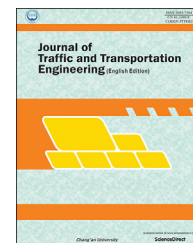




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Original Research Paper

# Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury: Population based case and control study



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HIGHLIGHTS

- This study confirmed association between feeling fatigue, tiredness or sleepy, aggressive driving behavior among drivers with a substantial increase in the risk of a vehicle crash resulting in serious road injury.
- Young drivers are more likely to be involved in collisions during lane-changing than non lane-hanging drivers.
- The levels of acute driver sleepiness measured by the Stanford score were in strong association with the risk of injuries.
- The fatigue, sleep deprivation and excessive speed in cars are widespread risk factors of crashes and injuries.

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ABSTRACT

**Background:** A few studies have been conducted to determine the relationship between road motor vehicle crashes (MVC) and serious injuries related to tiredness, fatigues and sleeping.

**Aim:** To determine the effects of aggressive behaviour, driver sleepiness and fatigue on MVC and related injuries among Turkish population.

**Design and setting:** Population-based case and control study conducted at the accident emergency departments of hospitals and roads.

**Subjects:** 515 car drivers involved in crashes with injury were admitted to hospital and 1030 car drivers involved while driving on public roads as control group during the study period.

**Methods:** The Manchester driver behaviour questionnaire (DBQ) measured the aberrant driving behaviours leading to accidents. Participants completed a fatigue severity scale (FSS) and Stanford Sleeping questionnaire an epworth scale with items related to socio-

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demographic information, driving experiences, adherence to traffic laws (such as speed limits and seat belt), and drivers' driving records.

**Results:** In a representative sampling, participant's age ranged from 25 to 65 and the mean and standard deviation were  $36.5 \pm 7.8$  for cases and  $37.0 \pm 8.0$  for controls. There was a significant difference in both group of drivers regarding BMI, level of education, marital status, driving experience, seat belt use, excessive speed limits, physical activity number of sleeping hours, mobile phone use, and cigarette smoking habit ( $p = 0.017$ ). Also, there was a significant higher mean score on all the DBQ violation questions among case group in comparison with the control group ( $p < 0.001$ ). Further, cases had higher prevalence of Epworth sleeping disorders ( $p < 0.001$ ) and fatigue severity ( $p = 0.003$ ) compared to control drivers. Multivariate logistic regression revealed that excessive speed, fatigue, lapses, errors, Stanford sleepiness score, violations, mobile phone use and Epworth sleepiness scale were significantly associated with injury involvement in vehicle crash, after adjusting for driving experience and annual mileage.

**Conclusion:** The current study confirmed that drivers with chronic fatigue, acute sleepiness, and careless driver behavior may significantly increases the risk of road crash which can lead to serious injury.

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## 1. Introduction

Motor vehicle crashes (MVC) and injuries are worldwide public health problems (Lyznicki et al., 1998; Philip et al., 1999; Sagaspe et al., 2010). Sleepiness and fatigue of drivers are significant causes and risk factors of MVC and fatalities. The percentage of sleepiness and fatigue varies from one country to another in the United State which is 1%–3% (Lyznicki et al., 1998), 10% in France (Philip et al., 1999; Sagaspe et al., 2010) and about 33% in Australia (Connor et al., 2002). The prevalence of driver sleepiness, fatigue and tiredness and their impact on the incidence of MVC and road traffic injuries documented very well in literature (Connor et al., 2002; Herman et al., 2014; Williamson et al., 2014) The pattern of acute tiredness, fatigue, chronic sleepiness, sleep disorders, and heavy workload has been related to decreased performance in psychomotor tests and driving simulators (Herman et al., 2014; Lajunen et al., 2004; Thompson and Stevenson, 2014) and increased rates of MVC, injuries and fatalities in selected populations (Bener et al., 2014). Meanwhile, the Manchester driver behavior questionnaire (DBQ) is commonly used to measure self-reported driving style and determine the relationship between driving behavior and accident involvement (Bener et al., 2013a, 2013b, 2014; de Winter and Dodou, 2010; Reason et al., 1990). Since most of road accidents are caused by human errors, DBQ is one of the most frequently used tools for studies carried to describes incorrect behaviors of the drivers in three basic dimensions such as errors, violations and lapses (Bener et al., 2013a, 2013b, 2014; Reason et al., 1990). Furthermore, changing behavior and attitudes have been major public health problem during the recent years world widely, therefore, Sun and Elefteriadou (2011) provided recommendations related to the implementation of study findings into micro-simulators to better replicate driver

behaviors in urban street networks. The drivers' decisions to change lanes are associated with driver characteristics and driver attitudes (such as aggressive behavior) and depends on many factors (Sun and Elefteriadou, 2012).

Driver sleepiness and fatigue are a few of the most significant factors leading to MVC and serious injuries (Ellen et al., 2006; Philip et al., 2003; Stutts et al., 2003). These factors includes age, mental illness, fatigue, sleeping and speed highly associated with accident involvement (Philip et al., 2003, 2010; Sagaspe et al., 2010; Teran-Santos et al., 1999). Several epidemiological researches in France indicated that sleepiness in car caused a higher risk of MVC and injuries (Philip et al., 1999, 2003, 2010). Consequently, sleep restriction, driver fatigue and falling asleep at the wheel are some of the key factors contributing to road accidents. As we know from research, driver fatigue causes 1%–3% of road transport accidents with up to 20% of those accidents occurring on major roads and motorways (Jamroz and Smolarek, 2013).

The aim of present study was to determine the effects of aggressive behaviors, driver sleepiness and fatigue on MVC and injuries among Turkish population.

## 2. Subjects and methods

A case-control survey was conducted from July 2015 through June 2016 in Istanbul, Turkey. All participants had valid driving licenses and got guarantee about anonymity and confidentiality.

The present study was based on drivers who had been admitted to the Accident Emergency Department of Cerrahpasa Faculty of Medicine Teaching Hospital and Medipol Faculty of Medicine Teaching Hospital for the road motor vehicle crash and related injuries. The samples of 696 trauma cases were available for this survey during study period. A total number of 515 drivers with a 74.0% response rate took

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