

TIMING CHARACTERISTICS FOR ROAD CRASHES IN KARACHI, PAKISTAN

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ABSTRACT

Transportation planners and Engineers recognize the fact that transportation systems constitute a potent force in shaping the course of regional development. Transportation encompasses a broad set of policy variables, and the planning and development of transportation facilities generally raises living standards and enhances the aggregate of community values. For the efficient planning of infrastructure and the constituent facilities, road traffic accidents has its own significance and demanding validity. Outputs from the system include the movement of people and traffic modes, improvement and deterioration of the physical environment as well. In contrast to all these factors, crash prevention is indirectly linked with the time of the occurrence or related incident. This corresponds to the spatial organization, circulation, visual properties, resources and symbolic properties.

This paper focuses on road traffic accidents of Karachi, Pakistan involving various types of road users in different timings of the day (24 hrs). Possible root causes with significant recommended measures is the extensive dimension of this research study. Deliberate number of crash implications perceived by the application of ANOVA in the comparative analysis of three years data record. It is quite evident from the analytical data record that rate of severity is directly linked with the increase in insufficient illumination during dusk and dark timings. Achievement of a balanced system is an important goal in order to best serve the varying nature of road users. This balance is based on principal analysis of each class. The positive progressive impact of time on traffic accidents is probably one of the greatest achievements that will control the magnitude of the casualties.

KEYWORDS

Traffic Accident, Day timings, Variability, Crash, Pakistan

1. INTRODUCTION

The objective of safety in traffic accidents is concerned straightforwardly with reducing the loss of life, injuries and damage to property. This objective is thus closely associated with the concerns over fear and intimidation listed under environmental protection and driving behavior in varying nature of day timings which is the concerned issue of the research study area.

It has been common practice for some time in developed countries to place money values on casualties and accidents of different severity, and to include these within a social cost benefit analysis. The safety objective has been subsumed within the efficiency objective. However there are some misgivings about some elements of the valuation of accidents and it is probably helpful to estimate the root cause of the fatalities and injuries involving road crashes.

There are several factors that may result in a road accident, such as law violations and improper behavior of road users, road conditions, and vehicle conditions. In most cases, the occurrence of accident is not caused by a single factor, but contributed by combination of two or more factors. To reduce the occurrence of the road accidents, various solutions could be used, such as two approaches (i) by reducing the damage effect that occurs in a crash, particularly for vehicle occupants, with building crash protection in roadways (wider shoulders, break-away light standards, etc.) and in vehicles (increased vehicle weight, energy absorbing vehicle design, air bags, etc.); and (ii) by requiring vehicle occupants [1]. Among the various factors of traffic accidents the most important factor leading towards serious injury is the inappropriate clear site vision for the road users and might be indirectly involved with the prime cause of a crash. This problem is highly observed in most of the developing countries especially in Pakistan as discussed in various sections of this research paper

2. OBJECTIVES

Following are some of the major objectives that deliberately involve in various sections of the discussed research study:

- To quantify the number of accidents in various intervals of time with the base line of developed time set criteria (Dawn, Daylight, Dusk and Dark)
- To elaborate the features of gathered data with the identification of root causes on the basis of statistical approach (ANOVA application)
- Identification of calming measures adopted in continuation with the contributory factors and pre existing situation of the Karachi City.

3. ACCIDENT PREVENTION WITH GOVERNING FACTORS

Accident prevention is generally concerned with the application of safety principles to new road improvements or traffic management schemes that are initiated to satisfy traffic or environmental demands, and are thus not justified on the basis of accident savings only. As such work on accident prevention usually involves the carrying out of safety checks on designs for these schemes to ensure that no problem feature is introduced and to identify whether any safety measure need to be added to lower their accident potential [2].

As per the main entity of research study it is quite evident and encompassed situation that traffic crashes are deliberately impacted during different day timings including Dawn, Daylight, Dusk and Dark. Crash prevention can be easily understood by having the clear perspective of root causes. In the real situation of road traffic accidents, possible causes that indigenously govern are glare recovery action and insufficient illumination problems for the road users. Each of the issue is indirectly linked with the associated time of incidence.

4. ROAD TRAFFIC ACCIDENTS IN KARACHI, PAKISTAN

Due to rapid increase in car ownership, there is the direct proportionate relationship between traffic accidents and the vehicular population. Among the various major cities of Pakistan, Karachi is seriously affected with the crashes of road. Each accident reported shows its own ideological factor governing the matter. These factors include slippery pavements, insufficient illumination, glare problems, animal actions, curve effect, over taking, over speeding etc.

Some of the reported and investigated accidents lead to the contribution of indirect road environmental factors depending upon the changes of traffic stream in different day timings. The identification and planning for systematic strategy for these kinds of crashes and its prevention might be the ultimate goal of this research evaluation study.



Figure 1 – A Reported Accident onNorthern Bypass (Yamaha Motors)

5. METHODOLOGY ADOPTED FOR THE RESEARCH PAPER

The whole study is based on the joint effort of Road Traffic Injury Research & Prevention Centre (RTIR & PC) at Jinnah Postgraduate Medical Centre, Karachi in collaboration with NED University of Engineering & Technology, Karachi [3].

The analytical accident injury data which is presented in this paper is from year 2006 to 2008 while the centre is being involved in the collection of data till now. Basically this Research Project was started in September, 2006 by the co-ordination of Ministry of Health. Accident data is collected from five major trauma centers namely Jinnah Post Graduate Medical Centre (JPMC), Abbasi Shaheed Hospital (ASH), Civil Hospital Karachi (CHK), Liaqat National Hospital (LNH) and Agha Khan University Hospital Karachi (AKU) through injury surveillance data base system. Various research assistants are deputed on these centers for the collection of data. For proper analytical views accidents are mainly characterized as Minor, Serious and Fatal injuries while road users are defined as Rider/ pillion riders, Passengers, Pedestrians and Drivers. For detailed analysis of the data, proper questionnaire with the related entities involving road crashes has been developed by the research centre and it is to be filled through interviewing techniques by various research assistants. For the detailed study of time dynamic characteristics, accidents are characterized in four broader timing areas as follows:

- Dawn: 6:00 am to 9:00 am
- Daylight: 10:00 am to 5:00 pm
- Dusk: 6:00 pm to 9:00 pm
- Dark: 10:00 pm to 5:00 am

A part from that, by the help of three years data trends of fatal road crashes are discussed in between the timings of 8:00 pm to 4:00 am (Combination of dusk and dark timings). The dusk and dark timings are considered to be the critical timings due to the high involvement of contributory factors including insufficient illumination and glare recovery action. The details of these two root causes are discussed in the analytical section of the paper. At the contrast consideration of facts and findings, hypothetically statistical tools are implemented in order to manipulate the governing factors of road traffic accidents in Karachi. The methodology of the paper has been developed in a way that pertains to the outcome of crash prevention system which is briefly discussed in the recommendation section.

6. CHRONOLOGICAL ISSUES RELATED TO ROAD CRASHES

6.1. Risk of Accidents in Older Age Driving

According to a study [4] most of the older-driver crashes involved colliding with another vehicle while in traffic. Few involved running off the road and hitting something, which is more common for young drivers. The crash analysis showed that the severity of crashes for older drivers also is very high compared to the rest of the population. When looking at the categories of crash severity, older drivers have the highest incidents in fatal crashes, as well as incapacitating and non-incapacitating crashes. Older drivers also had a higher percentage of crashes occurring at intersections and accidents happening during daylight. Normally it's the usual practice that older drivers prefer to drive during day times against night time driving and get involved in the accident but this ultimately converted to the glare recovery action for sunlight during day time.

6.2. Understanding the Night Time Death Toll

A disproportionate number of fatal injuries occur after dark. A sound physiological explanation for this is advanced based on the poor temporal characteristics of road photoreceptors. It is argued that processing information based on low luminance, low contrast targets are much slower than that for high contrast bright targets. To test the idea, simple visual reaction times were measured under typical low visibility conditions encountered [5].

6.3. Visual Acuity Perception of Road users

A driver usually perceives the actions of other vehicles, the location of objects, traffic control devices and the general traffic environment. Visual acuity refers to the sharpness with which a person can see an object [6, 7]. Visual acuity is affected by factors, such as the contrast and brightness of the object, the level of illumination and the relative motion between the observer and the object. Visual acuity is termed static in the absence of relative motion and dynamic when relative motion exists. Night driving requires artificial illumination of signs by either permanent fixtures or reliance on the vehicle's headlights. In addition acuity decreases with increasing visual angles. The clearest vision occurs within a cone of vision in the vicinity of 3 degrees and fairly good up to approximately 10 degrees. For practical design, traffic signs should be placed within the 10 degree cone and at location permitting ample distance for perception reaction and maneuver execution.

6.4. Glare Recovery Action

Drivers are blinded by the sunlight when it hits their windshield. But there is also 'veiled glare' which is indirect sunlight that comes in at angle or reflects off glass towers and other cars [8]. Every dust particles, steak, smudge becomes magnified by the illumination of sunlight so the only thing that can be seen is the windshield dirt instead of road and this is one of the most important issue prominent in Karachi city due to environmental degradation. When the sun is behind, the light often bounces off the reflectors of the traffic lights ahead, causing them to have the same brightness and to look like they are all the same color. Some users run the red light because it looks the same upon approach as

the green light they saw moments before and ultimately leads to the signal violation issue.

7. ANALYTICAL FACTS AND FIGURES FOR KARACHI ROAD TRAFFIC ACCIDENTS

7.1. Trends of Severities in different Day Timings (Data record, 2008)

As it is clearly shown in the table appended below that nearly 80 percent minor injuries are involved during the dusk and dark timings. Apart from that same percentage of injuries is recorded in the daylight comparatively with the high amount of traffic flow rate of morning.

Table 1 – Injury Severity in Various Day timings 2008

Injuries	Dawn	%age	Daylight	%age	Dusk	%age	Dark	%age
MINOR	1978	73%	10253	80%	4399	78%	7549	79%
SERIOUS	586	22%	2143	17%	1079	19%	1742	18%
FATAL	145	5%	431	3%	178	3%	320	3%
TOTAL	2709	100%	12827	100%	5656	100%	9611	100%

7.2. Comparative Analysis of Three years Contributory factors involving Road Crashes

Based on the literature review and detailed analysis of road accidents it can be predicted that the severity rate is indigenously increasing during the dusk and dark timings. The focused element in these crashes which has been identified based on the three years data record system of Road Traffic Injury Research and Prevention Centre is the insufficient illumination and glare recovery action on major corridors of Karachi.

Table 2 – Injury Involvement through Major Contributory Factors (2007, 2008, 2009)

Contributory Factors	2007	2008	2009
Insufficient Illumination	369	344	234
Glare	0	14	8

The related number of injuries is more clearly described in the graphical representation as shown below:

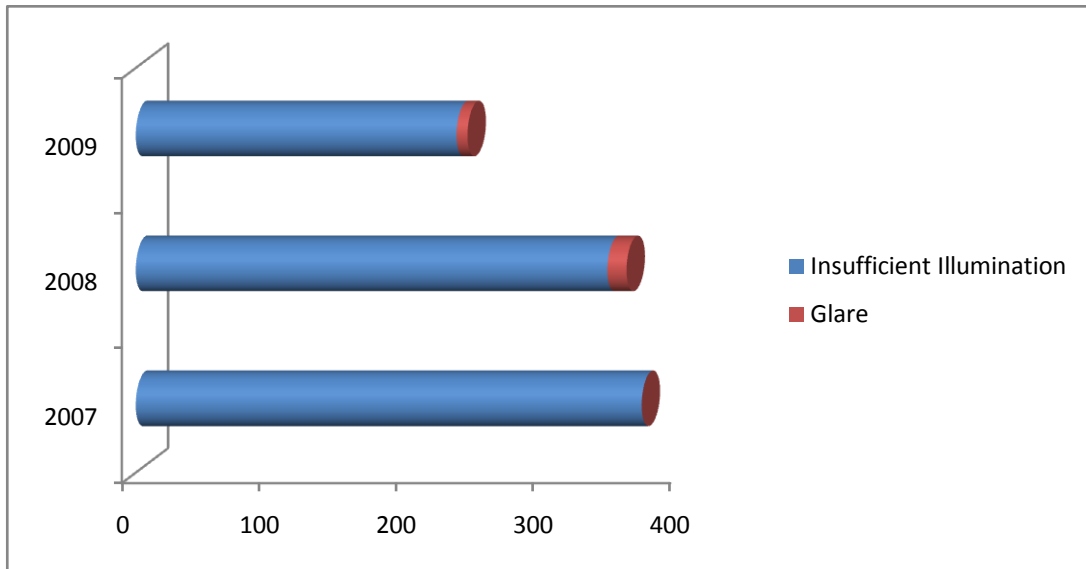


Figure 2 – Graphical Representation of Major Contributory Factors involved in Road Crashes

8. CONCEPTUAL APPROACH TO ANOVA (Analysis of Variance)

Basically this statistical tool is applied to compare two or more (multiple) treatments on a particular project. It provides the researchers and Engineers with much greater flexibility in design and analysis of experiments. Generally the analysis is anticipated on the basis of single factor and the analysis without replication. If the difference is found it can be assumed that the means of data sets are different, ultimately it describes the strangeness of data.

The strategy of ANOVA is implemented on the arrangement of data set (fatal road crashes involved during the time period of 8:00 pm to 4:00 am). This specific time is considered to be the combination of dusk and dark timings. The data which is gathered for this time period is as follows:

Table 3 – Fatal Road Crashes during the combination of Dusk and Dark Timings

Timings	2007	2008	2009
8:00 - 10:00	96	143	144
10:00 - 12:00	69	98	66
12:00 - 2:00	32	62	75
2:00 - 4:00	25	43	37

The governing factor for the whole analysis is F Ratio based on SS (Sum of Squares) and df (Degree of Freedom). The concept is briefly discussed in the pictorial view as follows:

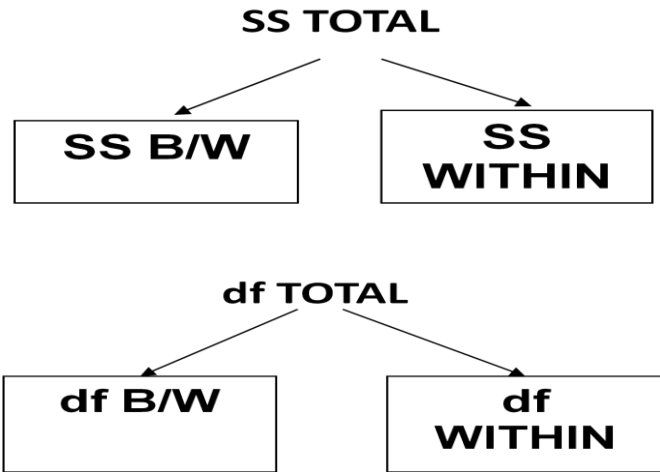


Figure 3 – Governing Factors of ANOVA features

$$F = \text{VAR BETWEEN TREATMENTS} / \text{VARIANCE WITHIN TREATMENTS}$$

$$\begin{aligned} \text{Var between treatments} &= \text{SS between} / \text{df between} \\ \text{Var within treatments} &= \text{SS within} / \text{df within} \end{aligned}$$

On the data shown above, implications of ANOVA are applied and the results are obtained as follows (Single factors and factors without replications):

Table 4 – Single Factor ANOVA Application

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2162.667	2	1081.333	0.636619	0.551326	4.256495
Within Groups	15287	9	1698.556			

As per the ANOVA results, F obtained is less than the F critical since the implementation strategies applied on the specific corridors for avoiding crashes during dusk and dark timings are not real. If the data replication is not allowed then the results are considerably changing as follows:

Table 5 – Analysis based on Factors without Replications

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	14179.67	3	4726.556	25.61048	0.000808	4.757063
Columns	2162.667	2	1081.333	5.859121	0.038832	5.143253

During the three years, crashes involved in the similar timings associated with the provision of facilities showing the improving factor (F Obtained is greater than F critical). This implies that the time changes from dusk to dark, features are

more visible to the road users in order to avoid road traffic accidents in the particular year but the comparison of the similar timings against the associated columns (year wise data) shows entirely ungrouped results (F_{Obtained} is less than F_{critical}).

It is quite evident based on the facts and findings that there is a need of supporting action maneuvers that provoke night time death toll.

9. VULNERABILITY OF ROAD USERS DURING DUSK AND DARK TIMINGS IN KARACHI

As people grow old their driving skills tends to deteriorate as a result of the degradation of functional and cognitive skills associated with aging [9]. In Karachi it has been predicted that night vision especially glare resistance and recovery time worsens with older age with the slower reaction time. In fact hearing action, walking speed and attention spans also affected in older pedestrians. In this contrary there is the need of awareness programs aimed at elderly drivers and Pedestrians which advice them in order to cope with their difficulties comparable with the road situations and give potential to reduce accidents involving older persons. Standards should be clearly defined by the law Enforcement and legislation authorities for each class of road users involving Riders, Pillion riders, Drivers, Pedestrians, Passengers and other non motorized modes. Transport policy framework might be given the perspective for the guidelines of elderly age drivers notifying the road crashes during dusk and dark timings with sustainable preventive measures.

In the present situation strong relationship should be bonded in between the road environment, human and vehicle contributory factors with the Engineering and Education measures.

10. REDUCING NUMBER OF CRSAHES WITH APPROPRIATE DRIVER INFORMATION SYSTEM

While incorporating the issues related to crash prevention, there should be proper and quite fair driver information system. These include:

- Proper selection of warning, informatory and regulatory traffic signage
- Design and siting of information signs including layout, symbols and color properties
- Support posts for the traffic signs, these should be the non descript color so as to blend in the background
- Use of variable message signs which differs from the conventional traffic signs in that they can be configured to show a range of different messages
- While enhancing the road marking features, their function should be quite clear in order to guide vehicle into definite positions on the carriage way

and to supplement the regulations and warnings of traffic signs and signals

- Proper selection of road marking material is mandatory regarding thermoplastic, paint, preformed tapes or sheets

11. CONCLUSION AND RECOMMENDATIONS

Based on the present practical situation and facts and figures of road crashes in Karachi, Pakistan up to the relevant perspective, following measures might be fruitful and task oriented for the designers and the decision makers:

- Selection of traffic control device should be entirely based on the need and significance of the particular road category
- Any measure provided should be based on the cost benefit analysis and practicable international standards
- Licensing and training should be given more priority and focused for the traffic situation of Karachi
- For the implementation of traffic control devices, suitable and appropriate contrast in varying colors should be enhanced that might be easily understood and accessible for each class of road user using the facility in 24 hours
- Standards should be followed for the implementation of street lights in order to avoid insufficient illumination
- Rules and regulations should be deliberately focused in vehicle inspection system. In this connection manufacturing companies may get involved with the stake holders and practitioners
- Strict enforcement action should be followed or policy should be developed while providing license to particular citizen by having clear medical check up with the issuance of medical certificate
- A part from the Engineering measures, safety campaigns would be the way forward action followed by the strict Enforcement and penalty action
- Implementation strategies should be clearly defined based on the nature and traffic of road users utilizing in Karachi, Pakistan

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