



Assessing the relationship between heavy vehicle driver sleep problems and confirmed driver behavior measurement tools in Iran



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ABSTRACT

Road traffic crashes have become an important public health problem. By studying the statistics of heavy vehicle crashes in the world, it becomes obvious that although heavy vehicle drivers experience fewer crashes than private car drivers, a large percentage of heavy vehicle crashes leads to death. So, it is important to identify the driving characteristics of heavy vehicle drivers. In this study, 474 Iranian truck drivers were interviewed face to face. Response rate of the survey was 80%, the participants who answered the questions on two behavioral questionnaires: Driver Behavior Questionnaire (DBQ) and Attention-Related Driving Error Scale (ARDES). Also, two sleep assessing questionnaires, Global Dissatisfaction with Sleep (GSD) and the Berlin Questionnaire, were completed. Confirmatory Factor Analysis (CFA) was used to confirm the validity of DBQ and ARDES for Iranian heavy vehicle drivers. After that, a Structural Equation Modeling (SEM) was used to identify the influence of sleep characteristics on truck driver behaviors. Results showed that more truck drivers are dissatisfied with their sleep, the more daily fatigue they suffer, and consequently, the more errors, slips, violations, and inattention they exhibit. Similar result trend was obtained for driver exposure. Also, the results showed that the more expensive a truck is, the less daily fatigue felt by the driver of the truck. Consequently, this leads to less aberrant driving behavior and inattention during driving.

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1. Introduction

Road traffic crashes are a serious public health issue (Peden et al., 2004). According to the World Health Organization (WHO), there were about 1.2 million deaths on roads across the world in 2010. From the year 2002 to 2010, road traffic crashes had risen from the eleventh to the eighth leading cause of mortality. According to the WHO report on road safety, the annual death rate from road crashes in Iran is 32.1 per 100,000 people; hence Iran is ranked 7th in the world with respect to road traffic fatalities (World Health Organization, 2013).

Although trucks are involved in fewer crashes per million kilometers driven compared with private vehicles (Walton, 1999), a large percentage of crashes involving trucks leads to death (Sullman et al., 2002). There are approximately 26,000 road fatalities in Europe each year, and 15% of these are related to heavy vehicles (Volvo truck corporation, 2017). While trucks account for around 8.3% of the total number of vehicles on Iran's roads, they were involved in 20.5% of all fatal

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crashes in 2014. Also, in 2015, 11% of crashes on roads led to the death of Iranian truck drivers/passengers, but this percentage is lower in developed countries: its 2% in the United States of America and 1% in the United Kingdom (World Health Organization, 2015).

Further, researchers declare that driver behavior is a significant factor in crash risk (Rowe et al., 2015). Different questionnaires are used to study driver behavior. Reason's research (Reason et al., 1990) on human behavior leading to dangerous situations introduced a self-report measure of driver behavior, named the Driver Behavior Questionnaire. Since its publication, more than 174 published papers have used this questionnaire (de Winter and Dodou, 2010) to investigate driver behavior. However, only a few published studies have used the DBQ to investigate aberrant driving behaviors among truck drivers. One of such studies is Sullman's study, which examined the truck driver behavior in New Zealand with the DBQ and found that 'violations' is significantly correlated with the involvement of truck drivers in crashes (Sullman et al., 2002). In another study, the behaviors of professional drivers were compared with those of non-professional drivers in Serbia using the Manchester DBQ. In the study, professional drivers are defined as drivers whose main job is driving a vehicle, and 79% of professional drivers were truck drivers (the rest included light goods delivery vehicle and bus drivers). The results of the study showed a correlation between non-professional drivers and ordinary/aggressive violations and errors, while professional drivers were associated with positive behaviors (Maslač et al., 2018). Also, in Egypt, a research investigated the effect of aberrant truck driver behaviors on truck involvement in crashes. The results of the study showed that fatigue and lack of sleep are two factors that influence the occurrence of truck accidents in Egypt (Elshamly et al., 2017). In 2010, a statistical research was conducted to find the aberrant driving behavior with the highest frequency among Iranian truck drivers. In this study, the researchers used the 50-item Manchester DBQ to measure the aberrant behaviors of heavy vehicle drivers, and they concluded that safety attitude has not sufficiently developed among Iranian truck drivers. One of the weaknesses of the study is that it only includes truck drivers in Yazd city, and so the results cannot be generalized to reflect the behavior of all Iranian truck drivers (Ketabi, 2011).

Finally, as truck drivers have a different set of demographics, skill base and attitudes compared with private vehicle drivers (Walton, 1999; Sullman et al., 2002; Baas et al., 2000; Walton, 1999) (previous studies have shown the differences between the behaviors of non-professional and professional drivers), it is necessary to study the driving behaviors of this group of drivers separately.

Driver inattention has an influence on safe driving (Qu et al., 2015). Previous studies have shown that inattention has a negative influence on driver performance and is an important risk factor for crash involvement (Qu et al., 2015; Farmer et al., 2010; Klauer et al., 2006; Lemerrier et al., 2014; Stutts et al., 2001). According to one study, 10–33% of crashes in the United States are as a result of driver inattention (Qu et al., 2015; Ranney, 2008). The results of other studies show that driver inattention is an important cause of vehicle accidents (Klauer et al., 2006; Dingus et al., 2006).

Drowsiness and insufficient sleep are important variables that influence driver behavior and attention during driving. They play a significant negative role in safe driving and accident rate. A study focusing on sleepy driving accidents in Britain reported that in the last 12 months, 29% of British male drivers came close to falling asleep. Moreover, 7% of the drivers who had accidents during the past 3 years attributed it to tiredness (Radun et al., 2015; Maycock, 1997). A study conducted by the National Transportation Safety Board (McCartt et al., 2000; National Transportation Safety Board, 1995), on single-vehicle large truck crashes, discovered that 17% of truck drivers who were recently involved in accidents had fallen asleep while driving. In another research on Norwegian drivers, 8.3% of participants reported that they had fallen asleep behind the wheel in the past year (Sagberg, 1999). Also, a study on the German population reported that the number of accidents experienced by drivers who are dissatisfied with their sleep is two or more times higher compared with other drivers (Ohayon and Zulley, 2001).

There is a lot of discussion about the definition of fatigue (Williamson et al., 2014; Noy et al., 2011) and how it is different from sleepiness (Balkin et al., 2011). Williamson et al. believe that "the causes of sleepiness uniquely relate to sleep (i.e., amount, quality, time since awakening and time of the day), whereas the causes of fatigue can relate to task-related factors (i.e., duration and workload) as well as sleep-related factors" (Williamson et al., 2014). It could be said that sleep problems are one of the reasons for driver fatigue.

The aim of this study is to assess heavy-vehicle driver sleep problems and fatigues. Also, this study attempts to measure aberrant truck driving behavior and its relationship with a truck-driver sleep problems and fatigue. Therefore, it is important to identify the factors that affect fatigue with respect to heavy vehicle drivers and consequently, how driver fatigue affects aberrant driving behavior. In this research, which adopts a structural equation modeling approach, the impact of many factors, including driver exposure, sleep quality, heavy vehicle technology, driver age and driver education level, on the fatigue of heavy vehicle drivers were measured. Afterward, the effect of driver fatigue on the components of driving behavior and inattention were evaluated. Because the 12-item DBQ and ARDES were developed and validated in specific social and driving conditions, new validation studies are needed to apply them to the Iranian truck driver cultural and geographic contexts. For this purpose, new versions of DBQ developed by Rowe et al. (2015) and ARDES developed by Ledesma et al. (2010) were confirmed for a sample of Iranian truck drivers by confirmatory factor analysis (CFA).

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