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Autopsy Study Pattern of Pedestrian Injuries in Road Traffic Accidents

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Research Article

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Abstract: India is one of the developing Asian countries having wide network of transport system. Due to migration of population to Ur ban area, Road Traffic Accidents (RTAs) are increasing every year compare to other countries. The objectives of this study were to determine the pattern of pedestrian injuries in traffic accidents that presented for autopsy, the identity of those autopsied, cause of death of victims, period of survival, education status of victims, offending vehicles and the year-round variation in these cases. The study period from 1st January 2016 to 31th December 2016 in Visakhapatnam. Total 1782 medico legal autopsies were conducted during the study period (2016). Road traffic fatalities accounted for 36.81% (n=656) of all autopsied cases, 8.5% (n=147) are pedestrians, accidents are from 6PM to 12 Mid night leading to 48% (n=71cases). Primary impact injuries present in all cases. Secondary impact injuries were found in 47.61% (n=70 cases) and secondary injuries in 97.27 % (n=143 cases). Brought to hospital 71%, died during transport to hospital 15% of cases and 13% died at the spot of accident. Most common site of primary impact injuries are legs and cause of death Head injury.
Keywords: RTA, Injuries pattern, Pedestrian, Types of roads, Vehicles, Autopsy, Death cause.

INTRODUCTION

According to the WHO, India has reported mortality rate from road traffic injuries as 18.9 per 100,000 people and 100 road fatalities per 100,000 vehicles. Road Traffic Accident (RTA) is one among the top 5 causes of morbidity and mortality in South-East Asian countries. RTI accounts for 30 to 86% of the trauma admissions to hospitals in low income and middle-income countries like India. Road transport is vital to India's economy as it contributes nearly 4.8% share towards Gross Domestic Product (GDP) of India in 2013 – 14. Road Traffic Accidents (RTAs) are important causes of mortality and morbidity due to the increasing number of vehicles, changes in lifestyle and the risk behaviours among general population. India is passing through a major epidemiological transition and technological revolution during the past two decades. This has leads to a rapid growth in motorization and concomitant increase in road traffic injury (RTI) related mortality. In actual numbers, 4,64,674 road accidents caused 1,48,707 deaths and injuries to 4,82,389 persons during 2015 (NCRB 2015) [1].

The highest number of persons died in road accidents were reported on the National Highways accounting for 33.4% (49,651 out of 1,48,707) followed by State Highways (27.7%) (41,219 deaths). Half of the world's road traffic deaths occur among motorcyclists (23%), pedestrians (22%) and cyclists (5%) – i.e. ―vulnerable road users‖ – with 31% of deaths among car occupants and the remaining 19% among unspecified road users (WHO, Global status report on road safety) [2].

The number of vehicles in India is rapidly increasing, with about 20 million new motor vehicles sold every year. (Society of Indian Automobile manufacturers) [3]. It is well known that enormous growth in the number of motor vehicles, increase in population and poor infrastructure in the form of inadequate access to healthcare and bad roads are some of the important factors in deaths due to pedestrian accidents. Medico-legal autopsies help answer a number of questions that assist in resolving a case, such as the cause of death, the time between injury and death, and the time since death, (Joseph HD. Medicolegal death investigation) [4] and these findings are admissible evidence in the court of law. Besides resolving legal issues, autopsy studies allow planners to determine logistics such as the number of beds, and

ambulances, and staff required for dealing with trauma efficiently; devise strategies for future training; and add to public health research [5]. Injuries and fatalities occur in all forms of transportation but numerically road traffic accidents account for the great majority worldwide. In developed countries, they are the most common cause of death below the age of 50 years, and in young men this trend is even more marked. The pattern of injury, fatal and otherwise, varies considerably depending upon whether the victim is a vehicle occupant, a motorcyclist, a pedal cyclist or a pedestrian. (Knight B, Saukko P. Knight Forensic Pathology – Transportation Injuries Chapter, Third Ed; Arnold Press. 2004, page 281) [6].

The speed of the vehicle is probably the most important factor in the causation of severe injuries. In a high-speed impact, the body can be flung high in the air and for a considerable distance, either to the side or in the path of the car – or even backwards over the roof, both primary and secondary impact injuries will be more severe.

In child victims, although the general pattern of injuries is similar, their shorter height and smaller weight affects the mechanics of impact. The primary contact is higher up their body, so they tend to be hit forwards rather than rotated upwards, though many do become scooped up onto the bonnet. Children tend to be projected further by impact and may be hurled in the air at lower speeds than with adults. The ‒Waddell's triad," identifies a triad of injuries associated with pedestrian/motor vehicle collision (MVC), including trauma to the head, abdomen, and lower extremities usually observed in children (Orsborn R) [7]. Autopsies revealed the brain to be the most frequently injured internal organ. Analysis of the various aspects of epidemiology of pedestrian accidents through detailed research becomes essential and an injury from road traffic crashes is the fact that most of these deaths are preventable.

MATERIAL AND METHODS

The present study is made on the deaths involving pattern of injuries pedestrians in road traffic accidents which occurred in Visakhapatnam which are subjected to post mortem examination at mortuary of Andhra Medical College, King George Hospital, Visakhapatnam, India during the period January to December 2016.

The details regarding the hospital admission, duration of stay in the hospital, the period of survival were recorded from the hospital records. Based on these observations and history obtained from the police regarding the accidents and inquest reports an attempt has been made to show the number of accidents, to increase the traffic awareness in public, safety methods of transportation, to develop traffic emergency medicine in the field of public health as vehicles on road are major causes of vehicular accidents.

RESULTS & DISCUSSION

During study period 2016 one-year total 1782 medico legal autopsies were conducted. Road traffic fatalities accounted for 36.81% (n=656), pedestrian accidents 147 cases. Visakhapatnam City roads area extends over length of 126 kilometres includes National Highway, State Highway and other important connecting points. Road network of Visakhapatnam is congested due to narrow carriage way, high pedestrian traffic and slow-moving vehicle concentration. Thus, resulting in high incidence of pedestrian accidents.

Most of victims sustained trauma on high ways which is 44 % (n=65cases). This can be explained on basis of lengthy highway covering entire city in between residences and highways being most busy roads with heavy traffic load and moreover there are no side lanes in Visakhapatnam city along majority of highway. Our study shows 45 cases of pedestrian accidents in secondary roads as there are more intersections of secondary roads with highways, traffic being deviated to secondary roads for quick reach of their destinations. 32 cases of pedestrian accidents were on village roads can be attributed outside city limits, brought to tertiary care hospital for better treatment.

The least number of cases at highway junctions and secondary junctions may not be considered as positive factor because majority of pedestrians do not cross roads at junctions as they have access although roads to cross because of lack of guard railings. As this study shows pedestrians accidents walking across roads is seen in 65% of cases and walking along the roads is seen in 35% of cases.

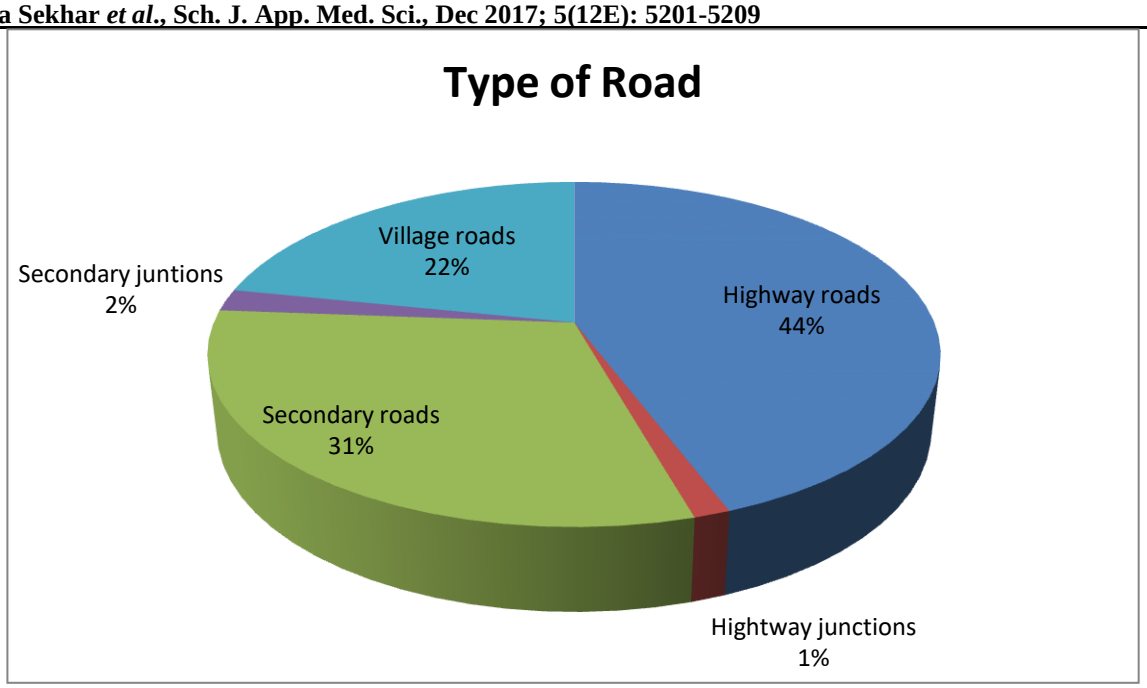


Fig-1

For the age groups divided at 10 years interval such as 1-10 years, 11-20 years and so on. The outcome of division highlights majority of victims are between 41-50 years and 51-60 years age group each accounting for 39 cases followed by 31-40 years and 61-70 years age group and least between 1-20 years and 81-90 years age groups.

The highest number of deaths 78 (53.06 %) between 41-60 years is a matter of great loss to the family, society and nation as this age group will pave the way for next generation for the bright future. The studies conducted by Yousaf Zia *et al*. [8], Mandel BK *et al*.[9], had similar statistics. Age group 35-55 is in accordance with Mandel BK *et al*. [9] studies.

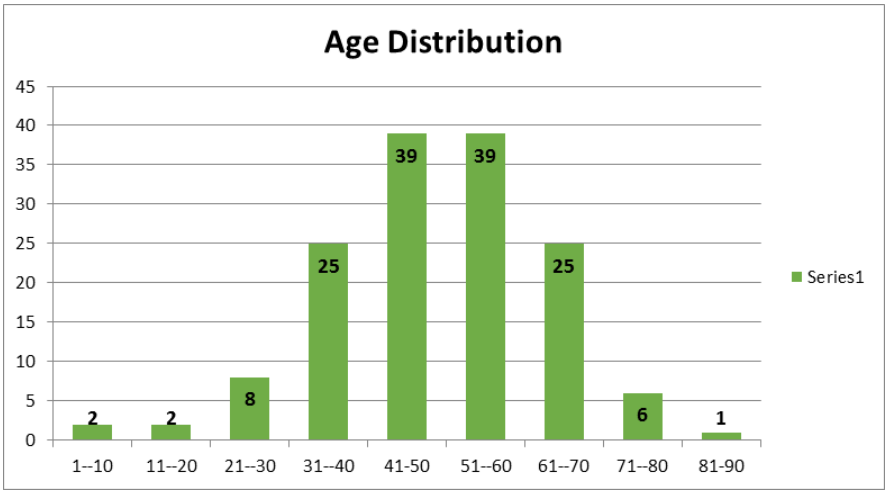


Fig-2

There are not much seasonal variations but majority of reported cases are during rainy season accounting for 34%, the reason could be slippery nature of road for both pedestrians and vehicles, moreover pedestrians will be in hurry in reaching their destinations and crossing the roads to get away from rain.

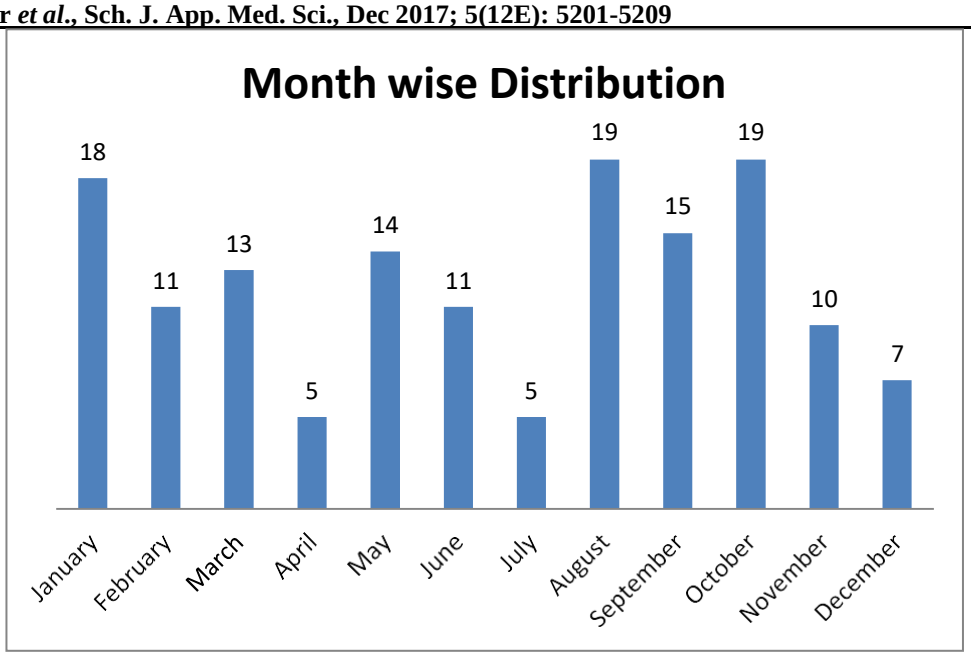


Fig-3

Most of the pedestrian accidents are from 6PM to 12 Mid night leading to 48% (n=71cases) followed by 12Noon to 6PM, 6AM to 12Noon and least is seen from 12Mid night to 6AM which is in concurrence with other studies such as Nupur Pruthi *et al.* [10], Kaci L. Hickox *et al*. [11], Cobb *et al*. [12].

This indicates pedestrian accidents are common in evening and early night hours. Vehicle traffic during these hours are usually peak and also increased pedestrian traffic and also associated with improper infrastructure facilities like absence of side-walks, walk overs (pedestrian bridges) to cross the traffic road. Reduced attention of vehicle drivers and pedestrians related to fatigue of day after their day work is contributory factor.

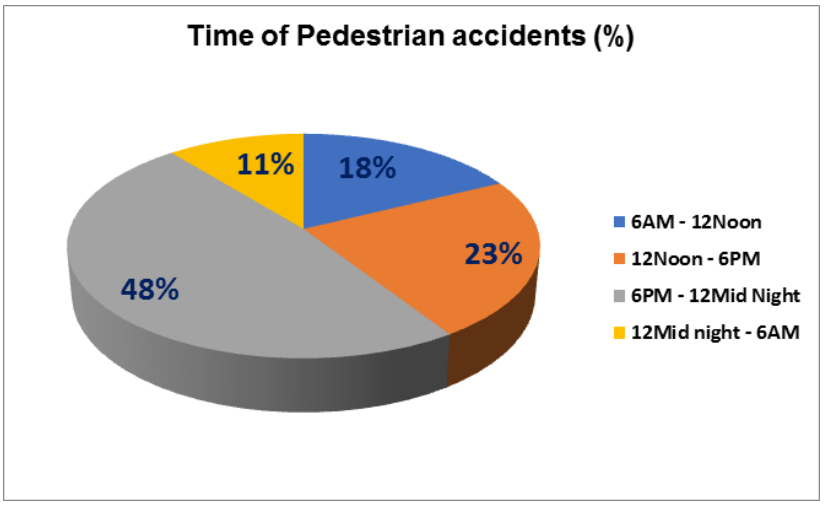


Fig-4

Majority of pedestrians were brought to hospital for treatment accounting for 71% as there are services like 108 service, emergency response service, at our place near to highways and state roads which reach within 5 minutes from toll free call. 15% of cases died during transport to hospital and 13% died at the spot of accident.

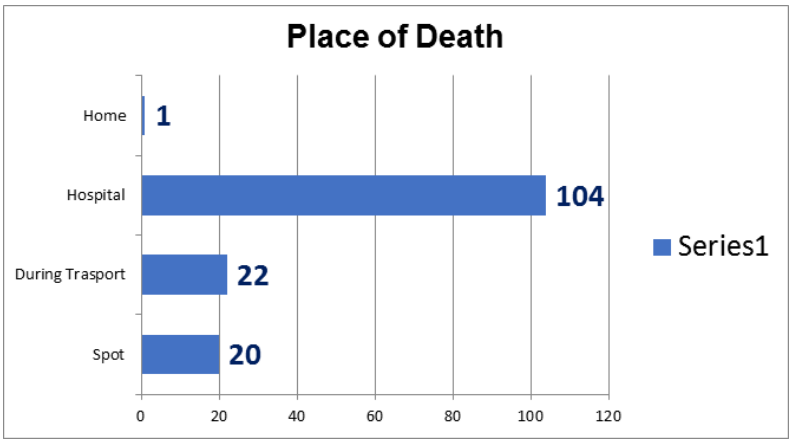


Fig-5

Period of survival is higher than other studies due to vast availability of public and private hospitals as well as good emergency services in and around Visakhapatnam.

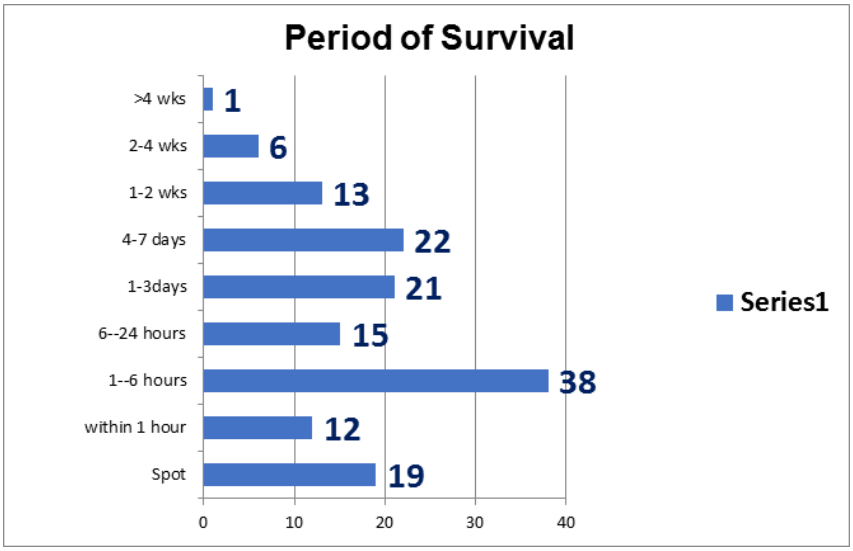


Fig-6

In this study, 41% (n=60) cases suffered fatalities because of motorized two wheeler vehicles which is consistent with other studies such as Nupur Pruthi *et al*.[10]. This may be explained by two wheeler being affordable for large number of people in society and among the vehicles two wheelers are most unstable vehicle when compared with other vehicles leading to more fatalities. Four-wheeler heavy motor vehicles are involved in 27% (n=40) of pedestrian accidents as there are no by passes in Visakhapatnam city, all vehicles pass through entire length of city along national highway. Four-wheeler light motor vehicles are involved in 14% (n=21) of cases is double edged both on part of driver and pedestrian as majority do not follow rule of the road and lack of awareness on traffic rules. 10% of cases were hit and run by unknown vehicles. 8% of cases involve three-wheeler auto rickshaw vehicles.

Similar observations in other studies which are having similar road situations such as Mandel BK *et al*. [9] and Nupur Pruthi *et al*. [10].

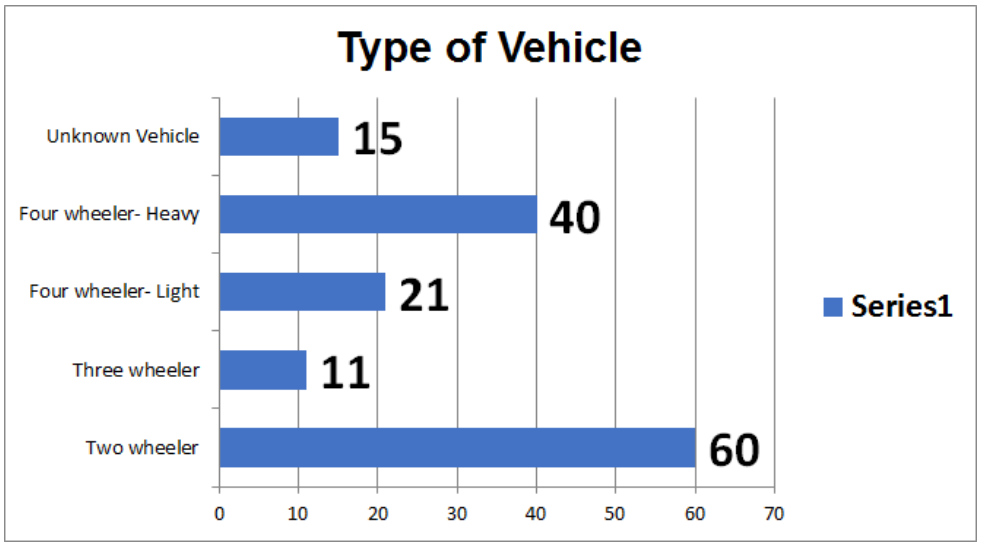


Fig-7

Drunken driving is also a factor which increases risk of causing accidents. In this study we did not explore role of contributing factors like alcohol, drugs etc although it has contributory significance.

In present study, all cases showed primary impact injuries. Secondary impact injuries were found in 47.61% (n=70 cases) and secondary injuries in 97.27 % (n=143 cases).

Table-1: Pedestrian Injuries

Type of injury	No. of Cases	Percentage
Primary Impact Injuries	147	100
Secondary Impact Injuries	70	47.61
Secondary injuries	143	97.27

Cause of death in different types of vehicles was also ascertained in our study as shown in the Table-1. Head injuries are common in three-wheeler vehicles hitting pedestrians accounting for 73% (n= 8) followed by light motor vehicles by 62% (n= 13), unknown vehicles by 60% (n= 9), two-wheeler vehicles by 58% (n= 35) and heavy motor vehicles by 42% (n=17). Multiple injuries are common in pedestrians' accidents involved with heavy motor vehicles representing 42%.

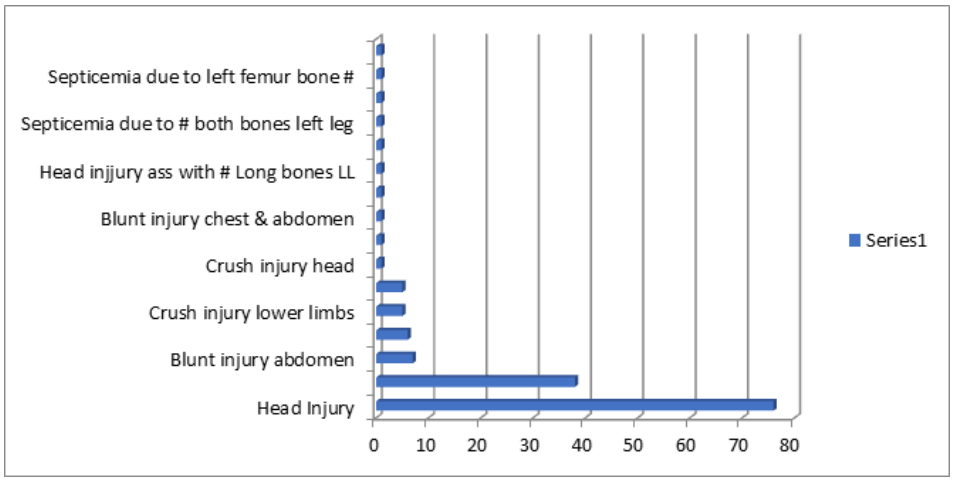


Fig-8: Cause of Death in Pedestrians

In this study, head injury was present in 52% cases. This is comparable to studies done by Farooqui JM, *et al.* [13], Georg Reith *et al.* [14] where it is 46.93% &56.6% respectively. From above facts, it is clear that head is the most vulnerable part of the body involved in pedestrian accidents.

Table-2: Cause of death in Pedestrians in different Vehicle types

Cause of Death	Two-wheeler		Three-Wheeler		Four-wheeler (LMV)		Four-wheeler (HMV)		Unknown Vehicle	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Head Injury	35	58%	8	73%	13	62%	17	42%	9	60%
Multiple Injuries	14	23%	-	-	5	24%	17	42%	1	6%
Blunt injury-Abdomen	5	8%	1	9%	2	9%	1	3%	1	7%
Shock and Hemorrhage due to long bone fracture	3	5%	1	9%	-	-	-	-	2	13%
Instantaneous death due to fracture dislocation of C2 Cervical vertebra	1	2%	-	-	-	-	-	-	-	-
Cervical Injury	1	2%	-	-	-	-	-	-	-	-
Crush Injury-Head	-	-	-	-	-	-	2	5%	1	7%
Crush injury-Lower limbs	-	-	1	9%	1	5%	3	8%	1	7%

These patterns of injuries were assigned with their names on reconstruction of scene basing on post mortem examination findings, crime scene photos, sketches, videos and visiting the scene in some cases.

Sites of injuries in relation to primary impact injuries, secondary impact injuries and secondary injuries was also derived as shown in Table 2.

Primary impact injuries are common in lower limbs leg with 46.94% (n=96) followed by upper limbs 18.37% (n= 27), head and face 17.01% (n=25), pelvis 16.33% (n=24), abdomen 12.24% (n=18), chest & shoulders 11.56% (n=17), lower limb thigh 10.20% (n=15).

Secondary impact injuries are not seen in 52.38% (n= 77). In cases where secondary impact injuries are present, most commonly affected part is head and face with 29.93% (n =44) followed by chest and shoulder 13.6% (n = 20), upper limbs 9.52% (n= 14), abdomen 6.80% (n=10)

Secondary injuries are common in head and face with 68.7% (n=101) followed by upper limbs 33.33% (n= 49), lower limbs 28.57% (n=42), chest 23.13% (n=34), shoulder 8.84% (n=13), abdomen 6.12% (n=9). Pelvic 1.36% (n=2) and no secondary injuries are found in 2.72% (n=4). Basing on this subdivision of injuries basing on their pattern, head and face are commonly affected part of the body.

Table-3: Sites of injuries in pedestrians

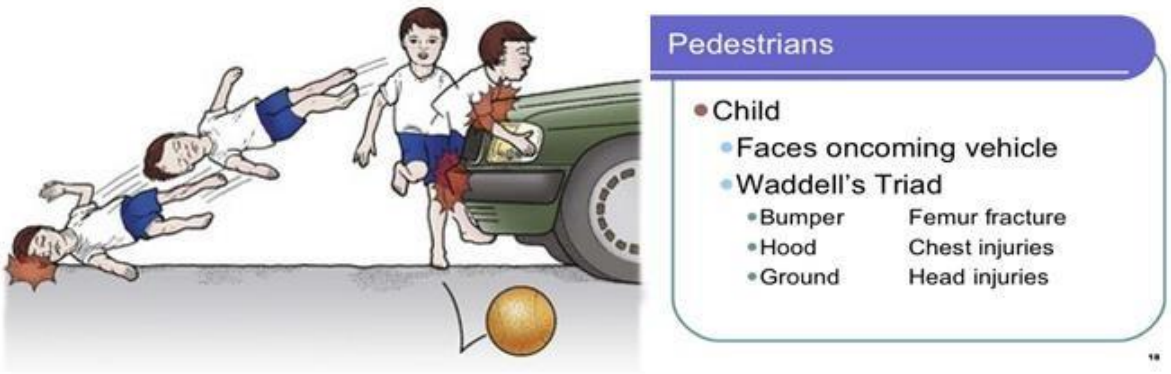
Site	Primary impact Injuries		Secondary Impact Injuries		Secondary injuries	
	Number	Percentage	Number	Percentage	Number	Percentage
Head & face	25	17.01%	44	29.93%	101	68.7%
Chest & shoulders	17	11.56%	20	13.6%	47	31.97%
Abdomen	18	12.24%	10	6.80%	9	6.12%
Pelvis	24	16.33%	2	1.36%	2	1.36%
Upper limbs	27	18.37%	14	9.52%	49	33.33%
Lower limbs-Thighs	15	10.20%	2	1.36%	42	28.57%
Lower limbs- Legs	69	46.94%				
No injuries	Nil	Nil	77	52.38%	4	2.72%

Injuries in pedestrians

The total number of external injuries among 147 victims of pedestrians was 803 injuries Dominated by abrasion 283, followed by contusions 214, Fractures 131, and lacerations 77, Crush injury 13, dislocation 4 and no injuries in 81 cases. This shows multiplicity of injuries amongst the pedestrian victims.

Table-4: Injuries in Pedestrians

Injuries	Primary Impact Injuries		Secondary Impact Injuries		Secondary injuries	
	Number	Percentage	Number	Percentage	Number	Percentage
Abrasion	122	82.99%	42	28.57%	119	80.95%
Contusion	65	44.22%	51	34.69%	98	66.67%
Laceration	32	21.77%	15	10.20%	30	20.41%
Fracture	64	43.54%	21	14.29%	46	31.29%
Dislocation	3	2.04%	1	0.68%	-	-
Crush injury	-	-	-	-	13	8.84%
No injuries	-	-	77	52.38%	4	2.27%



Waddell's Triad

CONCLUSION

- The present research shows pedestrian accidents are of concern and continue to be important public health problem in Visakhapatnam. In many cases pedestrian accidents are caused by human errors and are preventable. Age group 40-60yrs more involved, Common in late evening's timings. Two-wheeler vehicles are most commonly involved on highways.
- Head injuries are responsible for death of majority of victims along with thoraco-abdominal trauma and extremities. The health care system needs to be strengthened especially provision of emergency care services 24x7 should be expanded and strengthened.
- As pedestrians are vulnerable road users' steps to be taken to protect them from accidents. Health education to be promoted by media, hoardings and posters regarding adequate road safety measures. Traffic laws should be strictly implemented. Driving license test questions to be added on pedestrians.
- Roads traffic polices like pedestrian friendly paths, foot over bridges, underground pathways, separate lanes for LMV, HMV, two wheelers can reduce incidence of pedestrian accidents and its fatalities.

- Pedestrian should walk opposite direction vehicles on specified area of reads to minimize accidents. Keep left for vehicles, right for pedestrians.
- Use of fluorescent reflector while crossing road specially night to avoid or reduce accidents
- Usage of mobile phone talking/chatting strictly prohibited for both pedestrians and vehicle drivers to avoid road traffic accidents.
- Cross the roads at only at zebra crossings on national high ways and other roads, follow traffic signals, to minimize or avoid pedestrian accidents.

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