

# Driver fatigue in taxi, ride-hailing, and ridesharing services: A review of literature

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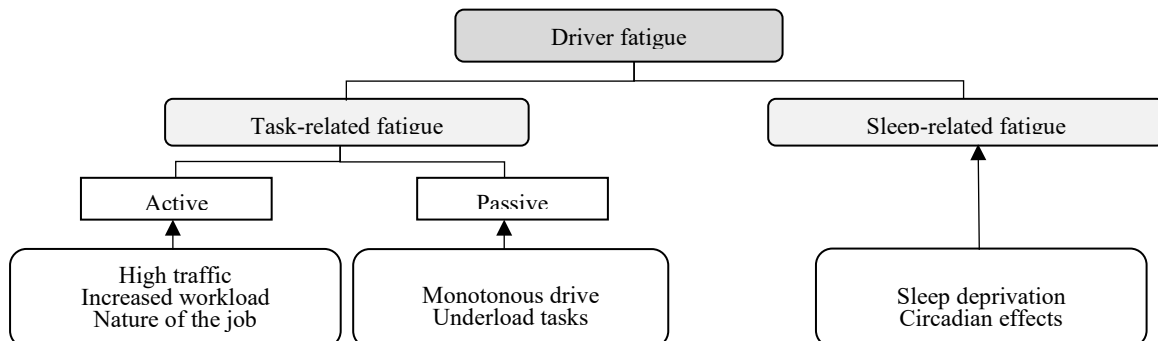
## Abstract

Driver fatigue is a major cause of road crashes. However, the public remains unaware of its potential consequences in the personalized transport industry. Driver fatigue is likely to be significantly exacerbated in this population due to the nature of their jobs; thus, a thorough study of driver fatigue in personalized transport is of utmost importance. This review summarizes the current state of knowledge about the causes and consequences of driver fatigue. We also suggested some potential control mechanisms for driver fatigue in the personalized transport industry along a fatigue risk trajectory. Findings to date suggest that driver fatigue in the personalized transport industry is as serious, or more serious than truck driver fatigue. Understanding the working conditions of these drivers is critical to establish effective policies and practices for reducing crash-related driver fatigue.

## 1. Introduction

Road traffic crashes are among the most frequent causes of death every year (WHO 2015). 10-30% of fatal crashes are attributed to fatigue (Philip and Åkerstedt 2006, Zwahlen et al. 2016) and its contribution to road crashes has been estimated to range between 5% and 25% in earlier research (Tefft 2012, Covington 2021). Fatigue was assessed as a significant factor for crashes on rural roads due to long and monotonous driving causing passive fatigue (Thiffault and Bergeron 2003). However, many occupations require people to drive in urban areas as part of their work, and urban driver fatigue has received little attention. This is especially prevalent in the personalized transport industry, which includes taxis, limousines, and ride-booking services.

Figure 1: A model of task-related driver fatigue for this review



This study aims to summarize the available evidence on driver fatigue in the personalized transport industry. We conducted a comprehensive review of studies that aim to identify the causes (contributing factors) and consequences (risk factors) of driver fatigue in the

personalized transport industry and provided some possible countermeasures along each level of the fatigue risk trajectory to reduce or mitigate driver fatigue.

## 2. Methods

### 2.1 Search strategy

We conducted a comprehensive search in September 2022 of the databases Web of Science and PubMed with no limit to the starting date. The search terms used to identify relevant articles were: (fatigue OR drows\* OR sleep\* OR crash OR “Driver vigilance” OR “Road accident” OR “Traffic accident” OR “Road safety”) AND ("cab driver\*" OR “Taxi drivers” OR rideshare OR ridesharing OR "ride share" OR "ride-share" OR "ride sharing" OR "ride-sharing" OR carpool\* OR ridehail OR "ride-hail" OR "ride hail" OR "ride hailing" OR "limousine drivers").

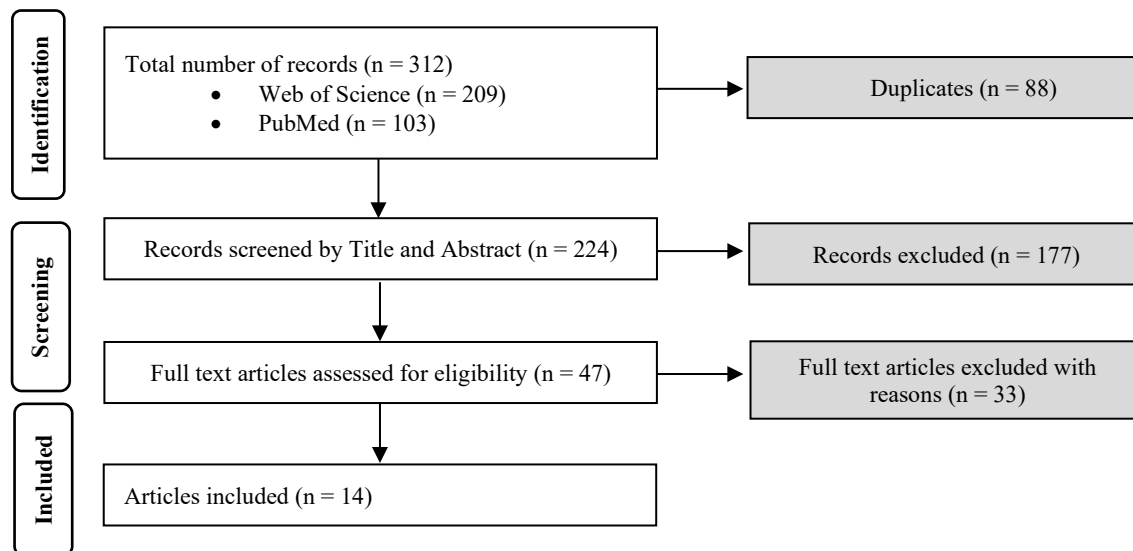
### 2.2 Eligibility criteria and assessment

Studies were included with a quantitative, qualitative, mixed-method design, or review if they met the following criteria: 1) reported one or multiple contributing factors of driver fatigue in Taxi, rideshare, or limousine drivers; and 2) were published in English and their full texts were available. Editorials, conference proceedings, theses, or commentaries records were excluded.

## 3. Results and discussion

312 studies were identified through the search strategy, of which 224 were unique. After reading through the title and abstract, 177 articles were excluded, and 47 articles were left for full-text assessment (see figure 2). Only 14 studies met the inclusion criteria after the full-text screening (Table 1).

**Figure 2: Flow chart of study selection**



**Table 1: Characteristics of included studies**

Study	Study location	Study design	Population	Method	Outcome measure	Contributing factors
(Dalziel and Job, 1997)	Australia	Cohort study	42 taxi drivers from a single regional co-operative taxi network	Questionnaire	Accident details with insurance records & self-reported fatigue and crash involvement	Driver distraction / rest break

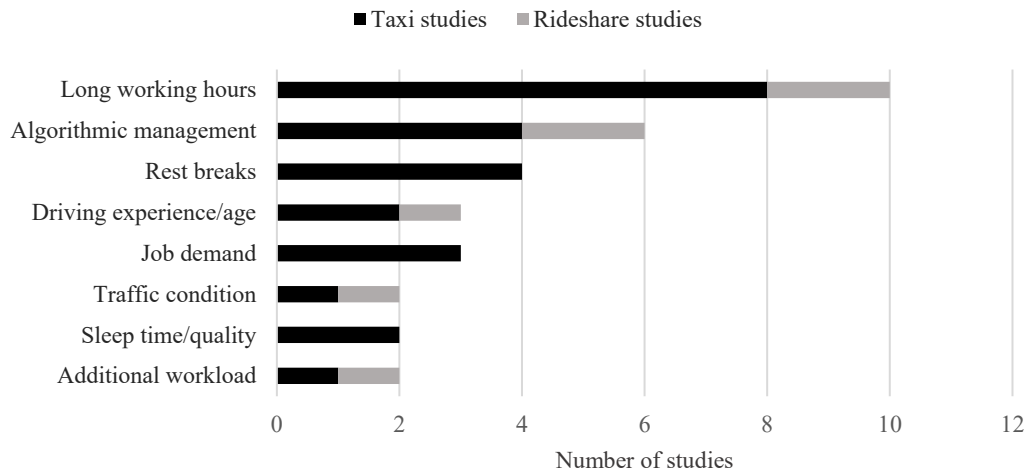
(Facey, 2003)	Canada	Qualitative	A convenience sample of taxi drivers from Toronto: number not reported	Interview	Self-reported fatigue	Economic uncertainty / long working hours
(Lim and Chia, 2015)	Singapore	Cross-sectional	Random selection of 340 taxi drivers out of 3,500 taxi drivers from a taxi company	Questionnaire	Epworth sleepiness scale	Sleep quality / holding an additional part time job / driving more than 10 hours a day
(Meng et al., 2015)	China	Cross-sectional	274 truck drivers from 5 largest areas and 286 taxi drivers from the Beijing airport	Questionnaire	Self-reported fatigue & self-reported fatigue-related crash involvement	Driving at nights / heavy traffic / sleep time and quality / short rest / long driving time
(Bernek ing et al., 2018)	—	Position statement	Ridesharing industry	—	—	Holding multiple jobs / not screened for medical problems such as obstructive sleep apnea
(Husain et al., 2019)	Malaysia	Cohort study	225 taxi drivers from 8 taxi terminals	Questionnaire	Occupational fatigue exhaustion recovery (OFER) scale & self-reported crash involvement	Individual and daily emotional demands
(Li et al., 2019)	China	Two cross-sectional	300 taxi drivers for time point one & 105 taxi drivers for time point two	Questionnaire	Self-reported fatigue-related accident data	Longer driving hours per working day / lower rest ratios / less driving experience / more confident about their fatigue resistance
(Meng et al., 2019)	China	Cohort	A convenience sample of 50 taxi drivers	Questionnaire	Self-perceived fatigue using the Brief Fatigue Inventory (BFI)	Driver's income / age / Number of driving hours
(Menéndez et al., 2019)	USA	Cross-sectional	996 taxi drivers from two large U.S. cities	Questionnaire	The driving-tired subscale of the Occupational Driver Behavior Questionnaire (ODBQ)	Job demands / the number of miles and hours / experiencing passenger-related violence
(Wang et al., 2019)	China	Cross-sectional	1021 taxi drivers from 21 taxi companies in four cities	Questionnaire	Self-reported fatigue & self-reported crash involvement	Higher amounts of working hours / lack of off days during the week
(Crain et al., 2020)	—	Review	Ridesharing industry	—	—	Algorithmic management / lack of strict regulations and protections for limiting long working hours / increased work-related stressor
(Peng et al., 2020)	China	Cross-sectional	2391 taxi drivers from four cities in different taxi companies	Questionnaire	Self-reported fatigue & self-reported crash involvement	Long working hours
(Mao et al., 2021)	China	Cross-sectional	189,815 rideshare drivers from a major city in China	Administrative data	The ride-hailing data from Didi Chuxing	Long working hours / operation during peak hours / years of being rideshare drivers

(Dang et al., 2022)	China	Cross-sectional	Rideshare drivers; number not reported	A computing framework	-	Driver's income
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### 3.1 Factors contributing to fatigue

Figure 3 outlines the number of studies included in the current review that address the contributing factors to driver fatigue in the personalized transport industry.

**Figure 3: Identified factors contributing to driver fatigue in the personalized transport industry**



The literature reveals that factors including long working hours, algorithmic management, traffic congestion, insufficient time to rest and sleep, poor quality of sleep, time of day (1 to 8 am and 2 to 6 pm), limited driving experience (especially, young drivers), job demand, and additional workload increase driver fatigue in the personalized transport industry. Furthermore, only four studies investigated driver fatigue in the rideshare industry (Berneking et al., 2018; Crain et al., 2020; Mao et al., 2021; Dang et al., 2022), thereby making it difficult to identify the contributing factors to driver fatigue. Driver fatigue may be more common among rideshare drivers because of the absence of regulations and safety training.

### 3.2 Prevalent risk factors for the personalized transport industry

The consequences of fatigue can be short or long term. Short term effects consist of falling asleep at work, short term memory loss, bad-decision making and judgement, headaches, dizziness, blurred vision, or reduced hand-eye co-ordination. However, long-term effects include heart disease, diabetes, high blood pressure, gastrointestinal disorders, lower fertility, anxiety, and depression.

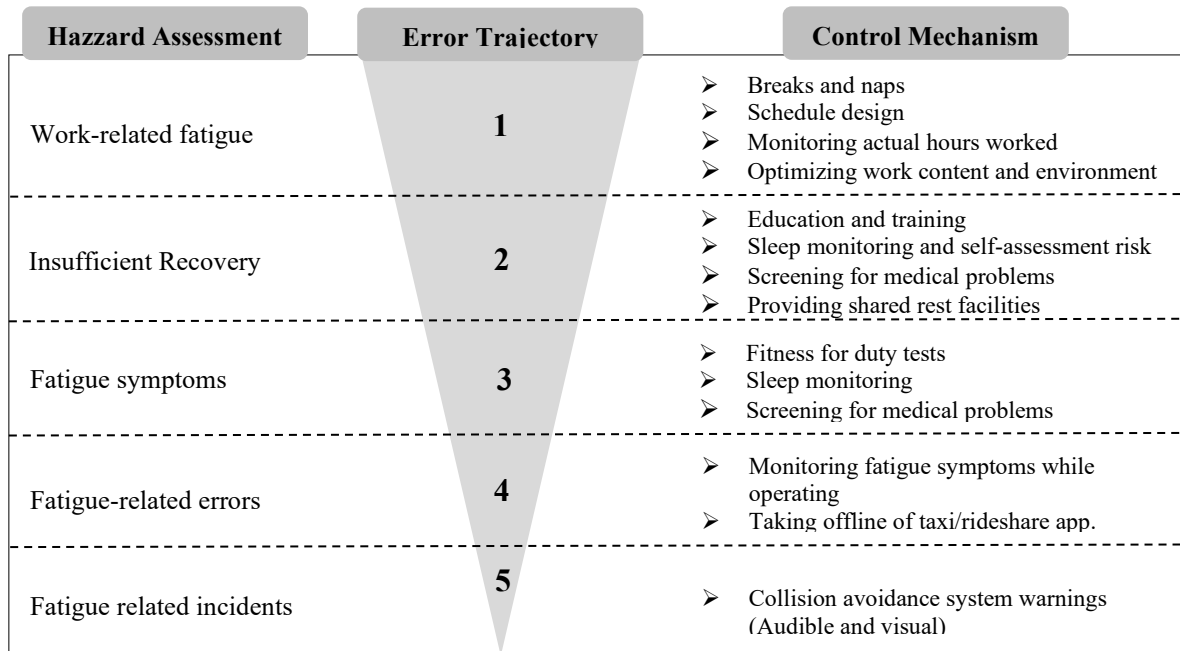
### 3.2 Mitigating driver fatigue in the personalized transport industry

The relatively high occurrence of fatigue-related crashes in the personalized transport industry (Meng et al. 2015) suggests that regardless of whether drivers recognize they are fatigued, optimism bias may induce them to engage in risky behavior or to fail to take preventive measures. Figure 4 summarizes potential control mechanisms along a risk trajectory for driver fatigue in the personalized transport industry.

Performance-based indicators of fitness for duty, such as psychomotor vigilance tests, can be administered either before starting duty or during breaks to determine the extent to which drivers have recovered from previous work in their free time (Phillips et al. 2017). Regardless

of monitoring fatigue by transport managers, drivers require further training to improve their fatigue awareness and correct drivers' optimism bias (Menéndez et al. 2019). This training can be conducted during orientation programs for new rideshare and taxi drivers or in seminars as a form of reminder.

**Figure 4: Potential control mechanisms along a risk trajectory for driver fatigue in the personalized transport industry**



## 4. Conclusion and future directions

This review explores the current research and knowledge of driver fatigue in the personalized transport industry. While it is widely acknowledged in the literature that driver fatigue in the personalized transport industry is as serious, or more serious than truck driver fatigue, its extent is unknown because there is a paucity of research investigating the cause and contributing factors to driver fatigue. The findings of this review highlight the importance and impact of driver fatigue in the personalized transport industry.

Algorithmic management, insufficient time to rest, driving experience and age, job demand, traffic congestion, poor sleep quality and additional workload increase driver fatigue in the personalized transport industry. Drivers often engage in secondary activities to manage fatigue while driving, causing distraction and consequently crashes. While the ride-sharing industry is growing across the globe, it is important to establish effective policies and practices for addressing the threat of driver fatigue in the personalized transport industry. Effective policies and regulations for the ridesharing industry are dependent on strong evidence-based research. Future studies are recommended involving comprehensive data collection using approaches such as naturalistic experiments and statistically sound road safety analysis methods (Behara et al., 2021)

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