THE URGENT NEED FOR TRAFFIC CALMING MEASURES FOR PEDESTRIANS IN INDIA

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SUMMARY

The pedestrian safety problem is immense in most developing countries. The main aims of this project and paper are therefore: 1) To understand pedestrian safety problems in a developing country, India, and in a specific city, Jaipur 2) To identify feasible traffic calming measures.

The project embraced literature studies and a wide range of field studies at seven intersections in the city of Jaipur. The most important field studies included speed measurements and conflict studies performed according to the Swedish Traffic Conflicts Technique (TCT). The Swedish TCT is a valid method to assess traffic safety based on “almost-accidents”.

The interaction and conflict studies showed that the intersections are very hostile places for pedestrians and that pedestrians are extremely exposed and vulnerable when crossing the road. According to the literature there is a strong relationship between speed and number of accidents and the severity of injuries. Literature also points at the extreme vulnerability of elderly pedestrians compared to other age groups when hit by motor vehicles at high speeds. With this information the high motor vehicle speeds measured at the intersections are clear indications of the unsafe situation for pedestrians and especially elderly pedestrians. On site observations of the intersection design showed that there seldom are proper footpaths and that existing pedestrian crossings are neither located nor designed to suit the need of pedestrians. The pedestrian crossings are often located too far from the intersection which implies a considerable detour which was demonstrated by pedestrians not using them. In addition, the median barrier proved to be an obstacle in itself as there seldom was a passage arranged through the barrier which meant that pedestrians had to climb the sometimes 40cm high kerb.

The main conclusion of the studies is that there is an urgent need for Traffic Calming measures in Jaipur and presumably in many other Indian cities. The proposed measures in this project are low cost “standardised Traffic Calming measures”. These consist of humps at all entrances and raised pedestrian crossing at all exits to ensure low speeds and raised footpaths at all corners to make the approaches for pedestrians as comfortable and safe as possible by preventing cars from being able to use that space. The medians and the pedestrian crossings are moved closer to the intersection so that pedestrians do not have to make large detours to use them and the median barriers are provided with a passage at the same level as the pedestrian crossing. The measures proposed are very simple and that is a very important part of the strategy. Without simplicity and low costs there will never be any large scale use.

Key Words: pedestrian; safety; speed; traffic calming; India

BACKGROUND

This paper is based on a project by CUTS, Lund University and ITT Delhi, financed by SIDA (Hydén & Svensson, 2009). The background is the immense pedestrian safety problem in developing countries. The main aims of this project and this paper are: 1) To understand pedestrian safety problems in a developing country, India, based on studies in Jaipur and 2) To identify feasible traffic calming measures.

According to WHO (2009), based on statistics from 2006 and 2007, low- and middle-income countries have higher road traffic fatality rates (21.5 and 19.5 per 100 000 population, respectively) than high-income countries (10.3 per 100 000 population), where India is somewhere in between with 16.8 per 100 000 population. Traffic safety is continuously improved in high-income countries while the problem of traffic injuries and fatalities increases in other regions of the world. Each year road traffic injuries kill 1.3 million people. If the trend continues road crashes will be the fifth leading cause of death by 2030. Of those dying on the world's roads, 50% are vulnerable road users, with a higher percentage in low- and middle-income countries than high-income countries. The report points out speed as a key risk factor for injuries among pedestrians and cyclists.

1. Speed as a key-factor for safety

A report by Elvik et al., (2004) investigates the effects of changes in speed on the number of road accidents or road accident victims. It is found that the relationship between speed and accidents or accident victims can be represented by the so called “Power Model” (Nilsson, 2004) and according to the following equation:

$$\text{Accidents before} / \text{Accidents after} = (\text{Speed before}/\text{Speed after})^{\mathbf{exp}}$$

Based on metaanalysis the report proposes estimates of the exponent depending on type of accident or injury severity (Table 1). It can be concluded that changes in average speed affects the most severe accidents and injuries most. Based on figures in Davis (2001) on relationship between impact speed in vehicle-pedestrian crashes and severity of pedestrian injury, Figure 1 was constructed. It can be concluded that pedestrians aged 60+ suffer more severe injuries than other age groups when hit with the same impact speed. At an impact speed of e.g. 50 km/h the likelihood to get killed is 61.6% for pedestrians aged 60+, 7.5% for pedestrians aged 15-59 and 5.5% for child-pedestrians aged <15.

Accident or injury severity	Best estimate of exponent	95% confidence interval
Fatalities	4.5	(4.1 – 4.9)
Seriously injured road user	3.0	(2.2 – 3.8)
Slightly injured road user	1.5	(1.0 – 2.0)
All injured road users	2.7	(0.9 – 4.5)

Table 1: Best estimates of exponents for the modified version of the Power Model (Elvik et al., 2004)

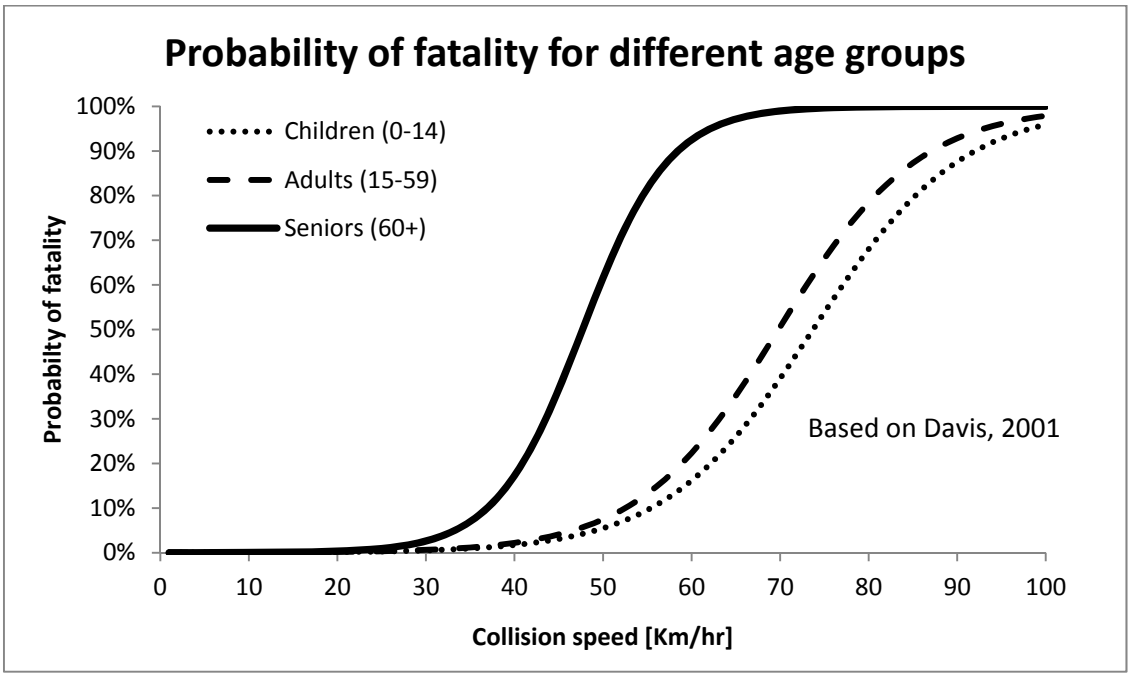

Figure 1: Probability of fatality for different age groups (Davis, 2001)

2. Traffic calming

The principle behind the concept Traffic Calming is to calm the vehicle speeds to below 50km/h in order to reduce injury accidents and pollution and thus making the area for people more pleasant. Safety is a key objective for virtually all traffic calming schemes, not only in terms of accidents, but also because of the degree of danger felt by people using the streets concerned. In Table 2 some commonly used measures to reduce the speeds of motorised traffic are presented together with their

estimated effect on accidents based on meta-analysis (Elvik et al., 2009). In Table 3 the effects on accidents of some traffic control measures for pedestrians are presented (Elvik et al., 2009). The figures clearly show the importance of not only marking a pedestrian crossing but to equip it with speed reducing measures in order to facilitate a safe crossing.

		Percentage change in the number of accidents	
Accident severity	**Types of accidents affected**	**Best estimate**	**95% confidence interval**
	Speed humps		
Injury accidents	All accidents on roads with speed humps	-41	(-57; -34)
Injury accidents	All accidents on roads nearby roads with speed humps	-7	(-14; -0)
	Raised junctions		
Injury accidents	Accidents at junctions	+5	(-34; +68)
	Rumble strips in front of junctions		
Injury accidents	Accidents at junctions	-33	(-40; -25)
	Speed zones		
Injury accidents	All accidents	-27	(-30; -24)

Table 2: Effects on accidents of speed-reducing devices. Percentage change in the number of accidents (Elvik et al., 2009)

		Percentage change in the number of accidents	
Accident severity	**Types of accidents affected**	**Best estimate**	**95% confidence interval**
	Marked crosswalk		
Injury accidents	Pedestrian accidents, two-lane roads	-8	(-43; +51)
Injury accidents	Pedestrian accidents, multi-lane roads	+88	(-32; +424)
Injury accidents	Pedestrian accidents, all roads	+44	(-6; +121)
	Raised crosswalk vs. no crosswalk		
Injury accidents	All accidents	-65	(-83; -27)
	Raised crosswalk vs. ordinary marked crosswalk		
Injury accidents	Pedestrian accidents	-42	(-70; +11)
	Refuge in marked crosswalk vs. ordinary marked crosswalk		
Injury accidents	Pedestrian accidents	-43	(-71; +12)

Table 3: Effects on accidents of traffic control measures for pedestrians (Elvik et al., 2009)

METHODS

The project embraced a wide range of methods: at site inspections of intersection design and crossing behaviour, speed measurements, interactional studies, traffic flow measurements and conflict studies, where the latter perhaps was the most important. The conflict studies were performed according to the Swedish Traffic Conflicts Technique (TCT) (Hydén, 1987) and the conflict observers were trained according to this technique. The Swedish TCT is a valid method to assess safety based on “almost-accidents” and is used as a complement to the far too often incomplete police statistics on accident data. In operational terms one can say that serious conflicts are characterized by the suddenness and harshness of the evasive action and have been found to have a relationship with injury accidents but are 10000-100000 times as frequent. During the conflict studies the number of conflicts is recorded together with a description of the process preceding each conflict and a mapping of the manoeuvres.

RESULTS

1. Speeds

The speeds were measured for approaching vehicles on the main road, in total 100 cars and 100 MC at each intersection. Due to unforeseen problems at site 7, it was not possible to measure speeds here. The results are presented in Table 4.

Site	**Car speeds**		**MC speeds**	
	Mean	85perc	Mean	85perc
1	43	52	41	50
2	42	50	42	48
3	45	54	43	51
4	45	54	44	52
5	41	50	39	46
6	40	50	41	48
7*				

Table 4: Car and MC speeds on approaches to 6 of the 7 sites. 7* = no data

2. Serious conflicts

Conflict studies were conducted from video-recordings of the seven intersections during 25 to 52 hours each and the results are presented in Table 5.

Site	Pedestrian conflicts	Bicycle conflicts	Other confl	Total	Obs. Hours
1	1.0	0.5	3.1	4.5	25.5
2	0.8	0.5	2.7	3.9	25.6
3	1.9	0.1	0.2	2.1	44.9
4	0.3	0.3	2.5	3.1	50.7
5	0.9	0.2	1.2	2.2	52.1
6	1.1	0.3	2.5	3.8	26.1
7	1.2	0.9	1.6	3.7	49.5
Total	1.0	0.4	1.7	3.1	274.0

Table 5: Number of serious conflicts per hour at the sites

These figures corresponds to circa 1.9 pedestrian injury accidents, 0.7 bicyclist injury accidents and 0.6 motor vehicle injury accidents per intersection and year. The speeds in the same type of conflicts (pedestrian or bicycle) are between 3 and 15 km/h higher for cars than for MC.

3. Behaviour studies and survey of intersection design

The behaviour studies show that pedestrian crossing behaviour is unorganized and non-channelized i.e. pedestrians do not only cross where they are supposed to cross but cross rather “everywhere” and a great number, 48-74%, cross in the middle of the intersection. The studies also show that a vast majority of the drivers of motorised vehicles completely neglect the crossing pedestrians i.e. they do not slow down or swerve, even if they pass very close. The predominant behaviour is instead that the drivers blow the horn to make pedestrians get out of the way. The survey of the intersections’ design showed that the intersection area often is far too spacious. This results in pedestrian crossings being located outside the intersection area and large distances between the medians. There are rarely proper footpaths. The medians are high, to be able to cross pedestrians have to climb the medians and the medians often have obstacles like bushes. There are seldom proper waiting areas for bus passengers and people often have to wait in to road.

DISCUSSION

The studies show obvious pedestrian safety problems at the studied intersections. The intersections are very hostile places for pedestrians and pedestrians are extremely exposed and vulnerable when crossing the road.

The results show that motor vehicle speeds at the intersections are high. Based on findings in the research literature on the established relationship between speed and number of and severity of injuries, it can be concluded that the high speeds indicate safety problems and that especially elderly pedestrians are at stake as they are more likely, compared to other age groups, to suffer more severe injuries when hit by vehicles at higher speeds.

Road users appear almost everywhere in the intersection, often at the wrong place and in the wrong direction. Pedestrians, for instance, cross in the middle of the intersection and pedestrian conflicts occur in the central parts of the intersections. Reasons to this may be found in the spacious intersection areas. On site observations of the intersection design showed that the spaces are extremely large and that there are no real guiding of road users where to be located while passing the intersection. Existing pedestrian crossings are neither located nor designed to suit the need of pedestrians. Due to the spacious intersection design the pedestrian crossings are often located outside the intersection area which implies a considerable detour and long crossing times which was demonstrated by pedestrians not using them. In addition, the median barrier proved to be an obstacle in itself as there seldom was a passage arranged through the median which meant that pedestrians had to climb the sometimes 40cm high kerb. The spacious intersection area also results in lack of guidance. Cyclists, for instance, are quite often involved in conflicts at locations in the intersection where they “are not supposed to be”. For pedestrians there are seldom are proper footpaths to channel pedestrian movements.

Due to the high speeds and lack of guidance for proper behaviour there is no safe and proper communication between motor vehicle drivers and pedestrians. All road user groups are somehow to blame but it is far too often the driver who demonstrates power by blowing the horn instead of adjusting speed and/or direction towards a crossing pedestrian.

When discussing the traffic issue with different parties in India, a frustration with MC drivers was often expressed, therefore the involvement of different motorised vehicles in conflicts was analysed. This showed that regarding involvement in pedestrian conflicts the share is representative with regard to the total volume of cars, MC and trucks. This is however not the case for bicycle conflicts, here cars are more represented in serious conflicts than their share of the volume, while MC and trucks/etc. are less represented in serious conflicts. Also cars have higher speeds when approaching the intersections than MC (Table 4). In addition the conflict studies

show that the speeds of conflict involved cars are higher than corresponding MC speeds.

To be able to predict the behaviour of the other road users, traffic at the intersections needs to be better organised. With lower speeds this would ensure improved and safer interactions. If the average travel speed is reduced from 52 km/h – which is the average speed at the seven sites) – to 40 km/h, the risk for a pedestrian to get killed is reduced by 55% according to the Power Model (Table 1).

The proposed measures in this project are low cost “standardised Traffic Calming measures” to ensure low speeds and more predictive behaviours. These consist of humps at all entrances and elevated pedestrian crossings at the exits to ensure low speeds and raised footpaths at all corners to make the approaches for pedestrians as comfortable and safe as possible by preventing cars from being able to use that space. The median barriers and the pedestrian crossings are moved closer to the intersection so that pedestrians do not have to make large detours to use them and the medians are provided with a passage at the same level as the pedestrian crossing. These measures will all in all hopefully be a strong enough incentive for the pedestrians to use the new zebra crossings when crossing and besides improving safety there is also a wish that the measures will improve the quality of life for pedestrians.

CONCLUSION

Based on these studies and visits to other locations in Jaipur, New Delhi and other cities in other parts of India, it is our strong feeling that the problems with high speeds, poor pedestrian safety, pedestrians crossing everywhere, etc. are “general enough” to be valid outside the seven intersections in Jaipur. The main conclusion of the studies is that there is an urgent need for Traffic Calming measures in Jaipur and presumably many other cities in India. The proposed measures in this project are low cost “standardised Traffic Calming measures” to ensure low speeds and more predictive behaviours. Besides improving pedestrian safety these measures will probably improve the quality of life for pedestrians. The measures proposed are very simple and that is a very important part of the strategy. Without simplicity and low costs there will never be any large scale use.

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