Effect of Fatigue on Traffic Law Violation of Bus Drivers in context of Developing Countries

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Abstract: Fatigue, a silent killer in transportation, is one of the problems responsible for the tiredness of the drivers arising from their mental or physical efforts. It dominates road accidents and casualty occurrences. However, very few studies concentrated on studying the effect of fatigue on the traffic law violations caused by bus drivers. This study aims for identifying factors that cause fatigue-induced traffic violations. In Bangladesh, a considerable number of fatalities are occurred due to fatigue. So, a questionnaire survey regarding fatigue conducted directly with the drivers. Poisson and Negative Binomial Regression are applied to build functional form between traffic law violations and explanatory variables e.g., work and travel patterns, driving hours, fatigue awareness, education, drug and alcohol consumption, and so on. The outcome shows that alcohol consumption, leisure time between trips, vehicle fitness, drivers' income, work pattern, trip distance have significant impact on drivers' fatigue induced traffic violations.

Keywords: Fatigue, Road safety, Traffic law, Tiredness, Statistical Count Model, Public Awareness

1. INTRODUCTION

Human fatigue is a threat to safe transport. It causes economic, health and environmental costs (Phillips *et al*., 2017). Thus, there is a need to understand driver's fatigue and tackle it as well to increase safety in transportation environment as transportation system is getting more complex and efficient day-by-day with the advancement of technology and society of living (Phillips, 2015). In general fatigue is being sleepy, tired and exhausted which is the transition period between awake and sleep (Lal and Craig, 2001). From the perspective of various fatigue related research, fatigue has been described as a feeling, experience, sense or awareness that is analogous to tiredness (Phillips, 2015). Driver fatigue is a state that reduces mental alertness which lessens cognitive and psychomotor tasks of a driver, including driving (Williamson *et al*., 1996).

Driver contributes up to 20% of road accidents that comprises of mostly fatal and grievous accidents worldwide (IRAP, 2008). In Bangladesh during the year 2009 to 2016, a total 19,450 number of accidents occurred of which 18,510 people lost their life (ARI Report, 2016). In 2010, at least 2,437 accidents occurred among which 1911 were directly related to fatigue (PSR Report, 2012). The fatigue related accidents are increasing tremendously. A study revealed that in Bangladesh about 83% drivers are directly or indirectly involved in fatigue related disability and psycho-social disorders (Talukder *et al*., 2013).

There are several studies have been carried out regarding driver's fatigue in perspective of transportation safety. The factors related to fatigue studies are, for example, "Gender and age" where researchers showed that about 50% drivers were reported to be fatigued were male with age under 30 (Horne and Reyner, 1995). Despite being fatigued, young drivers continue driving in fatigued condition (Hatfield *et al*., 2005). Apart from younger drivers, Campagne *et al*. (2004) pointed out that older drivers do more errors being fatigued than those of younger drivers. Another contributing factor is "lifestyle of driver". Combinations of alcohol and drug consumption enhance the probability to cause more traffic accidents (Horne *et al*., 2003). Some studies have been carried out on "vehicle types". Heavy vehicle drivers are more susceptible to fatigue, especially in the afternoon than light vehicle drivers who are to be experienced with fatigue at late night and early hours in the morning (Friswell and Williamson, 2013). "Road condition and geometry" is another factor which opens up that change of road condition from more complicated to simple reduces driver fatigue (Liu and Wu, 2013). On the other hand a recent study by Farahmand and Boroijerdian (2018) showed that higher varieties in road geometry (i.e., horizontal curves) can ensure better performance of the drivers. It can reduce fatigue and enhance driver alertness. The study also showed variety-road-design is an effective way to increase driver's mental workload in monotonous condition. Increasing "Break time between origin-destination trips" reduces fatigue in various ways. If drivers take one, two and three rest break, then it reduces driver's fatigue by 68%, 83% and 85% respectively compared to drivers who do not take any breaks (Chen and Xie, 2014). Long "driving duration" directly influences driver's fatigue. An analysis revealed that driving time has significant positive effect on fatigue (Wang and Pei, 2014). "Lack of sleep" is a major contributing factor of fatigue. Less sleep can threat to driving safety (Bogstrand *et al*., 2012) and sleep disorders directly or indirectly affect the cause of excessive daytime fatigue (Smolensky *et al*., 2011). Gander *et al*. (2006) went for questionnaire survey with truck drivers. The study found the effect of sleep on the truck drivers and concluded that in accident analysis the role of fatigue should be considered as a contributing factor. They found that truck drivers are more involved with crash with some degree of acute sleep restriction and drivers have insufficient knowledge on the danger of "driving sleepy". Davidovic´ *et al.* (2018) reviewed the sleep factor contributing on fatigue. They concluded that time of going to sleep has no effect on fatigue. But if they sleep less than 6 hour their driving performance reduces and therefore increases accident risks. "Drug use" is another cause of fatigue. Drugs can cause tiredness, fatigue, drowsiness that tends to have strong influence to the risk of fatal and grievous accidents (Elvik, 2013). Some studies analyzed the effect of "Work shift" on drivers' fatigue that revealed that drivers who work at night shifts have greater tendency to deviate from the dedicated lane of driving. Also, Bener *et al.* (2017) confirmed with driver behavior questionnaire survey data that combination of tiredness, fatigue, sleepy accelerates both fatigue and aggressive driving behavior.

Several other studies have been carried out on fatigue, its detection and prevention. In 2009, a study was carried out differentiating Sleep-related form of fatigue (e.g., sleep debt, prolonged

wakefulness) and task-related fatigue (e.g., mental overload and under-load) by proposing methodology (May and Baldwin, 2009). They emphasized on examining existing and emerging technologies for combating driver fatigue. They proposed lane departure warning and collision avoidance warning systems to be helpful in reducing fatigue. Also, rumble strips are recommended to be installed frequently in the highways to alert drivers. Yang *et al.* (2009) worked on identifying the characteristics of drowsy driving using simulator-based-human-in-the-loop environment. They found that drowsiness has greater effect on rule-based driving tasks (e.g., stopping at traffic signals) than skill-based traffic tasks. They used Static Bayesian and Dynamic Bayesian network to detect the factors of impaired driving. They used alcohol influence, motion sickness, stress, inattention, drowsiness as a contributing factor in the simulated environment to detect their effect on several driving tasks. Zhang *et al.* (2014) analyzed the similarities and differences between fatigue-driving and drunk-driving and their effect on driver's physical characteristics. Both of them have tendency to seriously impair some of the driving characters e.g., blood pressure, heart rate, eye sight and time deviation of speed anticipation. This study tried to distinguish driver's risky driving state and create countermeasures against it. Li *et al.* (2017) gave a method to automatically detect driver fatigue using driving information. They analyzed driver's operational characteristics during the conditions of awakening, drowsiness and very drowsiness and then combined it with driver's facial expression, head position and physical state recorded from video. This study used Neural Network to detect fatigue condition with an accuracy rate of 88.02%. Apart from detecting several effects on fatigue and their related countermeasures, slowly this field is shifting towards predicting driving fatigue. In a recent study, Mollicone *et al.* (2018) attempted predicting truck driver's fatigue using bio-mathematical method. They used hard-braking events as a function of fatigue. This study proved a concept that predicts fatigue based on drivers' sleep patterns and estimates driving performance in terms of safety condition.

From the above discussion it is clear that fatigue, as a psychological condition, is directly related to traffic safety. Several studies attempted to come up with the factors effecting fatigue, cause and effect, possible countermeasures and prediction of fatigue. However, none of these studies have explored how fatigue effects on traffic law violations. The objectives of this study are – i) to identify the reasons of traffic law violations due to fatigue induced factors through developing suitable statistical model; ii) to isolate the extreme group of drivers who are often involved in fatigue related violations.

2. MATERIALS AND METHODS

2.1 Data Collection

For preparing the questionnaire survey the most important task is how the questions would be selected for the survey and made them closed end. For these purpose, fatigue related information of the drivers are mainly collected through three steps. Firstly, previous studies related to drivers' fatigue were explored and variables used in those studies were extracted. Secondly, local context regarding fatigue was identified through the respondents open ended interview. These two steps are the screening part of forming questionnaire of this fatigue related study. Thirdly, a questionnaire was prepared based on the first two steps considering the demographic content and socio-economic background of the drivers. This set was followed by fatigue related information

(e.g., driver awareness about fatigue, driving focus difficulty, slower reaction time, feeling restless, missing traffic signal, sleep related information etc.), vehicle and licensing (e.g., vehicle types, fitness, license etc.), road geometry, travel pattern and trip details (e.g., daily driving hours, no. of trips per day, distance per trip, no. of break time, break time duration, gap between trips, driving shift, off day in a week etc.), road condition (e. g., basic route, monotonous road environment, resting facility in roads etc.), accident data (e.g., no. of accidents and fatalities related to these incidents, no. of accidents due to fatigue and no. of fatalities due to fatigue related incidents, etc.), driver's health issues and no of law violation by the drivers. The answers of the questions are mostly binary in nature. A detailed descriptive statistics of the questionnaire, variable classification and variables count with percentage are given in Table 1.

Table 1. Variables and classification of variables considered in the study

Variables	Variables levels/ classifications	Count (%)
Demographic and Socio-economic Data		
Age	Less than or equal to 25 years	2 (1.75%)
	25 to 44 years	53 (46.49%)
	44 to 60 years	58 (50.88%)
	Greater than 60	1 (0.87%)
Educational background	Primary	81 (71.05%)
	Junior	23 (20.18%)
	Secondary	8 (7.02%)
	Higher secondary	2 (2.17%)
	Honors/BSc.	0
Monthly income level	BDT 10,000	3 (2.63%)
	BDT 10,000 to 20,000	78 (68.42 %)
	BDT 20,000 to 30,000	31 (27.19%)
	BDT 30,000 to 40,000	2 (1.75%)
Marital status	Married	99 (86.84%)
	Unmarried	15 (13.16%)
Work pattern	Alternative driving	43 (37.72%)
	Continuous driving	71 (62.28 %)
Information regarding drivers' fatigue and health		
Drivers' awareness about fatigue	Yes – driver is aware of	51 (44.74%)
	No – driver does not aware of	63 (55.26%)
Drivers' disease	Diabetes	14 (12.28%)
	Hypertension	11 (9.65%)
	Heart disease	3 (2.63%)
	Other	20 (17.54%)
	No diseases	66 (57.89%)
Fatigue in different season	Summer	55 (48.25%)
	Winter	35 (30.70%)
	Rainy	24 (21.05%)
Fatigue due to traffic jam	Yes	108 (94.83%)
	No	6 (5.27%)
Fatigue due to improper driving of other vehicles	Yes	108 (94.83%)
	No	6 (5.27%)
Fatigue due to unauthorized movement (Jay-walking)	Yes	92 (80.70%)
	No	22 (19.30%)
Fatigue due to consuming heavy food	Yes	47 (41.23%)
	No	67 (58.78%)

Fatigue due to unnecessary horn	Yes	104 (91.23%)
	No	10 (8.77%)
Vehicles, licensing and safety		
Vehicle fitness	Very poor	0
	Poor	6 (5.26%)
	Normal	50 (43.86%)
	Good	48 (42.11%)
	Well facilitated	10 (8.78%)
License (obtain duration)	Within 6 months	0
	6 months to 1 year	0
	Within 2 years	0
	Within 5 years	20 (17.54%)
	More than 5 years	94 (82.46%)
Drivers' safety education	Yes	29 (25.44%)
	No	85 (74.56%)
Work related information		
Daily driving hour	Below 5 hours	0
	5 to 8 hours	0
	8 to 10 hours	6 (5.26%)
	10 to 12 hours	12 (10.52%)
	12 to 14 hours	40 (35.88%)
	More than 14 hours	56 (49.12%)
No of trips/day	Single trip	44 (38.60%)
	Double trip	69 (60.53%)
	More than double trip	1 (0.8%)
Driven distance/trip	Less than or equal to 100 km	0
	100 to 200 km	20 (17.54%)
	200 to 300 km	35 (30.70%)
	300 to 400 km	53 (46.49%)
	Greater than 400 km	6 (5.26%)
No of in-journey break- time	None	16 (14.04%)
	Once	92 (80.70%)
	Twice	4 (3.51%)
	More than twice	2 (1.75%)
Time gap between trips	Below 1 hour	16 (14.03%)
	Upto 1 hour	0
	1 to 2 hours	23 (20.18%)
	2 to 5 hours	42 (36.84%)
	Not continuous	33 (28.95%)
Law violation	Over-speeding	60 (52.63%)
	Wrong side	47 (41.23%)
	Signal break	5 (4.39%)
	Wrong route	0
	Illegal parking	2 (1.75%)
	Others	0
Off-day work pattern	Does another job	0
	Goes for recreational purpose	0
	Spend time with family	66 (57.89%)
	Personal work	19 (16.67%)
	Usually sleep	28 (24.56%)
	Others	1 (0.88%)
Questions related to sleep		

Off-day sleeping hour	Below 4 hours	0
	4 to 6 hours	2 (1.75%)
	7 to 9 hours	8 (7.02%)
	10 to 12 hours	30 (26.32%)
	13 to 15 hours	32 (28.07%)
	Greater than 15 hours	42 (36.84%)
On-duty sleeping hour	Below 4 hours	76 (66.67%)
	4 to 6 hours	36 (31.58%)
	7 to 9 hours	1 (0.88%)
	10 to 12 hours	1 (0.88%)
	13 to 15 hours	0
	Greater than 15 hours	0
Sleep related disease	Yes	8 (7.02%)
	No	106 (92.98%)
Travel related questions		
Daily Route	Dhaka – Mymensing	10 (8.77%)
	Dhaka – Panchogor	60 (52.63%)
	Dhaka to Khulna	4 (3.51%)
	Dhaka – Chottogram	25 (21.94%)
	Dhaka – Dinajpur	2 (1.75%)
	Dhaka to Faridpur	13 (11.40%)
Drug consumption		
Tobacco consumption	Never	14 (12.96%)
	Regular	87 (80.56%)
	Occassional	7 (6.45%)
Prescribed or non-prescribed medicine	Yes	23 (20.18%)
	No	91 (79.82%)
Alcohol	Never	93 (93.94%)
	Regular	0
	Occassional	7 (6.06%)
Number of time driver responsible for accidents	Fatal	24 (5.74%)
	Other injured	195 (46.65%)
	PDO	199 (47.61%)
Vehicle owners		
Relation with owner/ employer/ supervisor	Very bad	0
	Bad	0
	Moderate	31 (27.20%)
	Good	70 (61.40%)
	Very good	13 (11.40)

The study area of data collection involves Mohakhali and Gabtoli Bus Stand (Figure 1) as the majority of the inter-city bus routes origin from these two bus stands. In total 114 drivers were interviewed during the period of June, 2017 to October, 2017. All the interviewed drivers had experience in operating heavy vehicles (i.e., Inter-city Bus). About 84% of the interviewed drivers regularly drive for 12 to 14 hours per day. About 77% drivers were experienced in driving trip distance of 200 to 400 km per day.

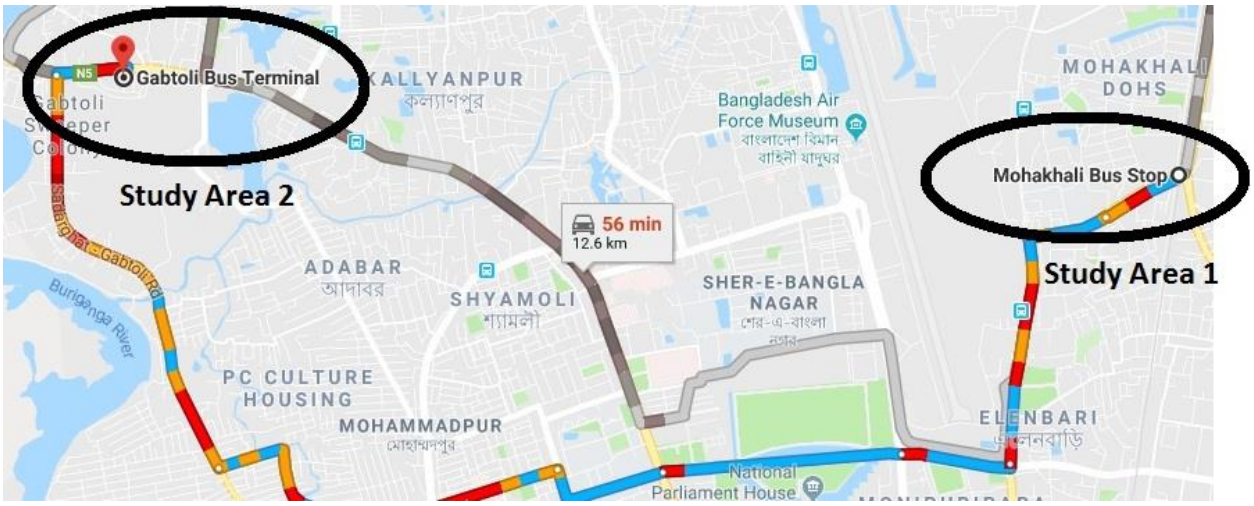

Figure 1. Study Area of the Data collection, Right: Area 1- Mohakhali Bus stand and Left: Area 2- Gabtoli Bus Stand

2.2 Methodology

Count data model is used here to analyze traffic law violation frequency, m and distribution model of number of violations, y. Let Y_i denotes the number of traffic violations experienced by drivers due to fatigue and other explanatory variables. The probability of traffic violation can be written as:

$$prob(Y_i = y_i) = \frac{m_i^{y_i} e^{(-m_i)}}{y_i!} \quad (1)$$

Poisson regression specifies the Poisson parameter m_i as a function of explanatory variables by using log-linear function:

$$m_i = e^{\beta X_i} \quad (2)$$

where, $\mathbf{X_i}$ is a vector of explanatory variables, e.g., driver fatigue (sleepiness, drug use, alcohol consumptions, etc) and other related variables e.g., travel and trip patterns of the driver, vehicle fitness, socio-economic characteristic of the drivers, etc and $\boldsymbol{\beta}$ is a vector of estimable parameters. The Poisson distribution has the limitation that the variance and mean should be approximately equal i.e.

$$\text{Var}(n_{it}) = E(n_{it}) = \mu_{it} \quad (3)$$

If this equality does not hold, the data are said to be under-dispersed ($E[n_{it}] > \text{Var}[n_{it}]$) or over-dispersed ($\text{Var}[n_{it}] > E[n_{it}]$). And, the standard errors of the estimated parameter vector will be incorrect. To account for this possibility, the negative binomial model is derived by rewriting

$$m_i = e^{\boldsymbol{\beta X}_i + \varepsilon_i} \quad (4)$$

Where, e^{ε_i} is a gamma-distributed error term with mean 1 and variance k. The resulting probability distribution under the negative binomial assumption is:

$$prob(Y = y) = \frac{\Gamma(k+y)}{\Gamma(k)y!}\left(\frac{k}{k+m}\right)^{k}\left(\frac{k}{k+m}\right)^{y} \quad (5)$$

Where, $\Gamma()$ is a gamma function. The Poisson regression is a limiting model of the negative binomial regression as 'k' approaches 0. Thus, if 'k' is significantly different from 0, the negative binomial is appropriate and if it is not, the Poisson model is appropriate (Washington *et al.*, 2003).

In general practice, parameters of count models are assumed to be fixed across the observation. But, it may overestimate the t-statistics of the estimated parameters from an underestimated standard error due to unobserved heterogeneity. To improve this, we conducted random parameter count model and found no significant unobserved heterogeneity. Because, both mean and standard deviation of the variables coming from random parameter are found statistically insignificant. If estimated mean and standard deviation are not statistically different from zero, the parameter is constant across the observations. Thus, in this paper, the fixed parameters models are used to estimate the final model.

3. RESULTS AND DISCUSSION

A statistical model (Table 2) has been developed between dependent variable - traffic violations and independent variables – drivers' fatigue, road condition, driver's trip and travel pattern, vehicle fitness, drug and alcohol use, socio-economic and demography of drivers etc.. Significance level was taken as 5%, which means any variable with p-value less than 0.05 are taken in the final model as a significant variable, otherwise is omitted.

Several models have been developed to find out the most suitable prediction model that can represent traffic violation occurrence. After several iterations, significant variables are retained in the final model which is termed as best fit model. Parameters of the model are computed using maximum likelihood method. Here, dispersion parameter alpha = 0, that rejects the null hypothesis that errors do not reveal "over-dispersion". So, Poisson regression model is rejected in favor of Negative binomial regression model. Table 2 shows the final model with 15 statistical significant independent variables that show their various effects on the traffic law violation frequency.

Table 2. Estimation results of final model

Variables	Parameter	Standard Error	t-statistics	P-value
1.Break time during trip				
No break/rest time taken by the driver during trip	1.42	0.28	-4.67	0.001
Two breaks/rest time taken by the driver during trip	2.23	0.76	2.57	0.007
2. Trip distance driven by the driver (200 to 300km)	-0.36	0.14	-1.91	0.031
3. Alcohol consumption of drivers (occasionally)	0.89	0.30	2.59	0.009
4. Work pattern of the drivers (alternative/ continuous)	-0.52	0.25	-2.29	0.024
5. Sleeping Hour				
Off day sleeping hour (7 to 9 hours)	-0.62	0.27	-2.44	0.006
On duty sleeping hour (4 to 6 hours)	0.31	0.19	1.43	0.034
6. Vehicle fitness				

Well-facilitated	-1.68	0.51	-3.35	0.002
Good	-0.59	0.21	-2.61	0.023
7. If the driver had any safety education or training	-0.39	0.26	-1.76	0.048
8. Driver's relation with the owner				
Very good	-0.86	0.28	-2.12	0.021
Moderate	0.31	0.22	1.72	0.042
9. Marital status of driver (Married)	0.42	0.31	1.91	0.043
10. Unauthorized(Jay walking) movement of pedestrian	0.92	0.34	3.31	0.002
11. Monthly income of driver (20k to 30k BDT)(1 USD= 83 BDT)	0.65	0.29	2.55	0.014
Number of observations:	114			
log-likelihood function:	-271.66			
Chi-square test statistics:	81.35			
Pseudo R-squared:	0.2302			

(All variables are modeled with 95% Confidence Interval)

If drivers take no break/rest during his driving period (β=1.42, p = 0.001), it is likely to increase the probability of law violation as expected. If a driver tends to drive without any rest, his psychological condition would not support his mind to drive further. As a result he might feel tired and drowsiness for such a long journey time. This result is similar to Chen and Xie (2014). On the contrary, if drivers take two breaks/rests (β=2.23, p = 0.007) during the driving period, it significantly increases law violation. This might indicate to time-management problem that projects a distraction and stress of driver's schedule and driving behavior. Usually drivers take breaks for about 20 to 30 minutes each, which can significantly lessen the driving hour while drivers are active. A psychological stress has been overlaid on the driver's driving behavior leading increased traffic law violation.

The variable "Trip distance driven by the driver (200 to 300 km)" exhibits negative value (β= - 0.36, p = 0.051). It indicates that long route trips are less subjected to traffic law violation. It can be described as sometimes slower speed might help drivers to maintain proper concentration in driving. Also, drivers might take breaks in their journeys. It might help them to take some rest, eliminate the tiredness and start driving again. Occasional alcohol consumption (β= 0.89, p = 0.009) could lead to significant risk in driving time. This may result in hallucination, lengthen response time, compromising diving skills and decision making. This result is quite similar with a previous study of Horne *et al.* (2003). .

Alternative work pattern (β= - 0.52, p = 0.024) decreases the possibility of law violation. This can be explained as drivers with continuous work pattern are subjected to more stress which easily make them fatigued and results in violating traffic rule. Seven to nine hours of sleep (β= - 0.62, p = 0.006) at off-day is likely to reduce the traffic violations lead by drivers. The results are very similar with the outcome of Bogstrand *et al.* (2012) and Gander *et al.* (2006). Moreover, on-duty 4 to 6 hours of sleeping (β= - 0.31, p = 0.034) increases the traffic law violations caused by the drivers.

Also, an well-supported and good facility in vehicle fitness including good suspension system, air conditioning system, best chassis and breaking condition are less likely to be involved in law violation. Drivers' proper education on the driving method, knowing of basic traffic rules and regulations, having any kind of road safety training are beneficial for them from safety

perspective comparing with those who don't have any previous knowledge or training. As this variable shows negative coefficient, it supports the presumption and proves that it decreases the possibility of traffic law violation. Driver's good relationship with the owner can be a preventive measure for diminishing crash or traffic law violation in Bangladesh as the analysis shows that it has a negative value of coefficient (β= - 0.86, p = 0.021) whereas in contrast drivers with moderate relationship with owners are likely to be involved in more law violation as it has positive parameter (β= 0.31, p = 0.042). It indicates that a good relationship with the vehicle owner can reduce the traffic law violation. Because, if the owners are satisfied with the driver, they feel positive for the drivers, especially by providing more wages and other service benefits. Thus, a well-paid service may reduce the stress from the driver which subsequently involves in less number of traffic violations. Thus, a good relationship between the drivers and owners is beneficial from less traffic violations' perspective.

Married drivers could lead to increase (β= 0.42, p = 0.043) the possibility of law violation. Excessive family stress may be responsible for distraction of drivers while driving. Unauthorized pedestrian movement has a positive coefficient (β= 0.92, p = 0.002) that denotes increasing the possibility of driver's traffic law violations. It can be easily explained that due to under-developed pedestrian movement facility in Bangladesh, the drivers are subjected to disturbance caused by the pedestrian. It can easily hamper drivers' concentration while on wheels.

Monthly income of approximately 20,000-30,000 BDT enhances (β= 0.65, p = 0.014) traffic law violation. Provocation of earning more money involves excessive hours of driving which may be the reason of this finding. From drivers' interview this explanation is further strengthened by finding that they don't get any certain monthly salary rather their salary is based on no. of trips basis.

4. CONCLUSION

From this study we can conclude that drivers having alternative pattern of work are less likely to be involved in traffic law violation whereas continuous driving leads to traffic law violation as well as road crashes. On the other hand having any kind of safety education or training could change the driving behavior of a driver in a positive manner that can allow to have a safe driving as well as avoiding serious crashes due to fatigue. Furthermore, in this study we have seen that consumption of alcohol could be a significant factor which causes mental distraction, deterioration of response time which hampers driver's normal driving skills and leads to serious law violation which might include fatal crashes. Fitness of the vehicle is also a considerable factor in road safety. From the previous discussion we found that vehicles those have good fitness and other facilities including comfortable environment, safety kits, good performance assist driver to drive safely. Unauthorized pedestrian movement can directly affect the driving performance and it might be an initial cause of causing road accidents. In Bangladesh presence of numerous industries, factories, markets, educational institution etc. beside highways trigger the considerable number of roadside accidents. Earning more money by attaining more trips are another reason of traffic violation identified by this study.

Bus owner and various government and non-government organizations should focus on various safety educational training, seminars, awareness campaign for drivers on the detrimental

effect of fatigue on driving. This could improve the current situation in a grand scale. Research and experience both suggest that effective progress on this issue requires a holistic response covering awareness, legislation, regulatory capacity, quality engineering and professional capacity,

This research has been conducted considering some limitations. This study has been performed in a micro scale that included only Dhaka city. A macro scale study approach will strengthen the results of this study by developing a more precise statistical analysis. The response rate could be increased through previous notification; such as seminars, awareness booth etc. Focused group discussion and Key informant interview approach can be applied.

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