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An Analysis of Pedestrian Safety in New Jersey in 2010

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Table of Contents

Introduction.....	1
Total Pedestrian Fatalities and Injuries.....	3
Gender.....	3
Age.....	4
Pedestrian Crashes by Road Type.....	5
Pedestrian Crashes by Median Type.....	7
Pedestrian Crashes by Time of Day.....	8
Pedestrian Crashes by Day of the Week.....	10
Pedestrian Crashes by Month.....	11
Pedestrian Crashes by Weather Condition.....	12
Pedestrian Crashes by Road Condition.....	13
Pedestrian Crashes and Alcohol Consumption.....	14
Conclusions and Implications.....	14

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Introduction

This report is prepared as a part of Task 2.3A of PB-9 (Governor's Pedestrian Safety Initiative Baseline Tracking). The data analyzed in this report was primarily extracted from the Plan4Safety database. The report presents annual and aggregated data on key variables for the state of New Jersey for the six-year period, 2003-2008.

The primary purpose of this report is to provide a baseline for tracking pedestrian crashes over time. In its current form, the report provides insights on the past trends and patterns of pedestrian crashes. However, in the coming years, the data provided in this report can serve as the baseline for comparison of current data on an ongoing basis.

This being the first effort at creating a baseline for pedestrian crashes, most analyses in this report have been conducted at an aggregate level for the state. Yet the analyses provide important information on key variables such as annual pedestrian fatalities and injuries, demographic characteristics of crash victims, the time of day when crashes occur, monthly and daily variations in crashes, weather conditions, etc. In the future years, the scope of the report will be expanded to cover additional analyses, including analyses of data for specific highway corridors identified by NJDOT, area types (e.g., urban, suburban, rural), and counties. Additional analyses will be carried out separately for the large urban centers of the state so that comparisons can be made across the centers and for each center over a period of time.



Because of the NJDOT's continued interest in identifying the impacts of investments on pedestrian safety, efforts will be made in the future years to collect and analyze additional data on safety investments, including geographic location of investments, nature of improvements, and dollar amounts spent. Such efforts will indicate to what extent funds are being directed for safety enhancements in critical areas or locations. Due to the difficulties in estimating investment impacts on crashes because of the rarity of the events (crashes, injuries, and fatalities), we will explore and apply statistical techniques that are appropriate for such circumstances.

The substantial amount of information on pedestrian crashes in this report can be useful to other researchers, planners, and policy makers. Since the primary objective of the report is to provide a baseline for future comparisons of data on pedestrian safety, it intentionally avoids a detailed discussion on the potential policy implications of the findings. The concluding section of the report briefly touches on some of the implications of the findings, but it does not suggest any specific strategies for addressing pedestrian safety. The concluding section also describes some of the methodological challenges in analyzing pedestrian safety data.

Total Pedestrian Fatalities and Injuries

In the six-year study period, 2003-2008, a total of 882 pedestrian fatalities occurred due to vehicle-pedestrian crashes in New Jersey at the annual average rate of 147 per year. During the same six-year period, a total 31,823 pedestrian injuries occurred due to such crashes at an annual average of 5,303 injuries. Despite slight year-to-year fluctuations, pedestrian fatalities have remained more or less constant during the six-year period, increasing by an insignificant amount from 137 in 2003 to 142 in 2008 despite increases in population and vehicular traffic. Pedestrian injuries decreased from 5,737 in 2003 to 5,077 in 2008, a decrease of 11% in the six-year period. However, the decrease primarily occurred between 2003 and 2006, followed by a slight increase in 2008.

Since crashes are influenced by how much people drive, another way to look at the changes in pedestrian fatalities and injuries is to compare these changes with changes in vehicle miles traveled (VMT). It is evident from the table below that pedestrian fatalities per million daily VMT increased between 2003 and 2006, but substantially decreased in 2007. In 2008, the rate was slightly higher than 2003. Pedestrian injuries per million daily VMT decreased significantly from 2003 to 2007, but increased slightly in 2008. In contrast to fatalities, pedestrian injuries per million daily VMT were substantially lower in 2008 than 2003.

Annual Pedestrian Fatalities and Injuries in New Jersey Compared to Changes in VMT¹

	Pedestrian fatalities	Pedestrian injuries	Daily VMT *	Pedestrian Fatalities per 1,000,000 Daily VMT	Pedestrian Injuries per 1,000,000 Daily VMT
2003	137	5737	195,237,000	0.70	29.38
2004	143	5695	199,119,000	0.72	28.60
2005	154	5597	203,076,000	0.76	27.56
2006	165	4855	207,131,000	0.80	23.44
2007	141	4862	208,419,000	0.68	23.33
2008	142	5077	200,051,000	0.71	25.38

* http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2009/VMT_HIST_09.pdf

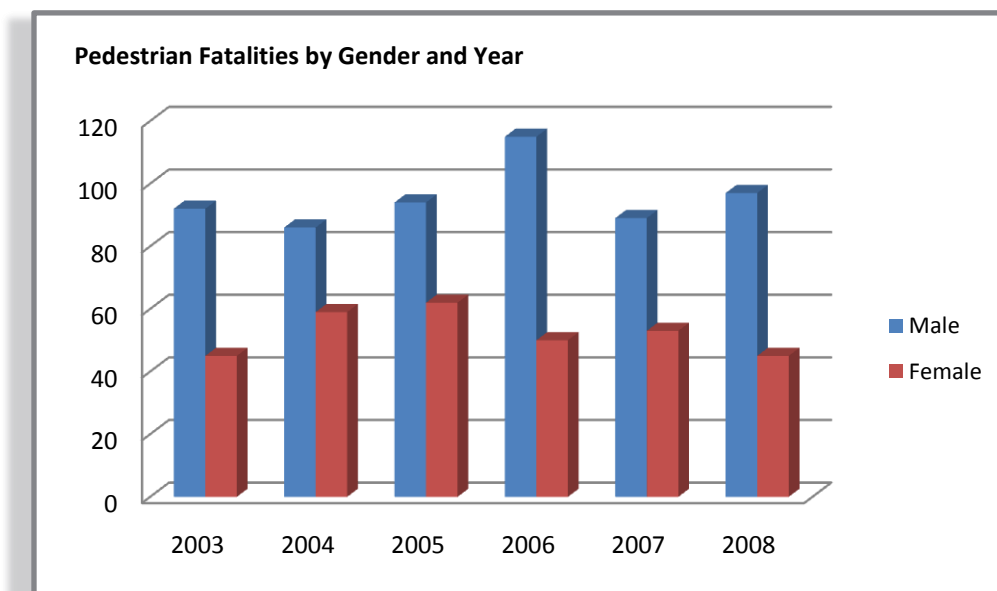
Gender

Men outnumbered women among pedestrian crash victims for every year between 2003 and 2008. The difference between male and female victims is substantially higher for fatalities than injuries. In 2008, male fatalities in pedestrian crashes were more than twice that of female fatalities (97 against 45). Although more men were injured than women in pedestrian crashes (3,112 against 2,537 in 2008), the proportional difference was smaller than fatalities.

¹ Note: The above cannot be compared to national data without properly converting Daily VMT to Annual VMT. National data is produced by NHTSA using annual VMT.

The most plausible explanation for a greater number of pedestrian fatalities and injuries among men could be greater exposure because men usually walk more frequently and for longer distances. Another reason could be their higher propensity to walk at night and other dangerous conditions. The greater difference of fatality than injury between men and women could also be potentially explained by their greater propensity to walk at night. Another potential reason could be greater alcohol use by male pedestrians than female pedestrians.

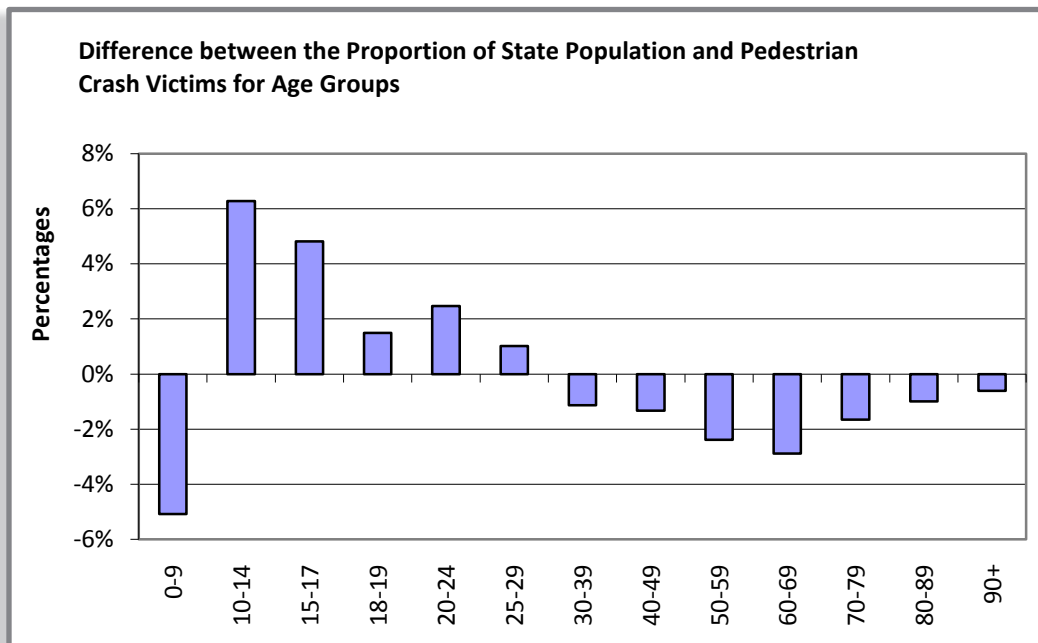
Pedestrian fatalities have not changed in any distinct manner between 2003 and 2008. The highest fatalities among men occurred in 2006, while most female fatalities occurred in 2005. For both men and women, the number of injuries have declined slightly over the six-year analysis period, although it is difficult to conclude that this is an indication of a potentially long-term trend.



Age

Aggregated data for 2003-2008 show that the highest incidences of fatalities and injuries occur to pedestrians in the 40-49 age group. Both fatalities and injuries tend to increase with age up to middle ages, followed by a decline in older ages. The primary reason for a large number of middle-aged crash victims is that their population size is large (i.e., baby boomers). The walking propensity among middle-aged persons is lower than younger age groups, but due to a large population size, a larger number of middle-aged persons are exposed to crashes. When population size of each age group is taken into account, persons in the 10-14 age group tend to become victims of pedestrian crashes more often than any other age group. For example, the proportion of pedestrian crash victims in this age group exceeds the proportion of persons in the age group by 6% points. Similarly, the proportion of crash victims in the 15-17 age group is almost 5% higher than the proportion of persons in that age group. In contrast, the proportion of persons in all age groups above 30 is higher than the proportion of crash victims in the respective

age groups. The same is true of persons below 10 years of age. The reason for a greater proportion of teenagers being victims of pedestrian crashes is their greater propensity to walk, especially for the purpose of attending school.



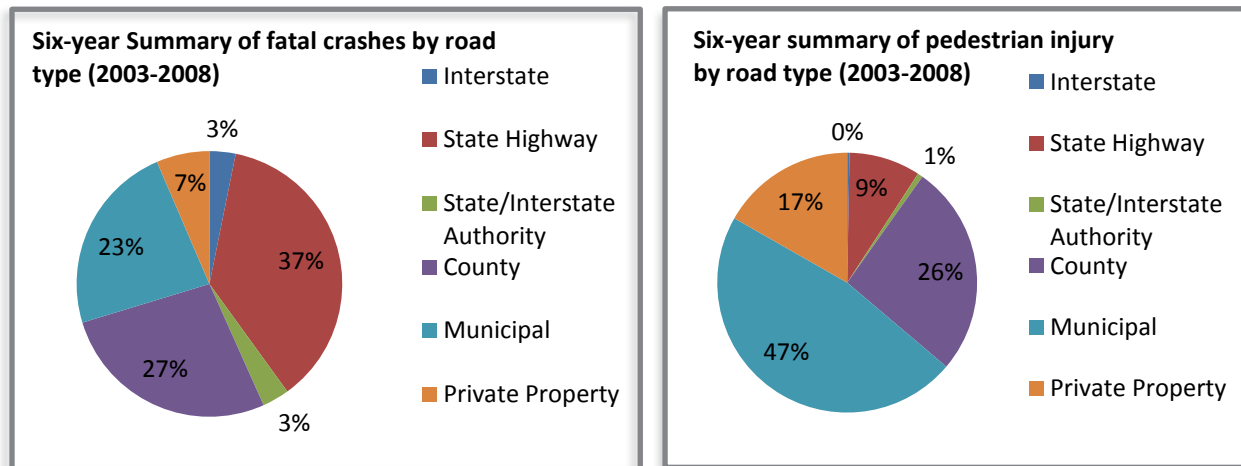
Pedestrian Crashes by Road Type

During the years 2003-08, the largest number of pedestrian fatalities occurred on state highways (325), followed by county roads (238), and municipal roads (205), respectively. However, when

one normalizes the fatalities by miles of roadways in each class, it becomes evident that fatalities are far less frequent on county and municipal roads (37 and 7 per 1,000 miles of roadway, respectively) than state highways (163 per 1,000 miles) than indicated by the aggregate number of fatalities. Pedestrian fatalities are relatively infrequent on Interstate highways when one considers aggregate number of fatalities (28). However when normalized by roadway miles (433 miles), fatalities are twice as common on Interstates as they are on county roads (65 against 37 in the six-year study period). One of the reasons for the relatively high fatality rate on Interstate highways may be crashes on ramps.

The data indirectly indicate that speed is a factor in pedestrian fatalities because vehicles travel faster on Interstate and state highways. State highways are of particular concern because they allow only limited pedestrian crossings at locations far apart from each other. State highways that are fronted by land uses that encourage pedestrian traffic, such as strip malls, are of significant concern for pedestrian safety. One reason for the concern is the potential increase in pedestrian and vehicular conflict points which could result in more pedestrian fatalities and injuries

Although municipal roads account for only a modest number of pedestrian fatalities compared to state highways, almost half the pedestrian injuries (47%) occur on these roads. One reason for the large number of injuries on municipal roads is that these ubiquitous roads constitute more than 70% of the total road miles in the state. When road miles are taken into account, most pedestrian injuries occur on state highways (approximately 1421 per 1,000 miles in six years), closely followed by county roads (approximately 1,300 injuries per 1,000 miles in six years). Only 515 injuries per 1,000 miles occurred on municipal roads during the same six-year period, whereas 208 injuries per 1,000 miles occurred on Interstate highways.



Pedestrian fatalities have remained fairly constant over the six-year period for each type of roadway. However, pedestrian injuries on municipal roads declined noticeably over this period, from 2,859 in 2002 to 2,274 in 2008. Although most of the decrease in overall pedestrian injuries between 2003 and 2008 was because of reductions on municipal roads, injuries decreased

between these two periods for Interstate and state highways also, but not for county roads, where the number of injuries remained fairly constant.

Pedestrian Crashes by Median Type

Aggregated data for the six-year study period on pedestrian fatalities shows that the largest number of fatalities (533 of 882 in six years, amounting to 60%) occur on roads without a median, followed by roads with a barrier median. Lower-level roads such as municipal roads usually do not have any median, while county roads usually have painted medians. In contrast, higher level roads such as Interstate highways always have barrier medians and state highways often have barrier or curbed medians. The large number of pedestrian fatalities on roads without barriers is due to the greater mileage of lower-level roads compared to higher-level roads. Moreover, lower-level roads are frequented by pedestrians far more often than higher-level roads. The Interstates are in fact inaccessible to pedestrians, whereas state roads allow pedestrian crossings only at specific signalized intersections.

Pedestrian Fatalities by Median Type over the Six-Year Period, 2003-08

	Median Type							Total
	Barrier Median	Curbed Median	Grass Median	Painted Median	None	Other	NULL	
Fatalities	154	39	74	39	533	13	30	882
Percent	17%	4%	8%	4%	60%	1%	3%	100%

Data on pedestrian injuries show that almost 83% of the injuries occur on roads without a median. It is not surprising that a large proportion of injuries occur on roads without a median because municipal roads account for almost half of all injuries. However, the primary reason for a significantly higher proportion of injuries on roads without a median is that they are frequented the most by pedestrians. Most homes and many schools and commercial establishments front these roads, resulting in a high volume of pedestrian activity.

Pedestrian Injuries by Median Type over the Six-Year Period, 2003-08

	Median Type								Total
	Barrier Median	Curbed Median	Grass Median	Painted Median	None	Other	NULL	Unknown	
Injuries	820	581	439	1679	26331	630	1332	11	31823
Percent	3%	2%	1%	5%	83%	2%	4%	0%	100%

As mentioned earlier, the total amount of annual pedestrian injuries declined by 11% between 2003 and 2008. Pedestrian injuries on roads without medians decreased from 4,981 to 3,885 during this six-year study period, a decrease amounting to 22%. The type of median that seems to be of great concern is painted median. Although data on this median type is not available for

the earlier years, data from 2006 to 2008 show a steady increase in injuries on roads with this type of median. Temporal analysis (i.e., change over time) of fatalities by median type could not be conducted because of the small number of annual fatalities and missing data for some median types.

Pedestrian Crashes by Time of Day

Combined data for the six-year study period shows that most pedestrian fatalities (65%) occur at night. This is not surprising because visibility is known to be one of the most critical factors in crashes. In contrast to fatalities, however, most pedestrian injuries (64%) occur during daytime. The relatively high proportion of injuries during daytime is obviously due to a greater amount of pedestrian activities in daytime. The fact that a higher proportion of injuries occur in daytime but a greater proportion of fatalities occur at night can be partially due to drivers' inability to see pedestrians in dark conditions. To a certain extent, the greater proportion of fatalities at night could also be associated with alcohol use by drivers and pedestrians.

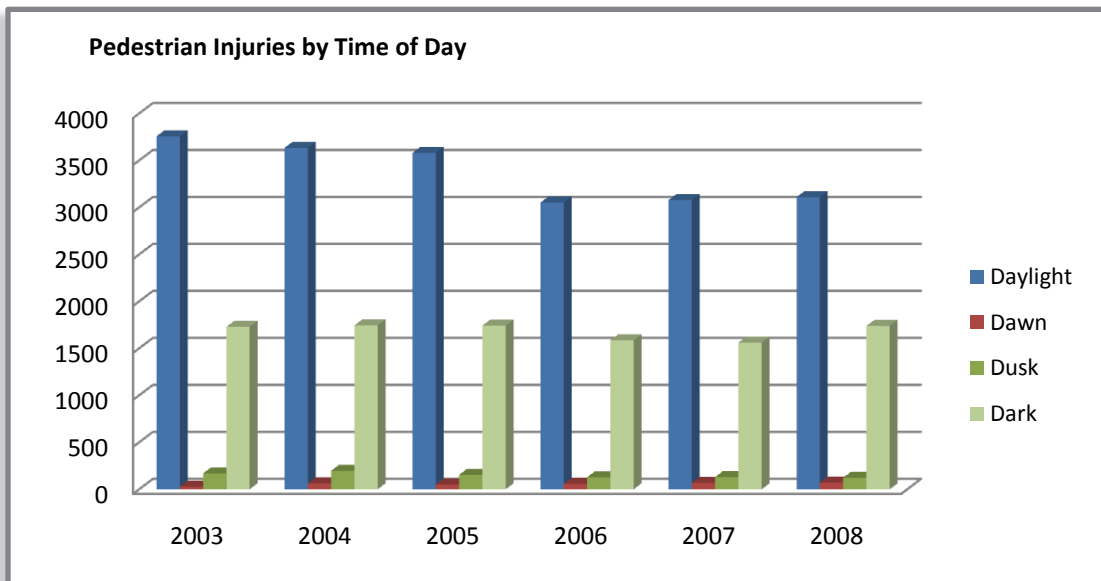
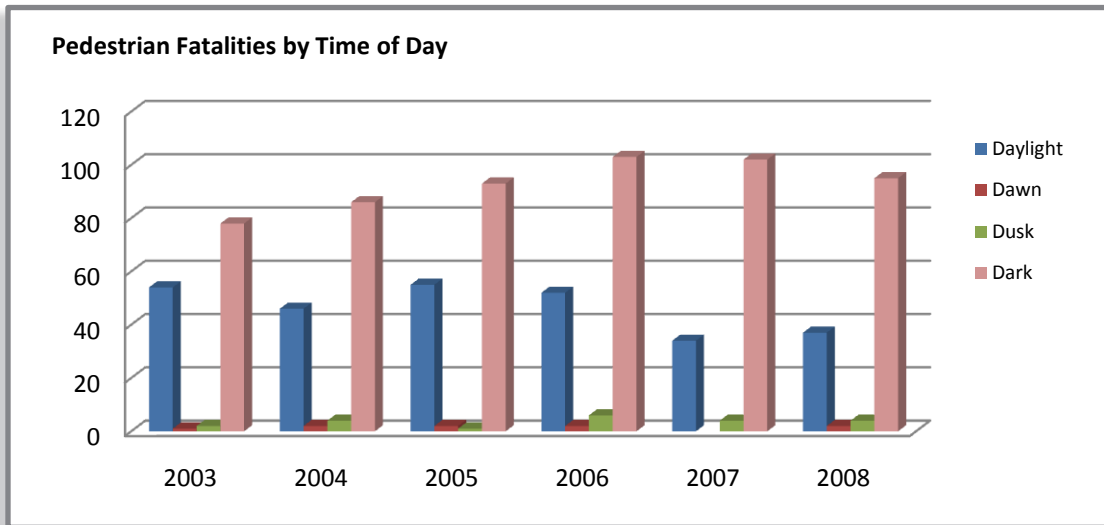
Pedestrian Fatalities by Time of Day

	Daylight	Dark	Dawn	Dusk	Total
Fatalities	274	554	8	21	857
Percent	32%	65%	1%	2%	100%

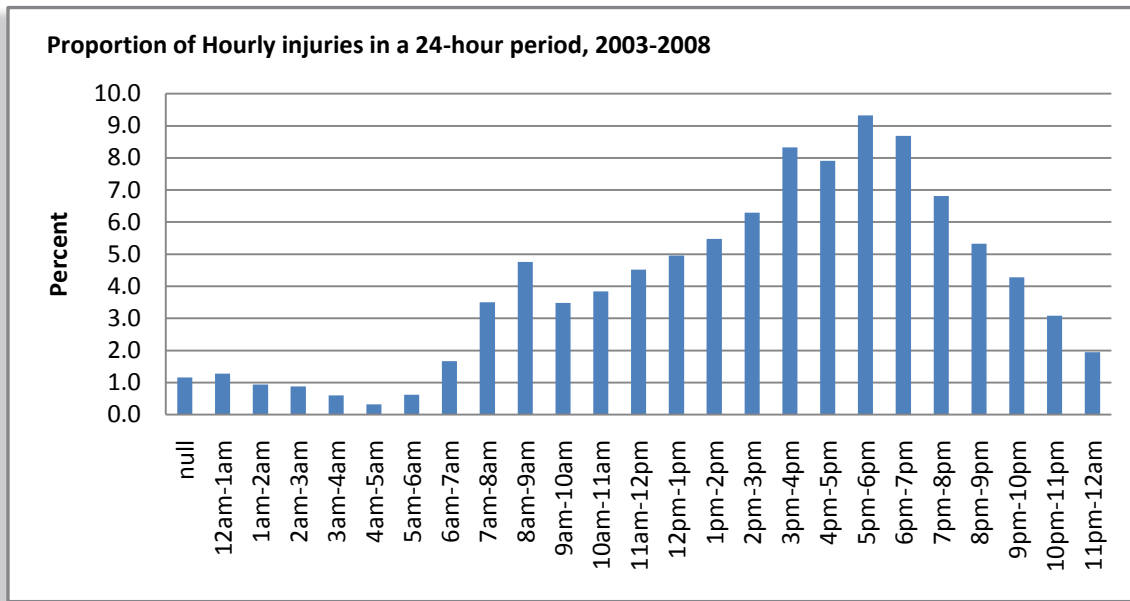
Pedestrian Injuries by Time of Day

	Daylight	Dark	Dawn	Dusk	Total
Injuries	20214	10105	341	903	31563
Percent	64%	32%	1%	3%	100%

Although darkness is often attributed to crashes, when the pedestrian injuries are classified by availability of streetlights, it appears that only small proportions (7%) of nighttime injuries occur in areas with no streetlights. In contrast, roads with continuous street lighting account for 83% of the nighttime injuries. A reason for the large number of injuries in areas with streetlights could be that streetlights are provided in areas with high pedestrian activities. Another reason could be that streetlights attract more pedestrians to a location and thus increase exposure. To understand the true impact of streetlights on pedestrian crashes, a more detailed and complex research approach would be needed.



Hourly data for the six-year study period shows that pedestrian injuries predominantly occur in the afternoon/evening period. During the four-hour period, 3PM-7PM, 35% of the pedestrian injuries occur. Only a very small proportion of injuries occur from midnight to 6AM. A morning peak consistent with work trips can be observed between 8AM and 9AM, but this peak is nowhere near the afternoon/evening peak. From 10AM onwards, injuries continue to rise with every hour until 6PM. This can be directly related to activities and road usage by individuals.



Pedestrian fatalities at night continued to increase from 2003 to 2006, but declined slightly in the last two years of the study period. Despite this decline, the total number of nighttime fatalities continued to be higher in 2008 compared to 2003. Daytime fatalities remained fairly constant between 2003 and 2006, but have declined in 2007 and 2008. While nighttime pedestrian fatalities increased from 2003 to 2008, injuries at night have remained constant over the six-year study period. In contrast, daytime injuries decreased by more than 600 from 2003 to 2008. Both aggregate and annual data seem to suggest that nighttime pedestrian crashes need more attention than daytime crashes.

Pedestrian Crashes by Day of the Week

Aggregate data for the 2003-08 period shows that pedestrian fatalities and injuries vary only modestly between the days of a week. However, both fatalities and injuries are at the highest level on Fridays. The higher frequency of crashes on Fridays may be due to a combination of various factors, including greater traffic volume, greater traffic and pedestrian volumes after dark, and alcohol consumption. One surprising fact is that despite lower traffic volumes on weekends, fatalities are higher on Saturdays and Sundays than Mondays and Tuesdays. The fact that injuries are lower but fatalities are higher on weekends suggests that higher speed due to lower traffic volumes may be a reason for the higher fatalities on Saturdays and Sundays.

Pedestrian Fatalities by Day of Week

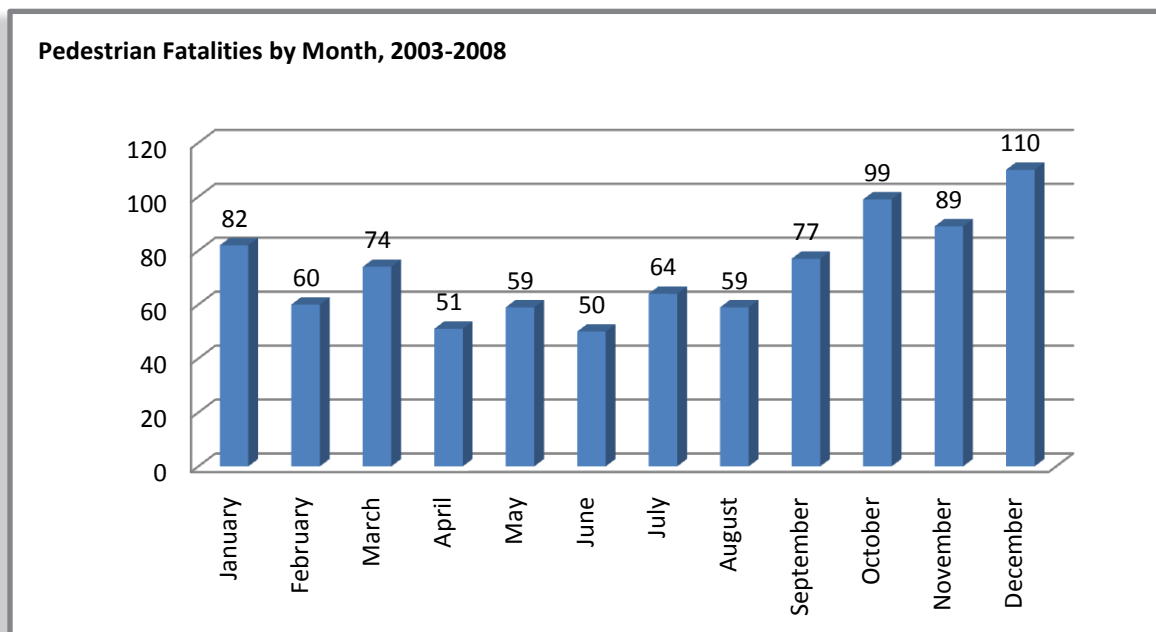
	Mon.	Tues.	Wed.	Thu.	Fri.	Sat.	Sun.	Total
Fatalities	114	107	125	129	144	131	124	874
Percent	13%	12%	14%	15%	16%	15%	14%	100%

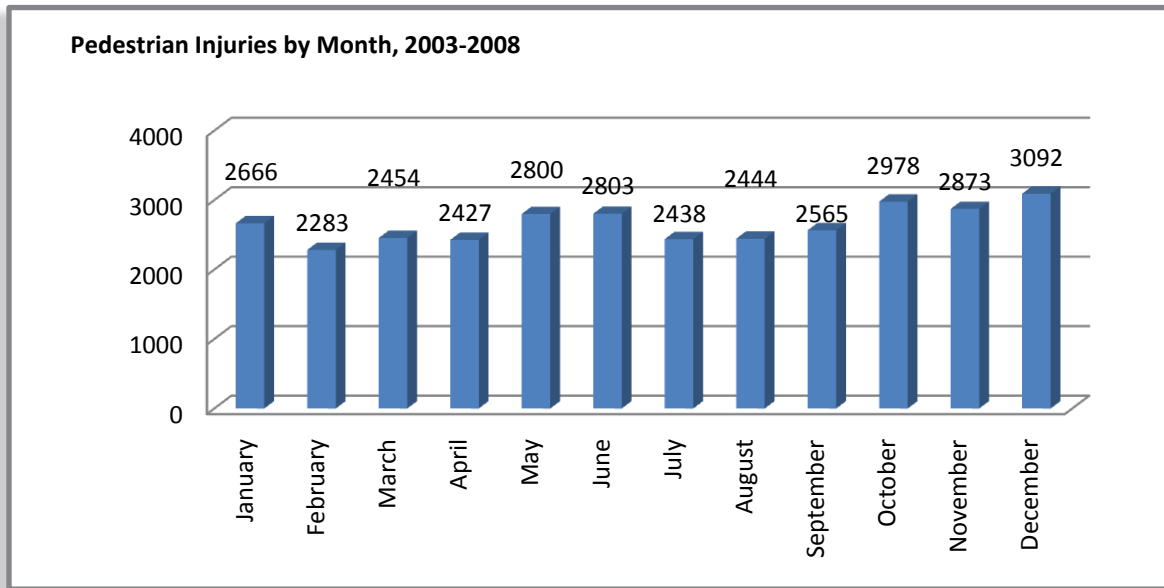
Pedestrian Injuries by Day of Week

	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.	Total
Injuries	4658	4852	4943	4784	5351	4216	3019	31823
Percent	15%	15%	16%	15%	17%	13%	9%	100%

Pedestrian Crashes by Month

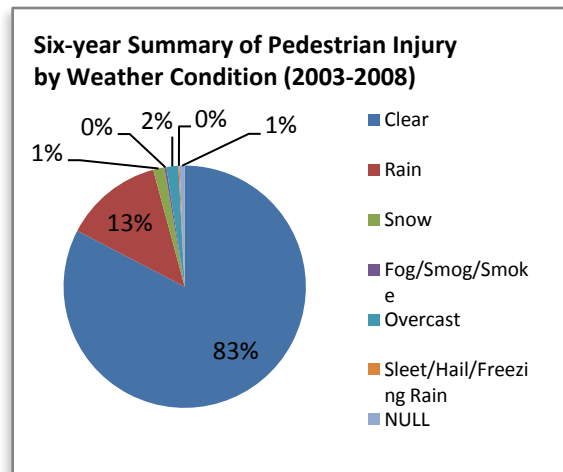
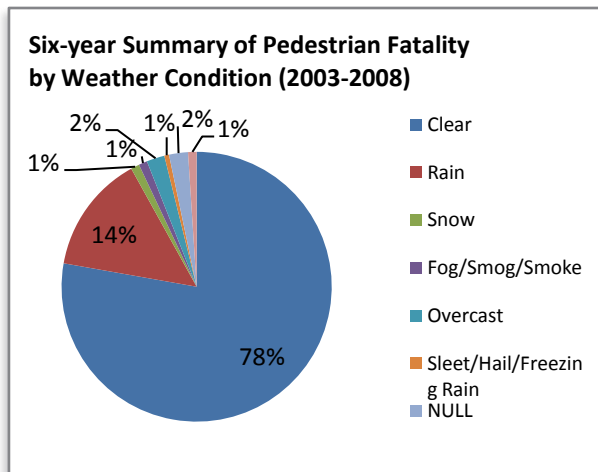
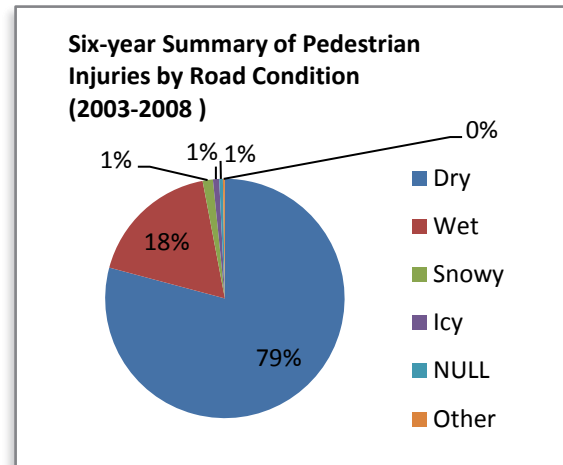
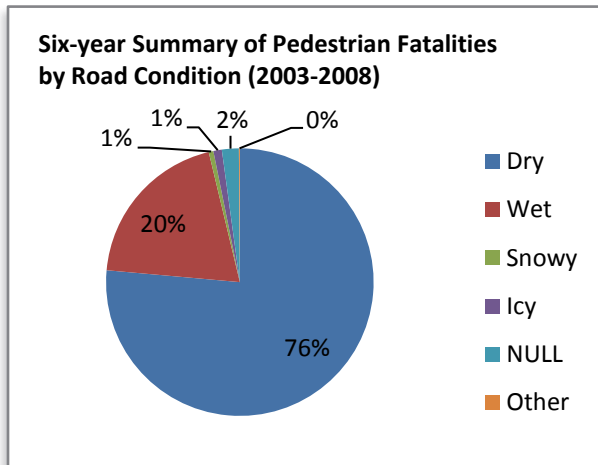
The largest number of pedestrian crashes occurs during the October-December period. Aggregate data from the 2003-08 period show that both fatalities and injuries peak in the month of December. The reason for a large number of crashes in December may be a combination of weather, a high volume of holiday traffic, and alcohol consumption. It is worth noting that a large number of injuries occur in the months of May and June also, which may be due to a combination of greater traffic and pedestrian volumes.





Pedestrian Crashes by Weather Condition

During the six-year study period, 78% of the pedestrian fatalities occurred during clear conditions, while 14% occurred in rainy conditions; the remaining 8% of pedestrian fatalities occurred in other conditions. Similarly, 83% of the pedestrian injuries occurred during clear conditions and 13% occurred during rainy conditions. A large proportion of fatalities and injuries occur during clear conditions because, at most times, weather condition remains clear in the state. Another reason is that pedestrians venture out less frequently in inclement weather conditions. If the duration of different types of weather conditions and the volume of pedestrians were taken into account, it is very likely that fatalities and injuries would be higher in inclement conditions. It may be noted that recent years have seen an increase in pedestrian fatalities in rainy conditions. Pedestrian injuries in such conditions declined from 2003 to 2007 but increased in 2008.



Pedestrian Crashes by Road Condition

More than three quarters of the pedestrian fatalities and injuries occurred in dry road conditions. This is consistent with the high proportion of crashes in clear weather conditions. The reasons, once again, are that roads are dry at most times and more pedestrians venture out when road conditions are dry versus when they are wet, snowy, or icy. When duration and pedestrian volumes are accounted for, more fatalities and injuries might be observed when road conditions are poor. Pedestrian fatalities in dry conditions increased modestly from 2003 to 2008, but fatalities in wet conditions remained unchanged. Pedestrian injuries decreased in both dry and wet conditions from 2003 to 2008.

Pedestrian Crashes and Alcohol Consumption

It is widely acknowledged by researchers that alcohol consumption by motorists and pedestrians is often the cause of crashes. Between 2003 and 2008, alcohol was involved in 13-22% of the total pedestrian crash fatalities. Involvement of alcohol seems to be significantly less for pedestrian injuries, as only 5-7% of the injuries can be attributed to alcohol consumption each year between 2003 and 2008. In pedestrian fatalities involving alcohol, pedestrians were impaired in 46.6% of the crashes versus 34% of drivers involved. Similarly, in pedestrian injuries involving alcohol, pedestrians involved were impaired 60.6% of the time versus 23.9% for drivers. The comparison of injuries and fatalities seems to suggest that alcohol consumption has a greater impact on pedestrian fatalities than injuries. It also seems to suggest that in injuries and fatalities involving alcohol, pedestrians are more likely to be impaired than drivers. This is consistent with a greater number of fatalities at nighttime, when more people are likely to be intoxicated than daytime.

Alcohol and Crashes Involving Pedestrian Fatalities and Injuries

	Pedestrian Fatalities Involving Alcohol	Percent of Total Pedestrian Fatalities	Pedestrian Injuries Involving Alcohol	Percent of Total Pedestrian Injuries
2003	28	22.2%	365	6.8%
2004	22	17.3%	354	6.4%
2005	27	17.8%	322	5.9%
2006	34	20.3%	324	6.0%
2007	19	13.2%	295	5.5%
2008	20	13.9%	327	5.7%

Conclusions and Implications

The analyses in this report provide some useful information on pedestrian crashes in New Jersey by focusing on fatalities and injuries during the period 2003-2008. New Jersey is a state characterized by predominantly suburban land use patterns and a ubiquitous network of Interstate and state highways. Yet the state also has the highest population density among all states. The combination of high overall population density and a large network of highways increase the exposure of the state's pedestrians to unsafe traffic conditions, resulting in a large number of casualties when controlled for by the state's population. According to the NHTSA Traffic Safety Facts of 2008, New Jersey ranks second only to New York among the 50 states when one compares pedestrian fatalities as a proportion of total fatalities resulting from crashes (22.9%). Although overall traffic fatalities in New Jersey is modest in comparison to many other states, (especially the southern and western states, in terms of pedestrian fatalities) the state ranks fairly high. This should be a concern for all transportation planners and policy makers in the state.

The analyses in the report provide some key information on pedestrian crashes in the state.

- **First**, far more men become casualties of pedestrian crashes than women. This is presumably because of exposure since men walk more often than women in general, but also in unsafe conditions and in darkness.
- **Second**, a significantly larger number of middle-aged pedestrians become victims of crashes compared to other age groups. However, when the population in each age group is taken into account, the 10-17 age group is the most vulnerable to pedestrian crashes. This may be the result of greater exposure (e.g., walking to and from school), risk-taking behavior, or both. Whatever the reason, there needs to be special attention towards promoting safety among teenage pedestrians.
- **Third**, most pedestrian injuries occur in daytime, but pedestrian fatalities are high at night. Although visibility is a serious factor in crashes, most nighttime pedestrian crashes occur in areas with continuous streetlights. The reason is that more pedestrians walk at night in areas with streetlights. To understand the true impact of streetlights on pedestrian safety, exposure of pedestrians will have to be controlled for.
- **Fourth**, most pedestrian crashes occur on municipal roads and roads without a median. A reason for a large number of pedestrian crashes occurring on municipal roads is that there are many more miles of these roads than other types of roads. State highways appear to be the most dangerous in terms of pedestrian fatalities, whether or not one controls for miles of roadway. The reason for a large number of fatalities on state highways is obviously a combination of high speed and limited pedestrian crossings.
- **Fifth**, pedestrian crashes follow temporal patterns. For example, more crashes occur during October-December than the other months, on Fridays compared to other days of the week, and during the 4-7PM period than at other times of the day. Obviously, the temporal variations in pedestrian crashes are tied to exposure.
- **Sixth**, alcohol use continues to be a factor influencing pedestrian crashes. The influence of alcohol on pedestrian fatalities is especially significant.

In order to make policy recommendations regarding pedestrian safety issues, cause-and-effect explanations are important. However, identifying the causes of crashes in a scientific manner from a large data set such as Plan4Safety is not an easy task. Obviously, more pedestrian crashes occur where more pedestrians congregate, and pedestrians usually congregate in areas where they feel comfortable walking. Today most planning strategies are aimed at enhancing walkability by making places more lively and attractive to pedestrians. However, the exposure of pedestrians to traffic could also be high in those areas because of a large number of pedestrians crossing roads.

Plan4Safety data does not include any information on exposure of pedestrians to traffic. Although crash data are sometimes normalized by researchers by using an area's population, VMT, or road mileage, such normalized data have limitations. A better denominator for normalizing crashes, fatalities, and injuries would be the actual number of pedestrians that are exposed to the conditions where crashes occur. However, pedestrian counts are rarely available for large areas such as a city or municipality, let alone a state. The Plan4Safety data set is also devoid of any information on land uses in the areas where crashes occur. In the absence of

adequate information on pedestrians' exposure and micro-area land use characteristics, it is difficult to identify specific strategies to address pedestrian crashes.