

# Characteristics of Pedestrian Accidents in Selected Cities of Saudi Arabia

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Pedestrian accidents are a serious safety problem in Saudi Arabia. Statistics indicate that in 1986, 16 percent of motor vehicle accidents in Saudi Arabia involved pedestrians. A lack of detailed local pedestrian accident data makes it difficult to understand the nature of the problem, so a better understanding of the pedestrian safety problem is sought through the analysis of a pedestrian accident data set gathered specifically for such research. The data needed were collected following special arrangements with the traffic police departments of two large cities, Dammam and Riyadh, and two small cities, Qasim and Qatif. The analysis of the data indicated that although some characteristics of the pedestrian safety problem were common to all four cities, each city also had unique problems. Smaller cities appear, in general, to have a more serious problem than larger cities. The Saudi Arabian pedestrian accident experience is markedly different from the U.S. experience in some respects and almost identical in others.

Accidents involving pedestrians and motor vehicles represent a serious safety problem in Saudi Arabia. Existing statistics indicate that in 1986, 16 percent of Saudi Arabian motor vehicle accidents involved pedestrians (1). In the United States, pedestrian-related accidents constituted only 0.4 percent of motor vehicle accidents but 18 percent of the motor vehicle fatalities in 1988 (2). Although the existing statistics in Saudi Arabia do not indicate the percentage of pedestrian fatalities relative to the total motor vehicle fatalities, it is not difficult to appreciate the seriousness of the pedestrian problem in Saudi Arabia in comparison with the United States.

The lack of detailed pedestrian accident data in Saudi Arabia makes it difficult to understand the nature of the problem and recommend countermeasures. This study was performed as part of a larger study (3) related to pedestrian safety and aims to obtain a better understanding of the pedestrian safety problem through the analysis of pedestrian accident data.

## DATA COLLECTION

Detailed Saudi Arabian pedestrian statistics are not available on a routine basis because there is no well-developed accident reporting system. Therefore, for this study, the traffic police departments (the entities responsible for collecting accident data) of four cities were asked to provide pedestrian accident data. These cities are the capital, Riyadh, at the center of the country; Dammam and Qatif, which are on the east coast; and Qasim, which is 200 km northwest of Riyadh. The populations and sizes of the cities are given in Table 1.

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These cities were selected because they form two contrasting classes. The first class includes Riyadh and Dammam, which are more developed than the cities of the second class, Qasim and Qatif. Furthermore, the former cities have large urban areas and their development pattern is dispersed, unlike Qasim and Qatif, whose populations cluster in remote small villages and densely populated city centers. Therefore, it is expected that urban travel depends on the vehicle in Riyadh and Dammam, whereas walking is more predominant in the urban Qasim and Qatif. These four cities exhibit an equal average automobile ownership rate estimated at 0.6 automobiles per person (1,4).

The traffic departments in Riyadh, Dammam, and Qasim were able to extract pedestrian accident information from the original accident forms that they began using recently. A special arrangement was made with the Qatif police department, which started collecting pedestrian accident data following the request of the study team.

Because of variations in the methods of accident data collection among the four areas, there are some differences in the levels of detail of accident data as well as the length of the reporting periods. Because of these differences, the common parts of the data were analyzed first and the finer details (which were available in the Qatif and Riyadh data) were analyzed separately. The duration of data collection and total numbers of accidents, together with other information, are given in Table 2.

The authors realize that the analysis periods for all the cities are short and therefore suggest that the results presented should only be considered preliminary, needing further verification with future data analysis. On the other hand, some useful information emerged from the data, as will be explained.

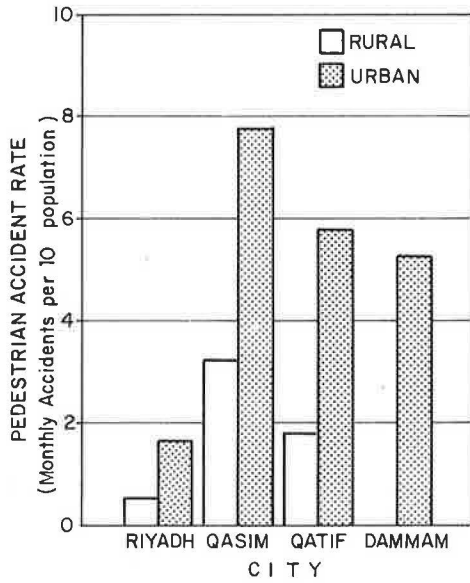
## ANALYSIS OF DATA

The analysis of the collected data was performed in two stages for the reasons given earlier. First the analysis of the data for common information is presented, and it is followed by the presentation of some finer details, obtainable for Qatif and Riyadh only.

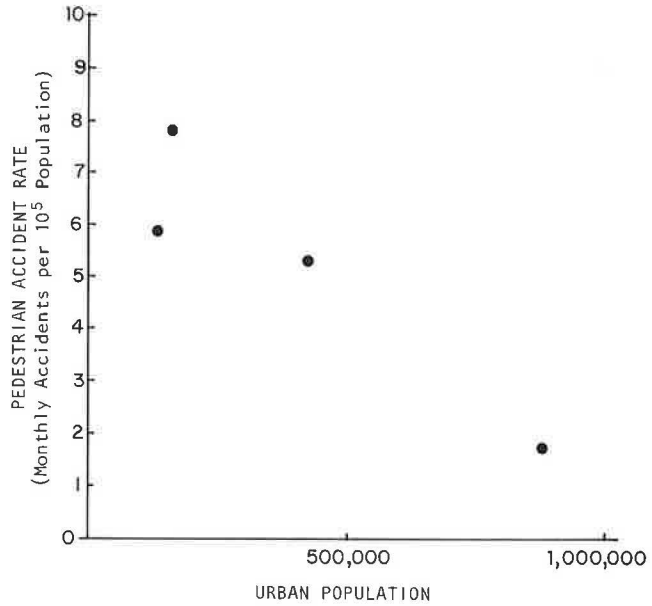
### Analysis of Data Items Common to All Cities

Frequencies of pedestrian accidents recorded on a monthly basis, as well as study durations and some important events during the study periods, are presented in Table 2. Although the study periods are short, and overlapping periods between





**FIGURE 1** Urban and rural pedestrian accident rates for cities.



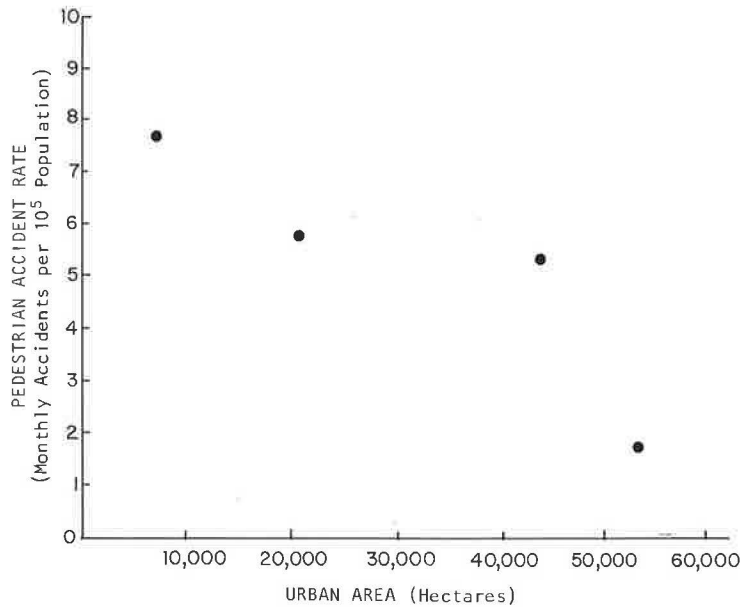
**FIGURE 2** Relationship between urban population size and pedestrian accident rate.

Figures 2 and 3 indicate that as the urban population and area sizes increase, the pedestrian accident rate tends to decrease. This could be due to many factors: for instance, short travel distances could foster more pedestrian activity in smaller cities.

The percentage distributions of urban and rural pedestrian accidents are presented in the following table:

	Urban (%)	Rural (%)
Riyadh	84	16
Qasim	75	25
Qatif	41	59
Dammam	100	0

The corresponding figures for the United States are 85 percent urban and 15 percent rural (2). The table shows that most pedestrian accidents occur in urban areas, with the exception of Qatif where 58 percent of the population lives in areas classified as rural (see Table 1). Qatif is a small agricultural city whose population is mainly involved in the outlying palm gardens and farmlands. Other than in Qatif, the pedestrian accident problem appears to be mainly an urban problem in Saudi Arabia. This is consistent with U.S. experience as demonstrated in the table.



**FIGURE 3** Relationship between urban area size and pedestrian accident rate.

**TABLE 3 Accident Experience for Age Segments**

City	Population Segment <sup>a</sup>	Population Distribution (%)	Pedestrian Accident Distribution (%)	Monthly Pedestrian Accident Rate per 100,000 population
Qasim	Children	62	61	5.68
	Adults	38	39	5.94
Qatif	Children	61	79	7.56
	Adults	39	21	3.19
Dammam	Children	52	71	7.24
	Adults	48	29	3.15

<sup>a</sup>Children: Age ≤ 18 years  
Adult : Age > 18 years

Monthly accident rates (per 100,000 population) by gender for three cities are presented in the following table, which indicates that the rate for men is twice as high as that for women:

	Women	Men
Qasim	3.56	7.90
Qatif	2.99	8.48
Dammam	3.77	6.20

Given that the ratio of men to women, as indicated by the population census data (4,5), is approximately 1:1, it appears that there is a higher incidence of pedestrian accidents among men. This could be explained in cultural terms, given that Saudi Arabian women are more restricted than men in their activities, including walking. In general there are fewer female pedestrians than male pedestrians. However, this difference is also at least partly due to a behavioral difference between the genders. Al-Senan et al. found that male Saudi pedestrians were more aggressive, that they took more risks in their street-crossing behavior than Saudi women (3). They reported that on average, a higher percentage of men (54 percent) than women (34 percent) did not stop at curbs. And a higher percentage of men (56 percent) than women (31 percent) crossed signalized intersections in prohibited phases.

Table 3 gives percentage distributions and accident rates for the cities for two age categories: 18 and younger, and older than 18. The Riyadh data were not available for these categories. For Qasim, the percentage distribution is the same for accident frequency as for the population distribution in each age category, implying that risk is the same for these age categories. This fact (for Qasim) is supported by the fact that the monthly accident rate per 100,000 population in each category is nearly equal. Rates for Qatif and Dammam show that the younger population is more at risk (about twice) than

the older group. It appears that at least in two of three cities, the younger pedestrian population is more at risk.

Table 4 presents the percentage distribution of fatalities and injuries. It appears that the large cities (Dammam and Riyadh) have the smallest fatality percentages. Riyadh's fatality and injury percentages are very similar to the average percentages in the United States, which are 11 and 89 percent for fatalities and injuries, respectively, in 1988 (2). Dammam's low fatality rate is due to the fact that it does not include rural accidents (as seen earlier) and, as is well established (2), rural pedestrian accidents are more severe than urban ones and adequate or timely medical attention is less likely. Rural accidents near Dammam are mostly included in the nearby cities such as Qatif.

Day and night distributions of pedestrian accidents are presented in Table 4. For all cities except Qatif, most pedestrian accidents occur during the day. The Qatif area is less developed than the other cities, and most of its streets are very poorly illuminated at night, which might lead to this situation. Furthermore, a significant portion of Qatif's working people work in nearby cities and return only during the late afternoon. Considering that 80 to 85 percent of average daily traffic occurs in the daytime hours in Saudi Arabia cities (3), the percentages of night pedestrian accidents are still too high. This, to a great extent, can be attributed to the visibility problem at night.

#### Analysis of Qatif Accidents

Qatif pedestrian accidents were collected for 6 months following the request of the study team. Although the period is short and the sample size is small, the records include some finer details and therefore are separately analyzed here.

Table 5 gives the frequency distributions of population and pedestrian accidents by age group. The most critical age categories are 4 years and less and 5 to 9 years, as these experience a disproportionately high percentage of fatalities and injuries in comparison with their population percentages. Children 4 and under are not usually allowed out unaccompanied by an adult; therefore, they suffer relatively fewer injuries than 5 to 9 year olds. However, the accident percentages for both categories are still high, which would appear to be mostly the result of a lack of adult supervision. It is very common to see very young children, even in those 4 and

**TABLE 4 Pedestrian Accident Percentage Distribution**

City	By Severity		By Time of Day	
	Fatal	Injury	Day	Night
Riyadh	9.8	90.2	69.7	30.3
Qasim	14.9	85.1	55.3	44.7
Qatif	16.0	84.0	19.1	80.9
Dammam	4.9	95.1	60.4	39.6
U.S. <sup>a</sup>	11.0	89.0	N/A <sup>b</sup>	N/A

<sup>a</sup>Source: Ref. 2

<sup>b</sup>N/A : Not Available

**TABLE 5 Percentage Distribution of Age and Percentage Pedestrian Casualties in Qatif**

Age	Population in Age Category <sup>a</sup> (%)	Pedestrian Accidents in Each Category (%)		
		Fatality	Injury	Total
4 and less	17.2	26.7	25.0	25.6
5-9	17.3	26.7	44.0	41.5
10-14	14.4	20.0	6.3	8.5
15-19	12.0	0	3.8	3.2
20-39	22.0	26.6	8.9	11.8
40-59	12.1	0	3.8	3.2
60 and more	5.0	0	8.2	6.4
Total	100	100	100	100

<sup>a</sup>Based on the latest census available, (5).

under, playing in busy streets unaccompanied by an adult. In particular, 5 to 9 year olds are in the most at-risk group.

The age category of 10 to 14, although still critical because it has a high fatality percentage, is not as critical as the younger categories. The category of 15 to 19 does not appear to have a pedestrian problem. The very active and productive age category of 20 to 39 appears to receive a disproportionately low percentage of pedestrian fatalities, perhaps because of the emotional maturity and physical well-being of those in this group. The category of 60 years and up appears to have only a slightly higher percentage in injury accidents than its population percentage. A larger sample of data is needed to verify all of these findings. But in general, age categories between 10 to 59 have lower percentages in total accidents than their population percentages. Striking differences are revealed when these accident percentages are compared with the ones from United States, which are presented in Table 6. The accident percentage in the categories of children 9 years and younger in Qatif (67.1 percent) is much higher than the percentage in the United States (24.3 percent). This indicates

**TABLE 6 Severity Distribution by Age in United States (2)**

Age	Killed or Injured (%)
4 and less	7.3
5 - 9	17.0
10-14	11.2
15-19	10.6
20-24	9.1
25-44	26.1
45-64	11.0
65 and over	7.7

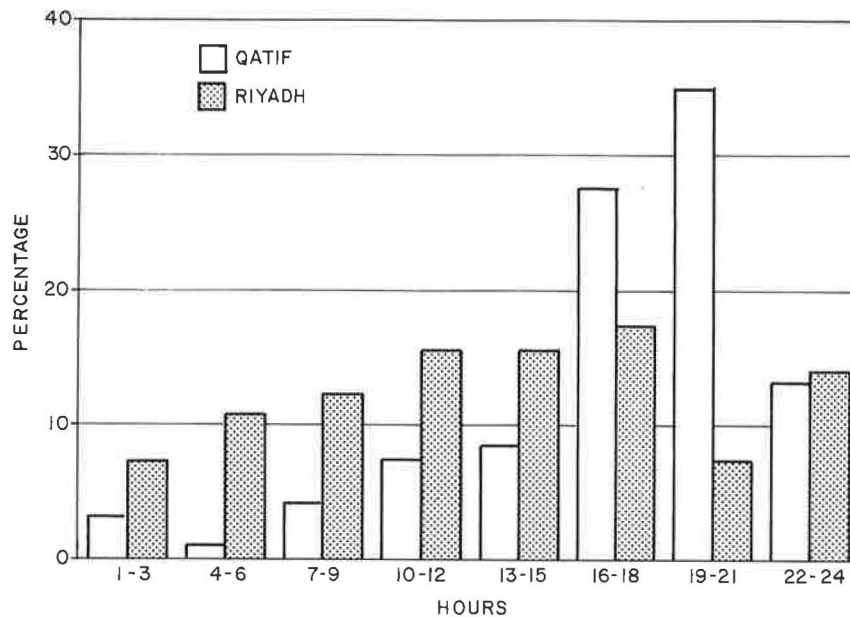
a much higher risk for these children in Saudi Arabia than in the United States.

Fatalities and injuries in rural and urban areas are compared in the following table:

	Fatality	Injury
Urban	27	43
Rural	73	57
Total	100	100

On one hand, almost three times as many fatalities occur in the rural part of Qatif than in the urban part. On the other hand, considering that 58 percent of the Qatif population lives in the rural areas, the fatality share of the rural areas is disproportionately high. The injury distribution (43 percent urban and 57 percent rural) is similar to the population distribution, so it appears that rural accidents are more severe than urban accidents. A logical cause could be the higher speeds of vehicles in the rural parts. Another factor may be the greater time involved in getting medical attention.

The hourly distribution of Qatif accidents is shown in Figure 4. A definite peak occurs between 4:00 and 9:00 p.m. In Qatif, as in other parts of Saudi Arabia, shops open at 4:00 p.m. (they are closed between noon and 4:00 p.m.). This peak accident period therefore corresponds to the period of con-



**FIGURE 4 Hourly distribution of pedestrian accidents in Qatif and Riyadh.**

centrated shopping activity. Furthermore, during the hot season (which starts as early as April and continues to November), children usually go out after 4:00 p.m. to play. Similarly, many adults limit their activities in this period to avoid the heat of the day. It should be noted that all the Qatif data were collected during the hot season. Finally, Qatif is an area with close social contacts where relatives and friends live near each other and children go out to play with others in the neighborhood. All these factors create a very high peak for Qatif. A different pattern will emerge for Riyadh, however.

#### Analysis of Riyadh Accidents

The Riyadh accident data were collected during 7 months, from November through May. During this period the weather is very pleasant.

Figure 4 shows the hourly distribution of pedestrian accidents in Riyadh. Obviously these accidents are more evenly distributed than those from the Qatif area. This consistency can be attributed to many things. First, because the period of data collection corresponds to a very pleasant time of the year, people can carry out their activities throughout the day. Second, Riyadh is a large and dispersed city lacking close-knit neighborhoods, so child activity in the streets is much less than in Qatif. Children usually play inside well-protected housing compounds and within their own gardens. Still, however, a slight peak occurs at 4:00 to 6:00 p.m., when shopping activity starts.

The daily distribution of pedestrian accidents for Riyadh is shown in Figure 5. It should be noted that the normal working days are Saturday through Wednesday in Saudi Arabia. The weekend corresponds to Thursday and Friday. It can be seen that Wednesday, which is the end of the normal working week, has the highest percentage of accidents. A similar trend is reported for the United States (6). What is unique about the Riyadh data is the occurrence of a second peak on Fridays, which is the second day of the weekend. One reason for this may be that most of the low-income expatriate workers, who

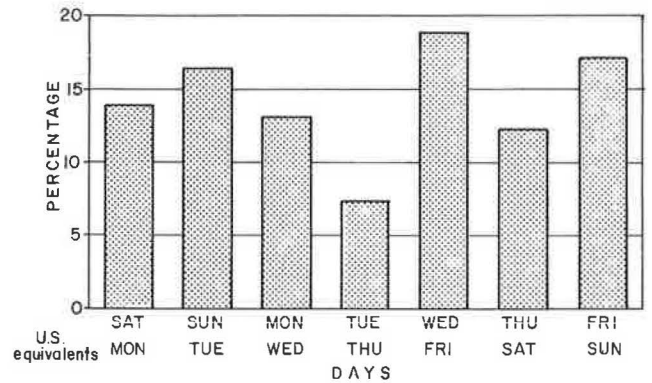


FIGURE 5 Daily distribution of pedestrian accidents in Riyadh.

usually work on Thursdays, do their shopping during this day. These workers do not own cars and are usually brought to shopping areas by buses. This creates a significant amount of pedestrian activity. Furthermore, most of these workers have low education levels and are not familiar with the rules of the road.

Table 7 shows the distribution of pedestrian accidents by action. Most accidents occurred while pedestrians were crossing at midblock (64 percent); this was followed by the number of accidents while pedestrians were crossing at intersections (11.5 percent). For the United States, the percentages are 34.5 and 23.3 (2) for midblock and intersection accidents, respectively. Apparently there is a higher percentage of midblock accidents in Riyadh than the United States, which makes Riyadh pedestrian accidents more serious, because, as shown in the literature (6), vehicles at midblocks have higher speeds, and pedestrian crossings at midblocks are not normally expected.

Riyadh streets are usually very wide. Twelve-lane arterials (four lanes for service roads and eight for the main road) are very common in the city. This increases the exposure time of pedestrian crossings. Furthermore, many of the signalized intersections in Riyadh, as well as everywhere else in Saudi

TABLE 7 Pedestrian Accidents by Action in Riyadh and United States (2)

Action	Percentage	
	Riyadh	U.S.
Midblock crossing	62.4	34.5
Midblock dart in front of a parked car	1.6	
Sub Total	64.0	
Crossing at Intersection		
Near side	3.3	
Far side	3.3	
With right-turning vehicles at Intersection	3.3	
With left-turning vehicles at Intersection	1.6	
Sub Total	11.5	23.3
While walking to or from a bus stop	0.8	
While walking on the side of road	2.5	
While walking on sidewalk	1.6	
With a reversing car	5.7	
Unknown	13.9	
Total	100	

Note: For U.S. data, the only reported percentages are shown.

Arabia, operate with unidirectional phases (i.e., a separate phase for each approach) and usually have very long cycles (180-sec cycles are common). This leads to very long waiting times for pedestrians to cross signalized intersections legally. Therefore, many pedestrians either avoid crossing at intersections or violate the signals at intersections and do not use refuge islands. Al-Senan et al. report that 56 percent of male pedestrians and 32 percent of female pedestrians cross signalized intersections in the prohibited phase (3). Special arrangements are needed, such as selecting signal phasing schemes that accommodate pedestrians or providing over- or under-passes for pedestrian passing at busy locations.

## SUMMARY AND CONCLUSIONS

The summary of the main research findings are as follows:

1. In general, pedestrian accidents tend to increase during the school intersemester breaks and decrease during the summer months; these times correspond with school holidays, when many families, especially the expatriate families that make up a major portion of the population, leave Saudi Arabia for vacation. This indicates that pedestrian accidents are somewhat related to school activities.

2. During the holy month of Ramadan an increase in pedestrian accidents was observed. This could be attributed to the shift of activities from day to night during this period.

3. It was found that more accidents occur in urban areas than the rural areas, which is similar to the experience of the United States.

4. The pedestrian accident rate appears to decrease with an increase in the urban population and the size of the urban area.

5. There is a higher incidence of pedestrian accidents among men than women. This is partly due to the greater exposure of men to traffic. However, it could also be attributed to the more aggressive behavior of men as pedestrians than women.

6. In general, the younger pedestrian population (younger than 18) appears to be more at risk than the older category (older than 18).

7. Fatality percentages in large cities are much smaller than those of the smaller cities. It appears also that the severity of pedestrian accidents is higher in smaller cities.

8. For all the cities, except for Qatif, most accidents occur during the day. But when exposure is considered (i.e., the percentage of traffic occurring during the day), the percentage of night pedestrian accidents is still disproportionately high. This discrepancy may be attributed to poor visibility at night.

9. In Qatif, the age categories most at risk were found to be 5 to 9 year olds, followed by 4 and younger. This result was attributed to a lack of adult supervision. The economically active age category of 20 to 39 year olds was found to have a disproportionately low percentage of accidents: this group makes up 22 percent of the population but accounts for only 11.8 percent of the accidents, half of what would be expected.

10. Almost three times as many fatalities occur in the rural part of Qatif than in the urban part. The injury distribution is similar to the population distribution. Higher severity rates

occur in rural areas because vehicular speeds in rural areas are higher and medical care is not as readily available.

11. Qatif shows a very high peak of pedestrian accidents during shopping and after-school hours from 4:00 to 9:00 p.m. Although Riyadh had a similar peak during the same period, it was not as high as Qatif. This was attributed partly to the different periods of data collection in the two cities. However, it could also be due to the different characteristics of these two cities.

12. The daily distribution of pedestrian accidents in Riyadh indicates that Wednesday is the peak working day equivalent to Friday in the United States. But a second peak was recorded on Friday, which is the second day of the weekend. The occurrence of this latter peak was partly attributed to increased pedestrian shopping activity by low-income expatriate workers.

13. Compared with the United States, a much higher percentage (62.4 versus 34.5 percent) of pedestrian accidents occur at midblocks in the Riyadh area. This was attributed, apart from some possible behavioral differences, to the very wide arterial streets (many with 12 lanes), which increase pedestrian exposure to traffic. It was also noted that the present unidirectional signal phasing and long signal cycles encourage illegal pedestrian crossing at intersections or at points other than intersections.

14. Although there are some shared characteristics of the pedestrian safety problem, each city also has unique problems. These individual areas can and should be studied in more depth in small-scale local studies.

15. Finally, more research is needed in the pedestrian safety area in Saudi Arabia. The results of this study should be considered preliminary since they are based on a very limited sample of pedestrian accidents.

## ACKNOWLEDGMENTS

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