

Seat Belt Law and Road Traffic Injuries in Delhi, India

Dinesh MOHAN
Professor
Transportation Research & Injury Prevention
Programme
Indian Institute of Technology Delhi
Hauz Khas
New Delhi 110016, India
Fax: +91-11-26858703
E-mail: d

Abstract: Road traffic injuries have become a serious health burden all over the world in general and in cities of low and middle-income countries in particular. Delhi, the capital city of India, records the highest number of road traffic fatalities of all cities in India. This study evaluates the effectiveness of the mandatory seatbelt law enacted in Delhi in 2002 in terms of observance of the law and estimated reduction in fatalities due to road traffic crashes. Seat belt use was monitored by road side observations at one location in 2001 one year before the compulsory use law. Road side observations on belt use were taken every year in March/April for the period 2002-2005 after the notification of the compulsory use law. Seat belt use by front seat passengers averaged 72% for the four years 2002-2005 (drivers 79%, passengers 58%). Belt use by front seat by passengers was about 25% lower than that by drivers in all the years. Since car occupants comprise only 2%-3% of the fatalities in Delhi, the belt law may have resulted in an overall fatality reduction of less than 1%, an estimated 11-15 lives per year.

Key Words: Road safety, seat belt use, Delhi, India.

1. INTRODUCTION

The Ministry of Road Transport and Highways, Government of India, prescribed that front seats of all motor vehicles must be equipped with lap and shoulder belts with effect from April 1994. Motorcycles and three-wheelers with engine capacity less than 500 cc were exempted. All vehicles sold in India after this date have been equipped with belts in front seats. Use of belts by front seat occupants was made mandatory nationally five years later on 18th March 1999. Installation of seat belts on all seats in cars was mandated in September 2000 but the use of seat belts by rear seat occupants is not yet governed by any national law. Since traffic is a state subject in the federal structure of the Indian constitution, traffic regulations have to be notified and enforced by each state. The Delhi Traffic Police made use of seat belts by front seat passengers compulsory with effect from 15th February 2002 and initiated enforcement of the same. Non compliance of the seat belt regulation would be punished with a fine of Rs. 100 (~2 Euro) in the first instance and Rs. 300 (~ 6 Euro) for subsequent violations. The Delhi Police fine about 2-3 percent of the motorists every month for non-compliance. This study evaluates the effectiveness of the mandatory seatbelt law in Delhi in terms of observance of the law and estimated reduction in fatalities due to road traffic crashes.

1.1 Delhi - Vital Statistics

Delhi, the capital city of India, had an estimated population of 6.22 million persons in 1981 which has grown to 16.96 million in 2008. In the same period the total number of vehicles

registered in Delhi has grown from 0.6 million to 5.6 million (Directorate of Economics & Statistics, 2008). The official statistics overestimate the number of registered vehicles because owners do not have to register their vehicles every year. Therefore, out-of-use vehicles remain on the record. Recent studies have estimated that the actual number of private vehicles on the road in Delhi is 60-70% of the official statistic (CRR, 2007; Expert committee on auto fuel policy, 2002). This means that the number of vehicles in Delhi in 2008 can be estimated to be about 3.6 million giving us a figure of 21 vehicles per 100 persons in the city.

Vehicle type	Percent
Cars and Jeeps	30.7
Motor Cycles and Scooters	63.6
Auto Rickshaws	1.3
Taxis	0.5
Buses	0.9
Goods Vehicles	2.9
Total	100

Table 1 Distribution of vehicle types in Delhi in 2008 (Source: Directorate of Economics & Statistics, 2008)

The distribution of vehicles by type is given in Table 1. These data show that cars and jeeps constitute less than a third of the vehicles in the city and motorcycles almost two thirds.

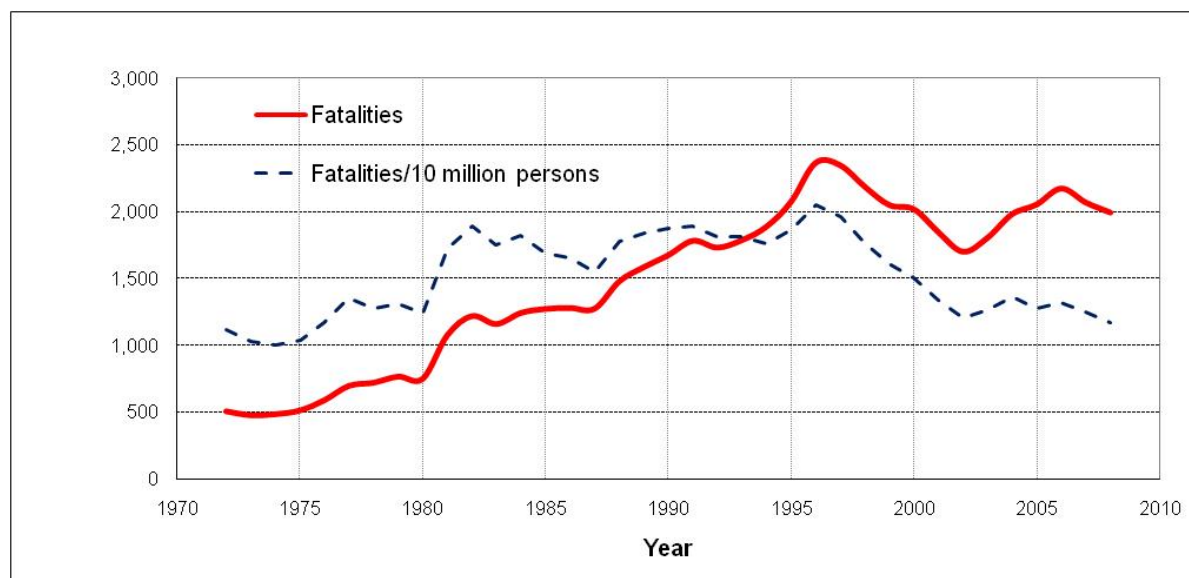


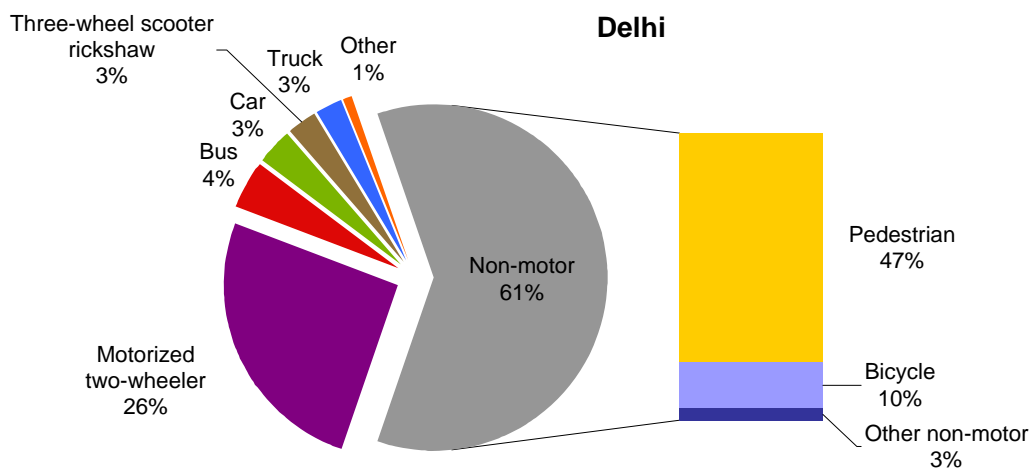
Figure 1 Road traffic fatality trends in Delhi (Source: Delhi Police data and Directorate of Economics & Statistics, 2008)

1.2 Road Safety Scenario in Delhi

Figure 1 illustrates the trend of the total number of people killed in Delhi in road traffic crashes and the rate per 10 million persons in Delhi between 1972 and 2008. The rate in 2008 was 1,173 per 10 million persons which is 34% lower than the peak in 1997. There was a reduction in fatality rates between 1997 and 2002 before the seatbelt law was enforced, but we do not have any scientific study explaining the causes of this decrease. It is generally accepted that average speeds reduced during this period due to congestion and this could be the reason for the lower rates. However, there has been little change in rates over the past few years. This is a cause for concern as many

Country	Vehicles per 100 persons	Fatalities per 10 million persons
Sweden	51	490
Netherlands	48	490
United Kingdom	51	530
Switzerland	56	550
Norway	55	560
Denmark	44	610
Iceland	72	640
Germany	58	650
Japan	59	660

Table 2 Vehicle ownership and fatality rates in selected high income countries in 2005 (Source: adapted from Mohan *et al.*, 2009)



countries around the world (Table 2) have much lower fatality rates along with higher vehicle ownership levels (Mohan *et al.*, 2009). The countries shown in Table 2 have almost 3 times the vehicle ownership than Delhi and about half the fatality rate.

The distribution of fatalities among different road users is also different in Delhi. Fatality data for the city of Delhi were obtained for five years (from 2001 to 2005) from the Delhi police in the form of a consolidated spreadsheet used for preparing annual reports. Figure 2 shows the distribution of fatalities by road user in for these five years (Mohan *et al.* 2009). It excludes fatalities for which no information was available and focuses on road user fatalities that were influenced by another road user. This shows that non-motorised modes a majority of the fatalities (61%) and motorised two-wheeler riders another 26%. Car occupant fatalities comprised an average of only 3% of the total for the period studied. This fact has an important bearing on the effectiveness of seat belt laws in reducing road traffic fatalities in countries like India.

2. METHOD

1) Seat belt use was monitored by road side observations at one location in 2001. This was two years after the mandatory belt fitment law was enacted, but one year before the compulsory use law.

2) Road side observations on belt use were taken every year in March/April for the period 2002-2005 after the notification of the compulsory use law. These observations were made in different locations of the city, both at night and during the daytime peak traffic hours. Observer teams were stationed traffic junctions and asked to observe the first 100 cars that went by in a group. Details of observations taken are given in Table 3.

Year	No of locations	No of cars
2002	11	1,834
2003	7	1,098
2004	11	975
2005	14	1,408

Table 3. No of locations and cars observed

3) The following information was recorded in addition to belt use status: driver or passenger, sex, location of passenger in the car, and time of observation.

3. RESULTS

Over a period of 4 years a total of 5,315 cars were observed with an average of 2.2 persons per car. Of the 2.2 persons per car, 68% were in the front seat and 32% in the rear seat. A significant proportion of the cars were chauffer driven, but we could not determine the number with any precision. Children could not be classified separately as no interviews were conducted to determine age of passengers. Qualitative notes by observers would suggest that children under age ten years were less than 10% of all the passengers.

3.1 Seat Belt Use by Drivers and Passengers

Only front seat passengers were found to be using belts after the announcement of the mandatory use law in 2002 by the Delhi Police. Belt use by front seat occupants increased from 12% to 70% after the announcement of the law. Use of belts by rear seat passengers was found to be negligible in all four years. Seat belt use by front seat passengers averaged 72% for the four years 2002-2005 (drivers 79%, passengers 58%). Belt use by front seat by passengers was about 25% lower than that by drivers in all the years. Figure 3 shows the details. Use remained similar in all the four years. A small increase was observed in 2005, but this was not statistically significant.

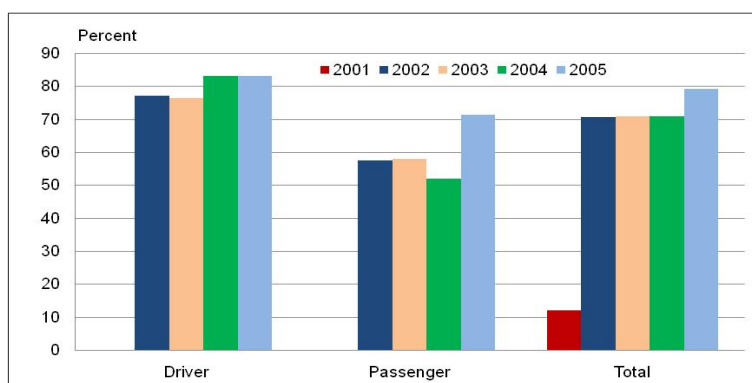


Figure 3 Seat belt use by front seat occupants of cars in Delhi 2001-2004

3.2 Seat Belt Use by Sex of Front Seat Passengers

Average values for males and females using seat belts was as follows:

- Male drivers – 82%
- Female drivers – 80%
- Male passengers – 58%
- Female passengers – 61%

Details are shown in Figure 4. There was no statistical difference in use rates between male and female drivers and passengers respectively. Male and female passengers belt use rates were lower than drivers by 29% and 24% respectively.



Figure 4 Seat belt use by sex of drivers and front seat passengers in cars in Delhi 2002-2004

3.3 Seat Belt Use by Time of Day

Seat belt use by front seat passengers at night time was lower than day time by 18% for males and 26% for females. These observations were made before 2100 hours as it was not possible to conduct the study at late night and early morning due to security and logistic reasons. It is possible that use rates are even lower during the periods not studied.

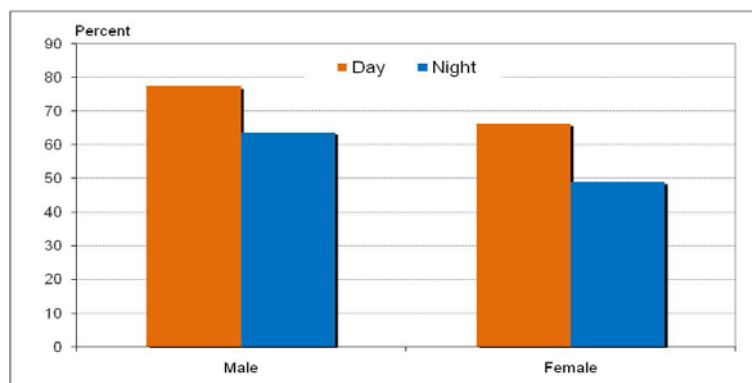


Figure 5 Seat belt use by time of day for front seat passengers in cars in Delhi, average for 2002-2004

3.4 General Observations

The observers collecting data also made qualitative observations during the period of study. As mentioned earlier, belt use by rear seat occupants was negligible. Almost none of the children (say under 10 years) were restrained whether under in the front seat or the rear seat. Many of the occupants did not have the belts secured snugly, however, it is not possible to estimate this number in this study. Anecdotal evidence suggests that some drivers drape their belts around them and do not buckle them in. However, are not able to estimate this proportion.

4. DISCUSSION

The seat belt use law for front seat occupants came into force in Delhi in 2002. Table 4 shows the number of cars registered and car occupant fatalities in Delhi for the years 2001-2005 (Delhi Traffic Police, 2007).

For calculating fatality rates the number of cars on the road is estimated as 65% of those officially registered (CRRI, 2007; Expert committee on auto fuel policy, 2002). The fatality rate of car occupants in the year 2001 when belt use among front seat occupants was 12% was 6.9 per 100,000 cars. In the following four

Year	Cars officially registered	Estimated number of cars on the road	Total car fatalities	Fatalities per 100,000 cars
2001	984,093	639,660	44	6.9
2002	1,147,762	746,045	50	6.7
2003	1,325,753	861,739	61	7.1
2004	1,415,729	920,224	42	4.6
2005	1,546,458	1,005,198	57	5.7

Table 4 Car occupant fatality rates in Delhi 2001 – 2005 (Seat belt use law enforced in 2002)

years the fatality rate was slightly less except in 2003 when it was 7.1 per 100,000 cars. For the 4 years preceding 2002 the average death rate for car occupants was 10.9 persons per 100,000 cars. The average car occupant death rate (including rear seat occupants) was 6.0 per 100,000 cars (SD 1.3) for the four years when seat belt use among front seat occupants was 72%. Though, the average fatality after set belt use was mandated is lower than before it is difficult to interpret these results to estimate effectiveness of belts as the overall fatality rate was declining sharply between the years 1996 and 2002 (Figure 1). Detailed epidemiological data are not available to attribute causal factors for his decline, but it is possible that much of this decline resulted from decrease in average speeds due to increasing congestion.

Seat belt use by car occupants is expected to save an estimated 45%-60% lives (Centers for Disease Control and Prevention, 2001). In Delhi the average use was 72% for front seat occupants and the latter comprised 68% of all car occupants. Therefore, we can estimate that about 49% of Delhi car occupants were protected by car occupants. This gives us an expected savings in lives of about 22% - 29% at these belt use levels. For an average of 50 car occupant deaths a year, this gives us a life saving potential of 11-15 fatalities per year in Delhi. If many of these occupants were not belted appropriately, as observed, then this number could be less. The average death rate 2002-2005 was 13% less than 2001 and 45% less than the average for 1997-2001. These numbers are too small for establishing statistical significance and it is not possible to attribute all changes to use of set belt alone as driving conditions changed in Delhi at the same time. An expected saving of 11-15 lives per year could easily be hidden within these numbers. If seat belt use was 90% of all car occupants then the savings in lives would amount to 21 to 27 lives for a base of 50 fatalities without belt use.

The above analysis shows that an estimated 11-15 lives may have been saved in Delhi per year due to current levels of seat belt use out of a total of 1,800-2,000 fatalities per year on Delhi roads. This amounts to less than 1% reduction in total fatalities due to road traffic crashes in Delhi because a vast majority of crashes comprise vulnerable road users and motorised two-wheeler riders. Even if all the vehicle occupants were protected by belts, the reduction in total fatalities would be less than 2%. While crashworthiness of cars and use of restraint systems is essential for vehicle occupants and must be ensured, these measures alone will not produce reductions in total road traffic injuries and fatalities as seen in high income countries.

The above analysis shows that mandatory belt use laws and normal enforcement methods can achieve 70%-80% nominal compliance by car occupants even in urban areas in low income countries. For higher compliance rates a much higher degree of enforcement is necessary. This may be quite expensive to promote all over the country in India. Since the number of lives saved is a small proportion of the total, it may be more cost effective to mandate passive measures like air bags in low and middle income countries.

5. CONCLUSIONS

1. Seat belt use rates for front seat car passengers increased from a nominal 12% in 2001 to over 70% as soon as the a mandatory belt use law was enforced in Delhi in 2002. The use law is enforced by fining car users on the spot or by sending a notice by mail.
2. The experience in Delhi shows that once the Police officials send a clear signal that a seat belt law will be enforced and car users fined for non-use, it is not difficult to reach overall use levels of about 70% even in less motorised countries like India.
3. Use levels seem to depend on the perception of the probability of being caught rather than the severity of the punishment and decrease at night. Even at very low levels of fines (2-6 Euro) for non-use of seat belts, more than 70% of the front seat passengers observe the law.
4. In our samples, driver belt use rates were higher than those of passengers and male and female rates were roughly similar.
5. Belt use rates have not changed significantly in the 4 years that the law has been enforced and neither have enforcement methods changed.
6. Since car occupants comprise only 2%-3% of the fatalities in Delhi, the belt law may

have resulted in an overall fatality reduction of less than 1%, an estimated 11-15 lives per year. This is assuming that front seat occupants comprise about 68% of all car passengers and belt effectiveness in reducing fatalities is 45%-60%.

7. Since the number of lives saved is a small proportion of the total, it may be more cost effective to mandate passive measures like air bags in low and middle income countries.

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REFERENCES

- Centers for Disease Control and Prevention (2001) **Motor-Vehicle Occupant Injury: Strategies for Increasing Use of Child Safety Seats, Increasing Use of Safety Belts, and Reducing Alcohol-Impaired Driving. A Report on Recommendations of the Task Force on Community Preventive Services.** CDC, U.S. Department of Health and Human Services, Atlanta, Report No.MMWR 2001;50(No. RR-7).
- CRRRI (2007) **Annual Report 2007.** Central Road Research Institute, New Delhi.
- Delhi Traffic Police (2007) **Road Accidents in Delhi - 2006.** Accident Research Cell, Delhi Police, New Delhi.
- Directorate of Economics & Statistics (2008) **Delhi Statistical Hand Book 2008.** Government of National Capital Territory of Delhi, Delhi.
- Expert committee on auto fuel policy (2002) **Urban Road Traffic and Air Pollution in Major Cities: Volume 1.** Government of India, New Delhi.
- Mohan, D., Tsimhoni, Sivak, M., & Flannagan, M. J. (2009) **Road Safety in India: Challenges and Opportunities.** University of Michigan Transportation Research Institute, Ann Arbor, MI, Report No.UMTRI-2009-1.