

Comparative analysis of pedestrian-vehicle crashes

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Abstract

In 1999 there were 450 fatalities due to road crashes in Riyadh, the capital of Saudi Arabia, of which 130 were pedestrians. Hence, every fifth person killed on the roads is a pedestrian. The aim of this study is to investigate pedestrian-vehicle crashes in this fast-growing city with the following objective in mind: to analyze pedestrian collisions with regard to their causes, characteristics, and most common patterns. Data from 638 pedestrian-vehicle crashes reported by police were used. The analysis showed that the pedestrian fatality rate per 10^5 population is 2.8 (2.1 in the USA). The analysis revealed that 77.1 percent of pedestrians were probably struck while crossing a roadway either not in a crosswalk or where no crosswalk existed. The paper also includes some international comparisons, in particular with the USA and UK.

1 Introduction

Motor vehicle crashes result in approximately 6,000 pedestrian injuries and 1,000 pedestrian deaths in the Kingdom of Saudi Arabia each year (Official Statistics 1999). More than one-fourth of the severe crashes in this developing country are pedestrian related. During 1999, there were 450 fatalities due to road crashes in Riyadh, the capital of Saudi Arabia; of these, pedestrians accounted for 130 (29 percent). Hence, every fourth person killed on the roads is a pedestrian. In this city Koushki (1988) studied walking characteristics and found that the average walking distance was about 859 m, which when compared with corresponding distances in other Asian cities was fairly low (Tanaboriboon and Jing 1999). In fact, since the oil boom in the early 1970s,

the motorization rate in Saudi Arabia has increased dramatically (about 50-fold). The typical mode of travel in this country is the private car (MOC 1997). However, the problem of pedestrian crashes is still increasing (Official Statistics 1999).

Pedestrian-vehicle collisions are a serious concern because of the severe nature of injuries to those who are struck by vehicles. Past research has established that pedestrians suffer very serious injuries compared with vehicle occupants. The traditional view of pedestrian traffic safety tends to place the burden of responsibility on the behavior of pedestrians and emphasizes education as the means to prevent accidents (Harruff et al. 1998). This view has been investigated by data from developed countries showing that educational efforts are less effective than efforts aimed at modifying the physical and social environment of the transportation system (Roberts and Coggan 1994). In order to help prevent pedestrian accidents, it is necessary to answer questions about the circumstances of pedestrian accidents and the characteristics of the persons involved (Fonaine and Gourlet, 1997). This study attempts to determine the extent of pedestrian responsibility in crashes between motor vehicles and pedestrians in Riyadh. The objectives therefore are twofold: to analyze pedestrian collisions with regard to their causes, characteristics, and most common patterns.

2 Data

To achieve the study objectives, 638 pedestrian-vehicle crashes in Riyadh (over the period 1997-1999) were analyzed. Using data collected from traffic police and hospital records, some of the characteristics of these crashes were examined. A brief summary of the investigative crash records was made, and a database was constructed containing the circumstances of the crash in which the pedestrian was involved. It appeared during this stage that not all necessary data could be found in crash records. The problem with crash data in terms of completeness, clarity, and accessibility is still a major issue in this country, as previous researchers have indicated (*Al-Amr et al. 1998; Al-Ghamdi 1998*). Data collection and record keeping are not computerized but are still done manually. Therefore, the study data, which had been entered manually, were obtained from archived files in the Riyadh Traffic Police Department. A systematic sampling technique was followed in which every third record was used.

3 Analysis and results

The counts in number of victims (in each crash one victim (i.e., injury or fatality) is involved), and proportion of occurrence of the study variables related to pedestrians involved in pedestrian-vehicle crashes are summarized in Table 1. For those variables shown in this table, the frequencies were sufficiently large to perform confidence-interval analyses assuming a normal distribution. It

should be emphasized that the primary purpose of this initial table was to provide an overall view of the data and to suggest variable levels or factors for further analysis.

Table 1: Pedestrian data and 95 percent confidence intervals.

Variable	Frequency	Proportion of Sample (%)	95 percent CI
<u>Age</u>			
0-15	272	42.63	(0.38 – 0.47)
16-30	104	16.30	(0.14 – 0.19)
31-50	160	25.08	(0.22 – 0.29)
50+	92	14.42	(0.12 – 0.17)
Unknown	10	1.57	(0.01 – 0.03)
<u>Sex</u>			
Male	517	80.88	(0.78 – 0.84)
Female	121	18.97	(0.16 – 0.22)
<u>Education</u>			
Literate	269	42.17	(0.39 – 0.46)
Illiterate	201	31.50	(0.28 – 0.35)
Unknown	168	26.33	(0.23 – 0.30)
<u>Nationality</u>			
Saudi	295	46.24	(0.42 – 0.50)
Non-Saudi	338	52.98	(0.49 – 0.57)
Unknown	5	0.78	(0.003 – 0.019)
<u>Social Status</u>			
Married	204	32.0	(0.28-0.36)
Single	330	51.72	(0.48-0.56)
Unknown	104	16.30	(0.14-0.19)
<u>Cause</u>			
Play on roads	36	5.64	(0.04 – 0.08)
Not paying attention	55	8.62	(0.07 – 0.11)
Crossing not at crosswalk	225	35.27	(0.32-0.39)
The above two causes	209	32.76	(0.29-0.37)
Pedestrian not at fault	98	15.36	(0.13-0.18)
Other	15	2.35	(0.01-0.04)

3.1 Age, sex, and nationality

The age of pedestrian victims ranges from about 2 to 67 years, with an average of 28.02 years (st.dev.=11.1). From Table 1, it can be seen that the largest proportion of victims was aged 15 years and under (42.63 percent). The fatality

data among those victims (75 deaths out of 272 victims) also revealed that that the fatality rate (fatalities per victim) is highest for this group (27.57 percent), indicating that there is a need for close attention to the analysis for this age group.

Figure 1 shows the distribution of age-specific fatality rates based on the population of Riyadh (*National Census 1998*). The overall fatality rate per 10^5 population is 2.8. The rates were lowest in the age range 20 to 29 years; compared with this group, the childhood (1 to 9 years) and young adult (10 to 19 years) groups had slightly higher rates and the old-age groups (60 to more than 80 years) had the highest rates (Figure 1).

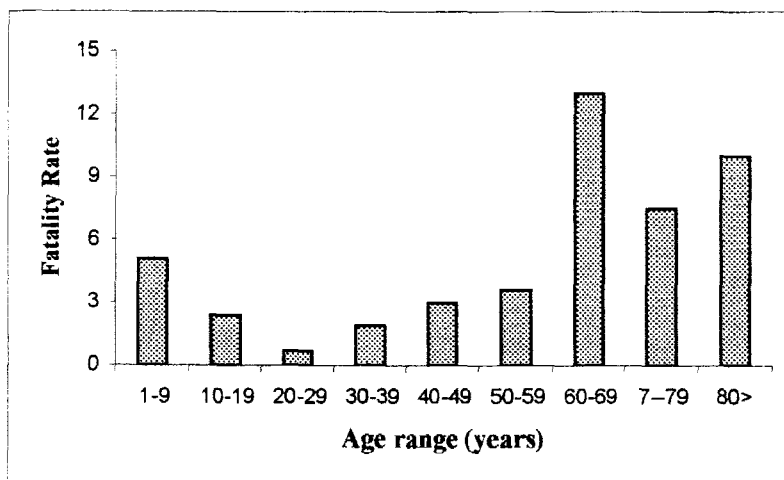


Figure 1: Distribution of age-specific fatality rates (deaths per 10^5 population).

Although women involved in pedestrian crashes accounted for only 18.97 percent of the sample (versus 80.88 percent for men) and their sex is underrepresented in the city (risk index (i.e., the ratio of percent crash involvement in group to percent population in group) of 0.43 versus 1.5 for men), their fatality rate (deaths per 10^5 population) is much higher than that for men, 28.93 percent versus 19.15 percent. Further analysis based on sex will be given later.

It appears from the data in Table 1 that more non-Saudis were involved in pedestrian-vehicle crashes on the basis of the study sample (52.98 percent). To read the picture more accurately, a risk index based on the proportion of non-Saudis in the population of this city was obtained. Accordingly, the risk index for non-Saudis is 1.6 (versus 0.68 for Saudis), indicating that the involvement of this group in pedestrian-vehicle crashes is disproportionate to their representation in the population (they are overrepresented). In other words, non-

Saudis are at much greater risk than Saudis to be involved in such crashes. It should be noted that this result is considered general because of the lack of data on unit exposure (e.g., walking distance traveled). Other characteristics are listed in Table 1.

3.2 Time of crashes

For day of crash, it appears from the study data that Saturday (the first day of the week in Saudi Arabia) has the highest proportion of pedestrian-vehicle crashes (16.93 percent) and Friday has the least (12.07 percent). The weekend days in this country (Thursday and Friday) reported the lowest proportion of crashes among all days. This result is consistent with the general trend in traffic accidents for the country. Official statistics show that Saturday has the highest number of crashes (Official Statistics 1999).

From the study data, it is clear that pedestrian-related crashes were more likely during the night (52.82 percent). Although 56 percent of all traffic crashes occurred in this city during the day (Official Statistics 1999), pedestrian crashes occurred more during the night, which can be attributed to visibility problems, particularly when it is known that more than one-third of such crashes in the study sample (35.31 percent) occurred during weak light conditions.

3.3 Driver characteristics

Looking at the data for drivers in this study, illegal-age drivers (under 18 years) were responsible for about 8 percent (significant at the 5 percent level) of pedestrian-related crashes. Under-age driving is a serious problem in this developing country (Official Statistics 1999). The group with the greatest involvement in these crashes is aged 21 to 30 (39.18 percent). It is clear that the three youngest groups (30 years and under) account for more than half of the driving population (61.49 percent). By nationality, although non-Saudis form about one-third of the population in Riyadh, their involvement proportion (29.31 percent) is less, indicating that this involvement is disproportionate to their representation in the population (the risk index is less than 1, i.e., 0.94).

3.4 Location of crashes

Most pedestrian-vehicle crashes (59.88 percent) in this sample occurred on divided roadways where posted speed limits were fairly high (from 70 km/h to 120 km/h). It should be noted that divided roads in Riyadh are typically busy with business activities (i.e., very congested). This result (i.e., median roadways have higher crashes) does not seem consistent with U.S. or European Studies. However, the study data show that more than two thirds (68.6%) of the women involved in pedestrian crashes (based on the study sample) were struck on

median roadways and we know that women wear black clothing (cultural cloth), which might lead to visibility problems and hence higher crashes on this type of roadway. In short, one can say that women with their cultural clothing may over-represent the problem of such crashes on median roadways in Riyadh.

Unlike results from international research, fewer crashes (less than 5 percent) occurred at intersections, which may be partly because pedestrians like to cross anywhere, even where no crossing is marked, and partly because of the absence of crosswalks at locations where they should be available (Al-Faraj 1998).

Residential streets account for 15.2 percent of victims (97 victims), the second-highest proportion. In Riyadh, no school bus system is available for public schools. Each neighborhood has at least one public school. Breaking down the 97 victims by age, it is apparent that more than half (55.67 percent) of the victims were 15 years old or younger, indicating the great risk for children of this age to be involved in a crash on this type of road. Another study showed that a typical mode for a school trip in residential neighborhoods is walking and that children use residential roads as play areas (Al-Faraj 1998).

In Riyadh the definition of a crosswalk does not depend upon markings on the pavement, and from the data it was sometimes difficult to determine whether the pedestrian was in a marked crosswalk or not in any defined crosswalk at the time of the crash. Unfortunately, even medical examiner reports did not always make a distinction between pedestrians struck within marked crosswalks and those struck in unmarked areas.

Table 2 shows that most pedestrians (77.12 percent) were probably struck while crossing a roadway either not in a crosswalk or where no crosswalk existed (more than 80% of pedestrian casualties in UK occurred while pedestrians were crossing the carriageway (Hunt et. Al 200)). Of those, 48.12 percent were crossing the roadway where no crosswalk existed within 500 m, indicating that there is an availability problem (i.e., a crosswalk is not available where it might be used). On the other hand, 29 percent were crossing where a crosswalk was available within 100 m, indicating either that pedestrians are not aware enough of the danger of crossing at an unmarked place or that the crosswalk is not conveniently placed.

Table 2 also reveals that discipline in crossing roads is not generally observed in Riyadh. This result is consistent with a field survey conducted by Al-Faraj (1998), who studied the attitudes of pedestrians in Riyadh toward crossing facilities. He found that pedestrians were not enthusiastic about using crossing facilities (either at signalized intersections or at underpass or overpass facilities). Similar attitudes have been observed in other developing countries (Tanaboriboon and Jing 1999).

Table 2: Location of crossing activity.

Crossing Activity	Frequency	Proportion of Sample (%)
Crossing roadway at crosswalk	36	5.64
Crossing roadway not at crosswalk ^a	185	29
Crossing roadway where no crosswalk exists ^b	307	48.12
No crosswalk defined	110	17.24

^aWhen marked crosswalk is available within 100 m.

^bWhen no marked crosswalk is available within 300 m.

Compared with those crossing the roadway, pedestrians less commonly (less than 2 percent) were struck as they were walking along or just standing in the roadway or on its shoulder. This finding might be due to the typical curb design in this city, which is higher from the pavement by at least 20 cm and thus may make it less likely for a vehicle to run onto the shoulder. Of all the cases studied, 13 pedestrians (2.04 percent of the sample) were struck as they were working on or otherwise attending to their own stalled vehicles or providing assistance to another motorist.

3.5 Vehicles involved

The study data shows the types of vehicles involved in the crashes studied. Light vehicles, including passenger cars and light trucks, were responsible for 66.9 percent and 22.1 of the cases, respectively. Heavy vehicles (trucks and buses) and vans together accounted for 10.4 percent of all cases.

3.6 Causes

More than half of pedestrian crashes (76.65 percent) were caused by not paying attention and by crossing the roadway without being in a crosswalk, as listed in Table 1. Overall, the proportion of crashes in which drivers were at fault accounted for more than half (47.65 percent) of all crashes. This result may indicate that drivers do not yield the right-of-way properly to pedestrians, who share this right-of-way with drivers. From the pedestrians' point of view, 45.61 percent were reported to be at fault (26% in UK due to pedestrian non-compliance (Hunt et. Al 2000)), indicating that many pedestrians do not pay attention and cross the roadway improperly, as shown from the large proportion mentioned earlier (57.68 percent). It seems from the two proportions (47.65 percent and 45.61 percent, of which the difference is insignificant, p -value = 0.40) that drivers and pedestrians share the burden of responsibility. Although there is a problem with availability and accessibility of marked crosswalks, as discussed earlier.

4 Conclusions

The study provided insight into pedestrian-vehicle crashes in Riyadh. A total of 638 pedestrian-related crashes were analytically investigated.

The study illustrated that young and old age groups are at a higher risk of being involved in pedestrian-vehicle crashes. Divided roadways with fairly high posted speeds and residential streets are the most likely locations for this type of crash.

With respect to causes of crashes, pedestrians and drivers bear the responsibility equally for being involved in pedestrian-vehicle crashes. Not paying attention and crossing a roadway either not in a crosswalk or where no crosswalk exists are the most common causes among pedestrians. Many drivers often do not respect the right-of-way of pedestrians.

The results from this study provide a better understanding of some of the risks and problems related to the age of pedestrians involved in these crashes. This knowledge could help in targeting certain age groups in the population with better designed educational and awareness programs to improve pedestrian traffic safety.

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