# Driver behaviour and crash involvement among professional taxi and truck drivers: Light passenger cars versus heavy goods vehicles


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**Abstract**

Professional drivers are drivers whose profession is to drive a vehicle such as truck and taxi for working purposes. However, these drivers constitute a heterogeneous group and generalizing assumptions about risky driving behaviour across the entire group might be misleading. The current study aimed to investigate similarities and differences of self-reported risky driving behaviour and crash involvement among different groups of professional drivers. Two rather large samples of taxi drivers obtained from 20 taxi stations in two cities (n=381) and heavy goods vehicles (truck) drivers obtained from a roadside survey in 10 provinces (n=785) completed the same 27-item Driver Behaviour Questionnaire (DBQ) in Iran. Principal component analysis showed that the DBQ segmented into four dimensions both among taxi and truck drivers. Further, a multi-group confirmatory factor analysis (MGCFA) supported strong measurement invariance in the DBQ factor structure across the two samples. The results showed that taxi drivers were more likely than truck drivers to commit errors as well as ordinary and aggressive violations. A one unit increase in ordinary and aggressive violations increased the probability of having experienced a traffic crash in the last year by 69% and 98% for taxi drivers, respectively, and 37% and 42% among truck drivers, respectively. This highlights that driving violations increased the probability of crash involvement almost twice as much among taxi drivers compared to truck drivers. Policymakers could target ordinary and aggressive violations by establishing better driving training, and by improving driving training and the licensing procedures among professional drivers.

**Keywords**: Risky driving behaviour, Professional drivers, Traffic crash involvement, Taxi drivers, Truck drivers, Measurement invariance

## 1. Introduction

The risky driving behaviour is one of the most important antecedents of road traffic crashes (Christ et al., 2004). Several research have exclusively investigated risky driving behaviour either among non-professional drivers such as private car drivers (e.g. Batool and Carsten, 2017; Stanojević et al., 2018; Nordfjærn et al., 2015; Hezaveh et al., 2017; Guého at al., 2014) or among work-related (professional) drivers such as bus (Mallia et al., 2015; Cornwall, 1962; Creswell & Froggatt, 1963), truck (Sullman et al., 2002; Maslac´ et al., 2017; Mehdizadeh et al., 2018; Blanco et al., 2016; Anderson et al., 2012) and taxi drivers (Machin and De Souza, 2004; Brown and Ghiselli, 1953, Dalziel and Job, 1997; Burns and Wilde, 1995).

Meanwhile, there are several differences between professional drivers and non-professional drivers. The term professional (work-related) drivers refers to drivers whose profession is to drive a vehicle for working purposes (Porter, 2011). The driving purpose of professional drivers is usually to perform their business duties, while non-professional drivers have several reasons for driving such as shopping, recreation and work trips. Professional drivers spend more time driving and usually have higher annual mileage than non-professional drivers (Davey et al., 2007). Further, stress-related working conditions and fatigue are highly prevalent among professional drivers (Useche et al., 2017; Dorn et al., 2010; Charlton and Baas, 2006). Nordfjærn et al. (2012) showed that non-professional drivers perceived significantly less control and had been involved in less accidents than professional drivers. Maslac´ (2018) found that ordinary and aggressive violations as well as errors were correlated with accident involvement among non-professional drivers, while positive behaviours were only related to professional drivers' accident records.

However, little is known about differences and similarities in risky driving behaviour and crash involvement across different groups of professional drivers. Also, to date predictors of traffic crash involvement among diverging groups of professional drivers have received little empirical attention. In general, there are several differences between diverging groups of professional drivers and their work-related contexts such as: (1) among light vehicle and heavy vehicle drivers, (2) passenger versus freight transport drivers, and (3) driving in urban versus interurban roads. For instance, the size and handling characteristics of heavy vehicles cause less leeway for the truck drivers to drive in a risky manner than light vehicles. Second, driving behaviour may be influenced by passengers' behaviour, while freight vehicle drivers usually do not experience this issue. Third, urban roads have lower speed limits and more traffic congestion than interurban roads. Such differences may be associated with differences in risky driving behaviour among professional drivers. Professional drivers constitute a heterogeneous group and generalizing assumptions about risky driving behaviour across the entire group might be misleading. Therefore, distinguishing risky driving behaviour among professional drivers could help policymakers to make better decisions regarding different work-related organizations and drivers.

Most researchers have unanimously reported that violations and errors are the main components of risky driving behaviours (af Wåhlberg et al., 2015; de Winter and Dodou, 2010). As a seminal work, Reason et al. (1990) found violations, errors and lapses as the three major risky driving factors. Later, several researchers have revealed aggressive violations as the other risky driving factor (Lawton et al., 1997). Concerning the definition of different risky driving factors, ordinary violations refer to intentional rule-violating driving behaviour, such as driving on a red light. Aggressive violation refers to a hostile motive to deviate from safe driving or the expression of hostility toward another road user, such as getting angry at a certain type of driver and expressing your anger any way you can (e.g. Parker et al., 1998). Errors are defined as the failure of planned behaviours to achieve their intended consequences while lapses are defined as ill-suited actions associated with the lack of focus on the task.

A literature review of professional drivers' risky driving behaviours showed that the Driver Behaviour Questionnaire (DBQ) is the most used instrument for measuring risky driving behaviours (e.g. violations, errors). The DBQ has been fitted to different factor structures among different professional drivers such as three (Davey et al., 2007; Wang et al., 2014), four (Sullman et al., 2002; Mehdizadeh et al., 2018), five (Maslać et al., 2017, 2018) and six (Dimmer and Parker, 1999)-factor solutions. Accordingly, studies found that ordinary violations among truck and professional fleet drivers are positively related to crash involvement (Sullman et al., 2002; Davey et al., 2007). Maslać et al. (2018) showed that among five DBQ factors only the lapses factor is positively associated with crash involvement of professional drivers. af Wåhlberg et al. (2011) found that the error component had a positive relationship with self-reported crash involvement among bus drivers, and the violation scale had a positive association with self-reported crashes among truck drivers. In addition, the cited studies have also reported influences of several background variables, such as demographic and socioeconomic characteristics and mobility features (e.g. annual mileage), on crash involvement among professional drivers either driving heavy or light vehicles. Sullman et al. (2002) showed that older truck drivers are less likely to be involved in a crash. Mehdizadeh et al. (2018) found that high-income truck drivers had less crash involvement. Meanwhile, Vahedi et al. (2018) showed that a higher annual mileage and more hours of driving were positively related to crash involvement of taxi drivers. In general, two sets of variables including (1) background variables (e.g. age, income status, fatigue, annual driving mileage) and (2) risky driving behaviours (e.g. violations, errors) have been reported as the most frequently investigated explanatory variables on professional driving behaviour and crash records.

Gaps in the present literature served as the motivation for this research. First, although previous studies have investigated risky driving behaviour among various professional drivers, they tended to not accommodate examinations of similarities or dissimilarities of the structure of risky driving behaviour among light and heavy work-related drivers into the empirical framework. Second, no study to date has differentiated the relative roles of different background variables as well as risky driving factors on the probability of crash involvement among professional drivers of light cars and heavy good vehicles. Hence, the present study attempted to partly fill these gaps in the literature by investigating similarities and differences between two rather large samples of professional drivers: passenger car drivers, i.e., taxi drivers who transport passengers with their light vehicles in urban road networks, and heavy goods vehicles, i.e., truck drivers who transport goods in intercity roads applying the same version of the Driver Behaviour Questionnaire (DBQ) in the same region (the territory of Iran). Third, most studies that focused on different types of professional drivers were carried out in regions with good safety performance or in Western countries (Davey et al., 2007; af Wåhlberg et al., 2011; Dorn et al., 2010). Iran is among one of the countries in the world that experiences the most profound challenges regarding transport safety (Mehdizadeh et al., 2017). According to official statistical data from the World Health Organization (WHO), Iran has a higher rate of death per 100,000 population (age-adjusted death rates) in road traffic crashes than the overall worldwide average rate (WHO, 2015). The rate of road crashes in Iran is twenty times higher than the world's average. Iranian professional drivers with their work-related vehicles were ranked second as the cause of fatal crashes to the total number of fatal crashes with 17%, after crashes of non-professional drivers by their four-wheeled cars or light vehicles with 32% of the road traffic crashes in 2005 (ILMO, 2006).

### 1.1. Aims and hypotheses

The main aim of the study was to investigate similarities and dissimilarities of risky driving behaviour and crash involvement between passenger car drivers and truck drivers. As an intermediate aim, the present study examined the factor structure of risky driving behaviour between these two types of professional drivers. As mentioned earlier, there are several dissimilarities between diverging groups of professional drivers among: (1) light vehicle and heavy vehicle drivers, (2) passenger versus freight transport drivers, and (3) driving in urban versus interurban roads. Considering the preceding arguments, the hypotheses of the current study are as follows: (1) heterogeneous groups of taxi and truck drivers have a different structure of risky driving behaviour, (2) taxi drivers have more risky driving behaviour than truck drivers. For instance, the size of heavy vehicles cause less leeway for the truck drivers to drive in a risky manner than taxi vehicles, (3) a wide-range of background variables (e.g. age, annual mileage) relate differently to the risky driving factors (e.g. errors, violations) of truck and taxi drivers. For instance, the number of weekly hours of driving may be positively related to commission of violations among taxi drivers while this variable may not be associated with commission of violations among truck drivers since taxi drivers have more variation in their weekly hours of driving rather than truck drivers, and (4) various sets of explanatory variables including background characteristics (e.g. age, annual mileage) and risky driving factors (e.g. errors, violations) associate differently with crash involvement of truck and taxi drivers. For example, since driving behaviour may be positively influenced by passengers' actions, risky driving behaviour such as errors may be less likely related to the crash involvement of taxi drivers than truck drivers.

## 2. Methods

### 2.1. Procedure and respondents

Two cross-sectional surveys were carried out to collect data among taxi and truck drivers. First, during September and October of 2012, a sample of Iranian truck drivers was recruited in 10 provinces of Iran (Mehdizadeh et al., 2018). Then, using the same questionnaire, a sample of Iranian taxi drivers were selected in two Iranian cities during October and November, 2016.

#### 2.1.1. Truck driver sample

For the sampling of truck drivers, 10 provinces were selected from all 31 provinces of Iran to make sure that all regions were covered in terms of socioeconomic, geographic and cultural factors. Criteria such as the number of truck drivers, the length of interurban main roads and the volume of goods movement which were available in public data sources were also used for selecting these regions. Data collection was conducted in welfare service complexes or in roadside parking in the selected provinces. All of the complexes or roadside parking facilities were located on main roads in freeways and multilane highways. Several scientific staff members and transport safety experts were instructed to clarify the purpose of the survey to the selected truck drivers and to instruct the truck drivers in how to complete the different parts of the form. Participation in the survey was anonymous and voluntary. The truck drivers were ensured about the confidentiality of the study and that the responses would have no effect on their driving assessment by the traffic police or goods companies.

1500 truck drivers were approached and 914 (61% response rate) truck drivers participated in the survey. However, 129 respondents either had not filled in most of the DBQ items or had not responded to the question relevant to self-reported involvement in traffic crashes. These observations were removed from analysis, leaving 785 valid cases which constituted the analytical sample. Notably, almost all Iranian heavy goods vehicle drivers are males. Accordingly, the present sample only included male truck drivers.

#### 2.1.2. Taxi driver sample

In Iran, taxis transfer passengers between dedicated stations (origins and destinations). This type of taxi has rapidly developed into a public transport mode because of the inconsistency in travel demands and insufficient supply of mass transit such as metro and tram in Iran. Taxis do not have dedicated paths in the roads and, hence, drive on all main roads and streets, similar to other personal cars in the cities. The taxi stations are usually fixed-point waiting locations for picking up and dropping off passengers. Taxis usually have a capacity of four passengers; as soon as the taxi picks up its maximum of four passengers, the driver starts driving toward the specified destination.

Based on local data resources, such as the number of taxi stations in the urban network and the number of taxi drivers, 20 taxi stations were selected for data gathering in two Iranian cities. The study areas were in Neyshabur and Bojnurd in Northeastern Iran. Neyshabur and Bojnurd have a population of 451,780 and 324,083 persons, respectively (Iran National Census, 2011). A total of 450 taxi drivers were approached and 405 (90% response rate) taxi drivers participated in the survey. Of the 405 distributed questionnaires among taxi drivers at the selected stations, 24 cases had either not responded to the question relevant to self-reported involvement in traffic crashes or had not filled in most of the items relevant to the DBQ. These observations were removed leaving 381 valid cases for further analysis. The taxi drivers were ensured about the confidentiality of the data and that the responses would have no effect on the driving assessment by the traffic police or taxi industries. The other sampling procedures of taxi drivers were similar to the sampling method among truck drivers.

### 2.2. Measures

The questionnaire of the two surveys had similar parts: demographic and socioeconomic characteristics, mobility attributes, self-reported involvement in traffic crashes, and the validated 27-item DBQ.

Data regarding drivers' demographic and socioeconomic characteristics and mobility attributes were asked in the first part of the questionnaire. Each driver reported their educational attainment (higher than high school = 1, otherwise = 0), marital status (being single = 1, otherwise = 0), the number of household members, car ownership status, and income level. Mobility characteristics including annual mileage (km), years of driving' experience and the number of weekly hours of driving were also recorded. Information regarding drivers' involvement in traffic crashes was also obtained. The survey further assessed how many crashes the drivers had experienced in the last year. The definition of crashes covered injury to the drivers (and any other person, such as pedestrians) and damage to vehicles or property (Sullman et al., 2002).

The second part of the questionnaire concerned risky driving behavior. Several studies have measured risky driving behaviour through the driver behaviour questionnaire - DBQ (af Wåhlberg et al., 2015; de Winter and Dodou, 2010). Reason et al. (1999) developed the first version of the DBQ by including 50 items in one instrument. This version of the DBQ measured violations, errors and lapses of drivers. Later, several studies extended the DBQ to also measure new factors, such as aggressive violations or shortened the number of items to 27 or 28 (Lawton et al., 1997; Parker et al., 1998; Lajunen et al., 2004). The validated 27-item DBQ (Lajunen et al., 2004; Lawton et al., 1997) was applied to measure risky driving behaviour. The back-translation method (Brislin, 1970) was used to adopt the DBQ. The original English items were translated into Persian by native Persian co-researchers, proficient in both languages (Persian and English). Afterwards, the items were translated back into English by a professional English expert. A six-point Likert scale (0 = never, 1 = hardly ever, 2 = occasionally, 3 = quite often, 4 = frequently, and 5 = nearly all the time) was used for measuring all items. Drivers were asked to indicate how often they committed each of the 27 behaviours in the past year. It should be noted that the truck drivers were asked about the frequencies of risky behaviors when they drive their truck and taxi drivers when they drive a taxi themselves.

The original instrument of the 27-item DBQ were divided into four groups (errors, lapses, ordinary violations and aggressive violations). The first group included eight items about errors, such as, "*brake too quickly on a slippery road*". Eight items were intended to measure lapses (e.g., "*switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers*"). The third group contained five items about ordinary violations (e.g., "*overtake a slow driver on the inside*"). The last group included six items about aggressive violations (e.g., "*get angry at a certain type of driver and express your anger any way you can*").

### 2.3. Statistical analysis

Descriptive statistics were used to reveal demographic, socioeconomic, and mobility characteristics as well as the overall scores of the DBQ items of the samples. Independent samples *t*-tests and proportion tests (*z*-tests) were carried out to test mean differences in continuous variables and categorical variables, respectively. Independent samples *t*-tests were also conducted to test mean differences in DBQ scores between taxi and truck drivers. In order to examine the DBQ's dimensional structure across the two samples, a principal component analysis (PCA) with varimax rotation and iteration was carried out. The Kaizer criterion (an eigenvalue above 1.00 was used as the criterion for factor extraction) and a visual inspection of the Scree plot were undertaken to determine the number of extracted components. A factor loading above 0.40 was used as a criterion for items to be retained in the DBQ dimensions (Hair et al. 1998). To examine the internal consistency and reliability of the scales, Cronbach's α (alpha) was calculated. Further, average corrected inter-item total correlations (Aiic) were calculated as indicators of reliability, because the Cronbach's α tends to be biased when the scales contain few or many items (Hair et al. 1998). The cut-off value of 0.30 was used for the Aiic (Nurosis, 1994).

Before comparing the two samples of taxi and truck drivers on the DBQ factors it is important that the factor structures or scores from the operationalization of a construct are similar and have the same meaning in the two samples. A multi-group confirmatory factor analysis (MGCFA) was conducted with AMOS 23.0.0 to test the multigroup invariance of the DBQ across the two samples. The fit indices used for the models were the root mean square error of approximation (RMSEA) and the comparative fit index (CFI). An RMSEA between 0.00 and 0.06 and a CFI above 0.90 is considered to reflect a good fit (Byrne, 2012; Kline, 2015). Measurement invariance is investigated across three steps (Byrne, 2012). In this process, initial models are tested individually for each sample and then three further analyses are conducted, each imposing more restrictions on the model and each reliant upon invariance being confirmed in the previous step (see Koppel et al., 2018).

As noted by Byrne (2012) and Koppel et al. (2018), step 1 tests whether the DBQ's structure is invariant across each sample (configural invariance). In this step, baseline/taxi and truck drivers' models are nested and examined simultaneously, producing one set of goodness-of-fit values for the MGCFA. After determining an appropriate model fit, the metric invariance is examined in step 2. Metric invariance tests whether the factor loadings are consistent across the two models and this test is conducted by constraining the loadings to be equal across the two CFA models. Metric invariance distinguishes whether similar patterns of responses are apparent across the samples. A non-significant change in Chi-Square (from the configural model) and a change in the CFI no greater than 0.01 supports invariance (i.e., the $\Delta\chi^2$ test should not be statistically significant and the ΔCFI value should be less than 0.01) (Byrne, 2012; Kline, 2015). Once the invariance of factor loadings is supported, structural invariance is investigated (step 3). Structural invariance needs the intercepts for each item on its factor to be constrained across models and determines that the interpretations of items remain similar across the two samples of taxi and truck drivers.

The relationships between demographic, socioeconomic and mobility variables with DBQ factors for the two samples were investigated through the calculation of Pearson's product moment correlation coefficients. To examine differences in the factor scores across the samples Multivariate Analysis of Covariance (MANCOVA) was conducted with type of drivers (taxi/truck drivers) as the fixed factor and the four DBQ factors as the dependent variables. Several demographic, socioeconomic and mobility characteristics, such as age and years of driving' experience, may also affect driver behaviour and were included as statistical covariates in this analysis. To provide effect sizes for all mean differences, Cohen's d values (for continuous variables) and Cramer's Phi-values (for categorical variables) were calculated. A logistic regression analysis was used to test the role of the DBQ factors as well as demographic, socioeconomic and mobility attributes for involvement in traffic crashes the last year (yes/no).

## 3. Results

### 3.1. Characteristics of the taxi and truck driver samples

The characteristics of the truck and taxi driver samples are presented in Table 1. There were significant differences between taxi and truck drivers' ratings on most of the variables. On average, the taxi and truck drivers were aged 36.26 years (SD=11.57) and 38.33 years (SD=10.70), respectively. The mean annual driving mileage was 79143.31 kilometers (SD=72875.12) for taxi drivers and 93850.18 (SD=98220.70) for truck drivers. The taxi and truck drivers had an average of 81.32 hours (SD=62.67) and 61.27 hours (SD=39.82) of driving in a week, respectively. A total of 38% of the taxi drivers and 18% of the truck drivers were involved in at least one traffic crash during the last year preceding the survey.

Table 1. Characteristics of the samples

| Variable | Description | Taxi drivers (n=381) | | Truck drivers (n=785) | | t-test | Cohen's d-value | z-test | Cramer's Phi-value |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | | | | |
| Age of driver | Continuous variable | 36.26 | 11.57 | 38.33 | 10.70 | -3.02*** | -0.19 | | |
| Educational attainment of driver | High (higher than high school)=1, low=0 | 0.37 | 0.47 | 0.41 | 0.49 | | | 2.87** | 0.01 |
| Driver's marital status | Single= 1, otherwise=0 | 0.14 | 0.34 | 0.13 | 0.33 | | | 2.15* | 0.01 |
| Driver's household size | Number | 2.90 | 1.82 | 2.89 | 1.81 | 0.09 | 0.01 | | |
| Number of owned private car in household | Number | 0.94 | 0.35 | 0.51 | 0.50 | 15.09*** | 1.00 | | |
| Driver's income status | Higher than two million Toman=1, otherwise=0 | 0.14 | 0.35 | 0.16 | 0.36 | | | 1.65 | 0.03 |
| The crossed annual driving mileage | Continuous variable (kilometers in the last year) | 79143.31 | 72875.12 | 93850.18 | 98220.70 | -2.60** | -0.17 | | |
| The number of weekly hours of driving | Continuous variable (hours in a week) | 81.32 | 62.67 | 61.27 | 39.82 | 6.62*** | 0.38 | | |
| Years of driving experience of a taxi/truck | Continuous variable (unit: year) | 13.42 | 14.21 | 11.26 | 9.17 | 3.12*** | 0.18 | | |
| Traffic crash involvement in the last year (self-reported) | At least one crash=1, no crash=0 | 0.38 | 0.48 | 0.18 | 0.38 | | | 5.75*** | 0.23 |

- One US Dollar is 4200 Toman (in April 2018).
- *: P < 0.05, **: P < 0.01, ***: P < 0.001.

### 3.2. Differences in DBQ items among taxi and truck drivers

Mean scores and standard deviations of all DBQ items reported by the taxi and truck drivers are illustrated in Table 2. As shown, the more common risky driving behaviours were aggressive violations (i.e., “get angry at a certain type of driver and express your anger any way you can in taxi drivers’ sample”; M= 2.24, SD = 1.97, “use your horn to indicate your annoyance to another road user in truck drivers’ sample”; M= 1.48, SD = 1.20) both among taxi and truck drivers. Taxi drivers reported a tendency to commit more risky driving behaviours (in all error items except DBQ8, all lapses except DBQ13 and DBQ15, and all ordinary and aggressive violations) in road traffic than truck drivers, such as *queuing to turn left onto a main road, you pay such close attention to the traffic on the main road that you almost hit the car in front* (*M*= 2.01, *t* = 7.99, *p* < 0.001, *d* = 0.52). T-tests also indicated significant differences regarding the tendency of taxi drivers to commit more risky driving behaviours than truck drivers (for 24 items).

Table 2. Means and standard deviations of all DBQ items reported by the taxi drivers (n=381) and truck drivers (n=785).

| Item | Taxi drivers | | Truck drivers | | t-value | Cohen d-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **Errors (E)** | | | | | | |
| Queuing to turn left onto a main road, you pay such close attention to the traffic on the main road that you almost hit the car in front (DBQ1) | 2.01 | 1.69 | 1.22 | 1.34 | 7.99*** | 0.52 |

Table 2. continued

| Item | Taxi drivers | | Truck drivers | | t-value | Cohen d-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Fail to notice that pedestrians are crossing when turning into a side street from a main road (DBQ2) | 1.97 | 1.43 | 0.88 | 1.21 | 12.82*** | 0.82 |
| Brake too quickly on a slippery road (DBQ3) | 1.85 | 1.27 | 1.31 | 1.30 | 6.76*** | 0.42 |
| Fail to check your rear-view mirror before pulling out, changing lanes, etc. (DBQ4) | 1.52 | 1.33 | 0.92 | 1.24 | 7.38*** | 0.47 |
| When turning left, nearly hit a bicycle rider who has come up on your left (DBQ5) | 1.21 | 1.06 | 0.50 | 0.94 | 11.12*** | 0.71 |
| Attempt to overtake someone that you had not noticed was signalling a right turn (DBQ6) | 0.97 | 1.10 | 0.84 | 1.13 | 1.88 | 0.12 |
| Miss seeing a "Give Way" sign and just avoid colliding with traffic having the right of way (DBQ7) | 0.83 | 0.97 | 0.66 | 1.10 | 2.68*** | 0.16 |
| Underestimate the speed of an oncoming vehicle when overtaking (DBQ8) | 0.67 | 0.88 | 0.96 | 1.06 | -4.93*** | -0.30 |
| **Lapses (L)** | | | | | | |
| Misread signs & exit roundabout on the wrong road (DBQ9) | 1.43 | 1.32 | 1.17 | 1.02 | 3.39*** | 0.22 |
| Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers (DBQ10) | 1.24 | 1.32 | 0.86 | 1.07 | 4.89*** | 0.32 |
| Attempt to drive away from traffic lights in the wrong gear (DBQ11) | 0.91 | 1.19 | 0.84 | 1.03 | 0.98 | 0.06 |
| Forget where left taxi/truck in a taxi/truck park (DBQ12) | 0.78 | 0.96 | 0.66 | 1.02 | 1.96 | 0.12 |
| Having set out to drive to one place, you suddenly realise you are on the road to somewhere else (DBQ13) | 0.75 | 1.03 | 1.39 | 1.12 | -9.67*** | -0.59 |
| Get in the wrong lane approaching a roundabout or junction (DBQ14) | 0.69 | 0.90 | 0.57 | 0.98 | 2.07* | 0.13 |
| Realise that you have no clear memory of the road you have been travelling on (DBQ15) | 0.64 | 0.87 | 0.95 | 1.04 | -5.34*** | -0.32 |

Table 2. continued

| Item | Taxi drivers | | Truck drivers | | t-value | Cohen d-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Hit something when reversing that you had not previously seen (DBQ16) | 0.58 | 0.94 | 0.54 | 0.88 | 0.70 | 0.04 |
| **Ordinary violations (OV)** | | | | | | |
| Drive so close to the car in front that it would be difficult to stop in an emergency (DBQ17) | 2.11 | 1.78 | 1.24 | 1.50 | 8.23*** | 0.53 |
| Enter an intersection knowing that the traffic lights have already changed against you (DBQ18) | 1.91 | 1.66 | 1.22 | 1.33 | 7.08*** | 0.46 |
| Overtake a slow driver on the inside (DBQ19) | 1.45 | 1.55 | 0.90 | 1.17 | 6.13*** | 0.40 |
| Disregard the speed limit on a residential road (DBQ20) | 1.31 | 1.22 | 0.92 | 1.26 | 5.06*** | 0.31 |
| Disregard the speed limit on a freeway or rural highway (DBQ21) | 0.96 | 1.05 | 0.89 | 1.26 | 1.00 | 0.06 |
| **Aggressive violations (AV)** | | | | | | |
| Get angry at a certain type of driver and express your anger any way you can (DBQ22) | 2.24 | 1.97 | 0.72 | 1.07 | 14.09*** | 0.96 |
| Use your horn to indicate your annoyance to another road user (DBQ23) | 2.03 | 1.84 | 1.48 | 1.20 | 5.31*** | 0.35 |
| Become angry at another driver and chase them with the intention of showing them how angry you are (DBQ24) | 1.93 | 1.75 | 0.63 | 1.03 | 13.42*** | 0.91 |
| Stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane (DBQ25) | 1.79 | 1.52 | 1.43 | 1.22 | 4.03*** | 0.26 |
| Race away from traffic lights with the intention of beating the driver next to you (DBQ26) | 1.73 | 1.44 | 0.72 | 1.00 | 12.32*** | 0.81 |
| Pull out of an intersection so far you force your way into the traffic (DBQ27) | 0.93 | 1.01 | 0.51 | 1.00 | 6.68*** | 0.42 |

- SD: Standard deviation.
- *: P < 0.05, **: P < 0.01, ***: P < 0.001.

### 3.3. Dimensionality and reliability indices of the DBQ for taxi and truck drivers

PCA with iteration and varimax rotation indicated that the DBQ items segmented into a four-factor solution, with a total explained variance of 55.12% for taxi drivers and 43.98% for truck drivers (Table 3). Six items were removed because they failed to load consistently in the two samples. The first dimension was represented by errors in both samples. Errors included eight items and explained 22.33% of the variance for taxi drivers ($\alpha = 0.765$). For truck drivers this dimension explained 19.12% of the variance ($\alpha = 0.810$). Ordinary violations (second dimension) was represented by six items with 13.47% explained variance for taxi drivers ($\alpha = 0.832$) and 10.32% explained variance among truck drivers ($\alpha = 0.748$). The third dimension was lapses (including six items) in both samples. Lapses explained 10.77% of the variance for taxi drivers ($\alpha = 0.710$), while for truck drivers it explained 8.42% of the variance ($\alpha = 0.721$). The last dimension, aggressive violations, consisted of three items (taxi drivers $\alpha = 0.742$ and the explained variance was 8.55%, truck drivers $\alpha = 0.710$ and explained variance = 6.12%). The four identified dimensions had satisfactory reliability with Cronbach's alpha values around 0.70 and average corrected inter-item total correlations above 0.30.

Table 3. PCA and reliability indices for the DBQ items in samples of taxi drivers and truck drivers.

| Dimensions | Loadings taxi drivers | | | | Loadings truck drivers | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| **1- Errors** | | | | | | | | |
| DBQ2; Fail to notice that pedestrians are crossing when turning into a side street from a main road (E) | 0.82 | | | | 0.78 | | | |
| DBQ6; Attempt to overtake someone that you had not noticed was signaling a right turn (E) | 0.76 | | | | 0.62 | | | |
| DBQ1; Queuing to turn left onto a main road, you pay such close attention to the traffic on the main road that you almost hit the car in front (E) | 0.73 | | | | 0.71 | | | |
| DBQ7; Miss seeing a "Give Way" sign and just avoid colliding with traffic having the right of way (E) | 0.71 | | | | 0.67 | | | |
| DBQ4; Fail to check your rear-view mirror before pulling out, changing lanes, etc. (E) | 0.70 | | | | 0.69 | | | |
| DBQ5; When turning left, nearly hit a bicycle rider who has come up on your left (E) | 0.64 | | | | 0.60 | | | |
| DBQ3; Brake too quickly on a slippery road (E) | 0.59 | | | | 0.53 | | | |
| DBQ14; Get in the wrong lane approaching a roundabout or junction (L) | 0.41 | | | | 0.43 | | | |
| **2- Ordinary violations** | | | | | | | | |
| DBQ17; Drive so close to the car in front that it would be difficult to stop in an emergency (OV) | | 0.74 | | | | 0.61 | | |
| DBQ18; Enter an intersection knowing that the traffic lights have already changed against you (OV) | | 0.70 | | | | 0.57 | | |
| DBQ21; Disregard the speed limit on a freeway or rural highway (OV) | | 0.65 | | | | 0.71 | | |
| DBQ20; Disregard the speed limit on a residential road (OV) | | 0.61 | | | | 0.63 | | |
| DBQ19; Overtake a slow driver on the inside (OV) | | 0.55 | | | | 0.50 | | |
| DBQ8; Underestimate the speed of an oncoming vehicle when overtaking (E) | | 0.46 | | | | 0.42 | | |
| **3- Lapses** | | | | | | | | |
| DBQ9; Misread signs & exit roundabout on the wrong road (L) | | | 0.68 | | | | 0.51 | |

Table 3. Continued

| Dimensions | Loadings taxi drivers | | | | Loadings truck drivers | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| DBQ16; Hit something when reversing that you had not previously seen (L) | | | 0.62 | | | | 0.49 | |
| DBQ15; Realise that you have no clear memory of the road you have been travelling on (L) | | | 0.57 | | | | 0.64 | |
| DBQ10; Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers (L) | 0.38 | | 0.40 | | | | 0.56 | |
| DBQ13; Having set out to drive to one place, you suddenly realise you are on the road to somewhere else (L) | | | 0.51 | | | | 0.62 | |
| **4- Aggressive violations** | | | | | | | | |
| DBQ23; Use your horn to indicate your annoyance to another road user (AV) | | | | 0.74 | | | | 0.66 |
| DBQ22; Get angry at a certain type of driver and express your anger any way you can (AV) | | | | 0.71 | | | | 0.72 |
| DBQ24; Become angry at another driver and chase them with the intention of showing them how angry you are (AV) | | | | 0.63 | | | | 0.64 |
| Cronbach's α- alpha | 0.765 | 0.832 | 0.710 | 0.742 | 0.810 | 0.748 | 0.721 | 0.710 |
| Average corrected inter-item correlation | 0.61 | 0.69 | 0.50 | 0.51 | 0.69 | 0.63 | 0.62 | 0.59 |
| Explained variance | 22.33 | 13.47 | 10.77 | 8.55 | 19.12 | 10.32 | 8.42 | 6.12 |
| Mean (SD) | 1.38 | 1.40 | 0.92 | 2.06 | 0.86 | 1.02 | 0.98 | 0.94 |
| | (0.50) | (0.50) | (0.34) | (0.13) | (0.27) | (0.15) | (0.28) | (0.38) |

Notes: Factor loadings <0.40 not reported. E: Errors, L: Lapses, OV: Ordinary violations, AV: Aggressive violations.

### 3.4. Measurement invariance of the DBQ for taxi and truck drivers

Single-group CFA proposed a 22-item DBQ model for each driver group. The factor structure was similar across the two groups, but based on the modification indices, an exceptionally large error covariance between DBQ10 and DBQ16 were found to improve model fit for both samples. After specifying an error covariance between DBQ10 and DBQ16, the initially hypothesized model of the DBQ structure resulted in a much better fitting model for both the taxi driver sample ($\chi^2(202) = 748.49$; CFI = 0.91; RMSEA = 0.04) and truck driver sample ($\chi^2(202) = 581.21$; CFI = 0.92; RMSEA = 0.05). Thereafter, as shown in Figure 1 the modified baseline model of the DBQ was established for taxi and truck drivers. Results related to the multi-group model testing for configural invariance (unconstrained model) revealed that the $\chi^2$ value was 1,562.11 (df = 404). The CFI and RMSEA values, were 0.92 and 0.05, respectively. On this basis it be can concluded that the hypothesized multi-group model of the DBQ structure was adequately fitted across the taxi and truck driver samples. This indicated that the structure of the DBQ remained similar across the two samples. As can be seen in Table 4, further testing of the metric model showed acceptable fit and $\Delta\chi^2$ (22) = 25.45 and $\Delta$CFI < 0.01. This information showed that the factor loadings were invariant across the two samples. Further, a scalar model was investigated, where the intercepts were also constrained across models. In this model, strong measurement invariance was also met ($\Delta\chi^2$ (34) = 39.27 and $\Delta$CFI < 0.01). Therefore, the DBQ factor structure was found to be equivalent across the two samples of taxi and truck drivers.

Table 4. Multi-group analysis of measurement invariance across the two samples of taxi and truck drivers

| | $\chi^2$ | df | CFI | RMSEA | ΔCFI | $\Delta\chi^2$ | Δdf |
|---|---|---|---|---|---|---|---|
| Taxi drivers/Baseline | 748.49 | 202 | 0.91 | 0.04 | __ | __ | __ |
| Truck drivers | 581.21 | 202 | 0.92 | 0.05 | __ | __ | __ |
| Configural (unconstrained) | 1562.11 | 404 | 0.92 | 0.05 | __ | __ | __ |
| Metric (factor loadings; weak Measurement Invariance) | 1587.56 | 426 | 0.92 | 0.04 | <0.01 | 25.45 | 22 |
| Scalar (intercepts; strong Measurement Invariance) | 1601.38 | 438 | 0.91 | 0.03 | <0.01 | 39.27 | 34 |

All models were significant ($p < 0.001$)

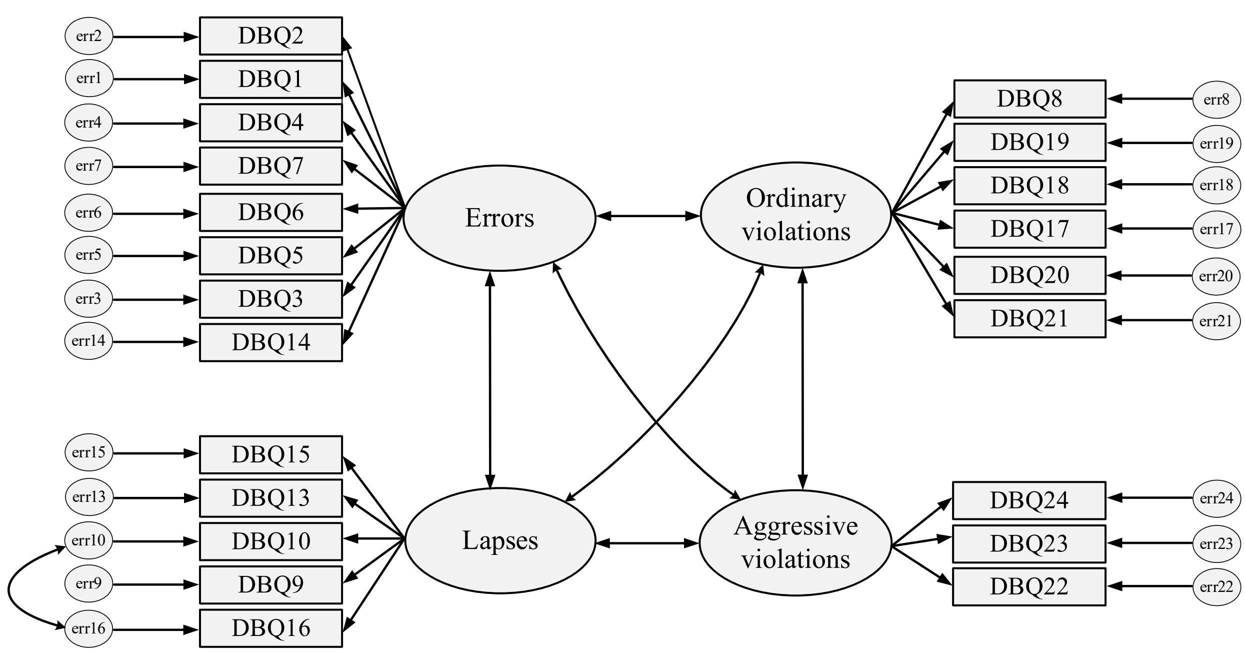


Fig 1. The modified baseline model of the DBQ structure for taxi or truck drivers

### 3.5. Correlations between the main background variables and DBQ factors in the two samples

Correlation coefficients showed that older drivers tended to report more ordinary and aggressive violations in both samples (see Table 5). Higher annual mileage was associated with less reported errors among truck drivers ($r^2$=-0.14, $P < 0.01$). Drivers with higher education background (higher than high school) were less likely to commit ordinary (taxi drivers $r^2$=-0.07, $P < 0.05$; truck drivers $r^2$=-0.13, $P < 0.01$) and aggressive violations (taxi drivers $r^2$=-0.45, $P < 0.001$). Drivers who were single were more likely to report aggressive violations (taxi drivers $r^2$=0.63, $P < 0.001$; truck drivers $r^2$=0.27, $P < 0.001$) than married drivers . Furthermore, taxi drivers with high income levels and more owned private cars were less likely to commit aggressive violations.

Table 5. Correlations between the main background variables and DBQ factors in the two samples

| Variable | Errors (*Taxi*/*Truck*) | Ordinary violations (*Taxi*/*Truck*) | Lapses (*Taxi*/*Truck*) | Aggressive violations (*Taxi*/*Truck*) |
|---|---|---|---|---|
| Age of driver | 0.11***/0.08*** | -0.08***/-0.29*** | 0.01/0.05* | -0.31***/-0.46*** |
| Educational background of driver | -0.03/-0.02 | -0.07*/-0.13** | 0.03/0.01 | -0.45***/-0.13 |
| Driver's marital status | 0.01/0.04 | 0.21***/0.07 | 0.08/0.08 | 0.63***/0.27*** |
| Driver's household size | -0.02/0.02 | 0.01/0.02 | 0.01/-0.02 | 0.03/0.01 |
| Number of owned private car in household | -0.07/0.01 | -0.06/-0.01 | -0.02/-0.10 | -0.09*/-0.12 |
| Driver's income status | -0.10/0.01 | -0.05/-0.09 | 0.04/0.04 | -0.16**/-0.04 |
| Annual driving mileage | 0.06/-0.14** | 0.14***/0.03 | 0.02/0.03 | 0.12*/0.05 |
| Hours of driving in a week | 0.12/-0.02 | 0.12***/0.08 | 0.09/0.11 | 0.32***/0.13 |
| Years of driving experience of a taxi/truck | 0.10/-0.08** | 0.09*/-0.02 | -0.10/-0.05 | 0.20/-0.09 |

*: P < 0.05, **: P < 0.01, ***: P < 0.001.
- *Taxi*: Taxi drivers, *Truck*: Truck drivers.

### 3.6. Differences in DBQ factors between the samples of taxi and truck drivers

The MANCOVA showed a Wilks' λ of 0.96 (F=5.61, p<0.001) for the taxi/ truck drivers as the fixed factor. This indicates that the overall main effect of being taxi or truck driver reached significance. Among the covariates, age (Wilks' λ=0.89, F=9.78, p<0.001), marital status (Wilks' λ=0.95, F=1.76, p<0.001), annual driving mileage (Wilks' λ=0.92, F=4.54, p<0.001) and the number of years of driving experience (Wilks' λ=0.98, F=4.10, p<0.001) also reached significance. As shown in Table 6, taxi drivers reported substantially more errors, ordinary violations and aggressive violations than truck drivers. Further, truck drivers reported more lapses than taxi drivers. Also, the effect sizes indicated strong mean differences for all DBQ factors.

Table 6. MANCOVA differences in DBQ factors among taxi and truck drivers.

| Factor | Taxi drivers | | Truck drivers | | F-value | d-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Errors | 1.38 | 0.50 | 1.10 | 0.23 | 9.93*** | 0.72 |
| Ordinary violations | 1.40 | 0.50 | 1.26 | 0.14 | 5.26*** | 0.38 |
| Lapses | 0.85 | 0.34 | 0.98 | 0.22 | -6.27*** | -0.45 |
| Aggressive violations | 2.07 | 0.13 | 0.94 | 0.38 | 54.92*** | 3.98 |

Notes: Wilks' λ taxi drivers/truck drivers = 0.96, F = 5.61, p < 0.001. Age, marital status, driving mileage in the last year and the years of driving experience used as covariates. ***p < 0.001.

### 3.7. Differences in factors associated with last-year traffic crash involvement among taxi and truck drivers

The final step was to test the association between background variables and DBQ factors with last-year traffic crash involvement (yes/no) among taxi drivers and truck drivers.

As shown in Table 7, the binary logistic model significantly predicted crash involvement among the taxi drivers (Model $\chi^2$= 176.21, p<0.001). The model indicated that 80.24% of the cases were successfully predicted by the model. Older drivers (OR =0.77, CI95%: (0.66, 0.91)) and higher income level (OR =0.84, CI95%: (0.79,0.98)) were negatively associated with involvement in a traffic crash. Results showed that being a single driver (OR =1.72, CI95%: (1.52,2.35)), having a higher annual mileage (OR =1.98, CI95%: (1.71,2.83)), and higher hours of driving (OR =1.76, CI95%: (1.45,2.64)) were associated with an increased risk of crash involvement. More ordinary violations (OR =1.69, CI95%: (1.49,2.38)) and more aggressive violations (OR =1.98, CI95%: (1.76,2.95)) were also related to an increased risk of traffic crash involvement.

As shown in Table 7, the binary logistic model significantly predicted crash involvement among truck drivers (Model $\chi^2$= 167.59, p<0.001). The model indicated that 75.91% of the cases were successfully predicted by the model. Higher number of owned cars (OR =0.82, CI95%: (0.76, 0.95)) and higher income (OR =0.86, CI95%: (0.78, 0.97)) were associated with reduced involvement in a traffic crash. More reported errors (OR =1.21, CI95%: (1.09, 1.52)), more ordinary violations (OR =1.37, CI95%: (1.17, 1.63)) and more aggressive violations (OR =1.42, CI95%: (1.23, 1.76)) were related to increased risk of involvement in a traffic crash.

Table 7. Driver behaviour associated with traffic crash involvement among taxi and truck drivers

| Variable | Taxi drivers | | | | Truck drivers | | | |
|---|---|---|---|---|---|---|---|---|
| | B | OR | 95% C.I. | Wald | B | OR | 95% C.I. | Wald |
| Age of driver | -0.23 *** | 0.77 | (0.66,0.91) | 6.15 | -0.11 | 0.92 | (0.73,1.18) | 1.66 |
| Educational background of driver | -0.12 | 0.96 | (0.89,1.13) | 1.47 | 0.13 | 1.14 | (0.94,1.35) | 1.59 |
| Driver's marital status (being single) | 1.31*** | 1.72 | (1.52,2.35) | 9.57 | 0.17 | 1.18 | (0.82,1.71) | 1.74 |
| Driver's household size | -0.02 | 0.98 | (0.96,1.08) | 1.23 | -0.09 | 0.90 | (0.58,1.41) | 1.16 |
| Number of owned private car in household | 0.08 | 1.05 | (0.95,1.19) | 1.76 | -0.13 *** | 0.82 | (0.76,0.95) | 8.12 |
| Driver's income status | -0.14* | 0.84 | (0.79,0.98) | 4.36 | -0.18* | 0.86 | (0.78,0.97) | 4.31 |
| Annual driving mileage | 0.80*** | 1.98 | (1.71,2.83) | 12.44 | 0.16 | 1.17 | (0.92,1.49) | 1.60 |
| Hours of driving in a week | 0.54*** | 1.76 | (1.45,2.64) | 11.21 | 0.15 | 1.13 | (0.92,1.31) | 1.48 |
| Years of driving experience of a taxi/truck | -0.05 | 0.97 | (0.92,1.14) | 1.51 | -0.06 | 0.92 | (0.76,1.19) | 1.35 |
| Errors (factor1) | 0.15 | 1.04 | (0.83,1.32) | 1.24 | 0.34*** | 1.21 | (1.09,1.52) | 9.41 |
| Ordinary violations (factor2) | 0.76*** | 1.69 | (1.49,2.38) | 12.43 | 0.62*** | 1.37 | (1.17,1.63) | 11.44 |
| Lapses (factor3) | 0.04 | 1.05 | (0.93,1.21) | 1.37 | 0.04 | 1.02 | (0.97,1.11) | 1.13 |
| Aggressive violations (factor4) | 0.83*** | 1.98 | (1.76,2.95) | 11.67 | 0.51*** | 1.42 | (1.23,1.76) | 8.58 |

Note: Model summary of taxi driver sample: Chi-square= 176.21, enter method, sig= 0.000. $R^2$= 0.22 (Cox & Snell), 0.38 (Nagelkerke), 80.24% correctly predicted. Model summary of truck driver sample: Chi-square= 167.59, enter method, sig= 0.000. $R^2$= 0.18 (Cox & Snell), 0.31 (Nagelkerke). 75.91% correctly predicted.

## 4. Discussion

The present study revealed both differences and similarities in risky driving behaviour and crash involvement among professional taxi and truck drivers. In line with the hypothesis of the current study, comparisons of the reported risky driving behaviour indicated substantial differences on the different DBQ factors. Drivers who transport passengers with light cars were more likely to commit errors, ordinary violations and aggressive violations than drivers of heavy goods vehicles. Meanwhile, the results showed that truck drivers reported more lapses than taxi drivers. A potential explanation for why freight drivers would engage in risky driving behaviour less often could be found both in the characteristics of the vehicles and drivers. For example, the larger size of heavy goods vehicles compared to light passenger cars does not allow truck drivers to easily maneuver between lanes (e.g., with the aim of overtaking a slow driver on the inside). Another possible reason may be the fact that the police have more focus on intercity roads than urban roads in terms of traffic penalties and safe driving in Iran.

As an intermediate purpose, the study also aimed to address an unanswered question regarding the measurement invariance of the 27-item DBQ structure in the samples of professional taxi and truck drivers. Although there were significant differences in terms of DBQ items between the two samples, the analysis of multigroup measurement invariance showed that the factorial invariance (or equivalence) of the DBQ is supported. Hence, unlike the first hypothesis of the study the factor structure has the same conceptual meaning in the two samples of taxi and truck drivers. As such, the findings showed that both the taxi and truck driver samples had a four-factor solution of the 27-item DBQ in Iran. Although the results are in contrast with the three-factor solution suggested by Davey et al. (2007) among professional drivers in Australia, Maslać et al. (2017) five-factor solution among vehicles transporting dangerous goods in Serbia and Dimmer, and Parker (1999) six-factor solution among drivers using passenger cars at work, this solution is in line with the suggested four-factor structure of the DBQ among truck drivers in New Zealand (Sullman et al., 2002).

Older taxi and truck drivers seem to make more errors than younger drivers in Iran, but older drivers make fewer ordinary and aggressive violations. This finding is not in line with Maslać et al. (2017, 2018), where no relationship between age of professional drivers (especially drivers of dangerous goods vehicles) with ordinary and aggressive violations were found. The authors also reported that older drivers commit fewer errors. However, Sullman et al. (2002) showed that older truck drivers have a stronger tendency to commit violations. Taxi drivers who were single were more likely to commit more ordinary violations in the current study, while this relationship was not supported for truck drivers. However, being a single driver was positively related to more aggressive violations in both groups of drivers. Longer driving experience was associated with an increase in taxi drivers' ordinary violations and related to a decrease in errors among truck drivers. Overall, these results partly support hypothesis 3. In other words, there are some background variables which may relate differently to the risky driving factors of truck and taxi drivers. According to previous studies, longer experience with driving is positively related to the self-confidence of a driver, which is related to a decrease in the number of committed errors on the one hand and an increased number of ordinary violations on the other hand (Maslać et al., 2017; Davey et al., 2007; Xie & Parker, 2002; Sullman et al., 2002).

Regarding the predictors of traffic crash involvement in both samples of taxi and truck drivers, a one unit increase of taxi drivers' age reduced the probability of involvement in traffic crashes by 23%, while this increment had no influence on truck drivers' involvement in traffic crashes.

Previous studies also showed that drivers had lower probability of crash involvement by 27% (Maslać et al., 2018; among professional drivers) and 4% (Sullman et al., 2002; among truck drivers) by increased age. Marital status was the significant variable on crash involvement of taxi drivers, while this variable had no effect on crash involvement among truck drivers. Taxi drivers who were single were more likely to be involved in a traffic crash. Single drivers may generally be more likely to conduct general risk-taking and excitement-seeking behaviour (Batool and Carsten, 2017; Korn et al., 2017; Shinar et al., 2001).

A higher annual driving mileage and weekly hours of driving increased the probability of involvement in traffic crashes by 98% and 76% among taxi drivers, respectively, while these variables had no significant associations with accident involvement among truck drivers. This issue may be related to the high exposure of passenger cars in urban roads. Davey et al. (2007) reported that work-related (people who work as drivers) drivers who spend longer periods on the road are more likely to be involved in a traffic crash. Further, income status of both taxi and truck drivers was a significant predictor of crash involvement. This finding is in line with some previous studies which have shown that drivers with high income are less likely to be involved in traffic crashes and risky driving behaviour (Batool and Carsten, 2017; Golias and Karlaftis, 2001).

Among the DBQ factors ordinary violations and aggressive violations were positively associated with traffic crash involvement, both among taxi and truck drivers. A one unit increase of ordinary violations increased the probability of being involved in traffic crashes by 69% and 37% in the taxi and truck driver samples, respectively. Also, a one unit increase of aggressive violations increased the probability of being involved in traffic crashes by 98% among taxi drivers and by 42% among truck drivers. The abovementioned finding also showed the stronger importance of violations on crash involvement among taxi drivers than drivers of heavy goods vehicles. Overall, these findings showed that hypothesis 4 of the study is supported. This implies that there are some significant differences in predictors of crash involvement among professional taxi and truck drivers.

Finally, while errors increased the probability of crash involvement among truck drivers, this probability was not influenced by errors among taxi drivers. Furthermore, in line with Sullman et al. (2002) lapses have not been found to be a significant predictor of crash involvement in both samples. However, Maslać et al. (2018) showed that a one unit increase in lapses increased the probability of crash involvement among professional drivers.

**4.1. Limitations**

The current study has limitations, such as the self-reported nature of the measurement instruments, the cross-sectional design and convenience sampling for both samples of taxi and truck drivers. This might impose limitations in terms of potential socially desirable responses, causal inferences, and issues regarding representativity (af Wåhlberg and Dorn, 2015). The present study has not considered some groups of professional drivers, such as bus and light goods vehicles. Future studies should be geared towards comparing driving behaviour of all types of professional drivers including light passenger car, bus, light goods vehicle and heavy goods vehicles. Furthermore, establishing a cross-cultural study of professional drivers may yield useful applications for national road agencies in different countries.

The results of the regression models which were aimed at predicting crash involvement of taxi and truck drivers may be adversely affected by common method variance (CMV) bias. Since the current study has used the self-reported DBQ as a predictor of the self-reported crash involvement, it is possible that some of the significant associations between the DBQ factors and crashes are attributable to the method rather than the actual interrelations between constructs (af Wåhlberg et al., 2015; af Wåhlberg et al., 2016; Podsakoff et al. 2003). Respondents may, for example, more likely to maintain consistency in their responses across related behavioural items and impression management is a well-known limitation in self-reported methods. In order to decrease the impact of CMV it would have been desirable to collect the explanatory and outcome variables from different data sources. Therefore, we recommend future studies to separately accommodate recorded crash data as the outcome variable, in addition to, self-reported crash involvement when they aim to investigate the influence of the self-reported DBQ in the Middle-East countries. This issue enables the researchers to know to what extent either the results of the recorded and the self-reported crash data are different or reliable in the Middle-East context.

## 5. Conclusions

To the best of our knowledge, this study is among the first studies that examined differences and similarities of driving behaviour among two groups of professional (or work-related) drivers including taxi and truck drivers. Findings indicated that self-reported risky driving behavior have stronger influence on the probability of traffic crash involvement among taxi drivers compared to truck drivers in Iranian context. Our findings also showed that although taxi drivers commit more risky driving behaviour than truck drivers, both samples have an equivalient (invariant) risky driving factor structure.

With regard to risky driving behaviour, an increase in violations (ordinary and aggressive) in two groups of drivers increased the probability of crash involvement almost twice as much for taxi drivers compared to truck drivers. A possible explanation for why taxi drivers have more risky driving behavious than truck drivers may be the fact that taxi drivers do not have to undergo specific qualification and training in Iran. Any person who has a regular driver's license and no significant criminal record can be employed as a taxi driver in this context. Truck drivers, however, must pass important training and qualification before they start their work. Policymakers could potentially decrease ordinary and aggressive violations by establishing better training, qualification, and licensing procedures for taxi drivers in Iran. Another plausible explanation may be the fact that traffic regulation enforcement has mostly focused on interurban roads in Iran by establishing speed cameras and an increased presence of stationary and mobile police vehicles in the traffic environment. Stronger and more committed traffic regulation enforcement for urban roads may also hold promise in Iran.

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