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How do driving behavior and attitudes toward road safety vary between developed and developing countries? Evidence from Iran and the Netherlands

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ABSTRACT

Introduction: The rates of road traffic injuries and fatalities in developing countries are significantly higher than in developed countries. This study examines the differences in driving behavior, road safety attitudes, and driving habits between a developed country (the Netherlands) and a developing country (Iran), which bear major differences in terms of crash involvement per population. *Method*: In this context, this study assesses the statistical association of crash involvement with errors, lapses, aggressive driving incidents, and non-compliance with traffic rules, attitudes, and habits. Structural equation modeling was used to evaluate data obtained from 1,440 questionnaires (720 samples for each group). *Results*: The results revealed that more insecure attitudes toward traffic-regulation observance, negative driving habits, and risky behaviors, such as traffic rule violations act as influential factors of crash involvement. Iranian participants showed a greater likelihood to get involved in violations and driving habits with a higher level of risk. In addition, lower levels of safety attitudes toward traffic-regulation observance were observed. On the other hand, Dutch drivers were more likely to report lapses and errors. Dutch drivers also reported safer behavior in terms of unwillingness to engage in risky behaviors such as violations (speeding and no-overtaking). The structural equation models for crash involvement based on behaviors, attitudes, and driving habits were also evaluated for their accuracy and statistical fit using relevant indicators. *Practical Applications*: Finally, the findings of the present study point out the need for extensive research in some areas to foster policies that can effectively enhance safer driving.

1. Introduction

The number of traffic casualties across the world is unacceptably high. Despite various measures taken to reduce the number of road crashes, the World Health Organization (WHO) revealed the reported outcomes are not even close to the main target of reducing crashes by 50 % by 2020 (WHO, 2018). Road traffic deaths have reached 1.35 million, which has made them eight underlying cause of mortality worldwide (OECD, 2017; WHO, 2018). It is noteworthy that crash rates are not the same worldwide, and developed countries report much lower rates than developing and underdeveloped countries. Moreover, the consequences of these crashes are also more severe: although developing countries have 1.5 times the number of registered cars in developed countries, the rate of casualties in developing countries is more than 11 times higher than in developed ones.

In Iran, which is a developing country, road crashes constitute a major public health issue, with the relevant fatality rate being 20.5 per 100,000 population. Although the death toll has decreased from 32 to 20.5 per 100,000 population over the last decade, it is still higher than the global average (18.2). Accordingly, Iran ranks 113th out of the 175 countries surveyed in the last WHO report (WHO, 2018). On the other hand, the average death toll per 100,000 population is less than a quarter of the global average in developed countries. For example, the Netherlands ranks 11th in the world with a death toll of 3.8 per 100,000 population, making it one of the countries with the highest level of road safety in the world (WHO, 2018).

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There is a relationship between a country's socioeconomic status and its road safety standing; therefore, it is essential to develop and execute internationally coordinated road safety policies and action plans to achieve UN road safety targets. A global objective for reducing road traffic crashes requires each country to develop and implement effective measures. Therefore, information and experiences about road safety trends and best practices should be exchanged internationally. During the process of evaluating policies and strategies to enhance road safety, countries will be able to compare their road traffic safety to that of the rest of the world. Accordingly, considering the policy measures that have been taken in developed countries, and reportedly led to a significant crash reduction, the present study may help identify nuances of safe or unsafe driving, which can shape policy benchmarks for developing countries. Furthermore, drivers are a major component in road traffic crashes, causing them and/or being involved in them; hence, their attitudes and habits toward road traffic safety may influence how they accept and commit to risky driving behaviors. Therefore, the identification of safe behaviors, habits, and attitudes of drivers in developed countries can facilitate informing a policy context aimed at mitigating risky behaviors, habits, and attitudes among drivers in developing countries.

1.1. Behavioral differences in driving

Although the level of road safety is typically affected by a diverse range of factors, such as road infrastructure, traffic operations, vehicle and built environment characteristics (Aidoo, Amoh-Gyimah, & Ackaah, 2013; Alberti, Shahar, & Crundall, 2014; Bergel-Hayat, Debbarh, Antoniou, & Yannis, 2013; Ersan et al., 2019; Rolison, Regev, Moutari, & Feeney, 2018; Sheykhfard & Haghighi, 2018, 2019), human factors have proven to be among the leading causes of road crashes. Numerous studies have reported the contributing role of the human element in more than 90 % of road crashes (Dingus et al., 2016; Mekonnen, Abere, & Olkeba, 2019; NHTSA. (n.d.). Motor Vehicle Traffic Crashes As a Leading Cause of Death in the United States, 2008; Rosli & Kadar Hamsa, 2012), thus justifying the need for a continuous investigation of driving behavior and its multi-faceted nuances. Even though socio-demographic characteristics can substantially relate to several aspects of human behavior, driving style and skill, interpreted as driving behavior and performance, are the main aspects of human factors that are directly associated with drivers (Blows, Ameratunga, Ivers, Lo, & Norton, 2005; Harbeck, Glendon, & Hine, 2017; Papadimitriou, Lassarre, & Yannis, 2016; Sheykhfard & Haghighi, 2020). Accordingly, driving performance is related to information processing and skills required for accomplishing the driving task, and driving behavior depends on the attitudes, motivation, and personality traits of drivers (de Winter & Dodou, 2010; Özkan, Lajunen, & Summala, 2006). On the other hand, driving behavior and performance also affect crash risk, the probability of committing a driving error, and the capability of timely error recovery (Özkan, Lajunen, Chliaoutakis, et al., 2006). Specifically, risky driving behavior may lead to critical hazards or conflicts, which can, in turn, result in crashes. Previous studies have reported various risky behavioral patterns, including the use of a cell phone while driving (Haque, Oviedo-Trespalacios, Debnath, & Washington, 2016; Kaye, Demmel, Oviedo-Trespalacios, Griffin, & Lewis, 2021; Lewis, Watson, & Ho, 2021; Yang et al., 2022), failure to fasten seatbelts while driving (Bao, Xiong, Buonarosa, & Sayer, 2015; Dun & Ali, 2018; Malenfant & Van Houten, 2008), speeding (Akbari & Haghighi, 2019; Bella, 2013; Fildes, Lawrence, & Oxley, 2019; Vadeby & Forsman, 2018), illegal overtaking (Feng, Bao, Hampshire, & Delp, 2018; Rasch, Panero, Boda, & Dozza, 2020; Shackel & Parkin, 2014), driving with anger (Brandenburg & Oehl, 2021; Z. Li, Man, Chan, & Wang, 2021; O'Hern, Willberg, Fink, & Useche, 2022; Zhang, Qu, & Ge, 2022), mind wandering, or any other kind of internal distraction while driving (Fountas, Pantangi, Hulme, & Anastasopoulos, 2019; Yanko & Spalek, 2014). To better understand the behavioral nuances that pose major risks in the driving task, several studies have carefully analyzed driving behaviors (Liu, Khattak, Richards, & Nambisan, 2015; Liu & Khattak, 2018; Tainter, Ryan, Fitzpatrick, Christofa, & Knodler, 2018; Useche, Cendales, Lijarcio, & Llamazares, 2021). To that end, Driving Behavior Questionnaires (DBQs) are among the most widely used data collection techniques, which have been long used to identify risky behaviors of drivers and determine factors bearing significant crash risk (Ang, Chen, Ngin, Oxley, & Lee, 2018; Butcher, Hamann, Reyes, & Peek-Asa, 2019; de Winter & Dodou, 2010; Hamann, Price, & Peek-Asa, 2020; Li et al., 2022; McIlroy, Useche, & Gonzalez-Marin, 2022).

Previous research has investigated and compared risky behaviors in several countries across the globe, often with different fatality rates from road crashes (Alonso, Oviedo-Trespalacios, Gene-Morales, & Useche, 2021; Blows et al., 2005; Iversen, 2004; Lewis et al., 2021; Useche et al., 2021). Specifically, the results of research on deviant driving behaviors in Tunisian and Algerian samples indicated higher scores of Algerian samples on DBQ items compared to drivers in Tunisia. Based on the results of logistic regression analysis, the occurrence of errors and lapses was found to affect crash involvement in the Algerian sample, while only aggression-speeding and lapses were identified as predictors of crash involvement for Tunisian drivers (Dhibi & Lotfi, 2012). Another study on the culture of road traffic using data from Turkey and Iran demonstrated that Iranian drivers were more likely to commit violations of traffic rules and speeding, and less likely to fasten their seat belts compared to their Turkish counterparts (Nordfjærn et al., 2014). Furthermore, research focused on driving behavior in China and Turkey showcased the moderating role of safety skills on the association between internal provisions (abilities and skills of road users that are required while being active in traffic) and violations. In addition, safety skills had a moderating role in the link between internal provisions and errors (Üzümcüoğlu, Özkan, Wu, & Zhang, 2020). A study by Warner, Özkan, Lajunen, and Tzamalouka (2011) showed that the frequency of aggressive and ordinary violations (apart from speeding) was lower for drivers in Finland and Sweden compared to those in Greece and Turkey (Warner et al., 2011). The study of Bener, Ozkan, and Lajunen (2008) revealed that errors, pushing-speeding, lapses, and aggression-speeding factors were different in Qatar and the United Arab Emirates to some extent (Bener et al., 2008). Ersan et al. (2019) examined the behaviors of Estonian, Greek, Kosovar, Russian, and Turkish drivers; the findings revealed that Kosovar drivers showed more positive driver behaviors when they behaved more hostile and perceived other drivers engaging in aggressive warning acts (Ersan et al., 2019).

1.2. Aim of the study

To the best of the authors' knowledge, no previous studies have compared driving behavior in developed and developing countries. Although some studies have reported the effects of factors such as habits and attitudes on the likelihood of crashes (Chen, 2009; Johnson, Oxley, Newstead, & Charlton, 2014; Lizana, Tudela, & Tapia, 2021; Ramos, Bergstad, & Nässén, 2020; Robartes & Donna Chen, 2018; Suzuki, Tang, Alhajyaseen, Suzuki, & Nakamura, 2022), there is very limited empirical evidence on the differences between these factors and their associated impacts among drivers in developed and developing countries. Therefore, the current paper seeks to identify the contribution of driving behaviors, habits, and attitudes in the contexts of two countries [developing (Iran) and developed (Netherlands)] through questionnaire-based

data. It is hypothesized that the Iranian sample has more risky habits and behaviors, as well as less safe attitudes toward traffic issues as a result of a higher rate of crash-related fatalities.

2. Method and materials

2.1. Participants

An online questionnaire was conducted that took about 20 minutes to complete. The questionnaire was advertised through social media platforms, including LinkedIn, WhatsApp, and Facebook. Additionally, the questionnaire was emailed to various institutions, organizations, and industries for further dissemination. Data were collected from samples of drivers in Iran and Netherlands through between March and May 2019. A total of 1,772 questionnaires were completed by Iranian (n = 1018) and Dutch (n = 754) participants. Out of the collected questionnaires, 80 from the Iranian and 34 from the Dutch sample had to be removed from the dataset because of incomplete information, thus leading to a final number of 983 and 720 completed questionnaires by the Iranian and Dutch participants, respectively. From the 983 questionnaires obtained from the Iranian samples, 720 were randomly selected to achieve equal sample sizes. Table 1 shows an overview of the demographic characteristics of participants in both groups. Significant differences were found between both groups in the number of years with a drivers license, daily average kilometers are driven, and number of crash experiences in lifetime. According to Table 1, relatively balanced proportions of males and females in both populations took part in the research, with a slight under-representation of female participants (57 % males and 43 % females for the Iranian sample, and 53 % males and 47 % females for the Dutch sample). Also shown in Table 1, individuals from different age groups participated in the present study. Although the Iranian participants were slightly younger than the Dutch sample overall, participants from a wide range of age groups filled out the questionnaires in both countries. Both samples included information from drivers with a wide range of driving experience, as suggested by the number of years the participants holds a drivers license. In both cases, almost half of the participants were quite experienced as they had a drivers license for more than 15 years. The average driving rate of participants, which indicates their different tendencies to use their cars as well as their exposure to road traffic, was also examined. A comparison of the two samples shows that Iranian participants were more inclined to use a private car and drive an average of > 30 km/day. In addition, Iranians reported more crashes than Dutch participants. Accordingly, about 80 % of Iranian participants (compared to only 45 % of the Dutch sample) experienced a crash at least once. Data also showed that Dutch participants were issued fewer fines compared to their Iranian counterparts, whereas about 28 % of the Dutch and only 5 % of the Iranian participants were never fined for risky driving behaviors.

2.2. Questionnaire

The Human Research Ethics Committee of the Babol Noshirvani University of Technology approved the study in terms of the protection of human participants' rights. Confidentiality of the participants' data was ensured during the research. The deviant driver behaviors were measured using the DBQ extended version, which is a 27-item questionnaire on driving behaviors that has been used by several previous studies (Bener et al., 2008; Lajunen, Parker, & Summala, 2004; Lawton, Parker, Manstead, & Stradling, 1997; Mehdizadeh, Shariat-Mohaymany, & Nordfjaern, 2019; Stanojević, Lajunen, Jovanović, Sârbescu, & Kostadinov, 2018). The questionnaire consists of a total of 27 items, including 3 items for aggressive violations, 8 for ordinary violations, 8 for lapses, and 8 for errors. In addition, drivers' safety attitudes toward certain driving behaviors and their driving habits were measured through a modified 15-item (Chen, 2009; Ulleberg & Rundmo, 2002, 2003) and 9-item (Ball et al., 1998; McNamara, Walker, Ratcliffe, & George, 2015; Wong, Smith, & Sullivan, 2015) versions, respectively. The English version of the questionnaire formed the basis for translation into Persian and Dutch while adapting it through back-translation. Native people (fluent in both languages and Eng-

Table 1
Demographic data of research participants.

Variable		Iranian Sample (N = 720) (%)	Dutch Sample (N = 720) (%)	P-value
Gender	Male	417 (57.91)	382 (53.05)	0.152
	Female	303 (42.09)	338 (46.95)	
Age Group (years)	18–25	132 (18.33)	101 (14.02)	
	25–35	190 (26.38)	156 (21.67)	
	35–45	126 (17.52)	133 (18.47)	
	45–55	94 (13.05)	137 (19.02)	
	>55	178 (24.72)	193 (26.82)	
Number of years with a drivers license (years)	<5	108 (15.00)	99 (13.75)	<0.001
	5–10	116 (16.11)	103 (14.32)	
	10–15	151 (20.98)	154 (21.38)	
	15–20	201 (27.91)	204 (28.33)	
	> 20	144 (20.00)	160 (22.22)	
Daily average kilometers driven (km)	<15	168 (23.33)	183 (25.42)	<0.001
	15–30	122 (16.95)	242 (33.61)	
	'30–45	178 (24.72)	161 (22.36)	
	>60	252 (35.00)	134 (18.61)	
Number of crash experiences in lifetime	0	150 (20.83)	394 (57.72)	<0.001
	1	137 (19.04)	160 (22.22)	
	2	123 (17.09)	92 (12.77)	
	3–5	148 (20.55)	51 (7.08)	
	5–8	88 (12.22)	18 (2.50)	
	>8	74 (10.27)	5 (0.69)	
Number of traffic tickets issued	0	18 (4.61)	109 (27.94)	0.313
	<5	67 (17.18)	131 (33.58)	
	5–10	129 (33.08)	69 (17.69)	
	10–15	97 (24.87)	43 (11.03)	
	15–20	51 (13.08)	27 (6.94)	
	>20	28 (7.18)	11 (2.82)	

Table 2
Sampling adequacy test and questionnaire reliability.

Country	KMO Test	Bartlett's Test		
		Chi-square	df.	Sig.
Iran	0.816	122.623	98	0.315
Netherlands	0.840	145.161	98	0.412

lish) cooperated in the translation of the items into Dutch and Persian. Then, a professional translator translated the questionnaire into English, indicating that there were no differences from the original version. Different expert groups in both countries also tested the questionnaire to confirm the compatibility between the English version and the translation of the questionnaire items.

2.3. Analytical methods

A structural equation model was used to examine the relationship between latent constructs and measured variables. The factor structure was computed using Smart PLS (version 3) and all other analyses were conducted using SPSS (version 26). To find underlying constructs that overlapped across questionnaires, exploratory factor analysis (EFA) was used as a statistical data reduction technique.

2.3.1. Correlation and reliability

The data suitability for factor analysis was assessed using the sampling adequacy test (KMO & Bartlett's test). This test measures the adequacy of sampling for every variable in the model and the complete model, representing a measure of the variance proportion among variables that may be common variance. Lower proportions indicate higher data suitability for Factor Analysis. KMO returns values in a range of 0 to 1. Values < 0.6 represent inadequacy of the sampling and data unsuitability for factor analysis, but values > 0.6 indicate suitable correlations between the data items to perform a factor analysis (Sarstedt & Mooi, 2014). Table 2 shows the results of the mentioned test (KMO & Bartlett's test) in both Iranian and Dutch samples. Given the KMO values of > 0.8, the sampling adequacy is deemed acceptable for the factor analysis. The questionnaire reliability was assessed using Cronbach's alpha coefficient, which takes values in the range of 0 to 1, and describes the reliability of factors derived from dichotomous (questions with binary outcomes) and/or multi-point formatted questionnaires or scales. Higher scores represent the greater reliability of the scale. Different studies have shown 0.7 as an acceptable reliability coefficient; however, there are some reports of lower thresholds in the relevant literature as well (Ma, Yan, Huang, & Abdel-Aty, 2010). Several other DBQ related studies used Crombach's alpha. Özkan, Lajunen, Chliaoutakis, Parker, and Summala (2006) applied the alpha to the three different parts of DBQ: ordinary violation, aggressive violation, and errors. Alpha values range from 0.59 to 0.85 (Özkan, Lajunen, Chliaoutakis, et al., 2006). According to Chu, Wu, Atombo, Zhang, and Özkan (2019), alpha values are 0.90, 0.81, and 0.79 for errors, violations, and lapses, respectively (Chu et al., 2019). As reported by Bener, Jadaan, Crundall, and Calvi (2020), alpha was 0.78, 0.83, and 0.72 for errors, violations, and lapses, respectively. For aggressive violations (Bener et al., 2020), Deffenbacher, Oetting, and Lynch (1994) determined alpha to be 0.80 (Deffenbacher et al., 1994). Table 3 shows Cronbach's alpha coefficient values calculated in the current paper. Since the calculated coefficient for each of the principal components of the questionnaire is higher than the value recommended in the references, the questionnaire data are considered to have a good (high) reliability.

3. Results

3.1. Factor analysis

The SmartPLS software was used to analyze structural equations. All questions were primarily converted to binary variables to evaluate the effects of different components on every single variable. In the next step, all variables were analyzed using varimax rotation. Table 4 presents the results of the factor analysis for the questionnaire data, according to which the questions (observed variables) fell into six latent variables. The questions were divided into six categories of components (i.e., errors, lapse, aggressive violations, ordinary violations, attitudes, and driving habits), based on factor loadings. Table 4 shows the factor loadings of each question for each group (component). Factor loading indicates the effect of each observed variable (question) on the latent variable (six principal components). Factor loadings are at a range of 0 to 1, with values closer to 1 indicating stronger effects of the observed variable (question) on each of the latent variables (principal components).

Figs. 1 and 2 show the structural equation model (SEM) based on the questionnaire data from the Iranian and Dutch samples, respectively. The yellow rectangles represent the questions that were identified, according to the factor analysis results (as shown in Table 4), to be associated with the six latent variables (principal components). These figures indicate the structure of the associations among the six principal components (i.e., errors, lapse, aggressive violations, ordinary violations, attitudes, and driving habits), with the observed variables. In general, measurement and structural models represent the relationships between the observed and latent variables and the internal associations of latent variables, respectively. The combination of the measurement and the structural models forms the overall structural equations model. Table 4 presents the factor loadings of every single question related to the latent variables. According to different studies, factor loadings are divided into three classes of low-, medium-, and high-risk probabilities identified in the ranges of 0–0.5, 0.5–0.75, and 0.75–1, respectively (Lee, Chung, & Son, 2008). A weak factor loading indicates a low probability of impact, or in other words, relatively little influence of an observed variable on a latent variable. Also, factors with moderate- and high-sized

Table 3
Questionnaire reliability.

Country	1st component (lapse)	2nd component (errors)	3rd component (ordinary violations)	4th component (aggressive violations)	5th component (attitudes)	6th component (habits)
Iran	0.84	0.88	0.91	0.89	0.82	0.83
Netherlands	0.87	0.82	0.86	0.92	0.89	0.88

Table 4
Factor analysis of questionnaire data.

Definition and calculation (L; Lapse; E:Error; OV: Ordinary Violation; AV: Aggressive Violation; ATT: Attitude; H: Habit)	Netherlands	Iran
25. Realise that you have no clear recollection of the road along which you have just been travelling (L)	0.20	0.22
9. Forget where you left your car in a car park (L)	0.38	0.45
17. Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers (L)	0.12	0.26
12. Intending to drive to destination A, you "wake up" to find yourself on the road to destination B (L)	0.36	0.41
18. Misread the signs and exit from a roundabout on the wrong road (L)	0.19	0.32
2. Attempt to drive away from the traffic lights in third gear (L)	0.15	0.23
21. Get into the wrong lane approaching a roundabout or a junction (L)	0.48	0.35
24. Hit something when reversing that you had not previously seen (L)	0.27	0.33
20. Queuing to turn left onto a main road, you pay close attention to the main stream of traffic you nearly hit the car in front (E)	0.52	0.38
11. Fail to check your rear-view mirror before pulling out, changing lanes, etc. (E)	0.59	0.63
13. On turning left nearly hit a cyclist who has come up on your inside (E)	0.67	0.58
1. Attempt to overtake someone that you had not noticed to be signalling a right turn (E)	0.57	0.61
19. Miss "Give Way" signs and narrowly avoid colliding with traffic having right of way (E)	0.67	0.57
10. Fail to notice that pedestrians are crossing when turning into a side street from a main road (E)	0.77	0.84
3. Brake too quickly on a slippery road or steer the wrong way in a skid (E)	0.58	0.55
14. Underestimate the speed of an oncoming vehicle when overtaking (E)	0.83	0.76
16. Pull out of a junction so far that the driver with right of way has to stop and let you out (OV)	0.64	0.85
22. Stay in a motorway lane you know will be closed ahead until the last minute before forcing your way into the other lane (OV)	0.19	0.36
23. Race away from traffic lights with the intention of beating the driver next to you (OV)	0.49	0.82
6. Cross a junction knowing that the traffic lights have already turned against you (OV)	0.36	0.61
26. Disregard the speed limit on a residential road (OV)	0.16	0.28
27. Overtake a slow driver on the inside (OV)	0.58	0.80
7. Drive so close to the car in front that it would be difficult to stop in an emergency (OV)	0.33	0.72
8. Disregard the speed limit on a motorway (OV)	0.41	0.76
4. Become angered by a certain type of a driver and indicate your hostility by whatever means you can (AV)	0.30	0.63
15. Sound your horn to indicate your annoyance to another road user (AV)	0.38	0.69
5. Become angered by another driver and give chase with the intention of giving him/her a piece of your mind (AV)	0.42	0.83
28.There are many traffic rules which cannot be obeyed in order to keep up the traffic flow (ATT)	0.45	0.67
29. Sometimes it is necessary to bend the rules to keep traffic going (ATT)	0.39	0.72
30. It is more important to keep up the traffic flow rather than always follow the traffic rules (ATT)	0.41	0.82
31. Sometimes it is necessary to break the traffic rules in order to get ahead (ATT)	0.22	0.56
32. Sometimes it is necessary to take chances in the traffic (ATT)	0.17	0.51
33. Sometimes it is necessary to bend the traffic rules to arrive in time (ATT)	0.52	0.86
34. A person who take chances and violate some traffic rules is not necessary a less safe driver (ATT)	0.11	0.65
35. If you have good skills, speeding is OK (ATT)	0.19	0.71
36. I think it is OK to speed if the traffic conditions allow you to do so (ATT)	0.35	0.76
37. Driving 5 or 10 miles above the speed limit is OK because every-one does it (ATT)	0.56	0.81
38. If you are a safe driver, it is acceptable to exceed the speed limit by 10 km/h (ATT)	0.35	0.69
39. If you are a safe driver, it is acceptable to exceed the speed limit by 20 km/h (ATT)	0.22	0.62
40. Adolescents have a need for fun and excitement in traffic (ATT)	0.18	0.54
41. Speeding and excitement belong together when you are driving (ATT)	0.22	0.55
42. Driving is more than transportation, it is also speeding and fun (ATT)	0.35	0.72
43. Driving in the snow (H)	0.09	0.42
44. Driving in the rain (H)	0.72	0.76
45. Driving at night (H)	0.41	0.88
46. Driving at peak hour (H)	0.14	0.78
47. Driving in foggy conditions (H)	0.25	0.47
48. Driving in high traffic roads (H)	0.44	0.55
49. Driving for long distance without a rest (H)	0.11	0.51
50. Driving in unfamiliar roads (H)	0.27	0.62
51. Responding to road signs and traffic signals (H)	0.87	0.39

loadings indicate the moderate and high influence of the observed variable on the latent variable. In Figs. 1 and 2, red, blue, and green ellipses have been used to better represent questions with low, moderate, and high factor loadings, respectively.

Overall, the results obtained in the present research showed more components with higher risk (higher factor loading; blue and red curves) in the Iranian sample than in the Dutch sample. In other words, the incidence of errors, lapses, aggressive violations, ordinary violations, negative attitudes, and bad driving habits among Iranians was more likely compared to Dutch drivers.

- Ordinary Violations

Among the Iranian sample, behaviors that may lead to ordinary violations are at three different levels. For example, items 8, 16, 23, and 27 represent behaviors at a high level of risk due to their high factor loadings (>0.75). On the other hand, items 6 and 7 indicate moderate-risk behaviors (factor loadings of 0.5–1), and items 22 and 26 show low-risk behaviors (factor loadings of < 0.5). However, there are no high-risk behaviors, leading to ordinary violations (factor loadings of > 0.75) in the Dutch population. As can be seen in Fig. 1, there are only two categories of aggressive violations with moderate- and low-risk levels, indicating that Dutch drivers are less likely than Iranian drivers to engage in behaviors leading to ordinary violations. For example, item 6 indicates the drivers' tendency to run through a red light, which has factor loadings of 0.61 and 0.36 in the Iranian and Dutch samples, respectively. Therefore, Iranian drivers are about 69 % more likely than Dutch drivers to commit this violation. In addition, a comparison of the factor loadings of the two samples for items 8 (speeding on highways) and 26 (speeding in residential areas) shows that Iranian drivers are 86 % and 75 % more likely than Dutch drivers to speed on these routes, respectively. Moreover, a comparison of the coefficients of items related to ordinary violations shows that

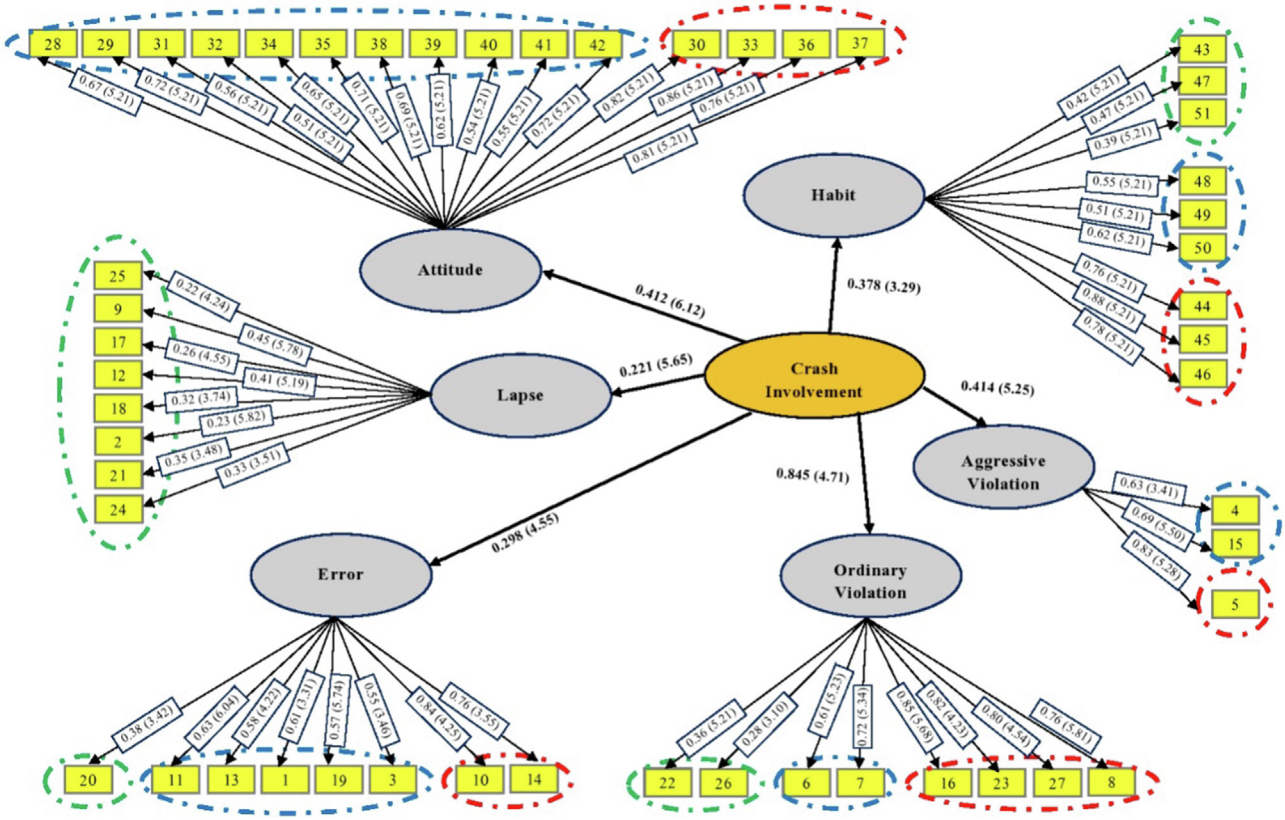

Fig. 1. Diagram of structural equations of crash involvement data in Iran.

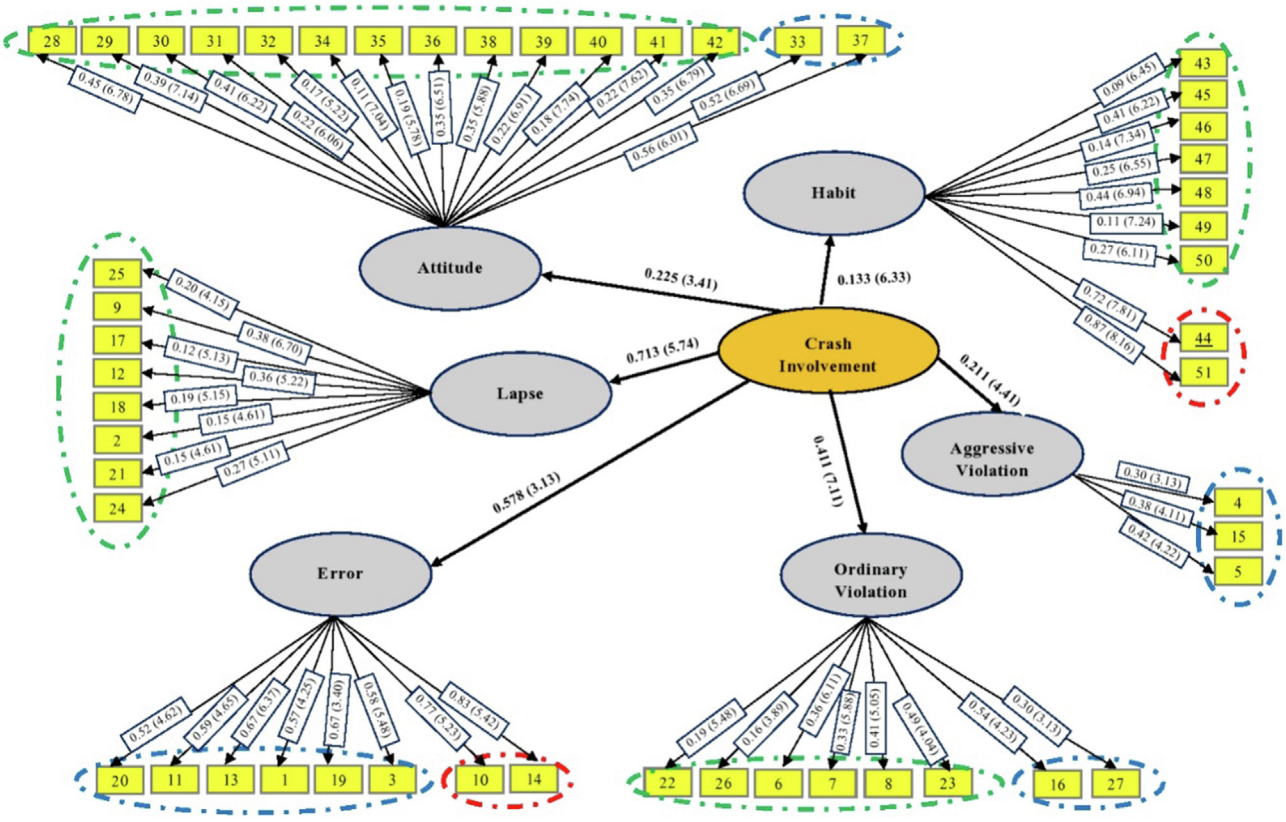

Fig. 2. Diagram of structural equations crash involvement data in the Netherlands.

violations such as failure to yield right-of-way (item 16), failure to drive within the lane and sudden change of the lane (item 22), racing with other vehicles (item 23), illegal overtaking (item 27), and failure to keep a safe distance from the vehicle in front (item 7) were 32 %, 89 %, 67 %, 38 %, and 218 % more likely in the Iranian than the Dutch sample, respectively.

- Aggressive Violations

Aggressive behaviors were examined through three items, namely "becoming angered by a certain type of driver and indicating hostility by whatever means possible" (item 4), "becoming angered by other drivers, and "giving chase with the intention of giving him/her a piece of mind" (item 5), and "sounding the horn to indicate annoyance to another road user" (item 15). Relatively high levels of aggressive behaviors were found among both Iranian and Dutch participants in the current paper. Dutch drivers self-reported moderate levels of these behaviors, while the Iranian sample reported higher levels of aggressive behaviors. According to the results, Iranian drivers reported 2.1 and 1.81 times more cases of becoming angered and sounding the horn than Dutch drivers, respectively. Moreover, chasing another car due to anger was observed to a greater extent (factor loading of 0.83) among Iranian drivers, with the latter being 1.93 times more likely than Dutch drivers (factor loading of 0.43) to indulge in this behavior. Overall, as the results show, Iranian drivers exhibit about twice as much likelihood of aggressive behavior as Dutch drivers.

- Errors

Driving errors were examined through eight common types of errors, including items 1, 3, 10, 11, 13, 14, 19, and 20. According to the results of the factor analysis, errors occurred at moderate and high levels in both Iranian and Dutch samples. For example, failure to note the pedestrians' crossing in turning into a side street from the main road (item 10) and underestimating the speed of an oncoming vehicle when overtaking (item number 14) resulted in loadings equal to 0.84 and 0.76, respectively, in the Iranian sample. The factor loadings of these two items were 0.77 and 0.83, respectively, in the Dutch sample, indicating the occurrence of some driving errors at high levels in both samples. On the other hand, some moderate-level driving errors (factor loadings in the range of 0.5–0.75) were similarly reported in both samples.

According to the results, the factor loading of the item "Attempt to overtake someone that you had not noticed to be signaling a right turn" was 0.61 for the Iranian and 0.57 for the Dutch samples. The items of "Brake too quickly on a slippery road or steer the wrong way in a skid" and "Fail to check your rear-view mirror before pulling out, changing lanes, etc." had factor loadings of 0.55 and 0.63 for the Iranian and 0.58 and 0.59 for the Dutch drivers, respectively.

The items "On turning left nearly hit a cyclist who has come up your inside" and "Miss Give Way signs and narrowly avoid colliding with traffic having right of way" constitute additional driving errors with moderate level of occurrence among Iranian (around 0.58) and Dutch (0.67) drivers.

- Lapse

Driving lapse were examined through eight items, the results of which showed low levels of risk in both samples (factor coefficient < 0.5). However, according to self-reported data, Dutch drivers were less likely than Iranian drivers to driving lapse. For example, the factor loading of item 18 was 0.19 for Dutch and about 0.32 for Iranian drivers. In other words, Iranian drivers had 68 % more difficulty reading signs than the Dutch sample, leading to more lapses in this sample. A comparison of other lapse-related items indicates relatively similar behaviors among the two samples, although the Iranian sample had a slightly higher factor loading coefficients than the Dutch counterpart.

- Attitudes

Fifteen items (28–42) were designed to assess the attitudes of individuals toward the rule of law and traffic regulation observance. According to the results of the data analysis, the Iranian sample showed much more insecure attitudes toward traffic regulations compared to the Dutch sample. The factor loadings of four items were larger than 0.75 in the Iranian sample, indicating the high level of risk concerning these items. Accordingly, Iranian drivers believed that keeping up the traffic flow had more importance than always following the traffic rules (item 30, factor loading of 0.82), while they thought that speeding was okay when the traffic conditions allowed (item 36, factor loading of 0.76). They also believed that driving 5 or 10 miles above the speed limit (item 37, factor loading of 0.81) was okay because every-one did it. From their perspective, sometimes, it would be imperative to bend the traffic rules to arrive on time (item 33, factor loading of 0.86). On the other hand, Dutch drivers reported safer attitudes toward traffic-regulation observance. From their perspective, it was of great importance to follow the traffic rules instead of keeping up with the traffic flow (item 30, factor loading of 0.41), which is almost twice as safe as the attitudes of the Iranian sample. Also, speeding was not acceptable from their perspective even if possible (item 36, factor loading of 0.36).

Regarding other items, both Iranian and Dutch samples had safer attitudes toward violations and breaking the traffic regulations, although the factor loadings of the items showed safer attitudes of the Dutch compared to the Iranian drivers. Breaking the traffic regulations to get ahead (item 31), taking chances in the traffic (item 32), and attitudes toward safe driving (items 34, 38, and 39) were some instances of these attitudes.

- Habits

Some of the main driving habits representing special driving conditions were questioned through nine items. As shown by the results, Iranian drivers were familiar with driving in the rain (item 44, factor loading of 0.76), driving at night (item 45, factor loading of 0.88), and driving at peak hours (item 46, factor loading 0.86). The high factor loadings of these three habits show their frequency among Iranian drivers. However, driving in the rain was reported as a highly frequent driving habit among Dutch drivers (factor loading of 0.72). Responding to road signs and traffic signals (item 51, factor loading of 0.87) was another driving habit of Dutch drivers, who were about 2.23 times more likely to exhibit this behavior than their Iranian counterparts.

Driving on unfamiliar roads (item 50, factor loading of 0.62) and driving for long distances without rest (item 49, factor loading of 0.51) were among the habits with moderate frequency among Iranian drivers but low frequency among the Dutch sample. Accordingly, coefficients of 0.11 and 0.27 indicate that the Dutch were less used to driving long-distance and on unfamiliar roads. Table 4 shows factor loading coefficients of other driving habits for the two samples studied.

3.2. The relationship between Habits, Attitudes, and behaviors with crash involvement

This research also aimed to highlight the effect of habits, attitudes, and behaviors on crash involvement in the Iranian and Dutch samples. Figs. 1 and 2 show the structural equation model

based on the relationships among these latent variables on crash involvement. Based on these figures, factors such as habits, attitudes, and behaviors have direct impacts (positive factor loading coefficients) on crash involvement in both populations. Smaller factor loading coefficients indicate that the factors have lower effects on crash involvement. Accordingly, errors, lapses, and driving habits contributed less to the occurrence of crashes in the Iranian sample. On the other hand, the structural equation model indicates a higher risk of crash involvement for people who have negative attitudes (factor loading of 0.412) toward traffic regulations. In addition, ordinary violations (factor loading of 0.45) were the most significant factors affecting crash involvement in the Iranian sample. In this regard, the role of aggressive violations (factor loading of 0.414) was also significant. On the other hand, although attitudes affected crash involvement in the Dutch sample (factor loading of 0.225), the low coefficient of this factor serves as evidence of their lower tendency to commit aggressive (factor loading of 0.221) and ordinary (factor loading of 0.411) violations. Although the coefficients of these two latent variables indicate their effect on crash involvement, the role of lapse (factor loading of 0.713) and driving errors (factor loading of 0.57) on the probability of crashes was much higher. The low impact of driving habits on crash involvement in the Dutch and Iranian samples is also noteworthy. Hence, it seems that driving habits, especially those associated with higher risk levels (such as driving at night or in the rain), did not have a significant contribution to the occurrence of crashes than other factors in these two samples.

3.3. Evaluation of SEM

The final model was evaluated through the assessment of the measurement and structural models and the overall evaluation of the model.

- Evaluation of the Measurement Model

Convergent validity is the evaluation criterion for the measurement model, in which the correlation of each factor with its indicators is examined (Höck & Ringle, 2010). The average Variance Extracted (AVE) shows the mean of the covariance between each factor and its questions. In other words, AVE indicates the correlation of a factor with its items, and the higher the correlation, the greater the fit. In a suitable model, the AVE must be greater than 0.5 (Chin & Quek, 1997; Höck & Ringle, 2010), which means the items must justify at least 50 % of the total variance of their corresponding indicators. According to Table 5, all variables of the present model have AVE $\geq$ 0.5.

- Evaluation of the Structural Model

According to the results, the variables included in the final model were significant through the relationships among the latent variables at a 95 % level. Resulting from the final model in this paper, R2 had a positive value for the dependent factor of the models (0.818 for the Iranian model and 0.716 for the Dutch model), thus supporting its suitability. The Q^2 criterion, related to the predictive power of the model, is the third index for the structural model assessment. Some researchers believe that models accepted by factor analysis should be able to make predictions related to latent factors within the domain of the model (Henseler & Chin, 2010). In other words, if the relationships among the factors in a model are defined correctly, the factors can sufficiently influence each other. If the value of Q2 for latent factors is less or equal to zero, the relationships between other factors of the model and the latent factors may not be well-specified, and the model must be revised. This criterion specifies the predictive power of the model and if the Q2 value for one of the endogenous factors has three values of 0.02, 0.15, and 0.35, it respectively indicates weak, medium, and strong predictive power, for the factor or its exogenous factors. The present study reported Q^2 values equal to 0.41 and 0.38 for the Iranian and Dutch models, respectively, which indicates that the exogenous (independent) factors adequately predicted the latent endogenous factor, thus supporting the appropriate fit of the structural model.

- Overall Evaluation of the Model

The overall fit of the SEM model is evaluated using the two indices of the Normed Fit Index (NFI) and the Standardized Root Mean Square Residual (SRMR). NFI is an incremental measure of fit for a statistical model, without being affected by the number of model parameters/variables (Hu & Bentler, 1998). Overall, values greater than 0.8 indicate the practical fit of the model with the data. On the other hand, RMSEA is one of the main fit indices in structural equation modeling, described by the difference between the observed and implicit correlation matrix of the model. According to many studies, values lower than 0.05 indicate the suitability of the model, although some studies have reported values lower than 0.08 as acceptable. The values of these two criteria for the Iranian and Dutch models were 0.929 and 0.869, for NFI, and 0.031 and 0.036 for SRMS, respectively, which provide evidence of appropriate fit for the final models.

Table 5
Evaluation of the measurement model.

Latent Variable	Convergent Validity		
	AVE		>0.5
	Iran	Netherlands	
Errors	0.618	0.568	
Lapse	0.582	0.620	
Aggressive Violations	0.604	0.556	
Ordinary Violations	0.595	0.576	
Habit	0.562	0.522	
Attitude	0.594	0.553	

4. Discussion

Results of the present study revealed that Dutch participants demonstrated safer driving behaviors and committed fewer violations, both aggressive and ordinary, than Iranian participants. Moreover, the impact factors (factor loadings) of the behaviors leading to a specific violation were lower for the Dutch sample, reflecting the different tendencies of the two populations to commit violations while driving, which has been supported by previous studies (Afshari, Ayati, & Barakchi, 2020; Lawton et al., 1997; Lucidi et al., 2010; Shaaban & Ibrahim, 2021; Shell, Newman, Córdova-Cazar, & Heese, 2015). The study also showed that Iranian drivers were more inclined to commit risky and aggressive behaviors such as speeding or illegal overtaking while driving. The SEM results indicated a higher probability of crashes for those committing more violations among the Iranian drivers. In addition, those with more insecure attitudes toward traffic regulations were more likely to get involved in crashes. There was also a higher risk of crashes for drivers committing more aggressive violations. In contrast, Dutch drivers with higher rates of driving errors experienced crash involvement to a larger extent. However, errors and lapses affected the likelihood of crashes in both populations; such impacts of both factors were also reported in previous studies (Chai, Wong, & Wang, 2017; Harland, Carney, & McGehee, 2016; Papantoniou, Yannis, & Christofa, 2019).

Legislation and enforcement can help outline the traffic rules in different countries. Penalties for offenders are another essential part of legislation. The punishments for violating traffic rules come in two flavors: criminal penalties (such as imprisonment for dangerous violations) and economic penalties (such as fines and license deprivations, such as suspension or withdrawal). Penalty points (or demerit points) are often used for license deprivation, and they are deemed to cut down on crashes and deaths (Rebollo-Sanz, Rodríguez-López, & Rodríguez-Planas, 2021). Drivers' attitudes about violating traffic rules may be affected by penalty systems; if fines or penalty points are too low, the drivers may become less cautious. Although it is possible to evaluate the causes of these tendencies from different aspects, higher fine amounts for traffic tickets in the Netherlands could be an effective factor leading to a lower tendency to commit violations.[1] Previous research (Factor, 2014; Foroutaghe, Moghaddam, & Fakoor, 2020; Luca, 2015; Lucidi, Mallia, Lazuras, & Violani, 2014) has examined the association between traffic tickets and driving violations. Although the suggestion to increase traffic tickets in Iran requires comprehensive research, a potential pilot implementation of this plan in some areas (accompanied by close monitoring and continuous evaluation) could deliver a more transparent illustration of the effects of this factor on traffic violations. The results also showed that the safety attitudes toward constant adherence to traffic regulations in Iran are less pronounced. In line with this result, some studies (Ge, Liu, Shen, & Qu, 2022; Johnson et al., 2014; Lucidi et al., 2014; Meesmann, Torfs, & Van den Berghe, 2019) have reported the role of attitudes on the probability of crash occurrence.

Education also contributes to the effectiveness of traffic regulations when combined with enforcement and legislation. By educating drivers about road traffic safety and promoting their spontaneous compliance with traffic regulations, road traffic enforcement may have a greater capacity in monitoring and controlling illegal behavior. The re-education of experienced drivers is also critical because over time, some traffic rules may be forgotten or road traffic regulations may be added or altered. In addition, it may be beneficial to improve drivers' awareness, attitude, and behavior, by reminding them of their responsibilities in terms of road safety. Since the cognitive and physical functions of drivers decline with age, it may become necessary to monitor their driving performance over time. Renewal of a drivers license may provide an opportunity for drivers to undergo re-education and get informed about the latest regulations, technological advancements (e.g., driving assistant systems), and safety issues. Such a retraining of drivers can also raise self-awareness of changes in their driving abilities, particularly among elderly drivers. This type of re-education, however, does not appear to be widely implemented; license renewals are scheduled less often (e.g., every 10 years) in a number of countries, and they usually focus on administrative procedures. Many countries face a challenge in educating drivers sustainably. It will be more informative to analyze how countries assess a driver's fitness to drive since it is influenced by a variety of historical and cultural factors. As a result, changes in the education of drivers over time would also affect the testing and licensing systems in each country.

Furthermore, it is critical to focus on psychological constructs in developing countries such as Iran, because social cognitive theories argue that low-risk perception, unsafe attitudes to traffic safety, and risky driver behavior are significant precursors to crash involvement. Investing in road traffic infrastructure may not be as efficient as intended if psychological cognitions and driver behavior are not taken into account. As a result of the assumption that developing countries must emphasize prevention along with reactive countermeasures in traffic safety, the present study showed that negative attitude toward traffic rules serves as an influential trait predictor of risky driving behavior and crash risk in both samples. Using this information, policy makers could identify risky drivers in Iran and implement human factor campaigns targeted at drivers with the disorder trait. By focusing more on enforcement policies, drivers with a high-risk propensity may also drive more safely.

5. Conclusion, Limitations, and future research

5.1. Implications of the results

In the present study, driving behaviors, driving habits, and attitudes toward traffic safety were evaluated and compared among two samples of Iranian and Dutch drivers. Using structural equation modeling, the present study identified factors affecting behaviors, attitudes, and driving habits in both populations. Initially, factor analysis was used to examine data obtained from a 51-item questionnaire consisting of 28 items measuring behaviors, 15 items measuring attitudes, and 9 items measuring driving habits. According to the findings, the Dutch sample was also more conservative toward violating traffic regulations, which may explain their lower likelihood of committing violations. In contrast, there were several circumstances in which the Iranian sample violated traffic regulations more frequently than the Dutch sample.

Generally, the results of the current study may be useful for future studies on the effect of driving habits and attitudes toward traffic rules on driving behavior. The ability to recognize drivers' faults in various driving conditions can be taught as a potential prerequisite in courses for obtaining a drivers license. Appropriate training of drivers on the possible causes of crashes, such as driving errors, lapses, and violations has the potential to raise their awareness about risky situations, and subsequently improve their behavior. Overall, the findings of this study re-iterate the necessity to expand road safety education, strengthen regulations and enforcement, reduce the tolerance for traffic violations and dangerous driving, and improve the level of infrastructure development. In addition, this study found that tolerance levels for traffic violations and dangerous driving differ between countries, which may also be evident from cross-country differences in traffic crashes and compliance rates. Creating a local traffic safety culture is essential for reducing crashes and violations, which means decreasing the tolerance of individuals and communities against traffic violations and dangerous driving.

Findings suggest that psychological factors could play a more significant role in driving behavior and attitudes toward traffic safety than risk perception. Therefore, established psychological theories may benefit from adopting a broader focus rather than just predicting perceptions of traffic risk. Policymakers can also use the findings of this study to further consider introducing psychological tests to driver correction programs. To control aberrant driving behaviors, those who are associated with risky driving behaviors may need to attend additional training workshops on behavior management. In light of the findings of the present study,

[1] It is also noteworthy that the average and minimum income in the Netherlands was 2816 and approximately 1685 Euros per month, respectively (De Nardi et al., 2021). According to the traffic tickets announced in the Netherlands, the fines for speeding can vary up to 400 Euros, and the illegal overtaking fine is around 250 Euros. In other words, assuming the average net monthly income of 2000 Euros (after taxes, etc.) in the Netherlands, the ratio of the maximum fine for speeding to average (net) income is equal to 0.19. On the other hand, the fine for speeding and illegal overtaking in Iran is a maximum of 2,100,000 Rials, which indicates a ratio of fines for speeding to the average monthly income of 0.08 assuming a minimum monthly income of 27,000,000 Rials. This comparison shows that traffic tickets for these two aggressive violations are 240% higher in the Netherlands than in Iran. However, given the recent approaches to increasing fines at a fixed rate of 5%, it will take a long time to set the traffic tickets in Iran at the same cost level with developed countries such as the Netherlands.

several recommendations regarding traffic safety are suggested, including:

- The psychological test should be included in the driver correction program for repeat offenders and crash-prone drivers;
- Virtual reality could be used to train road users' risky behavior toward traffic safety, and the consequences of their actions;
- Seminars or training sessions on road safety topics could be held for families, students, teachers, and administrators.

5.2. Limitations, and future research

The present study sought to examine attitudes, driving habits, and driving behaviors in a developed and developing population using questionnaire-based data. Although questionnaires are used as a valuable source of information in research, they may not lead to extensive and rich results due to some limitations. Some of the most significant limitations that could have influenced the results and findings of the current research include the scarce availability of precise information in the questionnaire (which could result in self-reporting bias), inadequate /limited sample size in the questionnaire (Brener, Billy, & Grady, 2003; Demetriou, Ozer, & Essau, 2015; Kawulich, 2012), and potential lack of representativeness of the samples. As a result, future extensions of this study could include the evaluation of the medical and behavioral-cognitive skills of drivers in addition to their psychological assessments, using computer tests and driving simulations, to analyze the impact of drivers' cognitive characteristics on the occurrence of road crashes. Besides, the current study aimed at presenting the best possible case study using the resources available, but it seems that future studies should consider some emerging sources of data. Precise assessment (through the use of sensors or video recordings) of the driving situations may help better understand the driving behaviors and habits of drivers. Also, to develop behavioral models of drivers, it is recommended that future studies focus on a larger and more representative sample of the drivers' population, as this may help thoroughly explore the differences in behaviors between drivers by analyzing socio-demographic factors, such as age, gender, or capability level.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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