SELF-REPORTED DIFFERENCES BETWEEN CRASH-INVOLVED AND NON-CRASH-INVOLVED THREE-WHEELER DRIVERS IN SRI LANKA

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Despite being an important mode of transportation in the developing world, little research has been conducted to understand the factors contributing to crashes involving three wheel vehicles. This study surveyed a convenient sample of 505 professional three-wheeler drivers in Sri Lanka to explore the similarities and differences in the demographic and work characteristics between three-wheeler drivers who reported experiencing at least one collision in the past twelve months and those who reported that they were not involved in any collisions. Our study revealed some interesting results that were quite different from those obtained in the studies on professional drivers in developed countries. In particular, both drivers with less than one year and more than five years of driving experience in our study were found to be associated with higher probability of crash involvement. Also, the number of trips per day and the average travel distance per trip were found to be insignificant in delineating between crash-involved and non-crash-involved drivers. Moreover, crash-involved drivers, on average, have significantly fewer working days per week and fewer hours per day, suggesting that the conventional approach used in most developed countries to tackle fatigue among professional drivers do not appear to be suitable for solving the road safety problem involving three-wheeler drivers in a developing country. Also, since the age of most drivers falls in a narrow range, this U-shaped relationship is not likely to be a result of youth and ageing but of inexperience in newer drivers and complacency in more experienced drivers. Lastly, since a relatively large proportion of the drivers had driven without a valid driving license, legislation and enforcement interventions are likely to be less effective than education and engineering countermeasures.

Key Words: Road safety, Three-wheelers, Sri Lanka, Driver characteristics, Work conditions

1. INTRODUCTION

According to a recent World Health Organization report[1], road traffic injuries constitute a major public health and development crisis, and without increased efforts and new initiatives, the total number of road traffic deaths and injuries worldwide is forecasted to rise by 65% between 2000 and 2020, while in low-income and middle-income countries, road deaths are expected to increase by as much as 80%. In 2002, nearly 1.2 million people

Table 1 Reported accidents in Sri Lanka

Year	Fatal	Grievous	Non-Grievous	Damage Only	Total Accidents	Population (Thousands)
1991	1,255	1,899	9,685	21,305	34,144	16,448
1992	1,302	2,112	10,386	23,977	37,777	16,631
1993	1,346	2,299	1,687	26,163	31,495	16,850
1994	1,414	2,554	11,992	27,855	43,815	17,089
1995	1,481	2,588	12,233	31,837	48,139	17,280
1996	1,560	2,615	11,510	32,990	48,675	17,490
1997	1,705	3,310	10,037	34,481	48,533	17,702
1998	1,874	2,393	14,417	35,275	50,959	17,935
1999	1,913	3,144	16,258	34,129	55,444	18,208
2000	1,992	3,006	11,765	16,724	54,250	18,467

Source: Police and Department of Census and Statistics

worldwide died as a result of road traffic injuries and 90% of these were in low and middle-income countries. In Sri Lanka, for example, the number of deaths per 10,000 people has increased by 84.5% between 1975 and 1998[2]. As shown in Table 1, there were 54,250 reported collisions in 2000, of which 1,992 were fatal crashes. Moreover, in contrast to most developed countries, the traffic fatality trends in many developing countries are on the rise. Figure 1 shows the fatal and total traffic collision trends in Sri Lanka from 1991 to 2000.

Part of the increase in the number of deaths per capita in Sri Lanka may have resulted from a rapid increase in the number of motor vehicles on the roads, which has increased from 213,000 in 1977 to 2,066,003 in 2004. This sharp increase is attributed to the policies adopted by successive governments, including the liberalization of the economy and the extensive development projects undertaken with foreign aid during this period. Prior to 1977, the government fully controlled the public transport system and buses were operated according to tight schedules even at night and to rural areas as well. After the liberalization of the economic policies in 1977, public transport services have been declining whereas private automobile fleets have grown rapidly. Although standard vehicles (petrol cars) were initially used as taxis, they were gradually replaced by three-wheelers (see Figure 2). By 2004, 163,319 of the 2,066,003 vehicles in Sri Lanka were three-wheelers and around 3,000 were being added each month. Presently, about 90% of the taxis in the capital, Colombo, comprise three-wheelers and their use is spreading all over the country as a low cost and convenient transport mode.

Despite its popularity in several developing countries like Sri Lanka, India, Thailand and the Philippines, little research has been conducted to understand the impact of these motorized three wheelers on road safety. In one of the few papers on three wheelers[3], the crash worthiness of these vehicles were examined using computer simulation. In addition, a few papers have examined three-wheelers as part of their studies and these papers include one study that performed a traffic conflict analysis for mixed traffic streams[4], and another that analyzed road traffic fatalities in Delhi, India[5]. As the driver is the final decision maker in the chain of events leading to a crash, it is important that research is conducted to understand his or her behavior. The purpose of this paper is to explore the similarities and differences in the demographic and work characteristics between three-wheeler drivers who reported experiencing at least one collision in the past twelve months and those who reported that they were not involved in any collisions.

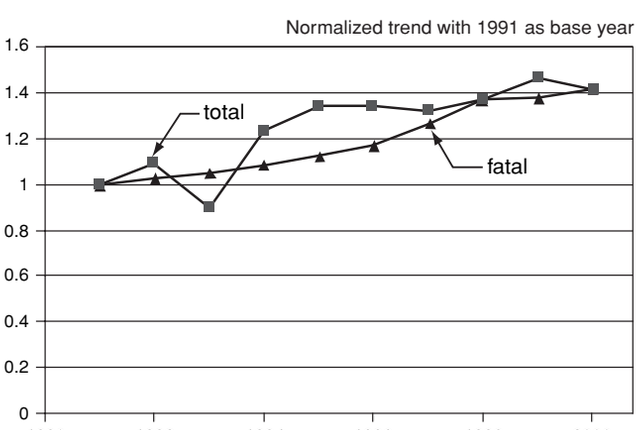

Fig.1 Crash per 10,000 population: 1991-2000

Fig. 2 Three-wheelers

2. METHODOLOGY

Although some official crash statistics is available in Sri Lanka, the under-reporting rate is expected to be quite high and the data available is not as comprehensive and complete compared to those available in most developed countries. Also, anecdotal evidence suggests that many of the collisions, especially non-injury crashes, are settled privately without any official report being filed. Similarly, although official data exist for licenses issued, anecdotal evidence suggests that a fairly large share of the driving population, as compared to most developed countries, does not have a valid driving license – a conjecture that is supported subsequently by the data collected.

Moreover, much of the crash data and information on drivers are not available electronically and matching these data would be very difficult. As a result, a questionnaire survey is deemed to be the most appropriate method to gather the information needed for this study and to include a more representative sample of the drivers.

Due to resource and time constraints, the survey was administered to a sample of 505 professional three wheeler drivers recruited face-to-face at convenient locations, including markets and depots, in five small cities comprising Galle (105), Ambalangoda (100), Wellawaya (100), Polonnaruwa (100) and Embilipitiya (100), where they form a major mode of transportation. These interviews were conducted between April and August of 2004 by undergraduate engineering students from a university in Sri Lanka, under the supervision of their lecturer. Although a conscious effort has been made to ensure that the sample is as representative as possible, there is no simple and feasible way to check for potential sampling bias. Therefore, this study should be considered as exploratory albeit one that is able to provide insightful and useful information.

A questionnaire was designed to gather, among other information, social demographic data on the drivers including age, marital status, vehicle ownership and driving experience, typical working conditions such as number of working days, number of hours per day, number of trips per day and average trip distance, as well as information on crash involvement during the last twelve months. Although information on self reported severity of crashes was available, it was not analyzed separately because the number of serious crashes, especially fatal crashes, was very small. In addition, the reliability of the severity data may not be very high, especially the reliability of self reported severity of injuries to the other party involved. Also, the gender of the driver is not examined in this study because almost all the professional drivers in this industry are males.

3. RESULTS

As shown in Table 2, the age distribution of crash-involved drivers of three-wheel vehicles is more evenly distributed than non-crash-involved drivers; that is, there is a higher percentage of younger as well as older drivers and fewer middle-aged drivers in the crash-involved group compared to the non-crash-involved group. However, these differences are not statistically significant using the chi-square test. Also, there is a slightly greater representation of non- married drivers in the crash-involved group relative to the non-crash-involved group but the difference is again not statistically significant. As expected, the percentage of drivers who own the vehicles they drive is lower for the crash-involved group compared to the non-crash-involved group even though the difference is not statistically significant.

On the other hand, the difference in the share of drivers who have driven without a valid driving license to drive a three-wheeler vehicle (Class E or F) is statistically significant between crash-involved and non-crash-involved drivers. As expected, the percentage of drivers who have driven without a valid operator license is higher in the crash-involved group (27.4%) as compared to the non-crash-involved group (23.1%). It should be noted that about a quarter of the respondents reported that they had driven without a valid operator license suggesting that sampling through the conventional means or using the official licensing data would exclude a large proportion of the three-wheeler drivers on the roads.

Again, as shown in Table 2, the distribution of driving experience for the crash-involved drivers of three-wheeler vehicles is more evenly distributed than for the non-crash-involved drivers; that is, there is a higher percentage of drivers with less than one year of driving experience as well as a higher percentage of drivers with more than five years of driving experience but a lower share of

Table 2 Three-wheeler driver characteristics

	Accident (%)	No accident (%)
Total (505)	39.0	61.0
Drivers' Age		
Below 21	16.8	13.6
21-30	35.0	44.5
31-45	27.4	26.3
46 and above	20.8	15.6
Marital Status		
Married	56.9	58.4
Not Married	43.1	41.6
Vehicle Ownership		
Yes	69.1	72.4
No	30.9	27.6
Driven Unlicensed Last Year *		
Yes	27.4	23.1
No	62.6	76.9
Experience *		
< 1 yr	28.9	19.5
1-3 yrs	28.9	35.7
3-5 yrs	13.7	21.1
> 5 yrs	28.4	23.7

Note: * denotes statistically significant difference at = 0.05

drivers with one to five years of driving experience in the crash-involved group compared to the non-crash-involved group. This difference in driving experience is statistically significant at the 95% confidence level.

The working conditions of the drivers are expected to have a significant impact on the safety of the drivers. As shown in Table 3, drivers who are crash-involved reported a lower average number of working hours per day than those who reported that they were not involved in any crash in the past year. This difference in the number of working hours per day between the crash-involved and non-crash-involved groups is statistically significant using the standard t-test for the equality of means at = 0.05. Also, statistically significant, albeit only marginally (= 0.10), is the difference between the number of working days per week, with the crash-involved drivers reporting a lower average than the non-crash-involved drivers. These results suggest that working time is an important factor in determining self-reported crash involvement.

Also, the average number of self reported trips driven per day was lower for the crash-involved drivers than the non-crash-involved drivers whereas the average distance traveled per trip for the crash-involved drivers was higher than the non-crash-involved drivers. However, these differences were found to be not statistically significant at = 0.10 using the standard t-tests for the equality of means. These results suggest that the actual driving time or active working time is not a significant factor in determining crash involvement.

4. DISCUSSION AND CONCLUSION

The three wheel motor vehicle constitutes an important mode of transportation, especially public transportation, in many developing countries like Thailand, the Philippines, India and Sri Lanka. Despite its importance, little research has been conducted to understand the factors contributing to crashes involving these vehicles. This study attempts to explore the influence of driver demographic characteristics and working conditions on crash involvement via a survey of a convenient sample of professional 505 professional three-wheeler drivers in Sri Lanka. Although the sample is relatively large and appears to be representative of the population of three-wheeler drivers, it is nevertheless a convenient sample and relies on self-reported data. Therefore, the results of this study should be treated as exploratory albeit one that is able to provide some important insights into a much neglected area.

One reason for choosing the face-to-face interview method and a convenient sample was to include a more representative sample of these professional drivers. Our results confirmed our suspicion that many of the three-wheeler drivers have driven without a valid driving license for three-wheeler vehicles and sampling through a conventional method may omit a large share of the drivers on the roads. This result also has serious implications on the types of intervention that are likely to be effective. Compared to most developed countries, legislation and enforcement are thus less likely to be as effective as public education and engineering measures because sanctions are more likely to induce drivers to drive without a valid license. In addition, the three-wheeler taxis are a popular form of transport and an important source of income and employment for the lower middle income population and imposing sanctions to improve safety may have other adverse impacts on the society. Health promotion and safety campaigns are therefore deemed to be the more appropriate intervention method.

It should be noted that there are many factors contributing to the driving risks among three-wheeler drivers including driving experience, fatigue, exposure, and economic needs (pressure to drive aggressively or longer), and the trade-offs amongst these factors are not clear at the outset. Our study found that relative to non-crash-involved drivers, crash-involved drivers tended to be represented to a greater extent by single drivers and drivers who own their vehicles although these differences are not statistically significant. Another statistically insignificant,

Table 3 Three-wheeler drivers' working characteristics

	Accident		Non Accident	
	Average	Std Dev	Average	Std Dev
Number of working hours per day *	12.65	2.42	13.12	1.81
Number of trips per day	15.40	5.16	15.75	4.66
Working days per week **	6.45	0.69	6.56	0.62
Average travel distance per trip (km)	2.56	1.10	2.43	0.88

Note: * & ** denotes statistically significant at = 0.05 & 0.10 respectively.

but interesting result is that the crash-involved drivers are represented by a higher proportion of drivers at both ends of the age distribution.

As age is highly correlated with driving experience, it is therefore not surprising that there is a statistically significant difference in the driving experience of crash-involved and non-crash-involved drivers. Similar to differences in age, crash-involved drivers are over represented at both ends of the experience range. This result is consistent with the widely accepted finding in most developed countries that the relationship between motor vehicle fatality rates and age has a U-shape. Although the factors influencing the higher crash rates among younger and more inexperienced drivers are likely to hold across countries and vehicle types, the more experienced and older age group in this sample consists primarily of drivers over the age of 30 years. Therefore, it is not likely that this increase in crash risk is associated with conventional factors such as reduced driving performance or ability in older drivers but more likely to be due to factors such as increased complacency in driving behavior among drivers with more than five years of driving experience. It is also possible that this difference may be due to increased pressure to drive longer and quicker in order to increase revenue. However, this inference is not consistent with the other results as discussed below.

With respect to working conditions, relative to non-crash-involved drivers, crash-involved drivers, in general, make fewer trips per day but travel longer distances per trip. These differences, however, are not statistically significant, suggesting that short-term driving fatigue or trip exposure may not be a significant differentiating factor between crash-involved and non-crash-involved drivers. Also, crash-involved drivers, on average, have a higher representation of drivers with fewer working hours per day and fewer working days per week. These results, however, are statistically significant and imply that shorter work time is associated with increasing crash involvement, reinforcing the inference that exposure or fatigue is not a delineating factor. This association could be related to the down time associated with crash involvement or the influence of confounding factors such as other work or family commitments that are not captured in the survey.

In summary, our study revealed some interesting results that were quite different from those obtained in the studies on professional drivers in developed countries. In particular, both drivers with less than one year and more than five years of driving experience in our study were found to be associated with higher probability of crash involvement. Also, the number of trips per day and the average travel distance per trip were found to be insignificant in delineating between crash-involved and non-crash-involved drivers. Moreover, crash-involved drivers, on average, have significantly fewer working days per week and fewer hours per day, suggesting that the conventional approach used in most developed countries to tackle fatigue among professional drivers does not appear to be suitable for solving the road safety problem involving three-wheeler drivers in a developing country. More research therefore should be conducted to better understand the contributing factors in crashes involving three-wheeler taxis in order to develop better programs and policies to improve the safety of these drivers.

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