



RESEARCH PAPER

OPEN ACCESS

Investigation of risky driving behaviors and attitude causing road traffic accidents on motorways, A case study of MI Motorway, Pakistan

Amin Khan*, Syed Akhtar Ali Shah

Department of Urban and Regional Planning, University of Peshawar, Pakistan

Article published on June 30, 2019

Key words: Accidents, Accident patterns, Lane violations, Over-speeding, Intelligent enforcement.

Abstract

The increasing level of road traffic accident is major public health problems and the consequent casualties have strengthened the case for its comprehensive investigation. The study has been carried out on M-1, which is an integral part of the grand Motorways network of Pakistan with the aim to explore the most influential drivers' risky behaviours causing accidents on motorways and to recommend guidelines for road safety. The main composites of driver's risky behavior include over-speeding and lane-violations. In the study historical data of accidents for the past five years (2012-2016), maintained by National Highways and Motorways Police (NH&MP), has been analyzed to explore the effects of drivers' risky behaviours during the past five years. In addition, the prospective scenario of such behaviours has also been portrayed to correlate both the data to ascertain the real causes of accidents on motorways. Contradiction in the recorded accident patterns and the assigned causes in the historical data have been noticed. There is misinterpretation of the recorded accidents patterns. In this study the frequently happening risky behaviours were found to be the lane violations and over-speeding while the most prominent accident pattern have been recorded to be rollover and nose-to-tail. The main impact which this study establishes is the exploration and identification of lane violation as the most commonly occurring phenomenon on the part of drivers which lead to serious accidents on motorways. The paper recommended that intelligent enforcement against lane violation and over-speeding can ensure the safety of the road users on motorways. The study strongly recommended establishment of command and control system for a close check on lane-violations and over-speeding.

*Corresponding Author: Amin Khan ✉ aminkhan01313@yahoo.com

Introduction

Accident has been explained by many researchers in a manner that it is either an independent or a combined outcome of internal factors of the multilevel socio-cultural and technical environment of traffic (Ozkan *et al.*, 2011). Road traffic accidents can directly be attributed to behavioral factors including: driver behaviour or style and performance or skills. Focusing on driver as an important factor in the road safety it has been established that human factor is the sole contributory factors of road traffic accidents (Bener *et al.*, 2008). It has also been emphasized that human factors are far more important than engineering factors (Hingson *et al.*; 1996). The human factor which include two different components i.e. driving style and the driving skills which is based on the factors of individual habits of driving and later is based on the motor skills and information processing ameliorate with training and practice (Bener *et al.*, 2008). Over-speeding and lane violations being the indicators of drivers behaviour are the main causes in fatal accidents (Blincoe, Jones, Sauerzap& Haynes, 2007; Goldenbeld, Twisk and Houwing; 2008; Haagsma *et al.*, 2016).

It is investigated that behavioral and socio-demographic factors are responsible for the accidents due to exceeding speed limit (Blincoe *et al.*, 2007). In a study it has been highlighted that inappropriate speed and excessive speed is the main factor in the road safety problem (Goldenbeldand Schagen, 2005). In Netherland in the year 1992 only 3% of all accidents occurred on Motorways with a speed limit of 120 Km/hr (Rienstra *et al.*, 1996) In the United States of America in 1991, 2% of all accidents occurred on roads with a speed limit 60-65 mph (NHTSA 1991). It has been reported that just 1% rise in speed may increase the factor of fatality risk of about 4-12%. On the rural roads, the speed and accident risk are estimated at twice when the travelling is just above the 10 km/h of the average speed due to fragmented roads. In some studies, speeding means excessive speed for the driving conditions at any point in time (Giles, 2004). In others, speeding is termed as a specific level above the

posted speed limit, generally referred to as 'tolerance', mainly to account for the accuracy of vehicle speedometers, radar and speed cameras (Johnston, 2004). The police ensure enforcement in five main areas which include, drunk-driving, speeding, seat belt, running on red light and lane violations. The success of enforcement is being measured through the fines issued and the time spent by the patrol force on roads and the effects are measured through reduction in violations and accidents (Goldenbeldand Schagen, 2005).

A study based on two assumptions was conducted in China. The assumptions were: if, the traffic violation rate could be reduced or controlled successfully, then the rate of serious injuries and fatalities would be reduced accordingly. Second, specific risk factors associated with traffic violations and accident severity required to be determined the results will be effective in reduction of accidents in the region. The study suggested interventions in traffic regulations and legislation-targeting different vehicle types/driver groups with respect to the various human, vehicle and environment risk factors (Zhang, 2013). Study reveals that for effective safety work, restrictions on speed is imperative and to this effect it has been worked out that due to human perceptual, cognitive, and motivational processes, drivers adapt to risks on the road, whilst being motivated towards faster speeds and objectively more risky behavior (Johan; *et al.*, 2018). While focusing on the significance of travel time reduction in the road safety field, studies reports that the main benefit of improvements to transport infrastructure is the saving of travel time and in case network of roads are established in such a manner that reduce the distance among different locations the speed will be reduced (Metz, D. 2008).

Studies show that reductions in average or median driving speed of 2 to 5 km/h can result in a reduction of up-to 30% in injury and fatal accidents while the increase in speed limit culminates in the increase in fatality and injury rate (Christensen, 1981, Wagennar *et al.*, 1990). Globally, Road Traffic Crashes (RTCs) are the eighth leading cause of death and are predicted to become the seventh leading cause of

death by 2030 (WHO, 2013). Worldwide, road crashes result comes in about 1.3 million people die, more than 20 million people suffer injuries and such incidents causes a loss of US \$518 billion a year across the globe (ibid). Fatalities from road accidents are declining in high income countries while in low income countries it is other way round (Khan and Fatmi, 2014). The developed world has been successful in bringing the increasing tendency of road crashes to its minimum. Traffic crashes in Korea increased almost eightfold, from 37,000 in 1970 to 290,481 in 2000 whereby the fatalities increased three-fold and injuries ten-fold over the same period. However, through multiple policy interventions including: enforcement against drunk driving and speeding, installation of traffic-monitoring cameras, financial rewards for citizens who reported traffic violations, introduction of a road safety evaluation system, correction of accident black spots in existing roads, and road safety education programs, the tendency of accidents have successfully been checked. In the aftermath of such interventions about two thousand road traffic deaths and nine thousand traffic-related disabilities were averted in 2001 alone (Yang B. *et al.*, 2003).

Due to lack of necessary safety measures the developing countries containing only 48% of the world registered vehicles, suffer 90% of the overall road traffic fatalities (Rao, 2013). Amongst developing nation, Pakistan being the 6th most populous country contains 180 million population & 7,800,000 registered vehicles where each year more than 30,000 road crashes happen causing 400,000 injuries a year (WHO, 2009). Road traffic crashes is a second cause of disability, fifth primary cause of loss of healthy life and eleventh primary cause of premature fatality in Pakistan (Lopez *et al.*, 2006). The trend of crashes in Pakistan has been reported to be 1500 crashes per 100,000 populations (Gaffar *et al.*, 2004). Whereas in another report a more worsen situation has been portrayed where 270,000 annual Road Traffic Crashes used to happen across the country (Fatmi *et al.*, 2007). The Road Traffic fatalities per 10,000 vehicles in Pakistan are one of the highest

across the globe (Haider M, Badami 2010). As a result of these crashes the country costing a total of Rs. 100 billion per annum (Ahmad, 2015) to the country.

In transport sector of Pakistan, Motorway is a new addition since, 1997. Movement of vehicles on motorways are faster than the entire national network hence, likelihoods of traffic crashes and its severity are also more (SURVIVE Group, 2006). For ensuring road safety World Health Organization (WHO) and World Bank (WB) have jointly articulated a 'system approach' and 'multi sectoral action' (Peden, 2004). This approach actually embark-upon the interactions between the road users, the vehicle and the road environment which are termed as Potential areas for interventions (Haddon, 1968). The United Nation's (UN), Global Plan for the Decade of Action for Road Safety 2011-2020 have retransformed the Road transport system by considering human error and attempting to share the responsibility from road users to those who design road transport system. The areas for intervention so designed are: enhancing road safety management capacity; improving the safety of road infrastructure and broader transport networks; further developing safety of vehicles, enhancing the behaviour of road users and improving post-crash care.

Pakistan with regard to huge variations in its physiography as well as diversity in socio-economic characteristics which culminate cultural diversity. Such variations lead to the diversity in the behaviours of the people of the country. Similarly, due to the centralization of all the specialized goods and services in urban centers, the movement of people from one locality to another is being affected by such variations. To devise road safety policies and strategies of the country Pakistan Road Safety Plan has been aligned with roads safety measures suggested in the Asian Development Bank report on Asia and pacific region on road safety.

The Road Safety Plan of Pakistan include: training and enforcement, first aid training, creation of a reliable data base, forensic science laboratory, creation of a tele-communication wing, revision of

laws, removal of encroachments, creation of public awareness, road safety education and road safety walks. However, because of limited knowledge of the main causes of accidents on motorways despite intervention of all a sundry the objectives of road safety have not been achieved so far, at its optimum level. Different studies conducted in the field of road safety however, limited work have been done on the analysis of accident patterns, its causes and its association with the risky behaviours of the drivers being portrayed on motorways.

Understanding the main causes of accidents on motorways a study was required to be conducted in a manner to extract the real causes of the accidents happened in the past on the basis of the analysis of its patterns and its comparison with the existing driving culture on motorways. To explore the main causes of accidents on motorways this paper was made on the following objectives:

1. To assess patterns of accidents happened during the past five years (2012-2016) on M-I.
2. To investigate the main causes of accidents on motorways

Materials and methods

Study area

The study area is M-1 which is 155km (96 miles) long stretch of Motorway, passing through Punjab and Khyber-Pakhtunkhwa(KP) provinces of the country. Almost 67km area of the road is lying in Punjab and 88km in Khyber-Pakhtunkhwa. M-1 starts in northeast of Peshawar and moves toward eastern part of the country. Although, this section of road makes only 1.34% of the entire road systems of National Highway Authority (NHA) and 8.03% of the existing entire Motorway network of the country administered by National Highways and Motorways Police (NH & MP) as a law enforcement agency however, its role is more critical in the global affairs for being part of the giant connectivity plan of People Republic of China with the rest of Afro-Asia/ Eurasia commonly known as *One Belt, One Road* plan (OBOR). Currently this patch of Motorway is a vital link of Pakistan-Afghanistan and Central Asia.

Survey design and data collection

In this paper the requisite data has been extracted from the doctoral dissertation, titled "Analysis of risky behaviours causing road accidents on Motorways, a case study of M-I" of the corresponding author (Amin Khan, 2018).

In this paper the historical data pertaining to the accidents happened during the period 2012 to 2016 has been analyzed in first place. The historical data comprises of total accidents and its outcomes, accident patterns, the tabulated causes by the police department, and the types of vehicles involved. While the primary data comprised of information relating to the major violations being committed by the drivers and intercepted by the police for the execution of relevant penalties.

The process of data collection was comprised of 04 rounds: the historical data collection, the Key Informants Interviews (KIIs), the primary data collection and again the KIIs. In this study first the secondary data was collected followed by KIIs then primary and then KIIs survey. Archival data for the last five years have been collected from the NH & MP, Islamabad. Questionnaire and observations methods have been used for primary data collection to portray the real picture of drivers' risky behaviours in the study area. The questionnaire was filled from each violator stopped by the police in different violations. Purposive sampling method has been used and data was collected from 500 violators. The study was conducted on a non-probability sample which is based on targeted population's characteristics. The retrieved data has been entered in SPSS V. 18 and analyzed for descriptive and inferential statistics. Key Informants Interviews (KIIs) has been conducted with the senior level officers of NH&MP, NHA, and ministry of communications, Islamabad and members of various transporters associations. In this survey the senior officers of field formations and Road Safety Institutes (RSTIs), M-I, of NH & MP were asked about the queries raised during secondary data and primary data analysis. A total 100 questionnaires were administered for Key Informants (KIs) and the relevant data was collected in KIIs.

Statistical Analysis

Based on the scale type, the data was bifurcated in nominal and ordinal categories. In which former represents the categorical data whereas the later depicts the Likert scale items. After getting the data normal, the results were analyzed in which regression techniques were used in addition to the correlation (Pearson). Both primary and secondary data were analyzed separately. For the analysis of the data SPSS V. 18 was used. Study parameters were entered in SPSS. As part of the inferential statistics, regression was applied. For the inferential part of analysis, data has been tested at a P value equal to 0.05. Hence, value of less than 0.05 has been declared as significant. Data analyzed has been produced in the form of Fig., bar graphs.

Results and discussion

Findings of the analysis of historical data

A comparative analysis of entire accident patterns happened during the past five years with their causes enlisted by the NH&MP and enforcement carried out by the said organization during the same period against lane violations and over speeding has been made to explore real causes of accidents and to ascertain the effects of enforcement in road safety. Following are the findings of the analysis:

Enforcement and accidents are not matching at macro level

In the study area during the past five years from year 2012 to 2016, there is enhancement in enforcement against lane violations and over speeding however, when compared with the accidents of the corresponding period such enhancement in enforcement could not prove to be effective in reducing the number of accidents at macro level. However, a close review and comparison of enforcement with accident year by year reflect that road safety is closely linked with enforcement.

There is an increasing tendency of accidents from the year 2012 to 2016. However, the data indicate an unprecedented increase in all types of accidents during years 2015 and 2016 (Fig. 1).

In order to find out the effects of enforcement in road safety, its detail has been analyzed in comparison with the accidents statistics. Similarly, to correlate the phenomenon of unprecedented increase in accidents during the year 2015 and 2016 the enforcement detail has been taken into consideration (Fig. 2).

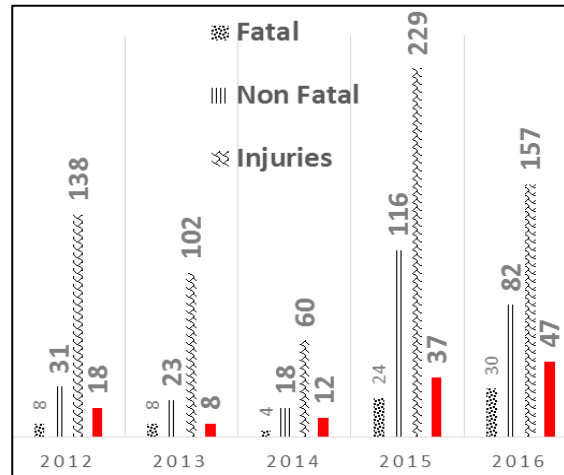


Fig. 1. Year-wise Accident Detail (NH&MP, 2012-2016).

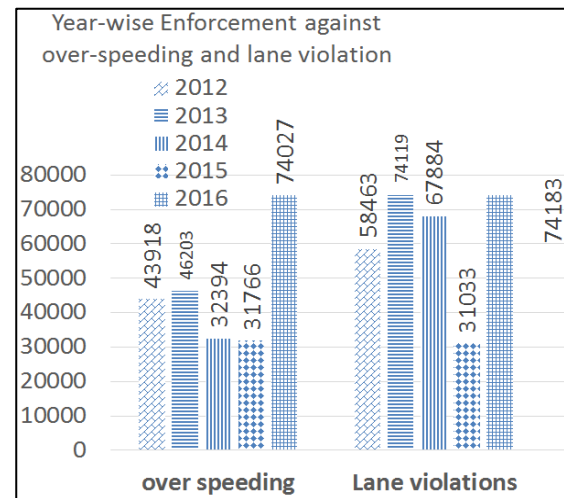


Fig. 2. Enforcement detail against over-speeding and lane violations during the years 2012 to 2016 on M-I.

The detail of enforcement shows that in the year 2012 the police have penalized 43918 violators of speed limits and 58463 violators of lane discipline while in the year 2016 the number of challans against over-speeding has been raised up to 74027 against over speeding and 74183 against lane violations. The given data shows enhancement in enforcement against the mentioned violations however, as evident from the accidents during the year 2012 and 2016 such enhancement in enforcement seems ineffective at

macro level rather counterproductive when a panoramic impression is made of all five years. Nonetheless if, closely reviewed year by year, enforcement has shown a positive role.

For example with the increase in penalties against lane violation from 2012 to 2013 the non-fatal accidents have shown a tremendous decrease. While as a result of decrease in penalties against over-speeding and lane violations during the year 2015 the number of accident has drastically increased. Thus based on this scenario the role of enforcement cannot be overlooked at all.

There is inverse relationship of enforcement with accidents as increase in enforcement can cause decrease in accidents. In this view, road safety is directly proportional to enforcement, better the enforcement the better will be the road safety situation and vice versa.

Rollover pattern appeared in most of the accidents

According to the causes recorded by the police during the period in the study area most of the accidents happened as a result of lane violations, tyre burst, fatigue and over speeding while the patterns of such accidents in most of the cases remained rollover. (Fig. 3).

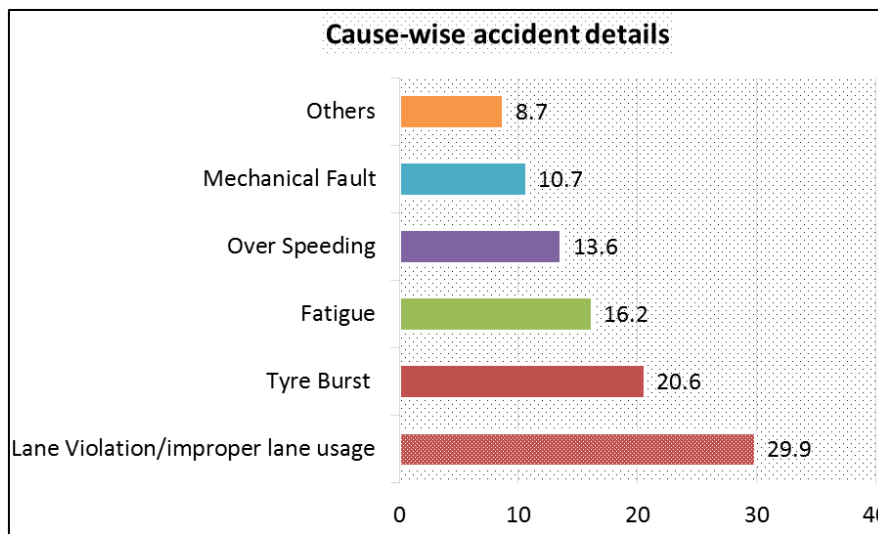


Fig. 3. Cause-wise detail of accidents during the years 2012-2016.

Fig. 3, indicate that in the causation of accidents lane violation has contributed large in the study area during the period. The second cause of accident recorded by the police is the tyre bursts followed by fatigue and then over-speeding. Here the over-speeding has been ranked 4th contributing almost 13.6% accidents during the past five years. However, in order to further probe into the matter analysis of major patterns of accidents have been done to extract the real causes of accidents. The Fig. 6 shows the major accidents patterns of the last five years from 2012 to 2016 recorded by the police:

The Fig. reflect that rollover pattern has contributed almost 50% of the entire accidents followed by nose to tail and side swipes. The above picture is self-contradictory with the causes already enumerated in

Fig. 3 where over-speeding has been ranked 4th. In the present case the rollover and nose to tail patterns are the top most contributory patterns found in most of the accidents. According to KIIs, vehicle with normal speed cannot be turn turtle until it is over speeded. Similarly, the nose to tail is also the reflection of over-speeding as the vehicle hitting the vehicle a head is due to not maintaining safe distance and again it happens due to over-speeding. In cases of nose to tail accidents, the following vehicle of such accidents is being held responsible for the damages caused to vehicle ahead. In such cases, the vehicle is moving with a higher speed without anticipating the situation a head and due to this haphazard movement suddenly come across with another vehicle which become impossible for the driver to maintain the distance that results in a crash.

The rolling over of a running vehicle occurs due to the impact of the huge centrifugal force applied at the car. This centrifugal force is generated as a result of over-speeding which overcomes the gravitational pull as well as the centripetal force, causing the vehicle turn turtle. As a result, the vehicle tend to over took the vehicles ahead with a speed higher than the other vehicles and thus due to rash driving the accidents happen. From this it can be established that in the study area the leading causes of accident are the over-speeding followed by lane violations. The discussion on this aspect of the study with KIIs came to the conclusion that rollover pattern is mainly caused by over-speeding while the agencies concerned due to lack of knowledge wrongly attribute other causes to the occurrence of such accidents. During discussion it has also been pointed out that the investigation agencies needs capacity building to record the exact causes of accidents. From KIIs it was also concluded that unlike over-speeding and other visible moving violations, lane violation cannot be monitored easily hence; its proper control is not possible through conventional vigilance or police patrol. Fatigue has also been appeared in most of the accidents. In the discussion it has been pointed out that due to lack of intelligent transport system and non-availability of the devices for the measurement of driving hours this tendency is on upward trajectory.

Cars, jeeps and LTVs are the vehicles mostly involved in accidents

The National Highway Safety Ordinance, 2000 gives definitions of 4 classes of vehicles, i.e. Car and Jeeps, Light Transport Vehicles (LTV), Heavy Transport Vehicles (HTV), and Public Transport vehicles (PSV). The comparison of accidents with these classes of vehicles reveal the impact of class of vehicles on driver behaviours. As evident from the Fig. there is huge involvement of small vehicles in the causation of accidents in the study area during the past five years. The reasons behind the huge involvement of cars/jeeps and LTVs in the accidents has been discussed in KIIs. Like cars and jeeps, LTV includes small vehicles carrying passengers and goods. The involvement of cars and LTVs in the accidents mainly

resulted due to its huge population in the study area and due to its shape. These vehicles are designed for moving with high velocity. The LTVs are the vehicles for the transport of passengers and perishable goods and most of the time operating in the area with high speed. Fig. 5 is based only on the data extracted for the Year 2016, because data for other years is not available with the NH&MP. It is evident from this Fig. that the cars/jeeps class resulted in almost two third of the accidents and this class of vehicle is an important determinant of drivers' behavior in the study area. The LTV class of vehicle has 20.5%likelihood of accident. The involvement of car, jeeps and other LTV class of vehicles indicate the speed of vehicles and its population in the study area. Focus on the movement of such vehicles may add to the road safety as these are the vehicles causing precarious situation for the road users.

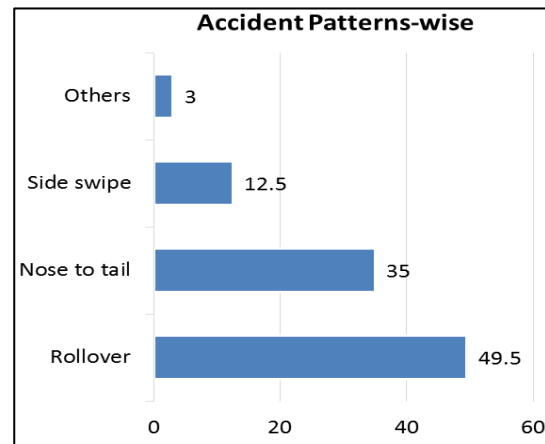


Fig. 4. Major accident patterns during the year 2012-2016.

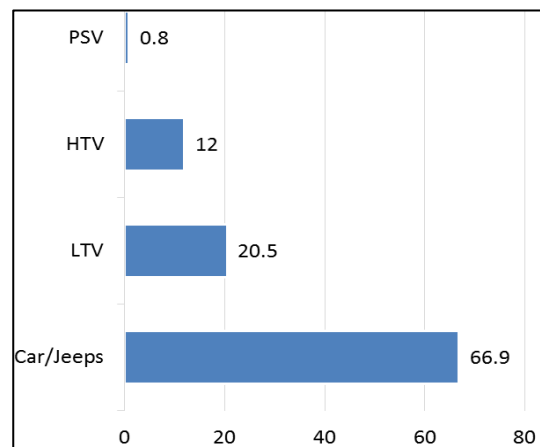


Fig. 5. Association of RTC with class of vehicles.

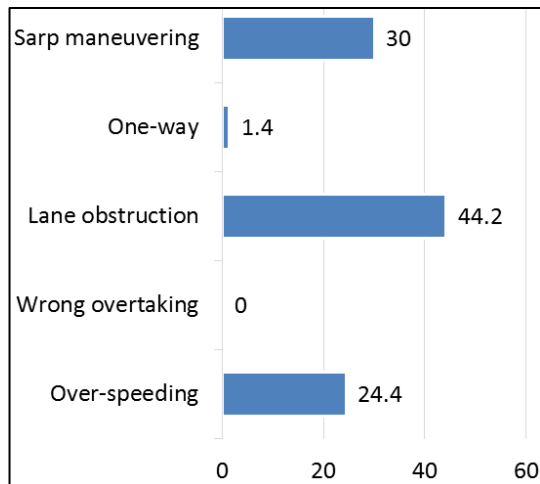


Fig. 6. Field Survey of M-I, April-2018.

Findings of the analysis of primary data

In order to further ascertain the causes of accidents on motorways it was imperative to have a close look of the driving culture on motorways and to quantify and analyze the risky behaviours of drivers being committed in the study area. The study visit was concluded in the month of April, 2018 and all those offenders and violators of traffic laws who were stopped by the police were brought to book and were properly interviewed. In the slot of moving violations the lane violations and over-speeding have been recorded as the most prominent violations on the part of drivers. The term lane violation is being used for lane obstruction, wrong overtaking, one-way violation and sharp maneuvering (Fig. 6).

Fig. 5, reveals that 44.2 percent of the violators are of lane obstruction and 30 percent of sharp maneuvering while 24.4 percent of the drivers were found to be violation speed limits. Such behaviours also appears more frequently in the causation of accidents in the historical data. According to Fig. 2, during the past five years 30% accidents happened in the study area only due to improper lane usage and 14% accidents due to over-speeding, the other causes including tyre bursts contributed 20% and fatigue 16%. According to the analysis and comparison of the primary and secondary data, there exists some mismatch between both the data regarding the accident patterns and causes recorded by the police. By comparing the violations given in the Fig. 6 with

the pattern of accidents exhibited at Fig. 4, it reveals that in the study area most of the violation are of lane obstruction, sharp maneuvering and over-speeding. Similarly, as per patterns of accidents during the past five years almost 50% accidents happened in rollover pattern, 35% in Nose to tail and 13% in side swipe patterns. These patterns indicate over-speeding and lane violations as it appears from the drivers violation scenario in the given Fig., 6 (KIIS). From this it is confirmed that the violations pattern being captured in the study area has close association with the frequency of violations in the study area. Based on accident patterns of the past five years and the present violation scenario it reflect that in the causation of accidents the lane violations and over-speeding are the main causes instead of the given causes enlisted by the police department (Fig. 3). The lane violation and over-speeding are the peculiar characteristic features of motorways traffic and its effects in the causation of accidents is evident (Fig. 4). Such, misconception of the causes and its effects is an issue of concerns on the part of executing agency.

Conclusion

1. Lane violation and over-speeding are the main causes of accidents on Motorways.
2. Intelligent and consistent enforcement against lane violations and over-speeding can bring positive changes in road safety

It has been ascertained that lane violations and over-speeding are the most influential behaviours of drivers causing road accidents on motorways. The cars and jeeps have been recorded to be the vehicles mostly involved in such accidents. The analysis of historical data in first place followed by primary data can give better results as the findings of the analysis of secondary data can indicate areas for further study in field. Therefore, this method can be applied in other disciplines for getting authentic and most reliable results. This paper recommends establishment of command and control system through surveillance cameras alongside motorways for close monitoring of traffic and capacity enhancement of the police force for conducting

proper investigation on scientific lines. Besides this, the study lays a firm foundation for further research in the area of transportation planning.

Acknowledgement

I am very thankful to almighty Allah for enabling me to accomplish this activity. This paper is part of PhD thesis of first author.

References

Al Reesi H, Freeman J, Davey J, Al Adawi S, Al Maniri A. 2018. Measuring risky driving behaviours among young drivers: development of a scale for the Oman setting. *Transportation research part F: traffic psychology and behaviour* **55**, 78-89.

Alfalahi E, Assabri A, Khader Y. 2018. *Pan African Medical Journal* **29(145)**.

Alvaro PK, Burnett NM, Kennedy GA, Min WYX, McMahan M, Barnes M, Howard ME. 2018. Driver education: enhancing knowledge of sleep, fatigue and risky behaviour to improve decision making in young drivers. *Accident Analysis & Prevention* **112**, 77-83.

Anders Af Wählberg E. 2006. Driver Celeration Behavior and the Prediction of Traffic Accidents, *International Journal of Occupational Safety and Ergonomics* **12(3)**, 281-296, DOI: 10.1080/10803548.2006.11076690

Ashkan Tatari, Gholamreza Khorasani, Ali Yadollahi, Milad Rahimi. 20120. Evaluation of Intelligent Transport System in Road Safety, conference of international journal of chemical, environmental and biological sciences, Kuala Lumpur, Malaysia, Volume **1**, 2012.

Bener A, Al Maadid MG, Özkan T, Al-Bast DA, Diyah KN, Lajunen T. 2008. The impact of four-wheel drive on risky driver behaviours and road traffic accidents. *Transportation research part F: traffic psychology and behaviour* **11(5)**, 324-333.

Bener A. 2005. The neglected epidemic: road traffic accidents in a developing country, State of Qatar. *International journal of injury control and safety promotion* **12(1)**, 45-47.

Bergeron M. 2018. *Crash Collision Analysis: Evaluation Road Safety in Austin, Texas 2014-2016*.

Bin Adai, al Bana H. 2012. *Safety 2012 World Conference*, 1-4 October 2012, Wellington, New Zealand, Volume 18, Issue 1.

Bjørnskau T, Elvik R. 1992. Can road traffic law enforcement permanently reduce the number of accidents? *Accident Analysis & Prevention* **24(5)**, 507-520.

Blincoe KM, Jones AP, Sauer zap V, Haynes R. 2006. Speeding drivers' attitudes and perceptions of speed cameras in rural England. *Accident Analysis and Prevention* **38**, 371-378.

Gaygisiz E. 2010. Cultural values and governance quality as correlates of road traffic fatalities: A nation level analysis. *Accident Analysis & Prevention* **42(6)**, 1894-1901.

Giles MJ. 2003. Driver speed compliance in Western Australia: a multivariate analysis. *Transport Policy* **11**, 227-234.

Goldenbeld C, Van Schagen I. 2007. The credibility of speed limits on 80 km/h rural roads: The effect of road and person (ality) characteristics. *Accident Analysis & Prevention* **39**, 1121-1130.

Goldenbeld CTD, Houwing S. 2008 'Effects of persuasive communication and group discussions on acceptability of anti-speeding policies for male and female drivers'. *Research Part F; Traffic Psychology and Behaviour* **11(3)**, 207-220.

Goldenbeld FC, Van Schagen I. 2005. The effects of speed enforcement with mobile radar on speed and accidents An evaluation study on rural roads in the Dutch province *Accident Analysis and Prevention* **37**, 1135-1144.

- Haagsma JA, Graetz N, Bolliger I, Naghavi M, Higashi H, Mullany EC, Ameh EA.** 2016. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. *Injury prevention* **22(1)**, 3-18.
- Haider M, &Badami MG.** 2010. Urbanization and local governance challenges in Pakistan. *Environment and urbanization ASIA* **1(1)**, 81-96.
- Hill C, Elefteriadou L, Kondyli A.** 2014. Exploratory analysis of lane changing on freeways based on driver behavior. *Journal of transportation engineering* **141(4)**, 04014090.
- Hyder AA, Ghaffar AA, Sugerman DE, Masood TI, Ali L.** 2006. Health and road transport in Pakistan. *Public Health* **120(2)**, 132-141.
- Johnston I.** 2004. Reducing injury from speed related road crashes. *Injury prevention* **10(5)**, 257-259.
- Khan AA, Fatmi Z.** 2014, Strategies for prevention of road traffic injuries (RTIs) in Pakistan: situational analysis. *Journal of College Physicians Surgeons Pakistan* **24(5)**, 356-360.
- Metz D.** 2008. The myth of travel time saving. *Transport reviews* **28(3)**, 321-336.
- NHTSA.** 2009. Analysis of Speeding Related Crashes: Definitions and the Effects of Road Environments. National Center for Statistics and Analysis. Washington DC; NHTSA.
- Özkan T, Lajunen T.** 2011. Person and environment: Traffic culture. In *Handbook of traffic psychology* pp. 179-192.
- Rao GK.** 2013. Road traffic safety management in india—analysis-exploring solutions. *International Journal pr Application or Innovation in Engineering &Management (IJAIEM)*.
- Rienstra SA, Rietveld P.** 1996. Speed behaviour of car drivers: a statistical analysis of acceptance of changes in speed policies in the Netherlands. *Transportation Research Part D: Transport and Environment* **1(2)**, 97-110.
- Wagenaar AC, Streff FM, Schultz RH.** 1990. Effects of the 65 mph speed limit on injury morbidity and mortality. *Accident Analysis & Prevention* **22(6)**, 571-584.
- WHO.** 2013. Violence, Injury Prevention, & World Health Organization. *Global status report on road safety 2013: supporting a decade of action*. World Health Organization.
- Yang BM, Kim J.** 2003. Road traffic accidents and policy interventions in Korea. *Injury control and safety promotion* **10(1-2)**, 89-93.
- Zhang G, Yau KK, Chen G.** 2013. Risk factors associated with traffic violations and accident severity in China. *Accident Analysis & Prevention* **59**, 18-24.
- Zhang T, Chan AH.** 2014. Sleepiness and the risk of road accidents for professional drivers: A systematic review and meta-analysis of retrospective studies. *Safety Science* **70**, 180-188.
- Zheng Z.** 2014. Recent developments and research needs in modeling lane changing. *Transportation research part B: methodological* **60**, 16-32.