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At home and away: Measuring the sleep of Australian truck drivers

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ABSTRACT

The causes of fatigue in truck drivers related to work hours have been studied extensively and are reasonably well understood. However, much less is known about how rest opportunities can be structured to optimise recovery from fatigue. The nature of the road transport industry often requires that rest be taken in various locations. New investigation in this area, focusing on sleep obtained in truck cabs and other non-home environments is critically important to complement existing understanding. This study examined sleep at home and in truck cabs, in truck drivers who were actively working during the time of the study. Thirty-seven male drivers aged between 24 and 63 years (age: 48.7 ± 9.0 years; mean ± SD) wore activity monitors (also known as 'sleep watches') and completed work and sleep diaries for a period of 21 days, recording their subjective fatigue levels before, during and after work shifts, and before and after sleep periods. They also self-rated their sleep quality and noted the number of times they woke during sleep periods. Analyses focused on home versus in-truck sleep periods. The subjective data suggested that a greater quantity ($P < .001$) and quality ($P < .05$) of sleep was obtained at home than in the truck, and that sleeping at home more effectively reduced fatigue levels ($P < .001$). The objective data showed trends towards longer sleep length at home, but other variables, including total sleep per 24 h and sleep quality, showed no significant differences. This study demonstrates that measuring sleep quantity and quality in operational road transport environments is feasible. The findings caution against over-reliance on laboratory and simulator studies since there are critical aspects of the operating environment that cannot be validly studied in artificially controlled settings. This study is unique in its direct examination of sleep quantity and quality in truck drivers sleeping at home and away from home.

1. Introduction

1.1. Driver fatigue

Numerous research studies have demonstrated the significant contribution of fatigue to road traffic accidents, using epidemiological, survey, and experimental studies. Within this body of research, the causes of fatigue specific to truck drivers have been examined, including hours of sleep and work prior to driving, as well as the hours and distance driven.

Many of the studies using objective (laboratory or simulator) measures have used non-professional, young adult driver participants (e.g. Reyner and Horne, 1998), since the young adult group is largely over-represented in fatigue related crashes. It is also the case that young adults are more likely to be available as study participants, particularly in university-based research. Field studies of truck drivers using activity monitors and sleep diaries have gathered contextually valid data to demonstrate the links between fatigue, accident risk and sleep opportunity (Hanowski et al., 2007; Heaton and Rayens, 2010). However, there are very few studies which have made direct comparisons of sleep in home and non-home locations, or examined the objective characteristics of sleeping (or napping) during work hours while on the road. Relevant studies have, however, been conducted in other industries.

1.2. Studies of sleep in other industries

1.2.1. Rail transport

A small number of studies most relevant to the value of rest breaks and sleep have investigated the impact of relay work on train drivers' sleep quantity and quality, using activity monitors and sleep diaries prior to and during short (<48 h) relay trips. These trips require two crews to drive from one specified destination to another and return working in alternating shifts (Lamond et al., 2005a,b). Findings showed an average of 7.8 h of sleep per night at home, compared to only 4.0 h during relay, with relay van sleep also showing longer sleep onsets, lower sleep efficiency and poorer

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subjective sleep quality than home sleep. Drivers obtained significantly more sleep during opportunities that occurred in the evening than those during the day. An extension of these studies, using objective electro-encephalographic (EEG) data, has shown that the quantity of sleep obtained in the relay vans was significantly reduced compared to sleep at home (average 3.3 h vs. 6.8 h), but that there were no significant differences for sleep quality (Jay et al., 2006).

1.2.2. Marine transport and offshore environments

A number of studies have investigated sleep and fatigue in marine transport and offshore installations, focusing on sleeping facilities and the physical environment (e.g. Parkes, 1994). Some of these studies have compared the sleep of offshore workers with personnel carrying out similar work onshore. Findings point largely towards reduced sleep quantity and quality at work, with noise, vibration and the number of occupants in shared sleeping facilities as the main causes.

This is supported by a study by one of the current authors (Reyner and Baulk, 1998), which investigated sleep quantity and quality in passenger ferry crew working a week-on, week-off schedule. Findings showed greater sleep length and quality during the week at home. Another study used activity monitors and diaries to examine sleep and fatigue for commercial fishermen at home and during extended periods at sea (Gander et al., 2008). While at sea, there was still a clear preference for sleep at night, but the fishermen were more likely to have split sleep, and more likely to sleep less than 4 h per 24-h period. While other measures of sleep quality did not differ, greater fatigue was also reported at sea.

Other studies have examined work/rest schedules, sleep parameters and fatigue in merchant marine personnel (Sanquist et al., 1997), onboard offshore installations (Menzees et al., 2004; Smith, 2008) and in marine simulators (Eriksen et al., 2006) to show that offshore workers experience greater negative effects than onshore workers. However, these studies have not directly compared sleep at home with that obtained in the workplace, or objectively investigated the nature of sleep in operational locations.

1.2.3. Aviation

Aviation studies are pertinent to the value of rest due to routine inclusion of 'layovers' (overnight stays in non-home sleeping environments) and crew rest facilities used for sleep on long-haul flights. Several Australian studies of sleep and fatigue in pilots (e.g. Lamond et al., 2006; Petrilli et al., 2006) examined the impact of international flight patterns and layovers of varying length. Detailed studies are lacking however, which compare the sleep of pilots and other personnel between home, in-flight and layover locations. One important study, using EEG, activity monitors and subjective measures in long-haul flight crews (Signal et al., 2005), demonstrated good correlations for sleep length, but less agreement regarding quality. As part of the study, sleep was measured both during an overnight layover (i.e. sleeping in a hotel room), and also during a 7-h scheduled rest break during the flight. The findings showed that sleep was shorter and of lower quality during flight.

1.2.4. Construction

A study of construction workers (Persson et al., 2006) examined the effects of extended hours and temporary accommodation on sleep and fatigue, against a second group working more regular hours and sleeping at home. The findings showed signs of impaired recovery between shifts for the temporary accommodation group, as indicated by higher physical exertion ratings at the start of work, higher fatigue scores, and higher daytime sleepiness.

1.3. Study aims

Studies from rail transport, aviation, and construction industries have used diaries, activity monitors and EEG measures to show that sleep obtained while away from home is generally shorter and of lower quality than that obtained at home. However, further research is needed to directly examine sleep obtained away from home, and to make comparisons with sleep obtained at home for truck drivers. This may provide scientific support for drivers to continue driving if they feel safe to do so and are within a certain time from arriving home (in order to obtain more restorative sleep).

The current study aimed to examine sleep quantity and quality during both work and non-work periods using subjective and objective methods for a group of Australian truck drivers.

2. Methods

2.1. Participants

In discussion with members of a road transport industry association, and communication to its wider membership, companies expressed interest in volunteering drivers to participate. Further information on the study was provided by phone and email, and individuals interested in participating were asked to complete a general health questionnaire to subjectively screen for sleep disorders and other health problems, and also to gather background information on topics such as driving experience and exposure. Participants were not paid for taking part in the study other than their usual salary while at work and all participants gave informed consent.

There were several drivers who did not fully complete their participation in the study, in some cases causing delays to the completion of data collection. Examples included: a driver taken seriously ill and forced to withdraw; a driver left the company they were working for and thus withdrew; drivers returned unused activity monitors and/or failed to complete and return sleep diaries.

2.2. Work setting

The drivers worked for 12 different companies throughout Australia, and the operations varied from owner-drivers with a single truck, to national companies with multiple depots. Work patterns varied and included night work, early morning work, and day work with no requirement to sleep away from home.

2.3. Procedure

Small groups of drivers from each company participated separately, each for a 21-day period, during which time all participants continued their regular, rostered work schedule, and went about their normal duties. Experimenters were contactable by telephone at all times. All drivers received confidential feedback on their own study results to help them understand their sleep pattern and other outputs in relation to their work hours.

2.4. Measures and data analysis

2.4.1. Subjective sleep duration and quality

Participants were asked to provide detailed information about their sleep using a sleep diary. For each sleep period (including naps), they recorded date/time of sleep onset, final wake time and the number and length of awakenings during the sleep period, their level of fatigue before and after sleep, and a quality rating for the sleep period on a 6-point scale: 1 = "very good"; 2 = "good"; 3 = "average"; 4 = "poor"; 5 = "very poor"; 6 = "did not sleep". The