COMPARISON OF FATIGUE RELATED ROAD TRAFFIC CRASHES ON THE NATIONAL HIGHWAYS AND MOTORWAYS IN PAKISTAN

Khizar Azam*, Abdul Shakoor*, Riaz Akbar Shah*, Afzal Khan*, Shaukat Ali Shah*, Muhammad Shahid Khalil**

ABSTRACT

Driver Fatigue is one of the leading causes of Road Traffic Crashes (RTC) in Pakistan . An attempt has been made in this research to compare the proportion of driver fatigue related RTC on the Motorways and National Highways of Pakistan. Data were collected from the National Highways and Motorway Police (NHMP). Data for 2003 to 2012 of all RTC on Motorways and 2003-2011 on the National Highways (N-5) were examined extensively by applying Australian Transportation Safety Bureau (ATSB) criteria for determining fatigue related RTC. The Total number of RTC on Motorways during 2003-2012 was 1750 out of which 497 were fatigue-related. The total number of RTC on (N-5) during 2003-2011 was 5080 out of which 483 were fatigue-related. The average percentage of fatigue related RTC on Motorways was 28%, however on National Highways (N-5) it was found to be 10%. Fatigue-related RTC is thus more prevalent on the Motorways. It was also discovered that fatigue-related RTC result in mostly fatal accidents on the Motorway (54%) and serious injuries on N-5 (41%).

KEYWORDS: *Road Traffic Crashes, Driver Fatigue, Fatal Accident, Serious Injury*

INTRODUCTION

Safety is one of the many basic human needs and worldwide efforts are being made to ensure human safety, however, RTC have been a threat to human safety and are a major, social and public health problem. According to World Health Organization (W.H.O) more than 1.3 million people die every year and many more are injured in RTC, with most of these deaths occuring in developing countries. Deaths and injuries are preventable, but requires a strong political will, integrated approach and informing the masses about this issue. These occurrences lead to enormous emotional and economic consequences, imposing high financial and social cost to the society. The World Bank has estimated that RTC cost approximately 1% to 3% of a country's gross domestic product. RTC are caused due to different reasons, one of them is driver fatigue, which is the leading cause of RTC in Pakistan[1]. Fatality rate due to RTC in Pakistan is significantly higher as compared to other countries.

The objectives of this research are:

- To compare the proportion of driver fatigue on Motorways and National Highways of Pakistan.
- To determine the size of fatigue related RTC problem by use of a criteria.

It has been assessed that about 90% of the reasons for RTC can be due to driver error[2]. As a result, investigations of the reasons of crashes have focused on driver-related factors. Fatigue is a major hazard in the transportation industry. Fatigued driver suffers from degraded judgment, poor decision making, poor performance, loss of memory, reduced reaction time and micro sleep. Dinges[3] defined fatigue as the disinclination to continue an activity, loss of concentration and performance deterioration, especially on tasks that require vigilance. The driver usually loses concentration during driving because of several factors. They get tired which can result in a disastrous crash in which not only they can lose their lives but also endanger the lives of others. The statistics of RTC in which fatigue is considered as a cause vary quite appreciably throughout the world, but it is estimated that 20% of all RTC are fatigue related[4]. Fatigue has been estimated to be involved in 2% to 23% of all crashes[5,6,7]. In the Southern U.K, sleep related RTC accounted for 16-20% of all crashes reported to police[8].

The symptoms of driver fatigue vary from driver to driver, they include loss of attentiveness, sleepiness, yawning, lethargic reactions, red eyes, micro sleep, tediousness, impatience, missing road signs, difficulty in keeping their head up, changing lanes, etc. The causes of driver fatigue are numerous; however, scientists have identified some factors. Factors that are responsible for

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driver fatigue include small amounts of sleep, tough schedules, lengthy working hours, age of the driver, experience of driver, sleep disorder, psychological factors and the time of day[9]. Most of the preventable traffic crashes are the crashes that occur due to driver fatigue.

Pakistan has a developed transport infrastructure. It has a large network of roads consisting of 259,758 km of major roads, of which 8,885km accounts for the National Highway and 2,027 km forms the Motorway (Figure 1). The share of the transport sector in the GDP is about 10%. The Government has planned to develop the National Trade Corridor, which is meant to improve and expand Pakistan's rail, road, air and port networks. This would provide a suitable transportation route for goods of other countries to reach the Central Asian Markets. The National Highways are responsible for the carriage of about 80% of the country's freight and passenger traffic. The importance of road safety in the economic landscape of Pakistan is thus indisputable, but there is no restriction on driving hours, poor road safety and no awareness of the driver fatigue problem.

It has been reported by the NHMP that fatigue is one of the leading causes of road accidents on the Motorways of Pakistan. In this research an attempt has been made to compare the proportion of driver fatigue-related road crashes on the Motorways and National Highways of Pakistan.

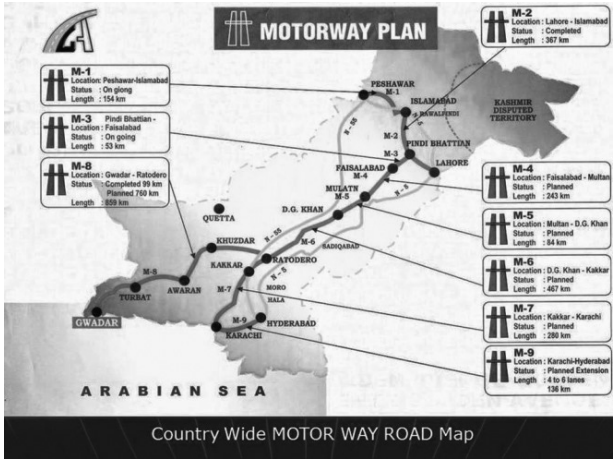

Figure 1: Major Road Network in Pakistan (source: National Highways Authority)

METHOD

Effective RTC prevention measures can be developed by the application of statistical techniques and from RTC data analysis inference can be made. The impact of fatigue in the RTC is not easy to measure because there is no test for checking the drowsiness level of drivers; Researchers have used different criteria to distinguish fatigue related crashes from other types of crashes.

In the U.K, Horne and Reyner[10] developed criteria that were used as a filter to recognize a traffic crash as fatigue related or not. The criteria are as follows:

- Good weather and visibility
- Blood Alcohol levels (BAL) under the permitted limit
- The vehicle does not have any mechanical defects
- Removal of "speeding" and "driving very close to the automobile in front" as a reason
- The driver had no history of medical disorder
- Vehicle either runs off the roadway, or runs into another vehicle, i.e. collides with the back of the vehicle going in front implying prolonged inattention
- No signs of application of brakes, i.e., absence of any tire mark before the accident
- The police officers at the accident site pointed fatigue as the main cause

In the United States the Expert Panel on Driver Fatigue and Sleepiness (1997) identified drowsiness-related road crashes by the following:

- Took place late at night, in the early morning hours or mid-afternoon
- Higher severity
- Involved a single vehicle leaving the roadway
- Took place on a high speed road

- No effort on the part of drivers for avoidance of the crash

- The sole occupant of the automobile was the driver

Australian Transport and Safety Board (ATSB) has also developed a criteria called (ATSB) operational definition of fatigue, it employs some of the criteria used in the United States, the United Kingdom and other Western countries.

The operational definition of a fatigue-related crash implemented in these resources is as follows;

The researchers first excluded crashes that occurred on roads with speed limits less than 80 kilometers per hour,

RTC that involved pedestrians and unlicensed drivers, RTC in which drivers had high levels of alcohol and over taking RTC.

Then included single vehicle crashes that occurred during 12:00 AM – 6:00 AM and 2:00 PM – 4:00 PM and head-on collisions where neither vehicle was overtaking at the time of RTC and RTC in which there were no evidence of brakes.

These criteria were used to identify fatigue related RTC. A few examples are as under

1. 23 May, 2005, at 1:30 AM on N-5 a truck hit the rear end of a dumper near Hassanabdal, 1 person was killed. The road was dry and straight, visibility was good, no tire marks were found at the site of RTC the vehicle had no mechanical defect.

2. 3 September, 2007 at 4:05 A.M on M2 a bus rolled over, the crash was fatal, resulting in 2 deaths, 1 serious injury and 8 minor injuries. The road was dry and straight, visibility was good, no tire marks were found at the site of RTC and the vehicle had no mechanical defect.

3. 25 June, 2007 at 5:54 AM on M2 in a bus crash 3 people died, 7 serious injuries and 22 minor injuries. The road was dry and straight, visibility was good, no tire marks were found at the site of RTC the vehicle had no mechanical defect.

Table 1: Check Sheet Determining Fatigue Related RTC

	ATSB Criteria	Case 1	Case 2	Case 3
1.	Occurred on roads with speed limits less than 80km/h	✓	✓	✓
2.	Pedestrian involvement	×	×	×
3.	Licensed driver	✓	✓	✓
4.	Alcohol level below permissible limit	✓	✓	✓
5.	Time of crash (12 AM – 6 AM & 2 PM – 4 PM)	✓	✓	✓
6.	Head on collision with no overtaking	✓	✓	✓

Table 1 shows the data analysis, check sheet that was used to determine three fatigue-related RTC where (×) shows absence and (✓) shows presence of the each ATSB criteria of determining fatigue related RTC. In this manner all other RTC was examined extensively and the results were obtained. Due to the non-availability of physical evidence it is not easy to assign fatigue as a cause of RTC by police officers because they had no knowledge about the driver's precarious condition. There may be many RTC in which the cause of traffic crash is reported as something else on the police report form, but actually the driver may have initially lost control of the vehicle due to drowsiness. Police usually under-report fatigue related accidents[11].

DATA

The data for data analysis is taken from MAAP (Micro- computer accident analysis packages), the database maintained by the NHMP. After visits to different NHMP offices which include Rashakai, Khairabad and Islamabad data for ten years (2003 to 2012) of all RTC on Motorways (M1, M2 and M3) and nine years RTC data (2003 to 2011) of the National Highways (N-5) section were collected. M1 is Islamabad-Peshawar (154 Km), M2 is Islamabad-Lahore (367 Km) while M3 is PindiBhatian - Faisalabad (54 Km) Motorway. N-5 Extends from Karachi to Torkham via Hyderabad, Multan, Lahore, Rawalpindi and Peshawar (1756 Km).

The NHMP usually record the details of RTC on

accident report forms. The hard copies and soft copies of different road traffic accident report forms were collected from different NHMP offices.

The RTC information collected from NHMP can be summarized as follows

1. Date, time, day, severity and location of RTC.
2. Number of vehicles involved.
3. No of causalities.
4. Main cause of RTC.
5. Road and weather condition at the time of RTC.
6. Action taken by the officer (if any).

This data were extensively examined based on the above mentioned criteria which took six months. The ATSB criteria determining the fatigue related crashes were applied and the following results were obtained.

RESULTS

A fatal RTC is a crash in which at least one person loses life, serious injury crash results in a serious injury, minor injury accident results in a minor injury which does not require hospitalization while property damage crash is an RTC in which damage is done to someone's property.

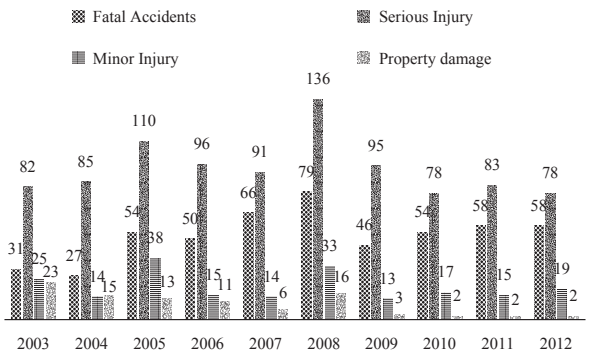

Figure 2: Frequency of RTC on Motorways of Pakistan (2003-2012)

Figure 2 depicts the count of RTC on the Motorways of Pakistan, according to the severity in 4 categories of RTC during the period 2003-2012 showing that most of the RTC causes serious injuries.

Table 2 shows the total number of RTC on the Motorways of Pakistan between 2003 and 2012. The table also depicts fatigue related RTC on Motorways of Pakistan identified after applying ATSB criteria of identifying fatigue related RTC. It was found from data analysis that the average number of RTC that took place on Motorways of Pakistan due to fatigue is 28 %.

Table 2: Proportion of fatigue-related RTC (2003-2012) on Motorways

Year	Fatigue Related RTC	Total RTC	Fatigue related RTC(%) age
2003	36	161	22.36
2004	42	141	29.79
2005	47	215	21.86
2006	50	172	29.07
2007	40	177	22.60
2008	94	261	36.02
2009	60	157	38.22
2010	41	151	27.15
2011	33	158	20.89
2012	54	157	34.39

Table 3 tabulates the total number of RTC that took place from 2003 to 2011. The table also shows the number of fatigue related RTC on National Highways (N-5) of Pakistan identified after applying (ATSB) criteria of identifying fatigue related RTC. It was observed that the

Table 3: Proportion of fatigue-related RTC (2003-2011) on National Highways (N-5)

Year	Fatigue Related RTC	Total RTC	Fatigue related RTC (%) age
2003	64	724	8.84
2004	52	551	9.44
2005	88	853	10.32
2006	65	625	10.40
2007	42	480	8.75
2008	58	603	9.62
2009	56	529	10.59
2010	39	413	9.44
2011	19	302	6.29

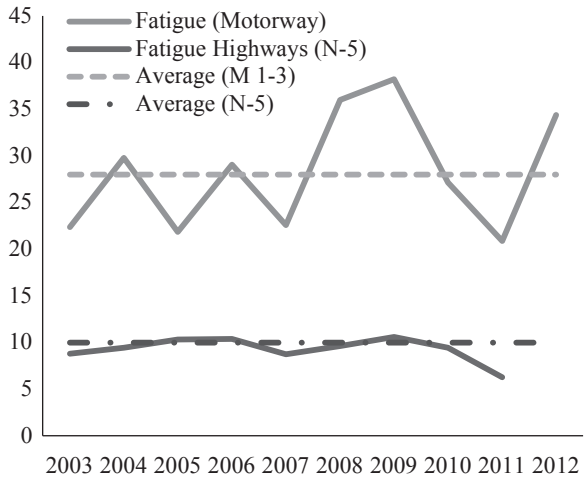

Figure 3: Comparison of fatigue-related RTC on National Highway (N-5) and Motorways

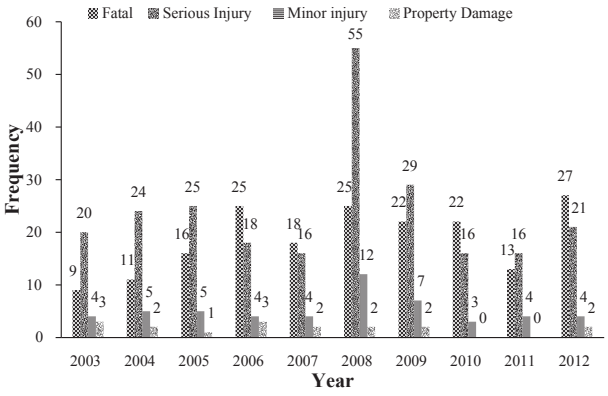

Figure 4: Fatigue-related RTC (2003-2012) on Motorways severity wise

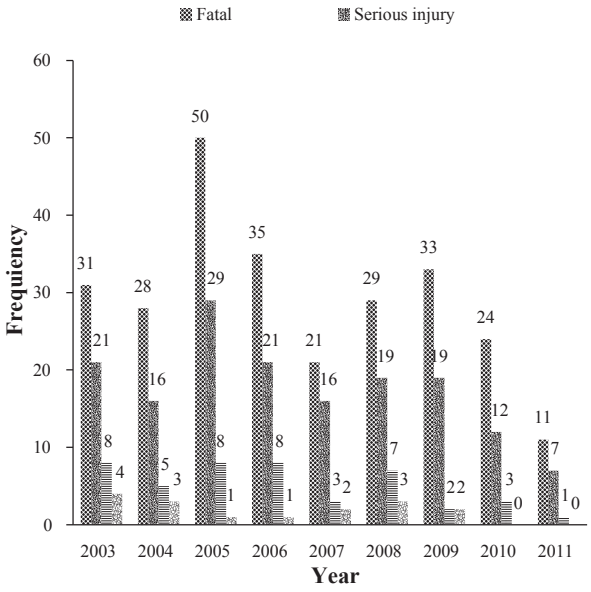

Figure 5: Fatigue-related RTC on National Highways (N-5) severity wise

Table 4: Comparison of fatigue related RTC severity wise

RTC Severity	% age Motor-ways (2003-2012)	% age National Highways (N-5) (2003-2011)
Average Fatal	37.83	54.24
Average Serious Injuries	41.29	33.13
Average Minor Injuries	10.46	9.32
Average Property Damage	3.42	3.31

average number of RTC caused due to fatigue is 10%.

Figure 3 shows the comparison of the fatigue-related RTC on the National Highways (N-5) and Motorways of Pakistan. It also identifies average fatigue on motorways is 28% and that on N-5 is 10%.

Figure 4 describes the fatigue-related RTC on Motorways of Pakistan and their resulting severity, including fatal, serious and minor injuries and property damage. The figure also shows the data distribution for RTC data for year 2003 to 2012. It shows that on Motorways the serious injury's occurrence is more compared to other severities.

Figure 5 describes fatigue-related RTC on N-5 of Pakistan severity wise, it shows that on N-5 fatigue related RTC mostly result in fatal crashes.

Table 4 shows that average fatal fatigue-related RTC on the motorways is 38%, while on National Highways N-5 this is 54%, while the serious injury, fatigue-related RTC are 41% and 33% on the Motorways and N-5 respectively. This table clearly indicates that fatigue-related RTC has serious consequences.

DISCUSSIONS AND CONCLUSION

The data were extensively examined and ATSB criteria were applied for the identification of fatigue related RTC. It was found that the average fatigue-related RTC

Figure 6: Photograph of M-2

on the Motorways (M1, M2 and M3) of Pakistan during the years 2003-2012 were 28%, while it is 10% on the National Highway (N-5) of Pakistan. Perhaps, fatigue related RTC is more prevalent on the Motorways as compared to N-5. Despite of the fact that the length of N-5 section is 1756 km, while the length of Motorways M1, M2, M3 is less. This prevalence might be due to the reason of monotony. On Motorways usually the scenery is homogeneous and the roads are mostly straight (Figure 6).

The driver usually drives the vehicle in overdrive to save fuel and maintains high speed. He remains mostly inactive and hence can easily succumb to sleep. This finding is also in line with similar findings. There is little traffic on the Motorways as compared to National Highways in Pakistan because of more strict compliance of traffic rules on the Motorways. Flatley, et al.[12], discovered that more traffic on a motorway resulted in a lower quantity of sleep-related accidents. The existence of other automobiles on monotonous motorways keeps a driver attentive and alert[13].

Taking a pause and rest while driving also reduces driver fatigue and most Pakistani Motorways have few stop over points (rest areas for the drivers) as compared to National Highways, which passes through all the major cities and have commercial activities taking place all along. Driver fatigue is more dangerous on Motorways because traffic flows at higher speeds and the drivers can experience boredom because of repetitive and somewhat passive experience of driving on long, wide, straight roads. This makes drivers to relax and lose concentration on the road and traffic around them[14,15]. Smith et al[16]. discovered that more road accidents along the Kaikoura coast in New Zealand took place on straight, simple roads following drivers that had descended from mountainous segments which require more attention. A large number of accidents occur on straight roads[10,17] also driving performance reduces more quickly on straight road segments than on curves[18]. Pennay[19] discovered that the largest proportion of sleep-related crashes occurred during the hours of midnight to 6:00 AM. In addition, this study also showed the influence of monotony with sleep related crashes as approximately 70% of the crashes occurred on either country roads (33%) or country highways (38%). In a self-described study, the drivers who belonged to U.S were found to be more likely to experience fatigue as compared to Norwegian drivers. Sagberg[20] made the argument that this may be due to the geometry, design and surroundings of U.S. roads. Performance is bad when task demand and stimulus variability are low. Tejero and Chóliz[21] pointed out that diminishing attentiveness resulting from highway monotony can be counteracted by changing the speed of automobiles, whereas Thiffault and Bergeron[22] suggested superior road design as a different means of contradicting repetitiveness. This finding is in line with the research being done in Western countries.

It has also been found in this research that the fatigue-related RTC on the Motorways and N-5 are mostly fatal and serious in nature. On the Motorway 54% of fatigue related RTC are fatal while on N-5 it is only 37%. It is due to the fact that commercial vehicles which includes passenger buses and coaches mostly travel on N-5. These vehicles have to make a stop on different bus terminals to load passengers as N-5 passes through almost all the major and small cities of Pakistan while on Motorway there is strict law enforcement and the toll tax is also high, thus traffic density and number of passengers per vehicle travelling on the N-5 is more as compared to Motorway. Another reason is that on the N-5 the number of pedestrians is high as N-5 passes through different markets (usually it has shops at roadsides) while the Motorway is fenced. There is a pressing need that Driver Fatigue Awareness campaigns should be carried out by the Government of Pakistan and the Government of Pakistan should construct Winding Motorways and increase the number of rest areas on the Motorways to save precious human lives.

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