Ilkogretim Online - Elementary Education Online, Year; Vol 20 (Issue 4): pp. 2407-2413
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.04.276

AN ATTEMPT TO ENHANCE THE UTILITY OF ZEBRA CROSSING TO MINIMIZE THE COLLISION AT INTERSECTION

PRATIK KUMAR SINHA, CIVIL ENGINEERING DEPARTMENT G H RAISONI COLLEGE OF ENGINEERING,NAGPUR
SUJESH D. GHODMARE, CIVIL ENGINEERING DEPARTMENT G H RAISONI COLLEGE OF ENGINEERING,NAGPUR
DR.B.V.KHODE, CIVIL ENGINEERING DEPARTMENT G H RAISONI COLLEGE OF ENGINEERING,NAGPUR

Abstract- A brief critical review and assessment of engineering modifications to the built environment that can reduce the risk of pedestrian injuries. In this paperreviewused the Transportation Research Information Services database to conduct a search for studies on engineering countermeasures documented in the scientific literature. This review classified countermeasures into 3 categories—speed control, separation of pedestrians from vehicles, and measures that increase the visibility and conspicuity of pedestrians. Also determined the measures and settings with the greatest potential for collision at intersection/ crash prevention.

Keywords: Pedestrian, Road crossings, Road transport authority

I. INTRODUCTION

Walking is a key non-motorized mode of transport used by pedestrians that connects different components of a multimodal transport network and interfaces with external activity areas. The pedestrian is often the most vulnerable road user of all transportation networks users, and frequently, the most overlooked. Traffic accidents involving pedestrians have become a major safety problem in most of the developing countries like India due to rapid urbanization, increase in vehicular growth and lack of adherence to traffic regulations by both drivers and pedestrians. Moreover, traffic is also mixed in nature encompassing vehicles with wide ranging static and dynamic characteristics. All these vehicles move on the same road space occupying any position on the road space based on the availability of free space without complying with any lane discipline. Pedestrians also sharing the same road space which results in severe conflicts with vehicles. In addition to that, in the existing road network designs, footpaths, approaches to bus stops, bus priority lanes, continuous pedestrian paths, lane for slow vehicles like bicycles and rickshaws, etc., have not been included. This often leads to unsafe conditions for pedestrians and slow moving vehicles, and congested conditions for motorized vehicles. As per National crime records bureau, 12,385 pedestrian deaths were reported for the year 2013 in India [1]. More than half of injured and killed pedestrians were young men in the age group of 16–45. At intersections, the complexity of interactions between pedestrian and vehicular traffic is severe. Such conditions are very common on urban roads of medium sized cities in developing countries like India.

The behavior of pedestrians under mixed traffic conditions especially in India is comparatively different from that of other countries. In developed countries, traffic and pedestrian movements are controlled based on certain priorities at uncontrolled intersections whereas in India rules of priority are not fully respected. Even though proper control measures like signals are provided at uncontrolled intersection, pedestrians tentatively decline to use the signals and avoid using pedestrian crossing locations which affect the pedestrian as well as the traffic stream characteristics adversely. In most of the signalized intersections in India, no exclusive phase is provided for pedestrian movement and they generally cross the intersection during the red phase provided for vehicles.

Hence, it is clear that pedestrian safety is the major concern of transport planners, traffic engineers and policy makers in India. In India, little attention has been devoted to study pedestrian road crossing behavior and pedestrian flow characteristics, and model them. Moreover, there are only limited studies which focus on the pedestrian road crossing behavior at un-controlled intersection under mixed traffic conditions. Hence, the present study focuses on the road crossing behavior of pedestrians at un-controlled intersection in mixed traffic conditions with the following specific objectives:

1.To identify the different types of crossing patterns of pedestrians at the intersection before and after installation of traffic signal.

2.To analyze and compare the waiting times and crossing speeds of pedestrians with respect to age, gender and crossing patterns before and after signal installation.

3.To develop a multiple linear regression model for the pedestrian gap acceptance by considering pedestrian and traffic characteristics.

To investigate these objectives, traffic and pedestrian data including the pedestrian demographic characteristics were collected from an intersection before and after installation of signal in Mangalore city, India. To achieve the first objective, video data was processed in an image processing software and type of pedestrian movements were noted by visual observation. For the second objective, waiting times, crossing speeds, age, gender and crossing pattern of pedestrians were extracted from the videos before and after installation of signal. Crossing speeds of different pedestrians were compared based on the age, gender and crossing pattern of the pedestrians. For the last objective, a model for the pedestrian gap acceptance was developed by incorporating pedestrian accepted gap size as the dependent variable and age, gender and crossing pattern of pedestrians, traffic volume, types and speeds of vehicles as the independent variables.

II. LITERATURE REVIEW

GowriAsaithambi: Traffic accidents involving pedestrians have become a major safety problem in most of the developing countries like India due to rapid urbanization, increase in vehicular growth and lack of adherence to traffic regulations by both drivers and pedestrians. The existing roads design does not provide adequate facilities for pedestrians and hence, there exists a constant conflict between the pedestrians and the vehicles in sharing the limited space available on a road. At intersections, pedestrian crossing behavior is even more complex since the vehicles have very little response time to control the vehicles, particularly in urban areas. All these issues are pointing towards the research work required for studying the road crossing behavior of pedestrians at urban intersections. The main motivation of this study is to investigate the changes in pedestrian road crossing behavior of an intersection under mixed traffic conditions before and after signal installation. For this purpose, traffic and pedestrian data were collected from an intersection located in Mangalore city. Different parameters like age, gender, crossing patterns, crossing times, waiting times and crossing speeds of pedestrians, speed and types of vehicles and vehicular flows were extracted from the videos. The study analysis shows that majority of the pedestrians chooses one-step crossing after signal installation since they get sufficient gap to cross the road during the red phase of the signal provided for vehicles. The waiting times of the pedestrians were increased after installation of the signal since pedestrians have to wait for gaps until the vehicles get dissipated during the green phase. The 15th percentile crossing speed of pedestrians for both the scenarios were lesser than the crossing speed (1.2 m/s) used in pedestrian facility design as per Indian Road Congress (IRC 103). Critical gap of pedestrians has reduced marginally due to the decrease in crossing speeds of pedestrians after installation of the signal. A model was developed considering pedestrian gap size as the dependent variable and pedestrian and traffic characteristics as the independent variables using multiple linear regression (MLR) technique. A total of 468 and 333 accepted gaps of pedestrians were used for modeling the before and after scenarios, respectively. It was found that pedestrian jaywalking behavior is reduced after installation of the signal. The study concludes that after signal installation the factors such as traffic volume, average speed of vehicles and age-group play a predominant role in estimating the pedestrian gap acceptance. This study will be useful for understanding the complex pedestrian road crossing behavior at intersections under mixed traffic conditions. The findings of this paper have great implications for designing pedestrian facilities and also, for devising traffic management measures for pedestrian safety.

ShahriorPervaz: Pedestrian accidents are a serious and growing problem in the cities of developing countries, especially in Dhaka, the capital of Bangladesh. Poor planning of road networks, poor traffic control and management at intersections, inadequate pedestrian facilities and the severe lack of priority and attention given to the pedestrians are the main causes of such dangerous situation. Particular concern is the urban intersections, specifically the signalized ones that have been identified as among the most hazardous locations on the roads which account for a substantial portion of traffic accidents (Helai, Chor&Haque, 2008). Study shows that out of more than thirty six hundred accidents in Dhaka city nearly 63% occurred at non-intersection areas whereas 37% at intersections from 2007-2014 in Dhaka metropolitan city (ARI, 2014). Pedestrian accidents (58%) dominated total accidents occurred during this period. The heterogeneity of traffic, inadequate crossing facilities, plying of modes with varying speed and

maneuvering time make the intersections even more complex. Field study also indicates that nearly 65% of total intersections in Dhaka city have Pedestrian Traffic Signal (PTS) whereas nearly 15% have no pedestrian control devices. Due to the Ineffective PTS and faded crossing marking, pedestrian's risk at intersections is increasing. This paper aims to provide a broad overview of pedestrian safety facilities at intersections in Dhaka city. Analyzing the survey data, it has attempted to shed some light on the major causes and factors of pedestrian accidents and also suggested appropriate safety measures to reduce the accidents and enhance crossing facilities at the intersections.

AjjimaSoathong: Vulnerable road users contribute to nearly half of road deaths globally. In New Zealand, this group accounts for 26% of road deaths, which includes 8% of pedestrian crashes. This paper provides a critical review of the road safety policies from the pedestrian's viewpoint for some of the best performing countries and discusses their effectiveness for the future. A case study is conducted for New Zealand to identify factors contributing to the pedestrian crashes and investigate the impact of the road safety policies on pedestrian crash trends. The policies are predominantly well informed by evidence-based approaches contributing to an overall reduction in the number of road crashes. However, little attention has been paid on pedestrian behaviourrelated to crashes. Finally, the paper makes recommendations for improving pedestrian safety to enable better safety outcomes that are closer to vision zero.

W. CZAJEWSKI , P. DĄBKOWSKI, P. OLSZEWSKI: Many pedestrians in Poland are killed or injured while crossing the road. this paper gives an overview of innovative solutions aimed at improving safety of pedestrian crossings: automatic pedestrian detection, dynamic Traffic signs and better lighting systems. Among the pedestrian detection systems, video technology with image analysis seems to be the most promising solution for the future – its problems, recent developments and advantages are presented. Pedestrian detectors are already utilized by dynamic traffic signs which include pulsating lights mounted on "pedestrian crossing" signs, activated when pedestrians waiting to cross are detected.

DonghoKa: One of the most widely used advanced driver assistance systems (ADAS) for preventing pedestrian–vehicle collisions is the intersection collision warning system (ICWS). Most previous ICWSs have been implemented with in-vehicle distance sensors, such as radar and lidar. However, the existing ICWSs show some weaknesses in alerting drivers at intersections because of limited detection range and field-of-view. Furthermore, these ICWSs have difficulties in identifying the pedestrian's crossing intention because the distance sensors cannot capture pedestrian characteristics such as age, gender, and head orientation. To alleviate these defects, this study proposes a novel framework for vision sensor-based ICWS under a cloud-based communication environment, which is called the intersection pedestrian collision warning system (IPCWS). The IPCWS gives a collision warning to drivers approaching an intersection by predicting the pedestrian's crossing intention based on various machine learning models. With real traffic data extracted by image processing in the IPCWS, a comparison study is con-ducted to evaluate the performance of the IPCWS in relation to warning timing. The comparison study demonstrates that the IPCWS shows better performance than conventional ICWSs. This result suggests that the proposed system has a great potential for preventing pedestrian–vehicle collisions by capturing the pedestrian's crossing intention.

Tibbalds (2001) states that the public realm is the most important part of towns and cities. According to him, some essential features of a people-friendly environment are pedestrian scale of design, individuality, variety and complexity of uses and activities, a pedestrian network consisting of streets, squares, public footpaths, parks and open spaces and extending also to riversides and seafronts, accessibility, quality of urban design, safety, comfort, permeability, psychological comfort, convenience and legibility.

Brambilla and Longo : Identify convenience, security, comfort and safety, as the parameters that are essential for a pedestrianfriendly environment. In Personal Space, Robert Sommer (1969) states that, the two important goals of a design program, are variety and flexibility. Ritter (1964) writes that a few elements like pedestrian-scale design, convenience and comfort are essential for a pedestrian-friendly environment. In Social Life of Small Urban Spaces, William H. Whyte (1980) lists out security, variety of activities, well-defined details and provision of Shops and eateries as the important components of a pedestrian space.

Kunstler: The Geography of Nowhere, provides a scathing critique of vehicle-friendly streets. According to him, the important elements of a pedestrian-oriented street are comfort, safety and visual image. Jacobs, in Great Streets, explains that the best streets are memorable; they help to create a sense of

community and history, and provide a space for urban public life. According to him, the qualities of a good pedestrian environment are enclosure/definition, complexity of path network, building articulation, complexity of spaces, transparency, buffer, shade trees, overhangs/awnings/ varied roof lines and physical components/condition .

Kouabenan (2002) has shown that there is significant relationship between the knowledge of risk perception and road accidents. Experienced drivers have high risk perception as compared to less experienced drivers. Ma et al. (2008) have found that risk perception significantly indirectly affects risky driving behavior. There is significant effect of risk perception and risk taking attitude on risky driving behaviour.

Ponnaluri (2011) analyzed that there is negative relationship between risk perception and risk taking behaviour. Rosenbloom et al. (2008) have described that high level of risk perception is perceived by drivers after the training as compared to before training. Female and adult drivers have high level of risk perception as compared to male and novice drivers. There is insignificant effect of age and driving experience on perceived risk.

Hoare (2007) has described that driving behaviour is affected by different variables such as optimism bias, age differences, cross-cultural difference gender differences, driving experience, exposure, and seatbelt usage. It is also identified that dimensions of risk perception is significantly influenced by driving behaviour, optimism bias, age differences, driving experience and exposure.

Naing et al. (2008) have observed that there are three level of driving tasks such as human, vehicle and environment. At human level, there are many factors which are associated with driving task such as loss of consciousness, acute medical condition, falling asleep, inattention, distraction, cell phone use, emotion, careless, mood and aggressive driving. The vehicle level includes high frequency driving tasks such as speed, acute technical failure and tire burst. The environment level driving tasks includes traffic density, traffic flow, slippery road conditions, temporary problems and adverse weather conditions. It is found that 64.6 per cent road accidents occur due to lack of vigilance.

Tahir et al. (2012) have described that 25 percent of road traffic accidents cases occur due to carelessness and 22 percent due to driving vehicle on wrong side. 45 percent cases of road traffic accident occur with motorcycle, 34 percent with cars, and 2 percent with trucks and 1percent with bus. Zegeer et al. (2012) have analyzed that most of road accidents occur due to poor traffic law of enforcement. O.G. et al. (2009) have found that road accidents occur due to old age; overtaking, and poor maintenance of vehicles. Driving after drinking and breaking the speed limits are causes of road accidents. Sundstrom et al. (2012) have analyzed that there is significant difference among ambulance drivers' performance regarding overtaking. Bener et al. (2005) have identified that most of drivers do not follow the traffic rules while driving.

Banik et al. (2011) have shown that drivers' behaviour is responsible for increase in number of road accidents due to exceeding the capability of driving and overtaking. Hassen et al. (2011) have identified that 66 per cent of road traffic accidents occur due to overtaking and overloading. **Afukaar et al. (2003)**, Vanlaar and Yannis (2006) and Brookland et al. (2010) have observed that speeding is responsible to increase 50 per cent of road traffic injuries. Yao and Wu (2011) have identified that driving vehicle on wrong side is associated with road accidents.

Silas et al. (2011) have observed that poor road conditions and maintenance, and culture are contributory factors in road accident deaths. Atubi et al. (2012) have identified that the length of roads, presence of road safety corps and population significantly influence road traffic accidents. Road traffic accidents significantly increase with increase in length of roads (km). Large area is likely to be involved in greater number of accident than small area due to higher traffic volumes.

Sliupas (2009) has demonstrated that most of road accidents occur due to vehicle breakdown. The lengths of road section, average daily traffic and road barriers are strongly associated with road accidents. Kircher and Andersson (2013) have pointed that 40 percent of trucks do not have any seat belts installed. Most of truck drivers do not take proper rest after long drive. Tahir et al. (2012) have described that speeding, carelessness, and wrong side driving are significantly associated with road accidents. 25 per cent of road accidents occur due to careless driving and 22 per cent due to driving on wrong side. 45 percent cases of road accidents are associated with motorcycle, 34 percent with cars, 2 percent with trucks, and 1 percent with buses. Lee et al. (2011) have observed that there is significant difference between male and female drivers regarding use of mobile phone. 36 percent of male drivers use mobile

phone as compared to 30 percent female drivers while driving. 48 percent of young drivers use mobile phone during driving as compared to 30 percent old drivers. Roehler et al. (2013) have observed that most of drivers and passengers do not wear the helmet while driving. Some drivers feel uncomfortable after wearing the helmet.

Lee et al. (2011) have found that 95 percent of road traffic deaths can be reduced by using seat belts by drivers and passengers. Most of drivers do not use seat belt during driving. 91 percent of car drivers wear seat belt while driving. 12 per cent of drivers feel discomfort and do not find it necessary to wear seat belt during driving. There is significant difference between male and female drivers to wear seat belt. 47 percent of male drivers wear seat belt as compared to 38 percent female drivers. Male drivers say that people should be free to choose whether to wear seat belt or not as compared to female drivers. It is also identified that 67 percent of young drivers do not wear seat belt while driving.

Hassen et al. (2011) have defined that most of drivers use mobile phone while driving. There are three elements of drivers' attitude as feeling, thought and behaviour. Behaviour can be measured by drivers' reaction in certain situation. Petridou and Moustaki (2002) have identified that there are many factors such as drowsiness, fatigue, eating, acute stress and acute alcohol, intoxication and temporary distraction affect drivers' performance.

McEvoy et al. (2006) have observed that risk of crash increase with use of mobile phone. Drivers are more likely to be injured in road accidents due to using mobile phone while driving. **Mangiaracina and Palumbo (2007)** have described that smoking is more likely to be the cause of road accidents than using mobile phone while driving.

Bamberg et al. (2003) have described that risk perception is negatively correlated with risktaking behaviors. High risk perception of drivers shows low probability of taking part in that behavior.

Ying et al. (2010) have found that novice and inexperienced drivers are involved in risky driving and talking on a cellular phone in some situations. Cellular phone tasks significantly decrease driving performance for both novice and experienced drivers. Experienced drivers are more benefitted from training as compared to novice drivers.

Klauer et al. (2006) have observed that 22 percent of crashes occur due to tasks distractions. Dialing a hand-held cellular phone increases the risk of crash or near crash by 2.8 times, and talking on a handheld device increases risk by 1.3 times. Sabey and Taylor (1980) described that human factors contribute 95 percent in road accidents. Driving behavior is the most important human factor in road accident. Driver, vehicle and environment factors play an important role in road accidents.

Hijar et al. (2003) has described that male drivers are 2.6 times more likely to suffer from road traffic injury than female drivers. Drivers in age groups 21 to 25 years take more risk while driving. Mayhew and Simpson (1995) have described that proportion of old drivers are more involved in road accident at intersections when entering traffic or crossing a main road.

Teye-Kwadjo (2011) has found that road drivers' behaviour and motor vehicles are influenced by key factors such as physical and social environments. Poor roadway lighting affects visibility of pedestrians. Weather conditions such as winter/snow make roads challenging. The values, culture and religious beliefs in the social environment affect road user behaviour. Road accidents are considered just punishments of God. It is also found that drivers' characteristics and environmental/situational factors increase road accidents. Different factors included in drivers' characteristics are poor traffic risk perception, fatalism, aggressive driving, feelings of invulnerability, inadequate driver training, and risk-taking tendency. The situational factors such as bad road infrastructure and equipment, nature and bad condition of passenger-carrying vehicles, and ineffective traffic law enforcement increase road accidents.

Naing et al. (2008) have highlighted that lack of attention increases road accidents. Three types of attention are identified such as inattention, distraction and competition for attention. Variables included in inattention are lost in thought, distraction due to using mobile phone and third is related to focusing on driving task like searching for road signs.

Waylen and McKenna (2002) have identified that there is significant difference between male and female drivers regarding distraction. Male drivers are more likely to be involved in road accident on turning point, during night and overtaking as compared to female drivers. It is also found that female drivers are more involved in road accidents at intersection as compared to male drivers.

Lajunen et al. (2003) have described that most of road accidents are committed by young drivers due to excessive speed of vehicle. Young drivers do not have the fear of loss of life. Most of road accidents occur under the 25 years age. Excessive and inappropriate speeds have been identified as the greatest contributing factor in single vehicle accident for young drivers.

Campbell and Stradling (2003) have found that the highest proportion of drivers in age groups of 21 to 29 years violate speed limit. Male drivers in the age groups of 16 to 25 years have been identified to drive at very high speed. Speeding is common behaviour in young drivers. Fildes and **Leening (1991)** found that speed choice is influenced by road width and number of lanes. Drivers prefer high speeds on wide roads, multiple lanes, and clear road markers.

Young et al. (2008) described that aged drivers are more likely to be injured than younger drivers in a road accident. Higher crash rate occurs with aged drivers due to poor visual, tiredness and poor body activeness. Beck et al. (2002) have found that young drivers are more likely to be involved in road accident as compared to older drivers. Young drivers are more involved in crashes from fatality to property damage. They have limited driving experience and immaturity and take more risk and overestimate their driving skill.

III. RESEARCH GAP

The extensive literature review has been done to highlight drivers' behaviour towards road accidents. The study is designed to fill the research gap. But it was hard to find studies based on drivers' behaviour. After literature review, it is found that most of studies are based on secondary data. A single study has not been found related to drivers' behaviour in India. Adequate numbers of studies are not available related to drivers' perception of risk and driving tasks. Many programs regarding road safety are organized by government to aware public but these programs have failed due to low education of public and poor enforcement of law. No study has been found that establish relationship between drivers' perception of risk and driving tasks and safety attitude. To fill that gap in literature the presents entitled "A study of road safety behaviour in Haryana" is conducted.

IV. CONCLUSION

Beginning with the positive findings; although the Government has started adopting measures to make disaster management more result oriented and capable to cope-up with any unexpected incident. It is observed that hazard, vulnerability and risk assessment do not matched with the resource availability. At present no mechanism is available for synchronization, communication and support as pointed by the charter. India is a victim of an unfortunate legacy of a lack of investment in equipment, training and resources. Presently, the Government structures have been devised such that the Road Safety is not dovetailed into Disaster Management and functionally these two aspects are being dealt with in watertight compartments. It is essential to establish a unified regime of both these functions. The problem of quality and standardization is another area where the DM and Traffic Management appear to fall short of the standards in vogue at international levels. The Law Enforcement agencies are reluctant to implement the standards, may be due to lack of resources and overburdening in performance of the tasks. This became evident through the questionnaire. The level of ethics also seems low at the disaster incident and accident time as fraud and corruption seem evident. The vehicle, road and driver related findings are exclusively applicable for road safety only.

REFERENCES

1. Traffic Safety Facts 2001. Washington, DC: National Highway Traffic Safety Administration; 2002.
2. National Electronic Injury Surveillance System—All Injury Program Operated by the US Consumer Product Safety Commission. Atlanta, Ga: National Center for Injury Prevention and Control; 2002.
3. Insurance Institute for Highway Safety. Fatality facts 2001: pedestrians. Available at: http://www.hwysafety.org/safety_facts/fatality_facts/pedestrians.pdf. Accessed January 31, 2003.

4. Knoblauch R, Nitzburg M, Dewar R, Templer J, Pietrucha M. Older Pedestrian Characteristics for Use in Highway Design. Washington, DC: US Dept of Transportation; 1995. DOT publication FHWA-RD-93-177.

5. McCarroll JR, Braunstein PW, Cooper W, et al. Fatal pedestrian automotive accidents. JAMA. 1962;180:127–133. [Google Scholar]

6. Curtin D, Syner J, Vegega M. Alcohol involvement in pedestrian fatalities—United States, 1982–1992. MMWR Morb Mortal Wkly Rep. 1993;42:716–719. [PubMed] [Google Scholar]

7. Vestrup JA, Reid JDS. A profile of urban adult pedestrian trauma. J Trauma. 1989;29:741–745. [PubMed] [Google Scholar]

8. Hobbs A. Safer Car Fronts for Pedestrians and Cyclists. Brussels, Belgium: European Transport Safety Council; 2001.

9. Vehicle Designs Affect the Harm That's Inflicted on Pedestrians. Arlington, Va: Insurance Institute for Highway Safety; 1999:4–5. Status report 34/3.

10. O'Neill B, Mohan D, Breen J, et al. Commentary on the World Bank's Global Road Safety Partnership. Traffic Inj Prev. 2002;3:190–194. [Google Scholar]