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Original Article

Aberrant Behaviors of Heavy Vehicle Drivers Carrying Hazardous Materials at an International Border in Iran

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Abstract

Background: Most road collisions are directly attributed to human factors. Since aberrant behaviors of drivers play a pivotal role in the occurrence of road accidents, it is worth studying driver behaviors in a riskier situation of carrying hazardous materials. This study aimed to evaluate the behaviors of the drivers carrying hazardous materials at the international border of Bashmaq-Marivan, Iran.

Methods: This descriptive-analytical study was conducted on 250 Iranian drivers carrying hazardous materials at the international border of Bashmaq-Marivan. The participants were included taking a census. Data were collected using the Manchester Driver Behavior Questionnaire (MDBQ). Data analysis was performed by SPSS v 16. The p-value of less than 0.05 was considered statistically significant.

Results: The drivers carrying inflammable liquids had more lapses compared to those carrying inflammable gases. The drivers with less driving experience and higher driving speed had more errors, as well as aggressive and ordinary violations. Higher rates of aggressive violations and errors were detected in young drivers, while the drivers with higher rates of accidents had comparatively more lapses and ordinary violation.

Conclusion: Considering the effects of age, driving experience, high speed, and accident experience on aberrant behaviors in driving, it is recommended that public training targeting specific groups be implemented regarding the legal constraints of driving.

Keywords: Aggression, Automobile driving, Census, Hazardous substances, Humans, Incidence, Iran

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Introduction

Road accidents are a leading cause of mortality and disability in the world. According to the World Health Organization (WHO), the number of traffic-related deaths reached a high rate of 1.35 million people in 2018. In addition, road accidents are considered the eighth leading cause of mortality in all age groups. According to a report, the annual road traffic mortality rate in Iran is 20.5 per 100,000 individuals (1). In fact, road accidents are the second cause of mortality and the main cause of life years lost in Iran (2).

Road traffic accidents mainly occur due to human, vehicle, and environmental factors (3). According to the statistics on the causes of road accidents, human failure is the most significant influential factor with the prevalence of 90-95% (4). Human failures encompass all the actions that could potentially lead to danger (5). Driving behaviors play a key role in the occurrence of road traffic accidents. Therefore, the attempts to change these behaviors and interventions to modify high-risk driving behaviors will have a major impact on the reduction of road accidents and their consequences (6). Self-report questionnaires are effective instruments for the identification of the high-risk behaviors of drivers (7). Reason *et al* designed the MDBQ to measure high-risk driving behaviors (8). More than 174 confirmatory and exploratory studies have been carried out since the publication of the results of the studies based on the MDBQ (9).

Heavy vehicle drivers are a large class of road drivers who have distinctive behavioral characteristics in terms of demographics, skills, and attitudes toward driving and about other drivers (10,11). Road traffic accidents involving vehicles carrying hazardous materials could have long-term adverse effects on the lives and health of individuals, as well as their properties and environment (12). Numerous studies have used the MDBQ to investigate the behaviors of heavy vehicle drivers. The questionnaire has also been used in other countries, such as New Zealand (10), Egypt (13), and Serbia (12). Moreover, various studies have applied the MDBQ in Iran to investigate the behaviors of heavy vehicle drivers. Such examples are the studies performed by Mehdizadeh *et al* (14), Naderi *et al* (15), and Ketabi *et al* (16). However, no research has exclusively used the MBDQ to examine the aberrant driving behaviors of the drivers of vehicles carrying hazardous materials.

Considering the potential difference of this group of drivers in terms of the types of goods and their possible risks compared to other heavy vehicle drivers, the data on these individuals cannot be generalized to other heavy vehicle drivers. The present study aimed to assess the behaviors of heavy vehicle drivers carrying hazardous materials at an international border in Iran.

Materials and Methods

This descriptive-analytical study was conducted on the Iranian drivers (n=250) carrying hazardous materials at the international border of Bashmaq-Marivan, Iran. The participants were included taking a census, and data were collected using the MBDQ. The MDBQ consists of 50 items, which are scored based on a five-point Likert scale (8). Inappropriate driving behaviors were classified into four categories of lapses, errors, aggressive violation, and ordinary violation (17).

The validity and reliability of the MBDQ in the evaluation of driving behaviors have been confirmed in various studies in Iran, such as the research by Arghami *et al* (18) and Goodarzi *et al* (19). To assess the reliability of the Persian version of the tool in heavy vehicle drivers, the questionnaire was distributed among 20 drivers carrying hazardous materials, and its reliability was confirmed by Cronbach's alpha of 0.94. After the initial assessment and ensuring the acceptable reliability of the tool, the questionnaires were completed at Bashmaq-Marivan terminal beside Marivan-Sanandaj Traffic Police Office.

The inclusion criteria were the minimum work experience of three years, minimum age of 28 years, and basic literacy. Initially, the process to complete the questionnaire was explained to the participants, and self-reported questionnaires were completed by the drivers.

Data analysis was performed by SPSS v 16 (SPSS Inc, USA). Descriptive data are shown as numbers, percentages, means, standard de*via*tions, median, and interquartile range. For comparing the results by groups, Chi-square was used to compare the qualitative variables and Kruskal-Wallis test for comparing quantitative variables in study groups (The distribution of quantitative variables was not normal). In all the statistical analyses, a p-value of less than 0.05 was considered statistically significant.

Results

Descriptive analysis

According to the information in table 1, the mean age and work experience of the drivers were 42.8±8.97 and 8.92±14.51 years, respectively. In addition, 85.2% of the subjects were married. Most of the hazardous materials carried by the drivers were flammable liquids (79.6%).

Inferential analysis

According to the obtained results, there were significant correlations between age, aggressive violations, and errors (Table 2), which had the highest median and interquartile range among young drivers (<40 years), indicating the reverse significant association between aggressive violations ($p<0.001$) and errors ($p<0.001$).

No significant associations were observed between age, driving lapses ($p=0.068$), and ordinary violations ($p=0.638$). Evaluation of the factors encompassing the unfavorable behaviors of the experienced drivers resulted in the recognition of significant correlations between aggressive violations ($p<0.001$), ordinary violations ($p=0.007$), and errors ($p<0.001$). Nonetheless, no association was detected between driving lapses and driving experience ($p=0.306$).

Evaluation of the influential factors in the aberrant behaviors of the drivers with a history of road accidents demonstrated that the history of road accidents was significantly correlated with ordinary violations ($p<0.001$) and driving lapses ($p=0.011$), among drivers with a history of three or more accidents. On the other hand, no significant associations were observed between aggressive violations ($p=0.708$), ordinary violations ($p=0.592$), and errors ($p=0.359$) among drivers carrying hazardous materials.

For the influential factors in the aberrant behaviors of the drivers with high speed, our findings indicated significant associations between high speed, aggressive violations ($p<0.001$), ordinary violations ($p<0.001$), and errors ($p<0.001$). The largest median and interquartile range of this correlation were observed in the drivers with a speed higher than 100 *km/h* in terms of aggressive and ordinary violations and errors, thereby demonstrating direct significant correlations between these variables. However, no significant association was observed between driving lapses and high speed ($p=0.212$).

Discussion

According to the results of the present study, the variables of age, driving experience, history of road accidents, high speed, and hazardous materials group significantly affected the behaviors of drivers. In addition, evaluation of the correlation between driving experience and aberrant behaviors of the heavy vehicle drivers carrying hazardous materials revealed a significant, reverse correlation between driving experience and aggressive violations (Table 2). In other words, more driving experience was associated with lesser aggressive violations in driving. In this regard, our findings are in line with the results obtained by Maslać *et al*, Lotfi *et al*, and Sonbolestan *et al* (12,20,21).

Based on Lotfi and Sonbolestan *et al*'s studies with the main focus on behaviors of taxi and automobile drivers and Maslać *et al*'s study evaluating the behaviors of

Table 1. Age, driving experience, marital status, and hazardous materials in the studied population (n=250)

Demographic variables	Category	Frequency	Percentile
Age(year)	≤40	112	44.8
	41-50	83	33.2
	≥51	55	22.0
Marital status	Single	37	18.8
	Married	213	85.2
Driving experience	≤10	108	43.2
	11-20	88	35.2
	≥21	54	21.6
Category of hazardous material	Flammable liquid	199	79.6
	Flammable gas	51	20.4

Table 2. Studied variables and median of each factor

Variable		Lapse	Ordinary violation	Error	Aggressive violation
Index		Median (IR*)	Median (IR)	Median (IR)	Median (IR)
Age	≤40	31.42(8.57)	34.11(9.54)	35.55(13.33)	26.66(13.33)
	41-50	33.33(8.57)	28.23(7.06)	33.33(6.67)	26.66(13.33)
	≥51	30.47(7.62)	25.88(4.71)	28.88(8.89)	26.66(13.33)
p-value		0.068	<0.001	<0.001	0.638
Driving experience	≤10	32.38(8.33)	32.94(11.47)	35.55(11.11)	26.66(13.33)
	11-20	31.42(7.62)	30.58(8.24)	31.11(6.67)	26.66(13.33)
	≥21	29.52(8.57)	27.05(7.06)	31.11(7.22)	20.00(6.67)
p-value		0.306	<0.001	<0.001	0.007
Number of accident s	Without accident	29.52(8.57)	30.58(11.76)	33.33(13.33)	26.66(13.33)
	One	33.33(6.67)	30.58(8.24)	33.33(6.67)	26.66(6.67)
	Two	34.28(6.43)	31.76(5.88)	33.33(6.67)	26.66(13.33)
	Three and more	34.76(6.19)	32.35(10.29)	33.33(7.78)	26.66(20.00)
p-value		<0.001	0.434	0.427	0.011
Hazardous material	Flammable liquid	32.38(8.57)	30.58(9.41)	33.33(8.89)	26.66(13.33)
	Flammable gas	29.52(7.62)	31.76(16.47)	31.11(13.33)	26.66(13.33)
p-value		0.014	0.708	0.359	0.592
Maximum speed	≤80	30.95(8.33)	30.95(7.94)	28.88(8.89)	20.00(6.67)
	81-100	26.00(7.00)	30.58(9.41)	33.33(8.89)	26.66(13.33)
	≥101	32.38(7.86)	33.52(15.59)	35.55(9.44)	26.66(20.00)
p-value		0.212	<0.001	<0.001	<0.001

*Interquartile range

found between aggressive violation (p=0.434), errors (p=0.427), and history of accidents.

Concerning the influential factors in the aberrant behaviors of the drivers carrying hazardous materials, our findings were indicative of a significant correlation between hazardous materials and lapses (p=0.014). The largest median and interquartile range belonged to the drivers carrying inflammable materials, demonstrating the high rate of driving lapses. However, no significant associations were the drivers carrying hazardous materials, it could be concluded that there is no significant correlation between decreased aggressive violations and type of vehicle. In fact, increased driving experience was associated with the reduction of intentional harmful and norm-violating behaviors.

The results of the present study indicated a significant reverse correlation between driving experience and driving errors (Table 2). In other words, more driving experience was associated with fewer errors

in driving. In this respect, our findings are congruent with the results obtained by Maslać *et al* and Lotfi *et al* (12,21). Therefore, it could be inferred that decreased errors were not correlated with the type of vehicle and driving errors decreased with increased driving experience.

The findings of the current research showed a reverse significant association between the driving experience and ordinary violation of the drivers (Table 2). In other words, more driving experience decreased the rate of ordinary violation in driving. In this regard, our findings are consistent with the results obtained by Lotfi *et al* (21). In the study by Maslać *et al*, a significant direct association was reported between ordinary violations and driving experience, and more driving experience was associated with the higher rate of unintentional driving offenses (12). Considering the consistency of our findings with the results obtained by Lotfi *et al*, there was no association between the reduction of ordinary violation and type of vehicle. In fact, the increased driving experience, could reduce the frequency of the ordinary violations.

No significant relationship was observed between driving experience and lapses (Table 2). In terms of the association between driving experience and influential factors in the aberrant behaviors of the drivers, 8-9 years of driving experience played a key role in the driving behaviors of the participants (22). Therefore, drivers with less driving experience were more likely to have high-risk driving behaviors due to their lack of experience (23). The positive impact of work experience on the reduction of unsafe acts is based on the models describing contributing factors to the cause, accident sequence, and high-risk driving behavior. In such models, work experience has been emphasized as a primary influential factor in unsafe driving behaviors (24).

According to the current research, there was a significant reverse correlation between the age of the drivers and their aggressive violation (Table 2). In other words, the increased age of the drivers was associated with less aggressive violations in driving. In this regard, our findings are in line with the results obtained by Azad *et al*, Sullman *et al*, Lotfi *et al*, and Stanojević *et al* (5,10,21,25).

In another study, Sonbolestan *et al* reported a significant direct association between age and aggressive violation as elder drivers had more aggressive violation (20). Given the consistency of our findings with the results obtained by Lotfi *et al,* Stanojević *et al* (behaviors of taxi and automobile drivers), Sullman *et al* and Azad (behaviors of heavy vehicle drivers), it could be concluded that decreased aggressive violation had no association with the type of vehicle. In fact, increased age was associated with the reduced frequency of aggressive violation in driving.

In the present study, a significant direct association was observed between the age of the drivers and driving errors (Table 2). In other words, increased age of the drivers lowered their driving errors. Our findings in this regard are in congruence with the results obtained by Azad *et al*, Sullman *et al*, Maslać *et al*, and Lotfi *et al* (5,10,12,21). Given the consistency of our findings with the studies conducted by Lotfi *et al,* Stanojević *et al*, Sullman *et al*, Azad *et al* and Maslać *et al* it could be inferred that there is no correlation between the reduction of driving errors and type of vehicle. However, increased age could result in fewer driving errors.

The results of the present study indicated no significant association between the age of the drivers and ordinary violation (Table 2), which is consistent with the findings of Azad *et al* and Maslać *et al* (5,12). Furthermore, no significant correlation was indicated between the age of the drivers and driving lapses (Table 2), which is in line with the results obtained by Haghshenas *et al* (26). Decreased rate of road accidents due to aging could be attributed to gaining more experience and becoming more cautious as a result. According to the literature, young inexperienced drivers tend to have more high-risk driving behaviors (24).

According to the current research, the intention to drive at an unauthorized speed decreases with increased age and driving experience. This is because the attitudes of elder and more experienced individuals toward the consequences of driving change from enjoyable/useful to unpleasant and harmful (27). In summary, young drivers accept a higher degree of risk while driving due to their tendency toward risk-taking and receiving compliments because of their great driving skills. Therefore, they are at a higher risk of road collisions and committing more violations while driving.

The results of the present study indicated a significant direct association between high-speed driving and

aggressive violation (Table 2). In other words, a higher speed while driving was associated with the higher frequency of the aggressive violation. In this regard, our findings are consistent with the results obtained by Azad *et al* (5). In addition, the results of the present study were indicative of a significant direct correlation between high-speed driving and driving errors (Table 2). However, no significant correlations were observed between high speed, ordinary violation, and driving lapses (Table 2).

To address the insignificant relation of ordinary violation and driving lapses, it could be stated that driving at high speed is an aggressive violation which was formulated as a question to measure the scores of violation and error in the questionnaire. On the other hand, one of the most important issues concerning the misbehavior related to high speed is the perceptual judgments for speed discrimination and distance of drivers.

Adaptation is an important influential factor in the perceptual judgment of driving speed as drivers who are adapted to higher speed will lower their speed while driving, and the drivers who are adapted to slower speed estimate that their speed is within a higher range. This phenomenon is more important during speed reduction when drivers assume that they are driving at a lower speed than their actual speed. Therefore, when drivers reduce speed, they are driving faster than they assume. Under such circumstances, drivers might drive at a higher speed than the authorized speed limit, which increases the risk of accidents (24).

With respect to the history of road accidents and aberrant driving behavior of heavy vehicle drivers carrying hazardous compounds, a direct significant correlation was observed between road accidents and driving lapses (Table 2). In other words, drivers with more experience of road accidents had more driving lapses. In this regard, our findings are in line with the results obtained by Azad *et al* (5). Furthermore, a direct significant association was detected between the history of road accidents and ordinary violations of the drivers (Table 2) as the drivers with more road accident experience had more ordinary violations. In this respect, our findings are consistent with the studies by Özkan *et al* and Tavakoli Kashani *et al* (28,29).

In the current research, no significant correlations were observed between the history of road accidents, aggressive violation, and errors (Table 2). The lack of significance might be due to higher adherence to safety recommendations by the drivers carrying hazardous compounds due to the risk for humans and the environment. The aberrant behaviors of these drivers are mostly caused by inattention, memory impairment, and ordinary violation.

Another important finding of the present study was the significant association between the aberrant behavior of the drivers and the history of road accidents, which is consistent with the theory of susceptibility to the accident. Accordingly, some individuals are more susceptible to unsafe acts and accidents due to a set of institutional characteristics compared to others. Notably, the mentioned theory has been modified to the emergency preparedness theory, so that the set of attributes that lead an individual to perform unsafe acts as a result of accidents would not be constant over time and may change with the probability of the individuals becoming more susceptible to various disasters.

To justify, increased experience and skill levels and decreased motor skills and sensory and mental functions as a consequence of aging are crucial determining factors. This finding is in line with the theory of susceptibility to accidents, according to which some individuals are more susceptible to accidents due to various factors (24).

In the present study, evaluation of the correlation between the hazardous compound group and aberrant behaviors of the heavy vehicle drivers carrying hazardous materials indicated that the hazardous compound group was just significantly correlated with driving lapses (Table 2). In this regard, our findings are in line with the results obtained by Maslać *et al* and Sullman *et al* (10,12). Moreover, driving lapses were observed to be more prevalent in the drivers carrying flammable liquids. However, no significant associations were detected between the hazardous compound groups, intentional/ordinary violation, and errors in the heavy vehicle drivers carrying hazardous compounds. It seems that the consistency between the results might be due to the type of vehicle.

One of the main limitations of the study was that majority of the imported and exported hazardous materials at the international border of Bashmaq-Marivan belonged to the second and third groups of hazardous compounds, and other hazardous materials

were not assessed in this study. Moreover, small number of subjects in the study carried flammable gasses which requires further evaluation compared to those carrying flammable liquids. Furthermore, the dynamics of heavy vehicles are different from passenger cars, and some behaviors of heavy vehicle drivers might not have been measured by MDBQ

Conclusion

Considering the effects of aging, driving experience, high speed, and history of road accidents on the aberrant behaviors of the studied drivers, a comprehensive approach encompassing general education, specific purpose-based training, and legal restrictions for drivers must be adopted and implemented. Since the data were collected using a questionnaire, it is suggested that other research methods (*e.g.* interviews and observation) be applied to further evaluate the aberrant behaviors of the drivers carrying hazardous compounds. Another suggestion is to add more questions to the MDBQ regarding the use of cellphone, sending SMS, and checking social media in future research. Moreover, other studies can be conducted to assess the prevalence of aggression in these drivers to compare the results with other road users *via* interviews to recognize their problems. It is recommended that special roads be constructed for heavy vehicles and vehicles carrying hazardous compounds in suburban areas and ring roads be constructed for cities to prevent the entry of these vehicles into urban areas.

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