truck drivers at-risk for poor sleep health and safety-relevant performance.
Materials and Methods: Using cross-sectional data from 260 long-haul truck drivers, we: 1) used factor analysis to identify possible latent sleep disorders; 2) explored the construct validity of extracted sleep disorder factors by determining their associations with established sleep disorder risk factors and symptoms; and 3) explored the predictive validity of resulting sleep disorder factors by determining their associations with sleep health and safety-relevant performance.
Results: Five latent sleep disorder factors were extracted: 1) circadian rhythm sleep disorders; 2) sleep-related breathing disorders; 3) parasomnias; 4) insomnias; 5) and sleep-related movement disorders. Patterns of associations between these factors generally corresponded with known risk factors and symptoms. One or more of the extracted latent sleep disorder factors were significantly associated with all the sleep health and safety outcomes.
Discussion: Using subjective sleep problems to detect latent sleep disorders among long-haul truck drivers may be a timely and effective way to screen this highly mobile occupational segment. This approach should constitute one component of comprehensive efforts to diagnose and treat sleep disorders among commercial transport operators.

1. Introduction

In the United States there are nearly 2,000,000 heavy and tractor-trailer truck drivers (Bureau of Labor Statistics, 2015c). Most of these drivers are considered long-haul truck drivers, whose work requires them to remain on the road for prolonged periods of time (Apostolopoulos et al., 2014; Bureau of Labor Statistics, 2015c). During these periods, nearly all on- and off-duty time – including sleep periods – is spent at worksites, which have been labeled 'healthy living deserts' and are not conducive of sleep health or other safety-related health behaviors (Apostolopoulos et al., 2016b; Apostolopoulos et al., 2011;

Lemke et al., 2016b).

Accident rates among long-haul truck drivers are indicative of poor sleep health. The broader transportation and warehousing sector had the highest reported rate of injuries and illnesses among private industries in 2014 and accounted for the largest share of fatal injuries of any occupation group (Bureau of Labor Statistics, 2015a, 2015b). Within this sector, drivers/sales workers and truck drivers accounted for two-thirds of all fatal injuries, with long-haul truck drivers in particular having fatal injury rates that are seven times higher than the overall average across all occupations (Smith, 2015). This emerging public health problem is not isolated to the United States; for example,

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road transport has been identified as a national priority under *The Australian Work Health and Safety Strategy 2012*–2022 (Safe Work Australia, 2012).

Numerous characteristics of the long-haul trucking profession impact sleep health. As a whole, long-haul truck drivers endure numerous hazards, many of which are related to the physical and psychological strains associated with the profession (Apostolopoulos et al., 2014). Principal among these strains are long work hours, shift work, job stress, and unhealthy work environments (Hege et al., 2015; Lemke et al., 2015). These strains reduce sleep quality and sleep duration and increase fatigue and sleepiness, which ultimately impact long-haul truck drivers' health and safety outcomes (Ebrahimi et al., 2015; Hege et al., 2015; Howard et al., 2004; Lemke et al., 2015; McCartt et al., 2000; Pack et al., 2006; Parks et al., 2009; Philip, 2005; Philip and Åkerstedt, 2006). These strains also induce sleep disorders, and the presence of sleep disorders, especially those that are undiagnosed, represent substantial threats to the health and well-being of long-haul truck drivers and the general motoring public.

Undiagnosed – or "*latent*" – sleep disorders continue to plague commercial driving, as the mobility of the population makes it pragmatically difficult to receive objective clinical sleep disorder diagnoses. For example, the most common sleep disorder for long-haul truck drivers is obstructive sleep apnea (OSA) (Sharwood et al., 2012; Xie et al., 2011), yet the sample used in the current study reported only a 11.6% diagnosis rate, compared to national estimates of a 17%–28% prevalence rate (Kales and Straubel, 2014). Other studies have suggested that OSA prevalence is much higher; for example, among 526 male truck drivers in Italy, over 50% were found to be at risk of OSA (Guglielmi et al., 2017). This suggests that the degree of latent OSA may be severe among truck drivers worldwide and warrants urgent attention. Untreated OSA continues to be a significant risk factor in roadway accidents among long-haul truck drivers (Tregear et al., 2009), as do other impactful sleep disorders such as restless legs syndrome (RLS), delayed or advanced sleep phase syndrome, insomnia, and narcolepsy (Krueger et al., 2007a).

The same factors that contribute to other sleep health problems also induce sleep disorders, resulting in heightened prevalence of sleep disorders and leading to fatigue and compromised safety performance (Anderson et al., 2012; Hege et al., 2015; Krueger et al., 2007a; Parks et al., 2009; Smolensky et al., 2011). The third and most recent edition of the American Academy of Sleep Medicine's International Classification of Sleep Disorders (ICSD-3) includes seven major categories of sleep disorders: Insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, parasomnias, sleep-related movement disorders, and other sleep disorders (American Academy of Sleep Medicine, 2014; Sateia, 2014). Extant studies indicate that sleep disorders increase subjective sleepiness and degrade alertness and driving task performance, and thus represent major risk factors in injuries and roadway accidents (Braeckman et al., 2011; McCartt et al., 2000; Sanna, 2013). Unsurprisingly, sleep disorders, and especially OSA, have been found to heighten accident risk among truck drivers worldwide, including in the United States, Japan, Portugal, Italy, Brazil, Argentina, and Iran; further, their impacts on workplace safety appear to disproportionately impact truck drivers compared to other professions (Amra et al., 2012; Catarino et al., 2014; Cui et al., 2006; de Pinho et al., 2006; Ebrahimi et al., 2015; Garbarino et al., 2016a,b,c; Garbarino et al., 2017; Guglielmi et al., 2016, 2017; McCartt et al., 2000; Tregear et al., 2009).

Given the severe consequences of sleep disorders for long-haul truck drivers, their families, their employers, and the public, their diagnosis and treatment within this population has become an imperative (Krueger et al., 2007a). A systems approach (Newnam and Goode, 2015; Newnam et al., 2017) to managing sleep disorders has been advocated, with relevant interventions identified at the driver-level, as well as at the company, supply chain, and regulatory/government levels (Ancoli-Israel et al., 2008; Krueger et al., 2007a); however, several

barriers have hindered progress. For one, federal regulations, such as those from the U.S. Department of Transportation (DOT) and the Federal Motor Carrier Safety Administration (FMCSA), are generally lacking (Hartenbaum et al., 2006; Kales and Straubel, 2014; Krueger, 2013). This, in turn, has not allowed for regulated enforcement or monitoring of the issue at the trucking company and supply chain levels. The recent decision by the Trump administration to reverse plans to make sleep apnea testing among truck drivers mandatory (Bowden, 2017) suggests further non-involvement at the federal level to address these issues. Another barrier has been the logistics of diagnostic methodologies: Many objective diagnostic techniques (e.g., polysomnography) require drivers to be on-site, which is problematic given the mobility of this population (Kales and Straubel, 2014). A coordinated effort between the U.S. DOT and the FMCSA would likely be required to design designated screening locations to overcome this barrier.

As an alternative to objective screening methods, subjective screening methods, which rely on self-report items (Kales and Straubel, 2014), may be more practical given the nature of long-haul truck driving. Subjective tools have been used for screening for several sleep disorders, such as OSA, shift work disorder, restless leg syndrome, and insomnia, and have been explored across populations such as nurses, preschool children, and older adults (El-Sayed, 2012; Flo et al., 2012; Iwasaki et al., 2010; Luyster et al., 2015; Sadeghniiat-Haghighi et al., 2014). However, the value of such screening methods among long-haul truck drivers, whose unique occupational milieu may induce distinct patterns of sleep disorders and subjective symptomology, have yet to be established (Dagan et al., 2006; Kales and Straubel, 2014). Exploring the value of subjective screening methods in this population appears to be worthwhile and may allow for better identification of undiagnosed sleep disorders in this safety-critical population.

Ultimately, identifying long-haul truck drivers with undiagnosed sleep disorders is a public safety and health priority, and along with the workforce characteristics of long-haul trucking – namely, the combination of long work hours, frequent shift work, poor environmental conditions, unhealthy behaviors, and an aging driver population –developing more efficacious screening methods has never been more important (Kales and Straubel, 2014; Zhang et al., 2012). Because sleep disorders are diagnosable, treatable, and manageable among long-haul truck drivers (Hoffman et al., 2010; Krueger et al., 2007a), enhanced screening guidance can provide practical benefits for long-haul truck drivers and other relevant stakeholders. Therefore, we explored the potential feasibility of using subjective screening methods by evaluating whether self-reported subjective sleep problems constituted psychometrically sound measures for detecting latent sleep disorders among a sample of long-haul truck drivers.

2. Materials and methods

2.1. Study design and participants

A detailed description of the study procedures and cohort characteristics has been described in previous manuscripts that used this same dataset (Apostolopoulos et al., 2016a; Hege et al., 2016, 2015; Lemke et al., 2016a; Lemke et al., 2017a,b,c; Lemke et al., 2015; Wideman et al., 2016). A non-experimental, cross-sectional design was employed to collect survey and anthropometric data from 262 U.S. long-haul truck drivers at a large truck stop located where two major interstates merge (I-40 and I-85) in North Carolina. Due to the consistent and high level of trucking activity, geographic location, and transient nature of the long-haul trucking profession, this specific location constituted a representative national truck stop – one that is part of the chain of truck stops recognized as the largest full-service travel center company in the U.S. – offering numerous truck maintenance services. The recruitment of participants involved researchers using intercept techniques by approaching drivers at the truck stop to invite