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Risky behavior of drivers of motorized two wheeled vehicles in India

Rakhi Dandona *, G. Anil Kumar, Lalit Dandona

Health Studies Area, Centre for Human Development, Administrative Staff College of India, Hyderabad, India

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Abstract

Introduction: Motorized two-wheeled vehicles (MTV) account for a large proportion of road traffic in India and the riders of these vehicles have a high risk of road traffic injuries. We report on the availability of drivers licenses, use of a helmet, driver behavior, and condition of vehicles for MTV drivers in Hyderabad, a city in India. *Methods:* Drivers of a MTV aged >16 years were interviewed at petrol filling stations. *Results:* There were 4,183 MTV drivers who participated in the study. Four hundred sixty one (11%; 95% CI 9.7–12.3%) drivers had not obtained a drivers license and 798 (21.4%) had obtained a license without taking the mandatory driving test. Two thousand nine hundred twenty (69.8%; 95% CI 67.9–71.7%) drivers reported no/very occasional use of a helmet, the significant predictors of which included that those driving borrowed a MTV (odds ratio 7.90; 95% CI 3.40–18.40) or driving moped/scooterette/scooter as compared with motorcycle (3.32; 2.76–3.98), lower education (3.10; 2.66–3.61), age >45 years (2.41; 1.63 – 3.57), and males (1.57; 1.16 – 2.13). Two thousand five hundred and eight (59.9%) drivers reported committing a traffic law violation at least once within the last 3 months. Overall, 1,222 (29.2%) drivers reported ever being caught by traffic police for a traffic law violation with data on violations available for 1,205 of these drivers, of whom 680 (56.4%) paid a fine, 310 (25.7%) paid by bribe, and 215 (17.8%) made no payment. The proportion of those who did not make payment for committed violation was significantly higher among females (46.8%) than males (16.3%). Two thousand fifty two (49%) of all MTVs had no rearview mirror. *Conclusions:* These data suggest the need to enact and enforce policy interventions for improving the drivers license system, mandatory use of a helmet, effective traffic law enforcement, and ensuring good vehicle condition to reduce the risk factors that potentially contribute to mortality and morbidity in road traffic crashes in MTV drivers in Indian cities.
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Keywords: Drivers license; Helmet; India; Motorized two-wheeler; Violations

1. Problem

Road traffic injuries cause a significant amount of injury-related mortality and morbidity around the world with an estimated 1.2 million people killed and about 20–50 million injured on the roads annually (Peden et al., 2004); they are ranked among the top 10 leading causes of death worldwide (Krug, 1999; Murray & Lopez, 1996; Peden et al., 2004). Nearly 85% of the global burden of road traffic injuries is accounted for by the low- and middle-income countries (Peden et al., 2004). Projections for the year 2020 estimate a decline of about 30% in mortality due to road traffic injuries in high-income countries but a substantial increase in low- and middle-income countries (Murray & Lopez, 1996). Road traffic crashes disproportionately impact the poor and vulnerable in the society. Pedestrians, cyclists, and moped and motorcycle riders account for large proportions of the road traffic and road traffic deaths in the low- and middle-income countries, and they are more often from the lower socioeconomic groups (Dandona & Mishra, 2004; Ghaffar, Hyder, & Masud, 2004; Mohan, 2002; Nantulya & Reich, 2002, 2003; Odero, Garner, & Zwi, 1997; Ojha, 2002; Peden et al., 2004; Yang & Kim, 2003; Wang et al., 2003).

Road traffic crashes result from a variety of factors, such as poor road design, failure to use safety devices such as helmets and seat belts, lack of appropriate vehicle maintenance, unskilled drivers, space conflict between the different

* Corresponding author. Health Studies Area, Administrative Staff College of India, Hyderabad - 500 082, India. Tel.: +91 40 2331 0952; fax: +91 40 2331 2954.
E-mail address: rakhi@asci.org.in (R. Dandona).

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types of road users, hazardous conditions, and impairment due to use of alcohol or drugs. It is possible to either control or prevent these factors to reduce mortality and morbidity due to road traffic injuries as evidenced by the decline in mortality due to road traffic injuries in the high-income countries (Peden et al., 2004). The recently released *World report on road traffic injury prevention* clearly emphasizes the need for data on road traffic injuries, conditions of roads and vehicles, and driver behavior, as these are imperative for setting intervention priorities and to formulate preventive policies (Peden et al., 2004). However, there is lack of this type of reliable data from the low- and middle-income countries, including India. A recent review of health research output from India for the year 2002 revealed that of all the health research published from India and included in the PubMed database, only 0.8% was on "injuries" (road traffic injuries: 0.1%), although "injuries" are estimated to cause 17% of the ill-health burden in India (Dandona, Sivan, Jyothi, & Bhaskar, 2004).

The number of deaths from road traffic injuries were the second highest in the South East Asia Region of the World Health Organization in 2002, and these deaths were mainly accounted for by India (Peden et al., 2004). The number of people killed in road traffic crashes in India has increased from 14,500 to 82,700 and the number of people injured from 70,100 to 404,800 from the year 1970 to 2002, according to the Government of India statistics based on the police records of road crashes (Government of India, 2004a). On the other hand, road traffic injuries were the 7th and 9th leading cause of death and of burden of disease, respectively, with an estimated 216,859 people killed and 7.2 million disability-adjusted life years lost in the year 1998 in India based on the health system records (Krug, 1999). Pedestrians and two-wheeler riders are the most vulnerable to fatalities and injuries in road traffic crashes in India as compared with people riding in cars (Dandona & Mishra, 2004; Mohan, 2002; Ojha, 2002).

The greatest growth rate in the number of motor vehicles in the world is expected in the Asian countries, and most of this increase is likely to be in the motorized two-wheeled and three-wheeled vehicles (Mohan & Tiwari, 1998). Currently, two-wheeled vehicles account for 80% of all the non-transport motor vehicles in India (Government of India, 2004b). In the background of the motorized two-wheeled vehicles (MTV) accounting for a large proportion of road traffic and the riders of these vehicles having a higher risk of road traffic injuries in India, we report data on availability of drivers license, use of a helmet, driver behavior, and condition of vehicles for MTV drivers in Hyderabad, India. Hyderabad is the sixth largest Indian city with an estimated population of 5.5 million in 2001 and has 70% literacy (Government of India, 2001). A total of 1,178,121 motor-vehicles were registered in the city in the year 2001-2002, of which 77% were MTVs, 11% cars, and the rest were other types of motor-vehicles (Government of Andhra Pradesh, 2004). Vehicles in India are driven on the left side of the road.

2. Methods

2.1. Study population

The study participants were selected from MTV drivers in Hyderabad. The MTV included: moped (<100 cc engine), scooterette (60–105 cc engine), scooter (100–150 cc engine), and motorcycle (>100 cc engine).

The study participants were recruited at the petrol filling stations in the city. Four oil companies retail petrol through self-owned or dealer-owned petrol filling stations in the city. All except one provided us with the list of their petrol filling stations after we discussed with them the purpose of the study. The lists included location, duration of functioning, and level of volume per day (high, medium, low) in terms of number of MTV drivers utilizing the services for each petrol filling station. From the 111 petrol filling stations within the administrative city limits, we excluded those that were functional for 6 months or less at the time of starting this study (19) and those for which the oil companies had some reservations for conducting this study (23). The remaining 69 petrol filling stations in the list were visited, and the petrol filling stations with not enough space to conduct interviews were excluded as it was not feasible to conduct interviews without interfering with the work at these stations (18). In the end, 51 petrol filling stations were available in the city for this study. Of these petrol filling stations, 17 (33.3%) were high-, 23 (45.1%) were medium-, and 11 (21.6%) were low-volume petrol filling stations. The study was designed to conduct interviews of at least 4,000 MTV drivers, with similar number of interviews of drivers for the high-, medium- and low-volume petrol filling stations.

Permission to conduct interviews was given by the managers of the respective petrol filling stations after assurances that their workflow would not be disturbed, and that the study team would contact the drivers outside the petrol filling station premises after they had filled petrol/air. The drivers who stopped to listen to the team members were explained the purpose of the study, and those who agreed to participate were asked to move to the interview area setup at one corner of the petrol filling station for interview. Only drivers 16 years of age or more were requested to participate in the study.

2.2. Data collection

Two teams, each consisting of a supervisor and four interviewers, were involved in data collection. Written informed consent for participation in the study was sought from all drivers after the interviewer provided details of the study. Interviewers, trained in the study procedures, then interviewed the participants using a questionnaire designed

for this study. The questionnaire was used to document participant's: household data including head of the household, number of members, and income; details on drivers license; use of a helmet; driving behavior of the participant including overtaking another vehicle; driving in direction opposite to the traffic direction; riding motorized two-wheeled vehicle with more than two people; use of hand-held mobile phone while driving; and traffic law violations in the last 3 months. In addition, the interviewers checked and documented the presence and working of a rearview mirror, front and back indicators, and rear stop light in the two-wheeler that the participant was driving. Reasons for using/not using a helmet, for driving in direction opposite of traffic direction, and for not having a rearview mirror in the vehicle were documented in detail. These were open-ended questions. The questionnaire contained a list of reasons for each of these questions, and the response given by the participant was marked by the interviewer against the reason listed on the questionnaire that correlated the most with it. The response given by the participant was documented fully in a separate column if it did not correlate with any of the reasons listed in the questionnaire. All the responses were marked if a participant gave more than one reason. The questionnaire was developed in English, was translated to Telugu and Hindi, the two main local languages, following which it was back-translated into English in order to ensure accurate and relevant meaning and intent of the questions. The interview duration ranged from 25 to 40 minutes. This study was conducted from April to September 2004.

Data entry operators entered data in a MS Access database designed for the study. All data entries made by a data entry operator were fully checked by another operator to detect and correct errors in data entry.

3. Data analysis

The main outcome variables assessed in the analyses were: not having a drivers license, no or very occasional use of a helmet, driving behavior, traffic law violations committed, and vehicle condition. Data were analyzed using SPSS software. Univariate analyses were conducted for the association of these outcome variables with other characteristics, and chi-square test for significance is reported. For this analysis, the traffic law violations were classified as - *driving violations* (e.g., red light violation, driving in the direction opposite of the direction of traffic, entering a no-entry zone, use of mobile phone while driving), *document violations* (e.g., lack of drivers license, vehicle registration documents), *vehicle violations* (e.g., no functional headlight, no horn, no rear-view mirror), and *parking violations* (parking in a no-parking zone). The age at which the respondent started driving a MTV on a public road and at which the drivers license was taken, and whether the mandatory test for obtaining the drivers license was given are also reported.

Multivariate analyses using multiple logistic regression were conducted for two outcome variables: (a) not having a drivers license and (b) no or very occasional use of a helmet. The possible interactions between different variables in the model were assessed in a separate model, and the significant interactions are reported. The 95% confidence intervals of estimates of the outcome variables were calculated.

4. Results

Attempt was made to contact 6,150 MTV drivers by the study team. Of these 984 (16%) drivers did not stop, 157 (2.5%) asked not be disturbed and did not hear about the study, and 5,009 (81.4%) stopped to listen to the purpose of the study. Of these 5,009 drivers, 4,183 (83.5%) participated in the study.

Table 1 describes the participant details. The majority of the participants were males and literate, and a little over half were between 16 to 30 years of age and were the main income earners in their households. The proportion of males currently married was higher as compared with females. The majority of the females were driving a scooter, and a little over half among males were driving a motorcycle.

4.1. Drivers license

There were 461 (11%; 95% CI 9.7–12.3%) drivers who had not obtained their drivers license. With multiple logistic regression (Table 2), the odds of not having a drivers license were significantly higher for drivers aged 16–25 years, with schooling up to class XII or less, those driving moped or borrowed vehicle, and those not having vehicle registration or insurance documents. No significant association of not having a drivers license was found with gender. There was no significant interaction between age and gender, and gender and type of MTV. Seven hundred ninety eight (21.4%) had obtained a license without taking the mandatory driving test, 335 (9%) had obtained their licenses >20 years ago, 270 (7.3%) had driven a vehicle on a public road (which has at least one traffic signal) between the ages of 10–15 years, and 18 (0.5%) reported having obtained a drivers license between 10–15 years of age.

4.2. Use of a helmet

There were 1,140 (27.3%), 123 (2.9%), 524 (12.5%), and 2,396 (57.3%) drivers who reported using a helmet always, very often, very occasionally, and never, respectively. Therefore, 2,920 (69.8%; 95% CI 67.9–71.7%) drivers reported no/very occasional use of a helmet while driving. With multiple logistic regression (Table 2), the odds of no/very occasional use of a helmet were

Table 1
Description of the drivers of motorised two-wheeled vehicles for the two genders that participated in the study

Variable	Variable categories	Gender		Total N=4183 Number (%)†
		Male N=3412 Number (%)*	Female N=771 Number (%)*	
Age group (years)‡	16–20	201 (54.5)	168 (45.5)	369 (8.8)
	21–25	705 (75.0)	235 (25.0)	940 (22.5)
	26–30	756 (82.4)	161 (17.6)	917 (21.9)
	31–35	566 (86.0)	92 (14.0)	658 (15.7)
	36–40	416 (86.7)	64 (13.3)	480 (11.5)
	41–45	325 (92.3)	27 (7.7)	352 (8.4)
	46–50	206 (93.2)	15 (6.8)	221 (5.3)
	>50	237 (96.3)	9 (3.7)	246 (5.9)
Marital status‡,§	Currently married	2124 (86.3)	338 (13.7)	2462 (58.9)
	Previously married	22 (73.3.)	8 (26.7)	30 (0.7)
	Never married	1265 (74.9)	425 (25.1)	1690 (40.4)
Education‡,§	No education or upto class V	97 (100)	0	97 (2.3)
	Class VI to X	530 (95.2)	2 (4.8)	557 (13.3)
	Class XI and XII	698 (91.8)	62 (8.2)	760 (18.2)
	Under graduate	925 (86.2)	148 (13.8)	1073 (25.7)
	Graduate or higher	1161 (68.5)	534 (31.5)	1695 (40.5)
Occupation‡	Professional	858 (81.7)	192 (18.3)	1050 (25.1)
	Semi-skilled worker	560 (89.6)	65 (10.4)	625 (14.9)
	Unskilled worker	608 (85.2)	106 (14.8)	714 (17.1)
	Self-employed	807 (98.4)	13 (1.6)	820 (19.6)
	Home duties /retired /unemployed	185 (62.3)	112 (37.7)	297 (7.1)
	Student	394 (58.2)	283 (41.8)	677 (16.2)
Participant main income earner‡,§	Yes	2186 (97.2)	64 (2.8)	2250 (53.8)
	No	1221 (63.3)	707 (36.7)	1928 (46.1)
Per capita monthly income for household (Indian Rupees)‡,§	≤500	34 (94.4)	2 (5.6)	36 (0.9)
	501–2000	1148 (95.8)	50 (4.2)	1198 (28.6)
	2001–4000	1074 (85)	190 (15)	1264 (30.2)
	>4000	612 (65.7)	323 (34.3)	932 (22.3)
Type of motorised two-wheeled vehicle‡	Moped	230 (92.7)	18 (7.3)	248 (5.9)
	Scooterette	995 (99.1)	9 (0.9)	1004 (24)
	Scooter	316 (30.0)	737 (70.0)	1053 (25.2)
	Motorcycle	1871 (99.6)	7 (0.4)	1878 (44.9)
Reported average distance travelled/day (kms)‡	1–10	211 (50.3)	208 (49.7)	419 (10.1)
	11–20	334 (60.7)	216 (39.3)	550 (13.1)
	21–30	494 (76.8)	149 (23.2)	643 (15.4)
	31–40	576 (87.0)	86 (13.0)	662 (15.8)
	41–50	581 (90.9)	58 (9.1)	639 (15.3)
	>50	1216 (95.7)	54 (4.3)	1270 (30.4)
Reported average driving speed in city (km/hr)‡	<40	1036 (68.5)	476 (31.5)	1512 (36.1)
	40–50	2092 (88.0)	284 (12.0)	2376 (56.8)
	>50	281 (96.6)	10 (3.4)	291 (7.0)
	Cannot say	3 (75.0)	1 (25.0)	4 (0.1)

Indian Rupees 500=US$ 11.1.
* Percent of total in that variable category.
† Percent of total (4183).
‡ $p<0.001$; Chi-square test.
§ Data not available for 1, 1, 5 and 753 participants on marital status, education, participant main income earner and per capita monthly household income, respectively.

significantly higher for the drivers >46 years of age, males, with lower education, for all other MTV as compared with a motorcycle, and those driving a borrowed vehicle. There was significant interaction between age and gender ($p<0.001$).

Fig. 1 shows the reasons for no/very occasional use of a helmet (not mutually exclusive). *Discomfort* (*suffocation*, *it feels hot,* and *it feels heavy on the head*) was the most commonly cited reason (32%) followed by *helmet was not needed for moped and scooter drivers* (12.3%). Reasons relating to inconvenience, distance and time of travel were the other significantly cited reasons. Among the 1,140 drivers who reported wearing a helmet always while driving, 1,084 (69.5%) reported using a helmet for safety, 417 (26.7%) as protection from pollution, 18 (1.2%) because they had had an accident, and 41 (2.6%) reported other reasons (reasons not mutually exclusive).

Table 2
Association of select variables with not having drivers license and with no or very occasional use of helmet while driving using multiple logistic regression

Variable	Variable categories	Total	Number without drivers license (% of total in that variable category)	Odds ratio for not having drivers license (95% confidence interval)	Number who never/very occasionally use helmet (% of total in that variable category)	Odds ratio for no/very occasional use of helmet while driving (95% confidence interval)
Age group (years)*,†	16–20	369	153 (41.5)	17.68 (9.09–34.38)	265 (71.8%)	1.00
	21–25	940	156 (16.6)	5.71 (3.00–10.87)	629 (66.9%)	1.07 (0.80–1.43)
	26–45	2407	132 (5.5)	1.42 (0.76–2.65)	1614 (67.1%)	0.93 (0.70–1.22)
	46–50	221	6 (2.7)	0.47 (0.16–1.32)	190 (86.0%)	1.84 (1.13–2.97)
	>50	246	14 (5.7)	1.00	222 (90.2%)	2.23 (1.32–3.76)
Gender‡	Male	3412	356 (10.4)	1.00	2477 (72.6%)	1.57 (1.16–2.13)
	Female	771	105 (13.6)	1.21 (0.74–1.97)	443 (57.5%)	1.00
Education‡	No education or upto class V	97	25 (25.8)	5.34 (2.77–10.31)	92 (94.8%)	7.06 (2.79–17.89)
	Class VI to X	557	108 (19.4)	3.14 (2.13–4.62)	514 (92.3%)	6.46 (4.60–9.08)
	Class XI and XII	760	111 (14.6)	2.38 (1.65–3.43)	649 (85.4%)	3.99 (3.14–5.05)
	Under graduate	1073	121 (11.3)	1.34 (0.95–1.88)	759 (70.7%)	2.11 (1.77–2.52)
	Graduate or higher	1695	96 (5.7)	1.00	906 (53.5%)	1.00
Type of motorised two-wheeled vehicle‡	Moped	248	56 (22.6)	2.32 (1.49–3.61)	240 (96.8%)	12.54 (6.01–25.95)
	Scooter	1004	117 (11.7)	1.17 (0.85–1.62)	880 (87.6%)	3.30 (2.46–4.13)
	Scooterette	1053	133 (12.6)	1.20 (0.75–1.92)	656 (62.3%)	1.82 (1.37–2.41)
	Motorcycle	1878	155 (8.3)	1.00	1144 (60.9%)	1.00
Ownership of vehicle‡	Own	4068	398 (9.8)	1.00	2811 (69.1%)	1.00
	Borrowed	115	63 (54.8)	2.31 (1.44–3.72)	109 (94.8%)	7.89 (3.39–18.40)
Had vehicle registration documents§	Yes	3644	216 (5.9)	1.00		
	No	539	245 (45.5)	5.67 (3.94–8.18)		
Had vehicle insurance documents§	Yes	3192	164 (5.1)	1.00		
	No	991	297 (30.0)	2.07 (1.46–2.95)		

* Some age categories combined based on initial iterations that showed similar values for outcome variable in order to increase the power of the analysis.
† $p<0.001$, Chi-square test - for not having drivers license and for no/very occasional use of helmet while driving.
‡ $p=0.011$ and $p<0.001$, Chi-square test - for not having drivers license and for no/very occasional use of helmet while driving, respectively.
§ $p<0.001$, Chi-square test - for not having drivers license.

4.3. Driving behavior and traffic law violations

There were 2,732 (65.3%), 234 (5.6%), and 1,217 (29.1%) drivers who reported over-taking another vehicle from the right, left, or any side depending on the traffic, respectively. Of the participants, 2438 (58.3%) reported having never driven a vehicle in the direction opposite to the flow of traffic. The reasons for driving in the opposite direction of traffic included (not mutually exclusive) - *to cut short the distance toward gap in the median* (967, 55.3%),

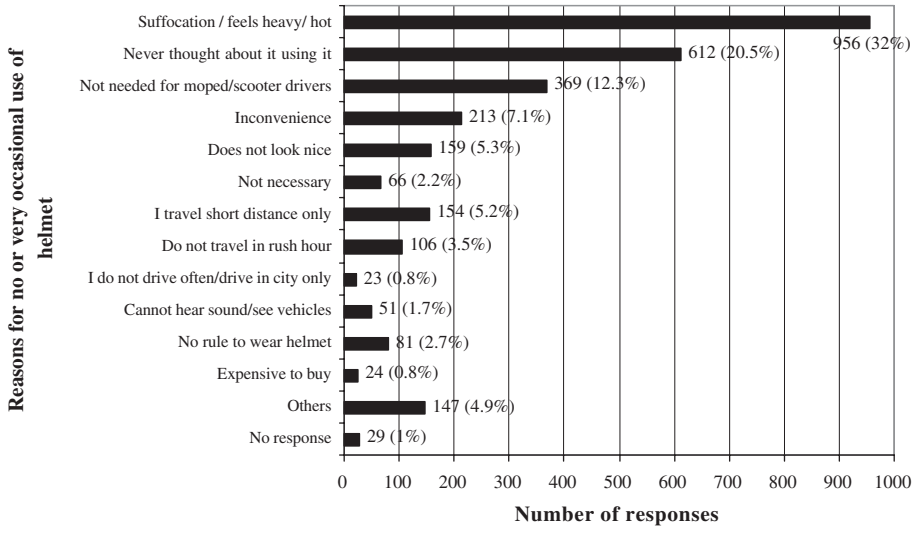


Fig. 1. Reasons for no or very occasional use of helmet while driving by the drivers of motorised two-wheeled vehicles (not mutually exclusive).

Table 3
Distribution of self-reported traffic law violations committed by the drivers of motorised two-wheeled vehicles in the last 3 months

Variable	Variable categories	Total	Number violated red light (% of total in that variable category) N=1270	Number violated no U-turn (% of total in that variable category) N=1168	Number violated no entry (% of total in that variable category) N=975	Number violated traffic direction (% of total in that variable category) N=1207	Number with any violation (% of total in that variable category) N=2058
Age group (years)*	16–20	369	130 (35.2)	77 (20.9%)	78 (21.1)	101 (27.4)	179 (48.5)
	21–25	940	330 (35.1)	265 (28.2)	246 (26.2)	320 (34.0)	504 (53.6)
	26–30	917	331 (36.1)	296 (32.3)	252 (27.5)	281 (30.6)	503 (54.9)
	31–35	658	188 (28.6)	194 (29.5)	156 (23.7)	210 (31.9)	327 (49.7)
	36–40	480	136 (28.3)	49 (31.0)	122 (25.4)	133 (27.7)	245 (51.0)
	41–45	352	85 (24.1)	78 (22.2)	64 (18.2)	101 (28.7)	151 (42.9)
	46–50	221	39 (17.6)	65 (29.4)	32 (14.5)	39 (17.6)	86 (38.9)
	>50	246	31 (12.6)	44 (17.9)	25 (10.2)	22 (8.9)	63 (25.6)
Gender*	Male	3412	1113 (32.6)	1114 (32.6)	920 (27.0)	1075 (31.5)	1846 (54.1)
	Female	771	157 (20.4)	54 (7.0)	55 (7.1)	132 (17.1)	212 (27.5)
Type of motorised two-wheeled vehicle*	Moped	248	72 (29.0)	64 (25.8)	54 (21.8)	77 (31.0)	132 (53.2)
	Scooter	1004	300 (29.9)	304 (30.3)	242 (24.1)	281 (28.0)	491 (48.9)
	Scooterette	1053	224 (21.3)	131 (12.4)	125 (11.9)	202 (19.2)	341 (32.4)
	Motorcycle	1878	674 (35.9)	669 (35.6)	554 (29.5)	647 (34.5)	1094 (58.3)
Has drivers license*	Yes	3722	1082 (29.1)	1028 (7.6)	833 (22.4)	1046 (28.1)	1785 (47.9)
	No	461	188 (40.8)	140 (30.4)	142 (30.8)	161 (34.9)	273 (59.2)

* $p<0.001$, Chi-square test; for violation of- red light, no U turn, no entry, traffic direction, and any violation.

Table 4
Distribution of the most recent traffic law violation committed by the drivers of motorised two-wheeled vehicles for which they were caught by the traffic police

Variable	Variable categories	Total	Number ever caught for traffic law violation (% of total in that variable category)	Type of traffic law violation* (% of number ever caught for violation in that variable category)			
				Driving	Document	Vehicle	Parking
Age group (years)†	16–20	369	93 (25.2)	42 (45.7)	39 (42.4)	10 (10.9)	1 (1.1)
	21–25	940	330 (35.1)	149 (45.8)	92 (28.3)	54 (16.6)	30 (9.2)
	26–30	917	282 (30.8)	153 (54.8)	41 (14.7)	51 (18.3)	34 (12.2)
	31–35	658	176 (26.7)	94 (54)	17 (9.8)	52 (29.9)	11 (6.3)
	36–40	480	142 (29.6)	76 (54.3)	14 (10)	42 (30)	8 (5.7)
	41–45	352	101 (28.7)	43 (43.4)	18 (18.2)	24 (24.2)	14 (14.1)
	46–50	221	53 (24)	23 (44.2)	2 (3.8)	17 (32.7)	10 (19.2)
	>50	246	45 (18.3)	18 (40.9)	8 (18.2)	14 (31.8)	4 (9.1)
Gender‡	Male	3412	1158 (33.9)	556 (48.6)	220 (19.2)	262 (22.9)	105 (9.2)
	Female	771	64 (8.3)	42 (67.7)	11 (7.7)	2 (3.2)	7 (11.3)
Type of motorised two-wheeled vehicle§	Moped	248	63 (25.4)	32 (52.5)	17 (27.9)	10 (16.4)	2 (3.3)
	Scooter	1004	336 (33.5)	152 (45.8)	61 (18.4)	89 (26.8)	30 (9)
	Scooterette	1053	137 (13)	68 (50.4)	28 (20.7)	21 (15.6)	18 (13.3)
	Motorcycle	1878	686 (36.5)	346 (51.1)	125 (18.5)	144 (21.3)	62 (9.2)
Drivers license	Yes	3722	1067 (28.7)	541 (51.4)	152 (14.4)	251 (23.9)	108 (10.3)
	No	461	155 (33.6)	57 (37.3.)	79 (51.6)	13 (8.5)	4 (2.6)
Type of payment#	Paid fine	680		312 (45.9)	123 (18.1)	166 (24.4)	79 (11.6)
	Paid bribe	310		159 (51.3)	67 (21.6)	62 (20)	22 (7.1)
	No payment made	215		127 (59.1)	41 (19.1)	36 (16.7)	11 (5.1)
Amount paid (Indian Rupees)#	1–50	714		345 (48.3)	117 (16.4)	166 (23.2)	86 (12)
	51–100	164		82 (50)	39 (23.8)	34 (20.7)	9 (5.5)
	>100	107		42 (39.3)	34 (31.8)	25 (23.4)	6 (5.6)

Indian Rupees 50=US$ 1.1.

* Data on type of traffic law violation not available for 17 participants.

† $p<0.001$, Chi-square test - for ever been caught for traffic law violation and for types of traffic law violations.

‡ $p<0.001$ and $p=0.002$, Chi-square test - for ever been caught for traffic law violation and for types of traffic law violations, respectively.

§ $p<0.001$ and $p=0.064$, Chi-square test - for ever been caught for traffic law violation and for types of traffic law violations, respectively.

\# $p=0.001$, Chi-square test - for types of traffic law violations.

to drive on a one-way road (941, 53.7%), *to save time* (820, 46.8%), *to save petrol* (261, 14.5%), and *due to other reasons* (61, 3.5%). One thousand seven hundred fifty three (41.9%) reported riding a two-wheeler with more than two people occasionally. There were 2,997 (71.6%) drivers who had a hand-held mobile phone, and of these 621 (20.7%) drivers reported using this phone quite often while driving.

Table 3 shows the details of self-reported traffic law violations committed by the drivers within the last 3 months before the date of interview. This shows that 1,207 (30.4%), 1,168 (27.9%), 975 (23.3%), and 1,207 (28.9%) reported having violated red light, no U-turn, no-entry zone, and the traffic direction by driving in the direction opposite to the flow of traffic, respectively, at least once in the last 3 months. Males, those driving a motorcycle, and not having a drivers license reported higher proportion of traffic law violations ($p<0.001$).

Of the drivers 1,222 (29.2%) reported having been caught by traffic police for a traffic law violation (Table 4), of whom 414 (34%) were most recently caught within the last 3 months, 221 (18.1%) between the last 3.1 to 6 months, 263 (21.6%) between the last 6.1 months to 1 year, and 321 (26.3%) more than a year ago. Of these 1,222 drivers, data on the type of most recent traffic law violation for which police caught the participant was available for 1,205 (98.6%). Of these, 598 (49.6%), 231 (19.2%), 264 (21.9%), and 112 (9.3%) drivers were caught for driving, document, vehicle, and parking violation, respectively. Of the drivers, 680 (56.4%) had paid a fine, 310 (25.7%) paid by bribe, and 215 (17.8%) made no payment for the violation. Fig. 2 shows the type of payment made for the traffic law violation for the two genders. Females were more likely not to make any payment for any type of violation as compared with males ($p<0.001$).

Table 5
Distribution of select vehicle components for the motorised two-wheeled vehicles of the participants

Vehicle component	Category	Number (% of 4183)	In working condition, if present (% of number present)
Rearview mirror	Both right and left present	958 (22.9)	953 (99.5)
	Right present only	1141 (27.3)	1131 (99.1)
	No mirror	2052 (49)	
	Not applicable*	32 (0.8)	
Front indicators	Both right and left present	3791 (90.6)	3576 (94.3)
	Either right or left present	27 (0.6)	22 (81.5)
	None present	89 (2.2)	
	Not applicable*	276 (6.6)	
Rear indicators	Both right and left present	3736 (89.3)	3489 (93.4)
	Either right or left present	66 (1.5)	53 (80.3)
	None present	112 (2.7)	
	Not applicable*	269 (6.5)	
Rear stop light	Present	4120 (98.5)	3958 (96.1)
	Not present	63 (1.5)	

* Particular vehicle component not part of certain old models of mopeds and scooters.

4.4. Vehicle condition

Of all MTVs, 2,052 (49%) had no rearview mirror (Table 5). When asked about the reason(s) for not having a rearview mirror (not mutually exclusive), 1,252 (61.4%) of the drivers said that it was not necessary to have a rearview mirror, 414 (20.3%) mentioned that it had broken and they were yet to replace it, 216 (10.6%) said that the rearview mirror caused difficulty in driving or parking (*difficult to navigate with rearview mirror in city traffic, creates*

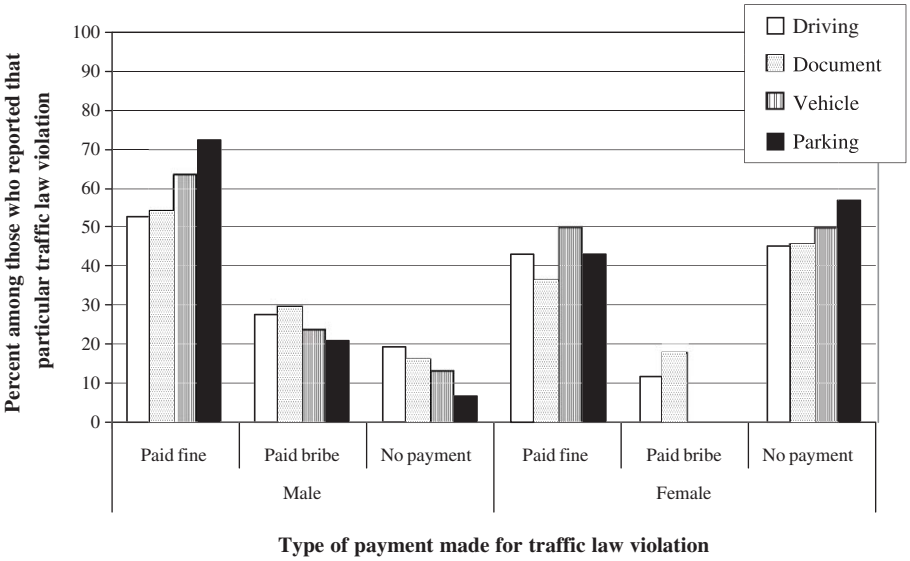


Fig. 2. Type of payment made for the traffic law violations for the two genders.

problem while overtaking another vehicle, reflection from it makes driving difficult, it touches other vehicles while parking), 132 (6.5%) cited some other reasons, and 21 (1.2%) refused to answer. Of the MTVs, 3,576 (85.4%), 3,489 (83.4%), and 3,958 (94.6%) had both right and left front indicators, both right and left rear indicators, and rear stop light in working condition, respectively (Table 5).

5. Discussion

Although all types of road users are at risk of being injured or killed in a road traffic crash, the pedestrians and two-wheeled vehicle riders are at a higher risk than the other road users, and they also bear the greatest burden of injury in the low- and middle-income countries (Dandona & Mishra, 2004; Ghaffar et al., 2004; Mohan, 2002; Nantulya & Reich, 2002, 2003; Odero et al., 1997; Ojha, 2002; Peden et al., 2004; Wang et al., 2003; Yang & Kim, 2003). We have documented the risky driving behavior of MTV drivers, and the condition of their vehicles in Hyderabad. The drivers who participated in this study may not be representative of all such drivers in the city, but no data on the profile of MTV drivers in the city are available to assess the extent of such a bias in this study sample. Hence, the results of this study should be viewed within these limitations.

5.1. Drivers license

Of the drivers in our study, 11% had not obtained a drivers license, and these participants were more likely to be young, and driving a moped or borrowed MTV. The interviewers had verified the availability of a drivers license with the drivers who were interviewed, and hence the proportion of those not having a drivers license is not underreported. In this study, 7.3% of the drivers reported driving a MTV on a main road between the ages of 10–15 years, which is below the age (16 years) of obtaining a learners drivers license for a MTV with <50cc engine. This finding of unlicensed driving in young people is of importance because globally road crash injury is a leading cause of death for young drivers, and the risk is higher for young men in their first few years of driving (Peden, McGee, & Krug, 2002; Peden et al, 2004; Williams, 2003). As reported by us elsewhere, among the people killed in road traffic crashes in Hyderabad in 2002, 31.8% were MTV riders and 47.5% of them were between 16–29 years of age (Dandona & Mishra, 2004). Among the MTV drivers caught for violations by the Hyderabad traffic police, the proportion caught for document violations (including not having a drivers license) has increased from 1.1% in 2001 to 18.7% in 2003 (Dandona, Kumar, & Dandona, 2005). Among those who had a drivers license, 21.4% reported having obtained it without taking the mandatory driving test. It is common knowledge in India that it is relatively easy to bypass the driving test to obtain a drivers license either through driving schools or by bribing the concerned officials. Furthermore, 9% of the drivers in this study had obtained their drivers license >20 years ago. The validity of non-transport vehicle drivers license in India is for 20 years or until the holder attains the age of 50 years, following which renewal is required. With such a long period of validity of license, and with no effective systems in place to ensure renewal of an invalid drivers license, to check driving skills or medical condition once a license is issued, or to link the license with traffic law violations or road traffic crashes for each driver, obtaining a drivers license in India is generally considered to be a once in a lifetime activity.

5.2. Use of a helmet

Helmet use by the MTV drivers in this study was quite low at 30.2%. This finding is of significance because non-use of a helmet is a major risk factor for road traffic injury in MTV riders. Head trauma is estimated to account for 55%–88% of deaths of two-wheeled vehicle riders (Commission of the European Communities, 2001; Radin Umar, 2002), and use of a helmet has been shown to reduce fatal and serious head injuries (Mishra, Banerji, & Mohan, 1984; Servadei, Begliomini, Giustini, Taggi, & Krause, 2003; World Health Organization, 2004). In India, helmet use varies from very low to 100% based on the level of enforcement of mandatory helmet law. For example, use of a helmet is optional in Hyderabad but is compulsory in New Delhi. Attempts are currently being made in Hyderabad to make it mandatory for the MTV drivers to wear a helmet.

Reasons such as *discomfort, feels hot in a helmet*, and *a helmet feels heavy on the head* could be directly related to helmet design and the hot climate in India. The helmets currently in vogue in the city have a style that covers the head and face, and are heavy. Helmets with designs that are lightweight and take into account the high temperatures in India are needed for safety as well as comfort (Mohan, 2002). We explored some attitudinal reasons for not wearing a helmet. Drivers of moped and scooter mentioned that *a helmet was not needed for moped and scooter drivers* because according to them helmets were needed by drivers of "powerful vehicles" that could be driven at a high speed such as motorcycles, and did not consider their vehicles "powerful." *Inconvenience* cited by 7.1% of the drivers included the inconvenience of carrying the helmet with them, as they were afraid that it could be stolen if left on the vehicle, and the inconvenience of removing it now and then for taking calls on the hand-held mobile phones while driving. Many of the 20.5% of the drivers who said *never thought about using it*, with further exploration mentioned that this was *because they were good drivers*. Clearly, these misconceptions and a helmet design needs to be addressed in addition to law enforcement to promote the use of a helmet.

5.3. Driving behavior and traffic law violations

Almost half of the drivers reported committing at least one of the assessed violations at least once within the last 3 months, suggesting that a significant proportion of MTV drivers do not follow traffic laws. The proportion of those committing these violations may be higher than that reported because people tend to under-report their bad behavior (O'Neill & Mohan, 2002). In Hyderabad, the city traffic police had registered 8,035 violations per 10,000 registered motor vehicles, and the MTV were among the most commonly registered vehicles for violations in 2003 (Dandona et al., 2005). A review of violations and crashes in EU countries concluded that violations promote crashes but the relationship between the two was neither deterministic nor strong (Zaidel, 2001).

Nearly 30% of drivers reported being caught by traffic police at least once for committing a traffic law violation, and more often for driving violations. The important finding here is that a little more than half of these drivers paid a fine for the violation (given ticket for the violation and receipt for the money paid) to the traffic police, 25.7% paid money as bribe, and 17.9% made no payment at all. Interestingly, females were less likely to pay for the violations if caught by the police. The study team members also reported that male MTV drivers mentioned to them during the interviews that female drivers were "not being punished" by the traffic personnel, and were "getting away by smiling at the police personnel." These data provide evidence of such practice in the city. Of the drivers, 72% paid less than Indian Rupees 50 (US$ 1.1) for the violations, and we have earlier highlighted the need to assess the effectiveness of this amount as a deterrent because this amount is less than the income of one day even for the lower end of the income spectrum of vehicle owners in Hyderabad (Dandona et al., 2005).

5.4. Vehicle condition

Half of the MTV did not have a rearview mirror, and the majority of the drivers did not feel the need to have one. It is common for these drivers to turn their heads right/left while changing lanes/overtaking to look for the vehicles behind them, thereby taking their attention off the road and vehicles ahead. *Difficult to navigate with rearview mirror in city traffic* as a reason for not having rearview mirror summarizes well the manner in which these drivers squeeze in their vehicles between the other vehicles on the road. Of the vehicles, 16.6% and 5% did not have rear end indicators and rear stop light in working condition, respectively. These play an important role in preventing rear-end collisions by providing indication of making a turn and slowing down to the drivers behind the vehicle. Having a working indicator is a pre-requisite to using it. Use of hand by these drivers to indicate the intent of making a turn is still quite prevalent. In addition, "the direction in which these drivers turn their heads and shift their body weight" is increasingly serving as an *indicator* of their intent of making a turn to the drivers behind them in the city. It is not possible to comment on what proportion of the drivers who had the indicators in working condition *actually* used them as we did not document this detail.

In conclusion, this study has highlighted the significant unlicensed driving, low helmet use, high rate of traffic law violations, and poor vehicle condition for the motorized two-wheeled vehicles in Hyderabad. These data could be used to enact and enforce policy interventions such as improvement in the driving license system, mandatory use of a helmet, effective traffic law enforcement, and ensuring good vehicle condition in order to reduce the risk factors that potentially contribute to road traffic crashes in MTV drivers in Indian cities. Further research is necessary to systematically document the role of these risk factors in road traffic crashes in India that result in mortality and morbidity in these drivers, and to monitor and evaluate the outcome of these interventions in reducing this mortality and morbidity.

6. Summary

Motorized two-wheeled vehicles account for a large proportion of road traffic in India and the riders of these vehicles have a high risk of road traffic injuries. The data from this study show significant unlicensed driving, low helmet use, high rate of traffic law violations by these riders, and poor vehicle condition for the motorized two-wheeled vehicles in an Indian city. These data suggest the need to improve the driving license system, enforce mandatory use of a helmet, make traffic law enforcement more effective, and ensure good vehicle condition in order to reduce mortality and morbidity due to road traffic crashes in the drivers of the motorized two-wheeled vehicles in Indian cities.

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Rakhi Dandona, PhD, is Associate Professor with the Health Studies Area at the Centre for Human Development, Administrative Staff College of India, Hyderabad. She is trained in public health, and has experience in population-based behavioral and clinical research dealing with road traffic injuries, HIV/AIDS, blindness and tuberculosis. She has published over 40 research papers in international and national peer-reviewed journals and has contributed two book chapters. Her professional interest is to contribute to the scientific evidence base to improve population health in India with specific focus on road traffic injuries and HIV/AIDS. She was previously Faculty at the International Centre for Advancement of Rural Eye Care, Hyderabad, India.

G. Anil Kumar, PhD, is Consultant Biostatistician with the Health Studies Area at the Centre for Human Development, Administrative Staff College of India, Hyderabad. He is trained in demography and statistics, and has skills in developing and managing large data sets. He is currently involved in data management and analysis of large studies on HIV/AIDS and road traffic injuries. He has previously worked as statistician and lecturer in demography at the Mahatma Gandhi Medical College and Research Institute, Pondicherry, India.

Lalit Dandona, MD, MPH, is Chairperson of the Health Studies Area and Director of the Centre for Human Development, Administrative Staff College of India, Hyderabad. His past affiliation included the Johns Hopkins University, USA. The focus of his work is on epidemiology and public health studies and their application to improve population health. He has led several large public health research studies in India. He has over 85 publications in international and national peer-reviewed professional journals, and has served on the editorial board of two journals.