

Aberrant Behaviors and Road Accidents among Iranian Truck Drivers, 2010

*Damon Ketabi¹, Abalfazl Barkhordari¹, Seyyed Jalil Mirmohammadi², Amir Houshang Mehrparvar²

¹Department of Occupational Health, School of Health, Shahid Sadoughi University of Medical Sciences-Yazd, Iran

²Department of Occupational Medicine, Shahid Sadoughi University of Medical Sciences-Yazd, Iran

(Received : 01 July 2011/ Accepted : 17 Oct 2011)

ABSTRACT

Background: Road accidents are a social phenomenon in different communities that its infra-structural dimensions of which as well as technologic failures such as road quality, and technical faults of automobiles, need to be assessed in detail. Iran has the first order in the world for deadly road accidents. This study was designed to assess the association between aberrant behaviors of truck drivers and the incidence of road accidents in Yazd, center of Iran, in 2010.

Methods: This cross-sectional descriptive-analytic study was conducted on 300 truck drivers in Yazd. We used 3 questionnaires, including one for demographic data, Driver Behavior Questionnaire (DBQ), and one for drivers' self-evaluation of the of their driving.

Results: Five types of the behavior had the highest frequency: Misjudge speed of oncoming vehicle when overtaking.; Deliberately disregard the speed limits late at night or very early in the morning.; Ignore 'give way' signs, and narrowly avoid colliding with traffic having right of way.; Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances.; Drive with only 'half-an-eye' on the road while looking at a map, changing a cassette or radio channel, etc. The more the driver's driving was influenced by emotional and mental states the more deliberate violations and slips.

Conclusion: Among truck drivers, safety has not developed sufficiently, and because of the dangers of road accidents both for the drivers and other people and its economic losses, the importance of the presenting some solutions is completely obvious.

Keywords: Aberrant Behaviors; Road Accidents; Drivers; DBQ, Iran

Introduction

Among all systems humans are exposed routinely, traffic system is among the most complex and dangerous ones. There are almost 1.2 million killed, and other 50 million injured annually because of road accidents, and it is predicted that these statistics will increase by 65 percent during next 20 years; unless some new strategies are introduced for prevention [1]. In 1998, road accidents were the 10th cause of

death all around the world and trucks were killed 98% of car passengers in multi-car accidents, it shows that trucks have the highest intensity of accidents [2]. Transition toward modernization and the resultant imbalance between the growth of road traffic and situations pertaining to it, has made vehicle accidents a more critical subject in developing countries, so these

countries (e.g. Iran) need a special attention in this issue [1].

Road accidents is a social phenomenon in different communities and its infrastructural dimensions (such as socio-cultural, psychological, promotional, judiciary and medical aspects, and police role) as well as technologic failures such as road quality, and technical faults of automobiles, need to be assessed in detail. Road accidents due to their specific characteristics (i.e. high incidence, high severity and probability of the direct involvement of all community members) have a special importance in all communities [1, 2].

The importance is more prominent in developing countries such as our country. Significant production of vehicles without paying attention to cultural and infrastructural background, disregarding the process of receiving driving license, and lack of periodic assessment of the drivers, low quality of roads, insufficient training of pedestrians, and so on [3], has resulted in a higher mortality rate due to road accidents than developing and even developed countries, although the index "vehicle \times traveled kilometers" in developed countries is ten times Iran [4].

Statistics show that the index "number of the killed per 10000 vehicles" in Iran is much higher than developed countries. For example this index was 29 in 1996 in Iran, but at the same time it was 1-2.5 and 3-15 for developed and developing countries, respectively [4].

In 2003, more than 25000 deaths due to road accidents were reported to forensic medicine centers in Iran, 5000 deaths belonged to truck accidents [5]. According to the report of Iran Ministry of Health, 27764 persons were killed because of road accidents in 2005 which trucks had second order of cause of death with 17% after motorcars with 31.9% [6], though it is reduced by 5000 deaths during the last 3 years; even though roads in Iran are amongst the most deadly ones in the world. Annually there are more than 400000 road

accidents in Iran, and our country has the first order in the world for deadly road accidents. The highest proportion of deaths with 60.5% was happened in suburban roads, in the accidents between trucks and other kinds of vehicles [7].

Considering aforementioned issues, it is clear that road accidents lead not only to the injury and death of many persons, but also it can deliver a high amount of financial damage to the country which can eventually lead to severe loss to the national economics, and can potentially cause a national disaster in recent future [8].

On the other hand, it is proved that aberrant behaviors are the major cause of road accidents

[9-12]. Aberrant behaviors are defined as a series of errors and violations during driving which may lead to road accidents.

Drew (1994) attributes 80-90% of accidents to aberrant behaviors [13]. Billing and Reynard (1990) introduce aberrant behaviors as the cause of 70-90 percent of accidents [14]. Older and Spicer (1986) believe that road accidents are the outcome of an interaction between the driver, the environment and the vehicle [15].

This study was designed to assess the association between aberrant behaviors of truck drivers and the incidence of road accidents in Yazd, center of Iran, in 2010. It seems that it is the first research in this issue in our country.

Material and Methods

This was a cross-sectional descriptive-analytic study on 300 truck (large good-carrying vehicle) drivers in Yazd, center of Iran. Subjects were selected from drivers referring to Yazd cargo terminal by simple random sampling. Their vehicles included any kind of truck (i.e. flatbed, dump, and trailer) except for small trucks. We had a list of all truck drivers who lived in Yazd Province and we chose 300 drivers from this list using random digit table. From 300 drivers, 23 refused from answering to the

questions, so we selected 23 other drivers by random digit table and substitute them. An informed consent was obtained from each participant [16, 17]. The study was approved by Shahid Sadoughi University of Medical Sciences Ethics Committee.

Our research instrument was the three-section Driver Behavior Questionnaire (DBQ) [18-21]. The first section consists of demographic data and the driving accident records during the last 5 years. The second consists of questions pertaining to aberrant behavior which may result in road accidents and the third section consists of 5 questions about the drivers' self-evaluation of their driving. Some researchers believe that standard DBQ does not differentiate pleasant from unpleasant mood [21], so we added another question (question number 6) to the third section of DBQ to solve this problem.

DBQ was translated into Persian and after cultural accommodation it was reassessed by two other expert translators; then its validity and reliability was confirmed. For confirming item clarity, we performed pre-testing. Questionnaire was delivered to 50 drivers, and they were asked to answer the questions and identify the questions which are not clear for them, then we made some minor changes to some questions. The questionnaire was delivered to 6 police officers (Accident Analyzer) in order to adapt it with our country rules and they confirmed it.

In order to identify internal reliability, we measured Cronbach's alpha for the data from the pilot study on 50 persons which was 0.89 for the scale and its sub-scales. Cronbach's alpha for the whole sample size was 0.89 and 0.87 for the scale and sub-scales, respectively. The study was single blind and the drivers were not aware of our survey [22, 23].

The Construction of the Driver Behavior Questionnaire (DBQ)

The DBQ consisted of three sections. The first section consists of 31 questions about demographic data including age, gender,

occupation, marital status, driving experience, traveled distance in a week, driving on a regular path (go and return), road accident record (considering the time), free-way use, and so on.

Section 2 consists of 50 questions. Subjects are asked to answer the questions by a simple analysis and identify how often they commit aberrant behaviors during driving.

Each question is designed based on two aspects:

1. The type of aberrant behavior.
2. Risk level imposed to others. Each aforementioned behavior is categorized in 4 major classes:
3. Slips (errors due to forgetfulness or lack of concentration).
4. Mistakes (errors due to incorrect assessment).
5. Unintentional Violations.
6. Deliberate Violations.

Although errors can be described by cognitive processes, violations are described only in a social context.

Each behavior is classified into 3 categories based on its risk level for others:

A: no risk for others, behavior which only brings shame for the driver

B: possible risk for others.

C: definite risk for others.

Section 3 included six, more general, and self-assessment questions. Subjects were asked to rate following questions on a three-point scale:

1. How skillful a driver are you?
2. How safe a driver are you?
3. How errors prone are you during driving?
4. How law-abiding are you during driving?
5. To what extent does pleasant mood influence your driving?
6. To what extent does unpleasant mood influence your driving?

Data was analyzed by SPSS (Ver. 17) using chi square and Pearson correlation coefficient.

Results

All subjects were male. Mean (\pm SD) age and driving experience was 48 (\pm 9.54) years and 14 (\pm 7.64) years, respectively. Mean, minimum and maximum driving speed on the road was 50 (\pm 5.32) and 110 (\pm 7.61) km/h. Frequency distribution of the demographic data of the subjects and their driving experience are shown in Tables 2-4, respectively.

Relative Frequency of the Driver Behavior Items

When the 50 items of section 2 were ranked according to the drivers' rated mean frequencies, five kinds of aberrant behaviors had the highest frequency among truck drivers:

1. Misjudge speed of oncoming vehicle when overtaking. (Mean \pm SD = 4.32 \pm 0.61)
2. Deliberately disregard the speed limits late at night or very early in the morning. (Mean \pm SD = 4.26 \pm 1.32)
3. Ignore 'give way' signs, and narrowly avoid colliding with traffic having right of way. (Mean \pm SD = 4.14 \pm 1.12)
4. Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances. (Mean \pm SD = 3.87 \pm 0.42)
5. Drive with only 'half-an-eye' on the road while looking at a map, changing a cassette or radio channel, etc. (Mean \pm SD = 3.76 \pm 1.14)

The results of DBQ section 2 can be observed in Table 5 and the association between the frequency of each aberrant behavior and the type of the behavior and its risk level are shown in Figure 1 and 2, respectively.

According to Fig. 1, deliberate behaviors are the most frequent ones among aberrant behaviors in drivers. Figure 2 shows that high-risk behaviors with certain danger for others are more frequent than low-risk behaviors. ($P < 0.05$; $X^2 = 3.95$).

Table 6 shows the predictors of aberrant behaviors (deliberate violations, slips and mistakes). Multiple regressions were calculated to establish which of the variables: age, driving skill, pleasant and unpleasant mood, law obedience, distance traveled a week, error proneness, freeway use and observance of safety issues, provided the best predictors of the types of aberrant behavior.

According to this table, older drivers and those who introduce themselves as obedient to law, report less deliberate violations. Those who drive a large distance during a week, like those whose driving is influenced by their mood, confessed to more deliberate violations.

Those who believe that they are more skillful drivers performed more deliberate violations than those who have judged themselves as drivers with average skill. The more the driving is influenced by mental states, the more mistakes. This influence was higher for unpleasant mood and negative emotions.

Freeway using had an inverse relationship with mistakes. The more the drivers observed safety issues, the less they mistook. Those who introduced themselves as error prone, reported more mistakes. This pattern is seen in slips as well.

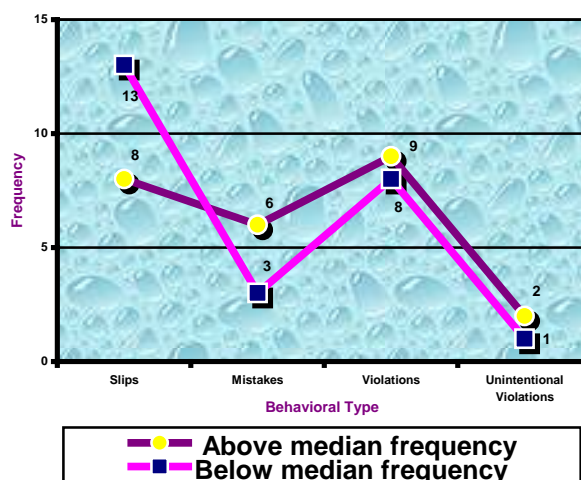


Fig. 1: The relationship between the frequency and type of the behavior

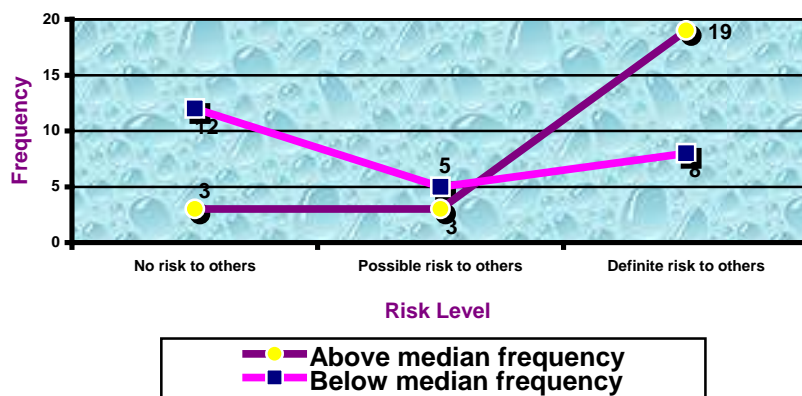


Fig. 2: The relationship between the frequency and risk level

Table 1: Number of questions with their risk level: A (Low), B (Medium), C (High) in each category of aberrant behavior in DBQ.

Behavior	Risk level	A	B	C
Deliberate violations		1	2	14
Unintentional violations		1	1	1
Slips		3	3	3
Mistakes		10	2	9

Table 2: Frequency distribution of the demographic data of the participants

Variable	State	Number	Percent
Education	Illiterate	26	8.6
	Under high school diploma	259	86.4
	High school diploma	15	5.0
Vehicle ownership of the driver	Educated	0	0.0
	The only owner	130	43.3
	Joint owner	139	46.4
Driving distance in a week (Km)	Not owner	31	10.3
	1-1000	154	51.3
	1001-2000	114	38.0
Freeway use (Km)	2001-3000	32	10.7
	< 500	62	20.7
	500-1000	128	42.7
Mean driving time during a day (h)	> 1000	110	36.6
	< 8	170	56.7
	> 8	130	43.3
The most prevalent driving time in 24 hours	1-5 a.m.	2	7.0
	6-12 a.m.	106	35.3
	13-18 p.m.	128	42.7
Regular work schedule	19-24 p.m.	64	21.3
	Present	164	54.6
	Absent	136	45.4
Traveling in a regular path (go and return)	Necessary	112	37.3
	Not necessary	188	62.7
	speeding	107	35.7
Type of the violation leading to fine	Dangerous driving	229	76.4
	Substance or alcohol abuse	0	0.0
	Other violations	300	100.0
Damage	Only minor financial (< 100 dollars)	31	10.3
	Only major financial (>100 dollars)	89	29.7
	Financial and human	180	60.0

Table 3: Frequency distribution of the road accidents record

Variable		State		Number	Percent
Road accident record	Present	Time of the accident	Day	95	31.6
			Night	196	65.4
		Absent	9	3.0	

Table 4: Frequency distribution of the road accidents data

Variable		State		Number	Percent
The driver is guilty for the most sever accident during his life	Yes	Establishment of change in driving method	Yes	136	45.3
			No	47	15.7
	No	Establishment of change in driving method	Yes	57	19.0
			No	60	20.0

Table 5: Items from Driver Behavior Questionnaire (DBQ) arranged in descending order of mean score

Variable	Item	Mean	SD	Behavioral type	Risk category
39	Misjudge speed of oncoming vehicle when overtaking.	4/32	0/61	S	C
30	Deliberately disregard the speed limits late at night or very early in the morning.	4/26	1/32	V	C
49	Ignore 'give way' signs, and narrowly avoid colliding with traffic having right of way.	4/14	1/12	V	C
25	Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances.	3/87	0/42	V	C
54	Drive with only 'half-an-eye' on the road while looking at a map, changing a cassette or radio channel, etc.	3/76	1/14	S	C
11	Check your speedometer and discover that you are unknowingly travelling faster than the legal limit.	3/63	1/32	UV	B
18	Distracted or preoccupied, realize belatedly that the vehicle ahead has slowed, and have to slam on the brakes to avoid a collision.	3/54	1/25	S	C
50	Fail to check your mirror before pulling out, changing lanes, turning, etc.	3/40	0/57	S	C
56	Get involved in unofficial 'races' with other drivers.	3/36	1/14	V	C
16	Drive especially close or 'flash' the car in front as a signal for that driver to go faster or get out of your way.	3/29	0/72	V	C
59	Misjudge your crossing interval when turning right and narrowly miss collision.	3/14	0/76	M	C
58	Brake too quickly on a slippery road and/or steer the wrong way in a skid.	2/92	0/97	M	C
57	'Race' oncoming vehicles for a one-car gap on a narrow or obstructed road.	2/83	0/65	V	C
29	Try to overtake without first checking your mirror, and then get hooted at by the car behind which has already begun its overtaking maneuver.	2/77	0/68	S	C
40	Hit something when reversing that you had not previously seen.	2/76	1/14	M	B
28	Angered by another driver's behavior, you give chase with the intention of giving him/her a piece of your mind.	2/73	0/87	V	C
51	Attempt to overtake a vehicle that you hadn't noticed was signaling its intention to turn right.	2/70	0/94	S	C
13	Become impatient with a slow driver in the outer lane and overtake on the inside.	2/69	0/84	V	C
37	Lost in thought or distracted, you fail to notice someone waiting at a zebra crossing, or a pelican crossing light that has just turned red.	2/56	0/92	UV	C
38	Park on a forbidden line and risk a fine.	2/52	1/28	V	A
14	Drive as fast along country roads at night on dipped lights as on full beam.	2/41	1/17	M	B
20	Turn left on to a main road into the path of an oncoming vehicle that you hadn't seen, or whose speed you had misjudged.	2/30	0/76	M	C
23	Miss your exit on a motorway and have to make a lengthy detour.	2/18	1/00	S	A
41	Fail to notice someone stepping out from behind a bus or parked vehicle until it is nearly too late.	1/83	0/80	S	C
46	Get into the wrong lane at a roundabout or approaching a road junction.	1/74	0/68	M	A
42	Plan your route badly, so that you meet traffic congestion you could have avoided.	1/61	0/67	M	A

Table 5: Continued...

47	Fail to read the signs correctly, and exit from a roundabout on the wrong road.	1/49	0/87	S	A
55	Fail to notice pedestrians crossing when turning into a side street from a main road.	1/20	0/75	S	C
32	Lost in thought, you forget that your lights are on full beam until 'flashed' by other motorists.	1/13	0/77	S	B
26	Intending to drive to destination A, you 'wake up' to find yourself en route to B, where the latter is the more usual journey.	1/02	0/62	S	A
12	Lock yourself out of your car with the keys still inside.	0/85	0/77	S	A
48	Fail to give way when a bus is signaling its intention to pull out.	0/89	0/55	V	B
22	'Wake up' to realize that you have no clear recollection of the road along which you have just travelled.	0/76	0/62	S	A
17	Forget where you left your car in a multi-level car park.	0/65	0/58	S	A
36	Have an aversion to a particular class of road user, and indicate your hostility by whatever means you can.	0/60	0/64	V	B
21	Misjudge your gap in a car park and nearly (or actually) hit adjoining vehicle.	0/53	0/56	M	B
31	Forget when your road tax/insurance expires and discover that you are driving illegally.	0/51	0/54	UV	A
24	Forget which gear you are currently in and have to check with your hand.	0/46	0/81	S	A
45	Cut the corner on a right-hand turn and have to swerve violently to avoid an on-coming vehicle.	0/44	0/47	V	C
43	Overtake a single line of stationary or slow-moving vehicles, only to discover that they were queuing to get through a one lane gap or roadwork lights.	0/36	0/44	M	A
44	Overtake a slow-moving vehicle on the inside lane or hard shoulder of a motorway.	0/31	0/43	V	C
33	On turning left, nearly hit a cyclist who has come up on your inside.	0/27	0/52	S	C
52	Deliberately drive the wrong way down a deserted one-way street.	0/24	0/91	V	C
53	Disregard red lights when driving late at night along empty roads.	0/20	0/90	V	C
34	In a queue of vehicles turning left on to a main road, pay such close attention to the traffic approaching from the right that you nearly hit the car in front.	0/18	0/73	S	B
19	Intend to switch on the windscreen wipers, but switch on the lights instead, or vice versa.	0/16	0/61	S	A
10	Attempt to drive away from traffic lights in third gear.	0/13	0/76	S	A
27	Take a chance and cross on lights that have turned red.	0/11	1/00	V	C
15	Attempt to drive away without first having switched on the ignition.	0/09	0/42	S	A
35	Drive even though you realize that you may be over the legal blood-alcohol limit.	0/00	0/00	V	C
Key to behavioral type:		Key to risk type:			
UV = unintentional violations		A= no risk to others			
V= violations		B= possible risk to others			
M = mistakes		C = definite risk to others		S=slips	

Table 6: Different types of the aberrant behavior predictors

Type of the aberrant behavior	Variable	Statistical indices		
		β	t	Significance
Deliberate violation*	Age	-0.29	-7.12	<0.0001
	Driving skill	-0.07	-3.17	0.0001
	Unpleasant mood	0.18	5.89	<0.0001
	Pleasant mood	0.21	5.13	0.0001
	Law obedience	0.42	8.15	<0.0001
	Distance traveled a week	0.09	5.29	<0.0001
	Error proneness	-0.10	-2.03	0.0186
Slips**	Freeway use	0.13	2.64	0.0013
	Observance of safety issues	0.05	2.32	0.0089
	Unpleasant mood	0.12	4.96	<0.0001
	Pleasant mood	0.29	4.58	0.0001
Mistakes***	Unpleasant mood	0.21	4.93	<0.0001
	Pleasant mood	0.15	4.51	0.0001
	Error proneness	-0.18	-3.86	0.0001

* The predictors are measured for 32% variance; ** The predictors are measured for 17% variance;

*** The predictors are measured for 12% variance.

Discussion

Driver's behavior during driving is very complex and there is no unique research method which involves all these complexities [24, 25]. Answering to questionnaires such as DBQ which are conforming to self-reporting include the kinds of aberrant behaviors identification of which is very difficult by direct observation, but these questionnaires present only descriptive evaluations of aberrant behaviors which a driver has experienced previously [25]. This information is only a part of happenings during driving. Thus such an instrument

as DBQ is considered when it presents clear results such as those we reached in this research [26, 27]. General image of the behavior during driving which was obtained from self-reports and self-evaluations of the truck drivers, is logically conforming to the viewpoints of some other different research methods; this conformity is specially observed in the association of the reported aberrant behaviors and age which is consistent with Harrington and McBride (1970) [20]. Lajunen and Parker (2001), Parker et al. (2002) and Holt (1981) showed that the truck drivers, whose driving is affected by mood, confessed to more deliberate violations and their mistakes were more which is consistent with our study. In another words, these truck drivers have some problems or can not sufficiently concentrate during driving or use driving as a means for discharging their anger or stress [28-30].

The effect of the mood on the driving was completely evident in this study, because the truck drivers were asked to distinct between their pleasant mood and positive emotions and unpleasant mood and negative emotions. The results show that although both pleasant and unpleasant emotions increase the possibility of committing driving violations, but the effect of unpleasant emotions is much higher. This study showed that truck drivers who introduced

themselves as obedient to laws, has reported less deliberate violations which are consistent with McGuire (1972) study [31]. We showed that the truck drivers with the highest rate of deliberate violations tend to introduce themselves as skillful drivers. This shows that these persons think that a good driver is a driver who can disobey the laws. The truck drivers, who committed more deliberate violations, consider themselves as the persons with significant skill for performing dangerous tasks or can perform tasks which are dangerous for less skillful drivers [31].

Many truck drivers exaggerate about their driving skills [10, 32]. In our study more than 68% of the truck drivers evaluated themselves as the drivers with skills higher than the average and only 4% judged themselves with less than average skills. The study of Lajunen and Summala in 1997 showed that individuals who believe that they are better truck drivers, committed more deliberate violations than those who evaluate themselves as an average driver which is completely consistent with our study [33]. Our study showed that older truck drivers reported less deliberate violations, which is consistent with Parker et al. study [34].

Conclusion

For improving road safety the present findings could play a part in shaping the psychological 'engineering' of road safety education and propaganda programs [10]. This research showed that safety has not sufficiently developed among truck drivers and because of the dangers of road accidents both for the drivers and other people and its economic losses, the importance of presenting some solutions is completely obvious. The high prevalence of aberrant behaviors leading to truck accidents could be attributed to the shortcomings of the

training about different subjects [10, 35, 36].

Since drivers' behavior is related to motivational factors, it seems that presenting some strategic solutions in order to distinct between motivational factors and cognitive subjects, especially among truck drivers to be effective. So designing some training courses for truck drivers about the risks of the different types of aberrant behaviors may affect this issue. Although this strategy may be ineffective in some deliberate violations among the truck drivers who want to put themselves in the limelight or those who sacrifice safety for speed. So for these types of behaviors changing the attitude is much more important [9, 10, 37].

Acknowledgment

The author would like to thank Shahid Saadoughi University of Medical Sciences for their financial support. Authors are grateful to the drivers who participated in this project. The authors declare that they have no conflicts of interest.

References

- [1] Peden M, Scurfield R, Sleet D, Mohan D, Hyder AA, Jarawan E, et al. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization. 2004
- [2] Peden M, Krug E, Mohan D, Hyder A, Norton R, MacKay M, et al. *A 5-year WHO Strategy on Road Traffic Injury Prevention*. Geneva: World Health Organization, Ref: WHO/NMH/VIP/01.03. 2002.
- [3] Hulbert S. *Effect of driver fatigue*. Wiley, New York, USA, pp. 67-89. 1992
- [4] Mohammadfam I, Sadri G. Epidemiologic assessment of the road accidents leading to death in Hamadan from 1998-1999. *Forensic Medicine* 2000; 6 (2): 5-12. [in Persian].
- [5] Naghavi M. *Mortality features in 18 provinces of Iran in 2001*. Ministry of Health, Center for Occupational and Environmental Health 2003. [in Persian].
- [6] Naseh MH, Kermanchi J, Sotoudeh M. *Universal report of prevention of road accidents*. Ministry of Health, Center for Occupational and Environmental Health. 2006 [in Persian].
- [7] World Health Organization. *World health organization report in 2003*. Geneva: WHO. pp.113-118. 2003
- [8] Elvik R. How much do road accidents cost the national economy? *Accident Analysis and Prevention* 2000; 32: 849-851.
- [9] Aberg L, Rimmo P. Dimensions of aberrant driver behavior. *Ergonomics* 1998; 41(1): 39-56.
- [10] Blockley P, Hartley L. Aberrant driving behavior: errors and violations. *Ergonomics* 1995; 38(9):1759-1771.
- [11] Levonian E. Personality characteristics of juvenile driving violators. *Accident Analysis and Prevention* 1969;19-16.
- [12] Lim C, Dewar R. *Driver cognitive ability and traffic accidents*. Calgary, Canada, pp. 123-38. 1989.
- [13] Raouf A, Dhillon BS. *System Assessment: A Quantitative Approach*. Lewis, New York, pp.42-68. 1994.
- [14] Braure R. *Safety and Health for Engineers*. Van Nostrand Reinhold, London, pp. 18-26. 1990.
- [15] Older SJ, Spicer BR. Traffic conflicts: A development in research. *Human Factors*; 18: 335-50. 1986.
- [16] Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers*, 2004; 36(4): 717-731.
- [17] Cohen J, Cohen P, West S, and Aiken L. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. Lawrence Erlbaum, Hillsdale, NJ.

- 2003.
- [18] Reason JT, Manstead AS, Stradling S, Baxter JS, and Campbell K. Errors and violations on the roads: a real distinction? *Ergonomics* 1990; 33: 1325-1332.
- [19] Quimby AR, Watts GR. *Human Factors and Driving Performance*. TRRL Report 1004 (TRRL: Crowthorne). 1981.
- [20] Rasmussen J. *What can be learned from human error reports? In Changes in Working Life*. Ed by K Duncan, M Gruenberg and D Wallis . Wiley. London. 1980.
- [21] Reason JT, Manstead AS, Stradling S, Baxter JS, Parker D. *Interim Report on the Investigation of Driver Errors and violations*. Department of Psychology, University of Manchester. 1989.
- [22] Harrington DM, McBride RS. Traffic violation by type, age, sex and marital status. *Accident Analysis and prevention* 1977; 2: 67-79.
- [23] Maycock G. *Accident liability and human factors researching the relationship*. PTRC Road Safety Seminar, Traffex '85, Brighton. 1985.
- [24] Sabey BE, Taylor H. *The Known Risks We Run: The Highway*. TRRL Supplementary Report 567. TRRL, Crowthorne. 1980.
- [25] Shinar D. *Psychology on the Road: The Human Factor in Traffic Safety*. Wiley, New York, USA, pp. 27-32. 1988.
- [26] Storie VJ. *Male and female Car Drivers: Differences Observed in Accidents*. TRRL Report 761 TRRL, Crowthorne. 1977.
- [27] Summala H. Zero- risk theory of driver behavior. *Ergonomics* 1998; 31:
- [28] Lajunen T, Parker D. Are aggressive people aggressive drivers? A study of the relationship between self reported general aggressiveness. Driver anger and aggressive driving. *Accident Analysis and Prevention* 2001; 33: 243–255.
- [29] Parker D, Lajunen T, Summala H. Anger and aggression among drivers in three European countries. *Accid Anal Prev* 2002; 34: 229–236.
- [30] Holt PL. Stressful life events preceding road traffic accidents. *Injury* 1981; 13: 111–115.
- [31] McGuire FL. *A study of methodological and psycho-social variables in accident research*. JSAS Catalogue of Selected Documents in Psychology. Ms. No. 195. 1972
- [32] Lajunen T, Summala H. Driving experience, personality, and skill and safety-motive dimensions in drivers' self-assessments. *Personality and Individual Differences* 1995; 19: 307-318.
- [33] Lajunen T, Summala H. *Effects of driving experience, personality, and driver's skill and safety orientation on speed regulation and accidents*. Ed by T. Rothengatter & E. Carbonell Vaya, Amsterdam, Pergamon, pp. 283–294. 1997.
- [34] Parker D, McDonald L, Rabbitt P, Sutcliffe P. Elderly drivers and their accidents: the aging driver questionnaire. *Accident Analysis and Prevention* 2000; 32: 751-759.
- [35] Summala H, Mikkola T. Fatal accidents among car and truck drivers: effects of fatigue, age, and alcohol consumption. *Human Factors* 1994; 36 2:315–326.
- [36] Xie CQ, Parker D. *A social psychological approach to driving violations in two Chinese cities*. *Traffic Psychology and Behavior* 200; 54:293-308.
- [37] Kontogiannis T, Kossiavelou Z, Marmaras N. Self-reports of aberrant behavior on the roads: errors and violations in a sample of Greek drivers. *Accident Analysis & Prevention* 2002; 34:381-399.