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A Study on Impact of Driver Behavior and Safety Measures at Urban Mid-Block Sections Under Mixed Traffic Conditions

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Abstract

One of the hardest phenomena to investigate is motorist behaviour along road segments, especially in the middle of a city block during rush hour. The number of pedestrians and the number of accidents involving pedestrians and vehicles have both risen dramatically in recent decades in developing countries like India. Mid-block sections are very prone to accidents and generally occurs because of ignorance of drivers driving in the zone. This study aims to study the drivers' behaviour and safety measures in respect to the occurrence of the road accidents at urban mid-block sections under mixed traffic conditions. To accomplish this objective, a survey methodology was brought in use. For this survey, a questionnaire was constructed based on the 2 hypotheses of the study. The questionnaire was distributed among the drivers riding in the zone. In urban mid-block portions with mixed traffic, it was discovered that both driver behaviour and safety measures have a significant impact in on-road accidents.

Keyword: Mid-Block, Safety Measures, Mixed Traffic Conditions, On-Road Accidents, Pedestrians

Introduction

Humans have historically relied heavily on motor vehicles. That's why we decided that cars and trucks were the foundation of the transportation system. There was a great deal of travel in the ancient times, and travel was the primary form of transportation. All transportation, trips, and journeys have beginnings and endings. The use of vehicles for transportation is efficient for both short and long distances. In urban areas, automobile travel also plays an important role in getting about. Vehicular motion is researched experimentally from every angle in order to give the best design spaces for human motion or circulation, such as at move for travelling to the hill station and travelling the job aspect and working the travelling to tour, etc [1]. There are two stages that propel it forward. Basic flow metrics such as speed and density of vehicular motion may be analyzed at the macroscopic level, while the pathways taken by individual vehicles can be studied at the microscopic level. This implies that vehicles are free to forge their own routes throughout the landscape. When it comes to the mobility and safety mode of signalized crossings, various cross roads such intersections are created for a road, give useful job to aid the automobile in moving from one side of the road to the other, and so on. Vehicles tend to cross the street in the middle of the block in areas with heavy traffic. In comparison to signalized junctions, however, there is no sense of security. These midblock areas are so busy that numerous intersections are used by cars. The width of roads is determined by the volume of traffic that uses them. Although there are a few published guides on the subject of road width, they lack precise standards for the minimum width needed to accommodate a variety of vehicles, as well as demand volumes and property types. Both one-way and two-way traffic patterns may be seen in vehicular traffic [2].

Although traffic moves in just one way in a unidirectional flow, it may move in both directions and interact with each other in a bidirectional flow. One of the primary focus of urban transportation engineering is on ensuring the security of vehicles on the roads. A key factor in the road safety problem is the unlawful behaviour of vehicles at intersections.

Pedestrians move along the roads or they cross the roads. Another general term used is road crossing. When crossing a road, there are various factors which must be followed to maintain road safety of pedestrians as well as road travellers [3]. The risk factor increases more when the place where a pedestrian is crossing the road in unsignalized and uncontrolled. Moreover, at such places, the behaviour of the pedestrians will be a major parameter for understanding the risks associated with the chances of suffering an accident. [4]

Designing and operating a proper road network is a very creative process and comprises of several challenges. There are countless aspects which are brought in consideration while designing and operating a road network such as maximizing the mobility, affects over safety, time consumption, travelling costs, pedestrian safety, pedestrian facilities, traffic signals, etc. There are several recommendation which can be made to the policy makers but before that, it is important to understand the conflict's nature and options available for making the travelling safer and simpler. [5]

Number of road accident cases reported in India in 2021, by state

In 2021, more than 55,000 road accidents were recorded in the Indian state of Tamil Nadu, with over 48,000 reported in the state of Madhya Pradesh. More accidents occurred at T-junctions than any other kind of intersection.

There has been a levelling down in the number of accidents in MP, but the fatality rate has risen virtually annually (by 1%) over the previous three years. In 2018, there were around 54662 recorded injuries and 21000 fatalities as a result of accidents. Injuries sustained in accidents are on the increase as well.

A deadly accident is one in which one or more people lose their lives. When one or more people are seriously hurt in an accident, it is called a "grievous injury" (not necessarily in terms of IPC definition of grievous injury). An accident is considered minor if the victim(s) do not need medical attention at a hospital.

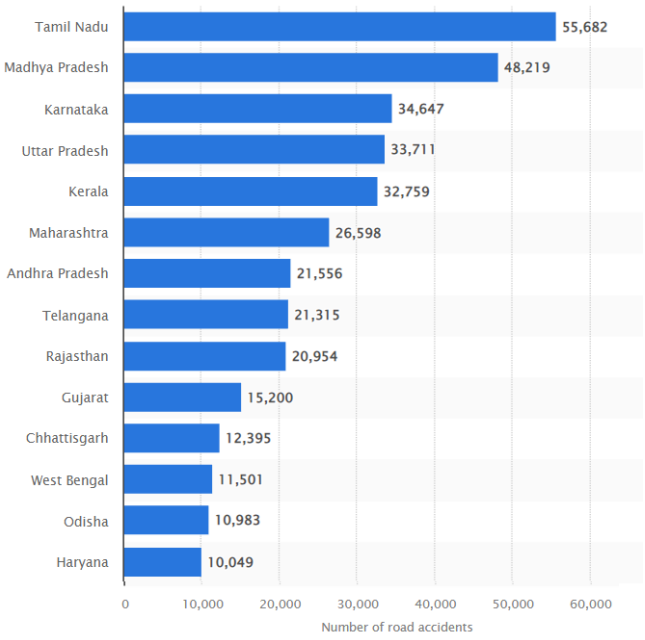

Figure 1 Number of road accident cases reported in India in 2021

Source: https://www.statista.com/statistics/633107/reported-road-accident-cases-by-state-india/

Mid-block section

Mid-block pedestrian crossings are locations between automobile junctions where pedestrians are permitted to cross the roadway. These crossings should be placed in the most pedestrian-friendly locations to encourage more frequent and safer road crossings [6]. This sometimes necessitates setting your shop in high-jaywalking areas, which can be risky for pedestrians. When a pedestrian doesn't have to wait at an intersection to cross the street, they may use shorter, more efficient routes. Even at these designated crosswalks, additional safety precautions are needed since cars are often far less vigilant for pedestrians outside of junctions.

Recent research has shown that towns may find the ideal number of midblock crosswalks. The research also discovered:

- When considering pedestrian detour, pedestrian signal delay, and vehicular bandwidths, improving the number, positions, and signal settings of

crosswalks all at once may provide significant gains;

- When the minimum spacing between crosswalks and the cost of vehicles are considered, it is possible that more crosswalks will not significantly reduce the cost of pedestrian crossings; and
- For the safety of pedestrians and motorists alike, two-stage crosswalks are preferable to one-stage crossings.

An integral part of the city's transportation network, pedestrians are especially at risk at unprotected mid-block sites while dealing with a variety of vehicle types. Midblock pedestrian crossings are popular in India and other developing nations [7]. In most cases, no pedestrian cross markers can be seen at the spots where walkers must make a crossing. The impact of these unmarked crossings are twofold. Pedestrians put themselves in harm's way, and motorists' ability to move quickly and safely is hampered. Some cars may stop for walkers who are already in the crosswalk in vulnerable mid-block sites. Yet some of the people are crossing at awkward times to avoid traffic [8]. The features of automobile traffic are therefore reduced as pedestrians utilise the mid-block crossing with imposed spacing. When pedestrians have access to attractive walking facilities, there is no discernible impact on the features of vehicle traffic flow. In this research, we looked at how a pedestrian crossing changed the dynamics of traffic flow in the middle of the block during peak and off-peak hours. [9]

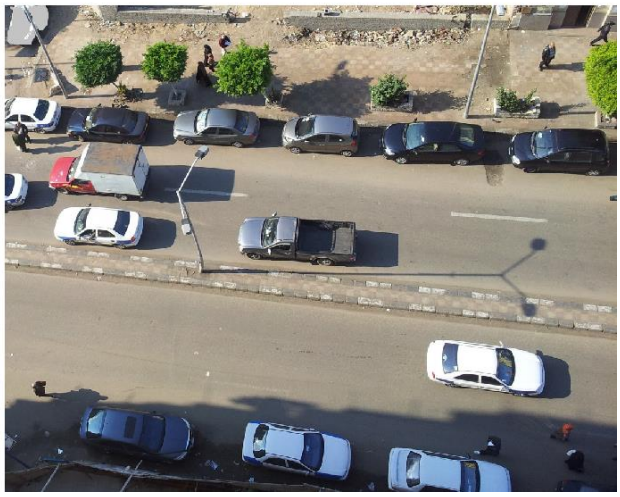

Figure 2 Midblock section

Most of the intersection are deprived of any type of traffic signal or traffic personnel for controlling the flow of traffic at that spot and is known as uncontrolled intersections. Such intersection usually does not comprise of much traffic but is surely accident prone. Several pedestrians lost their lived and were disabled or suffered major or minor injuries in some form or other at such uncontrolled intersections. [10]

Research Design

This study is based on a survey methodology. A survey was conducted based on the hypotheses of the study. A questionnaire was constructed and distributed to the respondents. Entrepreneurs and their employees were the target respondents for this study. The obtained responses were sampled and analyzed and the hypotheses of the study were tested. IBM SPSS software was brought in use for analyzing the data.

The structure and procedures of this approach are shown in the flowchart below:

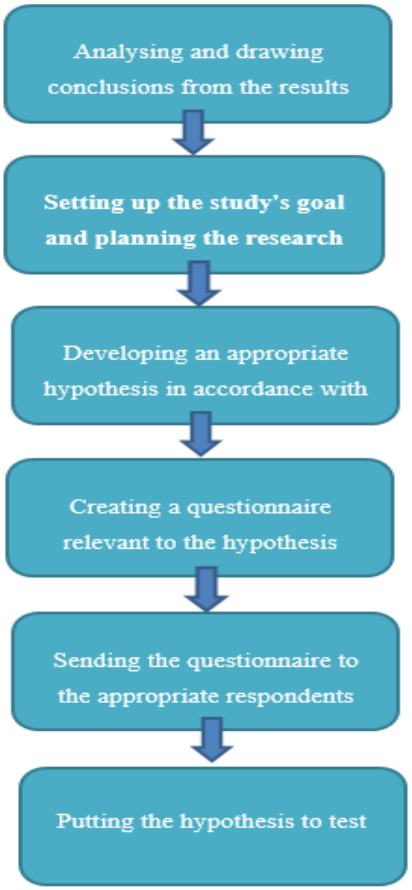

Figure 3 Structure and procedures of hypothesis testing

Area of the study

Bhopal, Madhya Pradesh is chosen as the research region for this investigation. India's most populous region; in 1972, Bhopal became the central district of Madhya Pradesh State. The Indian state of Madhya Pradesh includes Bhopal as one of its districts. Bhopal, the capital of the state, also serves as the district's administrative centre. Districts to the north of Bhopal's Guna district, to the northeast of Vidisha, to the east and south of Raisen, to the south and west of Sehore, and to the north of Rajgarh. The neighbourhood of Bhopal may be found in the city's southern half.

There is 1 area of **Bhopal** which are selected for this study:

Figure 4 Study area of Bhopal

1. Data analysis

The following chart comprises the responses of the respondents

Questions	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Driver safety measures					
Drivers are majorly responsible for the road safety of themselves and pedestrians	132	46	7	28	44
There are very less drivers who follow all the safety measures guided by the government and road safety department	122	42	31	5	57
The safety measures must be enhanced in order to prevent road accidents	127	26	54	29	21
Driver safety measures also depends on the design of the mid- block sections	62	79	51	56	9
Traffic conditions are mostly dependent on the drivers	116	64	66	11	0
Road accidents					
Rash driving is the major reason for road accidents, especially at urban mid-block sections under mixed traffic conditions	42	43	79	61	32
Vehicles collision mostly involves rash driving	101	68	47	15	26
If drivers follow all the traffic rules and norms, the ratio of road accidents will heavily fall	162	38	32	25	0
Road accidents can be avoided with better road signs for drivers	134	63	28	7	25
It is important to check the driving ability of the drives on yearly basis.	97	91	24	11	34
Driver's behaviour					
Drivers panic when you see a sudden entering of vehicle in front of them	81	74	50		52
Drivers react to minor collision with politeness and patience	91	48	78	26	14
Drivers keep a safe distance from other vehicles	105	94	52		6
Drivers keep an eye for the pedestrians and think about their safety	108	96	36	10	7
Drivers take the traffic rules and regulations seriously	91	65	34	40	27

Hypotheses testing

Hypothesis 1

H_{01}: There is no significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions

H_{a1}: There is a significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions

Table 1: Hypothesis 1

ANOVA					
ROAD ACCIDENTS					
	Sum of Squares	df	Mean Square	F	Significance Value
Between Groups	1252.436	9	139.160	99.508	.000
Within Groups	345.424	247	1.398		
Total	1597.860	256			

Interpretation: The hypothesis-1 of this study tested using one-way ANOVA and based on the results mentioned in the above table, it was interpreted that there is a significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions, since significance value<0.05.

Hypothesis 2

H_{02}: There is no significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions

H_{a2}: There is a significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions

Table 2: Hypothesis 2

ANOVA					
ROAD ACCIDENTS					
	Sum of Squares	df	Mean Square	F	Significance value
Between Groups	1352.323	11	122.938	122.670	.000
Within Groups	245.537	245	1.002		
Total	1597.860	256			

Interpretation: The hypothesis-2 of this study tested using one-way ANOVA and based on the results mentioned in the above table, it was interpreted from the there is a significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions, since significance value <0.05.

Area: The study area for this study is selected as Prabhat petrol pump road. This is a very busy road through out the day and thousands of drivers use it regularly.

Sampling size: There are 2,505,000 people living in Bhopal. Hence, a confidence level of 95% that an actual value is within ±5% of a measured or surveyed value requires 385 or more measurements/surveys.

Sampling unit: The drivers of Bhopal will be the sampling unit for this research work.

Hypotheses of the study

Hypothesis 1

H_{01}: There is no significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions

H_{a1}: There is a significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions

Hypothesis 2

H_{02}: There is no significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions

H_{a2}: There is a significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions

Conclusion

The driver's intent may be inferred from the driver's action, which is the extension of the driver's mental thinking. There has been a lot of research done on driver behaviour in the past. Head motion, eye-gaze dynamics, hand motion and gestures, body movements, and foot dynamics are all examples of typical driving behaviour. Several indicators of driving behaviour have been useful in estimating drowsiness, distraction, and focus behind the wheel. Accurate intention inference may be improved by learning more about drivers' actions linked to driving.

Based on the responses of 257 drivers, it was determined that both driving behaviour and safety measures have a significant influence in urban mid-block portions with mixed traffic. This study helped in understanding the behaviour of the drivers at different density of traffic.

Among all the respondents, 41.6% respondents were using 2 wheelers as their vehicle and 45.1% respondents were using 4 wheelers. More than 68% respondents stated that drivers are majorly responsible for the road safety of themselves and pedestrians. Half of the respondents stated that there are very less drivers who follow all the safety measures guided by the government and road safety department. It was also observed that 153 respondents, out of 257 respondents, agreed that safety measures must be enhanced in order to prevent road accidents. The study also revealed that most of the people think driver safety measures as dependent on the design of the mid- block sections. In addition, majority of the respondents stated that vehicles collision mostly involves rash driving. On the basis of the findings, it can be stated that driving ability of the drivers must be evaluated on yearly basis, as nearly 3 quarters of the interviewees agreed to this statement.

The major findings of the study include:

- There is a significant impact of driver safety measures on road accidents at urban mid-block sections under mixed traffic conditions
- There is a significant impact of driver's behaviour on road accidents at urban mid-block sections under mixed traffic conditions

Drivers are majorly responsible for the road safety of themselves and pedestrians. There are very less drivers who follow all the safety measures guided by the government and road safety department. The safety measures must be enhanced in order to prevent road accidents.

Suggestions

In addition to it, following suggestions should be followed and guidelines need to be implemented strictly to avoid accidents at mid-block sections.:

1. One Should develop the right attitude while driving, (in terms of skills & maturity).
2. The driver should make a commitment to himself/herself to practice a responsible attitude about driving.
3. Proper street lighting should be provided at every mid-block section.
4. Reflective pavement marking should be done at mid-block section in transverse direction and from time to time it should be painted it gets fade.
5. The driver's driving ability must be evaluated at every fix interval
6. There must be a speed limit sign board at every mib-block section.

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