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Pedestrian Safety and Travel Behavior

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Abstract

Due to urbanization, increased automobile growth, and lack of attention by drivers as well as pedestrians to the traffic regulations, traffic collisions affecting pedestrians, which have now become a serious safety issue in many developed nations such as India. The established road design does not have sufficient pedestrian facilities and thus there is a constant dispute between automobiles and pedestrians over sharing the limited space on a road. This often contributes to a dangerous situation and overcrowded traffic conditions for the slow speed vehicles and pedestrians. Although adequate control systems including signals are given at unregulated crossings, but still most of the pedestrians do not use the signals and tend to avoid pedestrian crossing areas that adversely impact the characteristics of the flow of traffic and the movement of road users. The objective of this research is to bring out the factors related to pedestrian accidents, characteristics of pedestrian behaviors, their crossing patterns, and also focusing on pedestrian safety with the use of infrastructure and vehicle technologies.

Keywords: Pedestrian Safety, Pedestrian Behaviour, Platooning Behavior, Pedestrian Crossing Pattern, Safe system Approach

1. Introduction

Walking is considered as a predominant non-motorized form of transportation utilized by pedestrians linking different elements of a multi-modal transportation network and communicates with outside operational areas. Of all transport network users, the pedestrian is the most insecure road user, and often the most overlooked. Traffic is frequently mixed in nature and involves vehicles with large technologies. These vehicles move within the same road space, taking every position on the road depending on the availability of area or space without compliance with any lane discipline. Pedestrian sometimes share the same area on the road that contributes to serious vehicle conflicts. Additionally, the current road network did not include designs, footpaths, bus stop approaches, uninterrupted pedestrian paths, a lane for slow-moving vehicles, and lanes for bus priority. This also is the cause of unsafe situations and congested motor traffic situations for slow-moving vehicles and pedestrians. Although adequate control systems including signals are given at unregulated crossings, still most of the pedestrians do not use the signals and tend to avoid pedestrian crossing areas that adversely impact the characteristics of the flow of traffic and the movement of road users. There is no exclusive system or phase for the movement of a pedestrian at most of India's signalized intersections; moreover, they usually traverse the intersection during the red phase given to automobiles. Therefore, the safety of pedestrians is a major problem.

2. Pedestrian Crossing Behavior

Two separate patterns may describe pedestrian crossing actions at crosswalks. One of which describes pedestrian behaviors as part of a large group named platooning behaviors while standing on the curb or during crossing the road and the

second model was concerned with the individual movement of pedestrians. (Huseyin Onur Tezcan, 2019) [1]

2.1 Platooning or Grouping behavior

It is a community or a group of pedestrians walking on the sidewalk and crossing the road together in cases due to factors such as traffic signals, the layout of the road, etc. A thorough study of platooned pedestrians showed three dominant behaviors: (a) Leave/Quit and Go (LaG): the pedestrian stood on the sidewalk in a group but then crossed the street all alone; (b) Join/Meet and G o (JaG): the pedestrian stood alone on the sidewalk but crossed the street in a group; (c) Wait/Stay and Go (WaG): the pedestrian stood in a group at the curb and crossed the path in a group as well. In the case of JaG, the grouping often happens during the crossing, although there was still grouping curbside for LaG and WaG. People are either accompanied by others to create a platoon or a group at the sidewalk or otherwise, they arrive at the pavements in a group where those who might or may not already be waiting (Huseyin Onur Tezcan 2019) [1]

2.2 Individual Behavior

Observed actions of the various pedestrians when they navigate the path is a human action. Though crossing in platoons is easier, in general, individuals will not willingly join them unless they ride with someone they meet. Because of vehicular traffic, particularly the sidewalk platoons are formed and this structure is irrelevant because group activity does not often contribute to crucial decisions. However, the actions of individual crossings clearly showed a propensity while alone to pay more concern to the traffic. (Huseyin Onur Tezcan 2019)[1]

3. Crossing Pattern of Pedestrian

Two types of significant crossing trends have been studied, such as single-step in which the pedestrians cross the road without stopping in the center and the other is two-step crossing in which pedestrians cross at once up to the center and afterward cross the other side. Based on findings, the patterns are subdivided across three types- perpendicular, oblique, and combined crossing. In which a pedestrian traverse through the road along a straight line, it's called perpendicular crossings. Oblique crossing is the one where pedestrians traverse the road along with zig-zag patterns. Combined crossings are the mix of both forms of crossings - perpendicular and oblique. (Gowri Asaithambi 2016) [2]

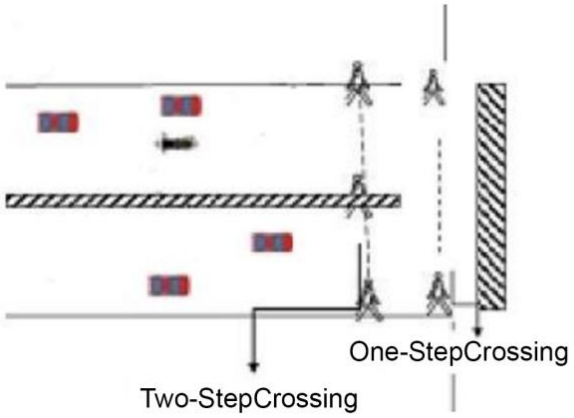

Fig.1. Single and two step crossing
(Gowri Asaithambi 2016) [2]

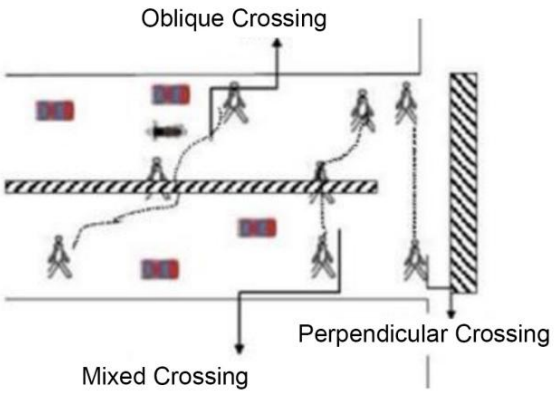

Fig.2. Sub-classification of sequence crossing
(Gowri Asaithambi 2016) [2]

4. Pedestrian Fatalities

Pedestrians account for 22% of all traffic fatalities worldwide, and in certain nations, that percentage is almost large as two-thirds. In traffic accidents, lakhs of users get wounded while walking, some of them becoming permanently impaired. These events lead to immense suffering and sorrow for families and loved ones as well as economic hardship. Around 1.32 million pedestrians risk their lives on roads around the world each year. Globally, pedestrian accidents are the eighth leading cause of death for all age group and 50million pedestrian injuries occur every year.

(WHO 2011) [3]

Every year about one fifth of the total people who died on roads were not driving a vehicle, or two-wheeler or cycle, rather they are pedestrians. Pedestrian accidents are the leading cause of death for children and young adults of aged 5-29years. On an average 46 children lose their life on Indian roads every day. (WHO 2011)[3]

Accidents and injuring in which pedestrians are involved is usually avoidable and there are established remedies, but pedestrian safety at many locations does not gain the attention it needs. The key risks to pedestrians involve problems pertaining to a number of factors such as behavior of driver especially in terms of speed and even drunk drinking, services with lack of dedicated infrastructure for the road users, which includes- pavements, intersections, raised dividers or medians and the design of different vehicles. (Loreta Levulyte 2016) [4]

4.1 Major Causes for Pedestrian Accidents

High vehicular speed, consumption of alcohol while driving, lack of pedestrian safety facilities and insufficient pedestrian visibility are key major causes for pedestrian injuries. Some of the causes that contribute to pedestrian accidents include: careless driving, attention of the driver, driving while using a cellphone, driver tension, vehicle-pedestrian collision at the pedestrian crossing locations, decreased response times, low moving speeds of people, the lack of ability of youngsters to determine the speed of vehicles, lack of pedestrian disturbance including cell phone usage, driver and pedestrian behavior, poor implementation of traffic laws, the inability of commuters to obey the space and width of pedestrian crossings as well as other related information of safely crossing the road alone. The threat of pedestrian accident is increased by a variety of factors relevant to the road environment, such as- high vehicular speed, insufficient crossing services, vehicle gaps while passing, insufficient distance from vehicles, number of lanes to cross, low sight distance while crossings, difficulty and unpredictability of traffic patterns at the intersection. (Papadimitrioua 2016)[5]

5. Vehicle Pedestrian Accidents

As a consequence of increasing urbanization, rapid growth of vehicles, lack of enforcement by both pedestrians and drivers with traffic laws, traffic collision including pedestrians have become an significant safety issue for most developing nations such as India. The road design that has been developed does not have adequate pedestrian infrastructure and thus there is a persistent conflict between vehicles and pedestrians over occupying the space available on a lane. Crossing behavior of pedestrians is much more complicated at intersections as drivers have hardly any response time to regulate pedestrians, especially at intersections in most of the urban settings. In a variety of cases, there are accidents between pedestrians and vehicles, including: walking into a vehicle's path, particularly when attempting to cross a lane, walking while boarding or leaving public transport vehicles and also while walking along the roadside. Road traffic collisions affecting pedestrians result from many reasons, involving social and environmental conditions, most sometimes attributable to pedestrian mistakes. Pedestrian accidents can occur due to both wrong driver behavior and pedestrian behavioral errors. (Loreta Levulyte 2016)[4]

6. Vehicle and Transport Technology

Safety system for vehicles include- passive and active protection in automobiles, which play a significant part in reducing the number of pedestrian accidents. For such cases where crashes cannot be avoided, successful in-vehicle technologies can reduce impact severity and tries to make some kind of safety for the pedestrian. Infrastructure has had a major influence on pedestrian health. To avoid or mitigate such collision, devices with Autonomous Emergency Breaking had come up which use lasers and video cameras in different forms that activate the brakes and automatically apply them when an upcoming collision is sensed. Modern technologies are able to detect moveable pedestrians and bicycles in the path or perimeter of the vehicle. This form of device will alert the user, will apply breaks or will do both the functions. Systems like Intelligent Speed Assistance can enhance the protection of pedestrians and cyclists by improving compliance with speeds. (Loreta Levulyte 2016)[4]. According to vehicle ad-hoc network (VANET) which provide a compelling way to accomplish the target of pedestrian-vehicle collision prevention by utilizing the framework of VANET community:

- By using a vehicle-to-vehicle technology: Cars connect either directly with other cars or by intermediary vehicles.

- By using a vehicle to infrastructure technology: Signals are conveyed between vehicles and roadside systems situated at the highway and arterial intersections.

- By using vehicle mobiles/ special devices: Signals are conveyed among pedestrians and vehicles by sending and receiving signals on their mobiles. (Loreta Levulyte 2016)[4]

7. Traffic Safety of Pedestrians

The primary concern is the safety of sensitive road users or pedestrians. While reforms to road safety are increasingly enforced, road injuries and their effects remain a significant social concern. Several countries have adopted and prioritized strategies to promote active mobility and enhancing pedestrian and bicycle safety. The major driver mistakes at the pedestrian crossings are speed and also not offer priority to the pedestrians as shown in Fig3. Whenever it comes to deaths in which pedestrians were misunderstood, leading to the dangerous crossing of the lane, an overwhelming majority (67%) of the accidents occurred. Further violations are committed by pedestrians to include breaking a red light (13%) and passing in restricted areas (13%), stated in Fig4. (Mako 20116)[6]

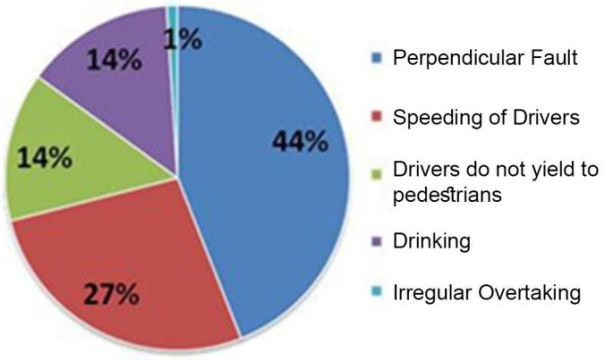

Fig.3. Major factors of pedestrian deaths where drivers are liable, at marked crosswalk

The strategy of a safe system addresses risk factors and strategies related to pedestrians, vehicles, and road infrastructure in an integrated manner, making for more efficient preventive steps. In many situations around the regions, this strategy has been seen to be acceptable and successful, in several instances promoting improvements in road safety where more improvement has emerged to be a major challenge. It also recognizes that transport is vital to the community and supports the principle that movement should be secure for pedestrians and other road users as they work and encourage communication through roads and automobiles.

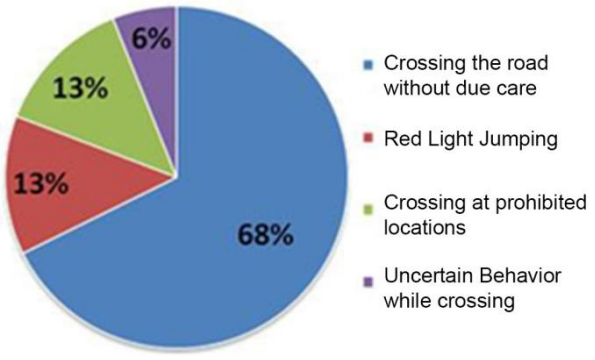

Fig.4. Major factors of pedestrian deaths where pedestrians are responsible, at marked crosswalk

The system focuses on eradicating tragic incidents and mitigating severe injuries by developing a stable transportation network that neglects human error and takes individuals' sensibility to severe injury into consideration. It is accomplished by a legislative focus on road networks, vehicles, and speed, accompanied by a range of programs relating to educational, behavioral reform, legislation, compliance, and penalties activities. (Loreta Levulyte 2016)[4]

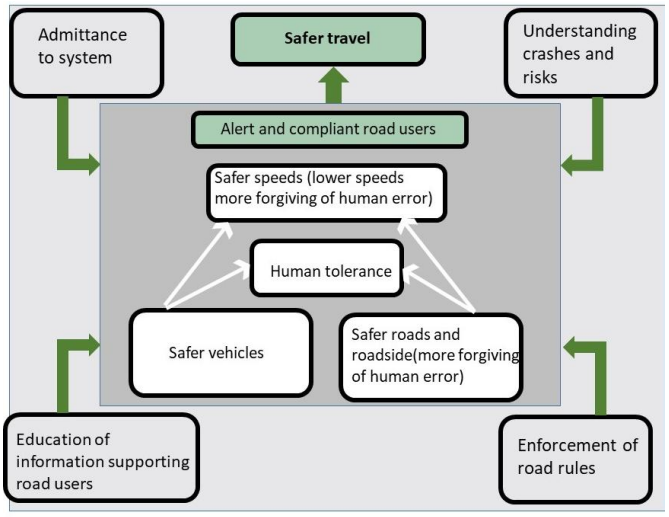

Fig.5. Ambitious road safety targets and the Safe System approach

This system has some major elements for pedestrian safety:

• Human fault detection in the transport network:

Most of the accidents and deaths are often lead by people who make faults. The approach of a safe system does not neglect the behavior or actions of the road users, but it focuses that action is only one of the factors required to improve road safety.

• Acceptance and limitations of physical human susceptibility:

Severe injuries or deaths could occur as humans have a restricted acceptance to direct action.

• System accountability by promotion:

Concerns related to traffic safety should be communicated by various road users as well as network designers. These users are required to abide by traffic laws and regulations, network designers and operators must create a transport infrastructure that is as secure as practicable for passengers.

• Promoting legal principles related to traffic safety

The main principle behind the solution of the safety approach is that any degree of significant harm occurring from the road transport system is not acceptable. People will tend to act more responsibly, but often mistakes may naturally occur. Mistakes may cause accidents but accidents and serious injuries are not unavoidable outcomes.

• Encouraging social standards

Besides securing safety, it is anticipated that the road transport network would lead to overall social values, especially in three areas – economic growth, individual choice, and human and environmental health. As a structure for pedestrian safety, the safe system approach has the following advantages:

• Examination of a range of harmful causes

The system shifts pedestrian safety studies aside from concentrating primarily on a single or several harmful causes.

• Incorporation of extensive action

The safety approach focuses on requiring special attention to the design of vehicles, road engineering, traffic rules like speed limit, and implementation of traffic rules and regulations. A limited emphasis on a particular issue is less successful than a holistic approach to the various aspects involved in pedestrian safety.

• Assimilation of lessons learned.

When countries are seeing growing numbers of motor vehicles, enhancements to both pedestrian and automobile facilities are required, rather than simply relying on pedestrian actions as the primary factor affecting pedestrian safety. A typical characteristic of low and middle-income nations is that traffic conditions is of mixed nature where pedestrians, cars, and cyclists share the same road area, with little to no designated infrastructural amenities for pedestrians.

• Partner Association

The safety of pedestrians is a major challenge that needs a detailed understanding of factors, effects, and strategies while analyzing them. Although different organizations might be responsible for particular elements of pedestrian safety, the fact is that a unified approach including coordination among decision-makers, policymakers, scholars, government leaders, democratic institutions and the community is very essential to enhance pedestrian safety, particularly in developing nations. Cooperation between diverse organizations and industries is a pillar of the safe system approach. (WHO 2011)[3]

Conclusions

With rapid urbanization, the traffic in India has increased many folds in the last decade. This sudden increase has become a source of concern as accidents involving pedestrians have also increased due to a lack of traffic rules and regulations. The existing road network does not include footpaths, continuous pedestrian lanes, slow vehicle lanes, bus priority lanes, etc. This creates complexities as both pedestrians and vehicles have to share very limited space. This leads to dangerous conditions for both pedestrians and vehicle drivers. Speeding, not giving pedestrian priority, the reckless crossing of the road by pedestrians are some of the main reasons behind these accidents. Vehicle safety technology plays a crucial role in reducing the number of pedestrian collisions. Autonomous Emergency Braking and Intelligent Speed Assistance (ISA) can minimize or prevent collisions. These technologies should be brought into use for the safety of pedestrians.

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