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Using Linked Data to Evaluate Severity and Outcome of Injury by Type of Object Struck (First Object Struck Only) for Motor Vehicle Crashes in Connecticut

Crash Outcome Data Evaluation System (CODES)

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16. Abstract

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LIST OF ABBREVIATIONS

AIS	Abbreviated Injury Score
CAAI	Collision Analysis Auxiliary Input Files
CHA	Connecticut Hospital Association
CHIME®	Connecticut Health Information and Management Exchange
CHREF	Connecticut Healthcare Research and Education Foundation, Inc.
CTMDS	Connecticut State Mortality Data Set
DOT	Department of Transportation
ED	Emergency Department
ICD-9-CM	International Classification of Disease, 9th Edition Clinical Modification
ICF	Intensive Care Facility
LOS	Length of Stay
MVC	Motor Vehicle Crash
SNF	Skilled Nursing Facility

ABSTRACT

A deterministic algorithm was developed which allowed data from Department of Transportation motor vehicle crash records, state mortality registry records, and hospital admission and emergency department records to be linked for analysis of the types of objects struck in motor vehicle crashes in Connecticut in 1995, and their consequences. Only objects listed on the police report as 'first object struck' were analyzed. Of 132,918 vehicular crash records, 14.4% were thus identified as having struck an object; similarly, fourteen percent of the crashes which resulted in treatment in the ED or hospital admission visits were thus identified as having struck an object. Mean total hospital charges for these visits were $3,021; the mean length of stay for those visits resulting in an admission was slightly less than 5 days. Logistic regression analysis identified the most frequently reported factor correlated with striking an object to be driver illness (identified by the traffic safety officer), followed by dark conditions and speeding. Deer were the first object struck almost 5% of the time, resulting in 1.7% of the hospital visits. The highest mean total charges were for crashes involving a wall as first object struck, $5,986, while the first object struck resulting in the highest frequency of hospital visits were metal beam guide rails, in 13% of the cases (with mean total charges of $3,326). Wire rope guide rails and Jersey barriers resulted in lesser utilization of hospital services, while metal beam guide rails, vehicles off road, and trees resulted in greater medical utilization. Similarly, the largest number of fatalities resulted from crashes involving metal beam guide rails and trees as first objects struck.

INTRODUCTION

This report examines motor vehicle crashes occurring in Connecticut during 1995, using several linked data sets. The findings reported herein illustrate the usefulness of using linked data sets to perform these types of analyses. Alone, each data set could not provide the type and depth of information provided by the group of linked data sets.

Data sets used for the studies include:

- The CHIME® database, including Inpatient and Emergency Department data
- Ambulatory Surgery data from 31 general acute care facilities
- State of Connecticut, Department of Transportation (DOT) crash file
- State of Connecticut Mortality Data Set (CTMDS).

The CHIME® dataset identifies all people involved in a MVC (motor vehicle crash) who had inpatient, emergency, or ambulatory surgery treatment at a Connecticut facility regardless of the state in which the MVC occurred. The DOT dataset identifies all MVCs and people involved in a crash, regardless of whether or not they had treatment at a hospital. The mortality dataset identifies deaths from MVCs. It includes all deaths from MVCs in Connecticut, whether the fatality was a resident of Connecticut or not, in addition to deaths of Connecticut residents who died in MVCs outside Connecticut which were reported by the state where they died.

Linking these data sets allows in-depth analysis of severity and outcome of injury by type of object struck. For instance, for the evaluation of severity and outcome of injury by type of object struck, the type-of-object-struck variable is contained in the Department of Transportation data set. Linking the CHIME® and DOT databases contributes diagnoses and procedures resulting from the crash as well as total hospital and Emergency Department charges, while linking the mortality database furnishes information regarding the eventual survival or mortality of the persons involved. Thus the full picture of the effects of crashes with any particular object may be observed.

What follows are a description of the linking, a statistical analysis of the data, and a summary of our findings.

This study was funded in part by the National Highway Traffic Safety Administration as part of the CODES demonstration project[1], and performed in collaboration by the Connecticut Healthcare Research and Education Foundation (CHREF, a non-profit affiliate of the Connecticut Hospital Association), the State of Connecticut Department of Transportation (DOT), and Hartford Hospital.

METHODS

Data Sources

Motor Vehicle Crash (MVC) Data

The MVC data were obtained from the 1995 Collision Analysis Auxiliary Input (CAAI) Files. This is a database of motor vehicle crash data, owned by the State of Connecticut Department of Transportation.

There are six different record formats in the DOT files, described as follows:

- Record Type 1: Crash Summary Record
- Record Type 2: Traffic Unit Information Record
- Record Type 3: Traffic Unit Pen-Based Only Record
- Record Type 4: Involved Person Record
- Record Type 5: Property Damage Record
- Record Type 6: Crash Narrative Record.

Record Types 1, 2 and 4 were used for this analysis. Record Type 1 contains information pertinent to the crash as a whole, such as date and time, location and other crash-specific information. Record Type 2 identifies each vehicle or pedestrian involved in a crash, defined as a vehicle involved in a crash or a pedestrian who was struck by a vehicle involved in a crash. Record Type 4 contains information about vehicle operators, struck pedestrians, passengers, and witnesses. If more than four persons were involved in a crash, more than one person-record was created[2]. Table 1 summarizes the number of records in these files.

Table 1. Summary Of 1995 Collision Analysis Input Files

File Type	Number of Records
Type 1: Crash Summary Records	72,677
Type 2: Traffic Unit Information Records	136,165
Type 4: Included Person Records (1 - 4 persons each)	79,931

The working MVC data file was constructed based on Type 1, 2 and 4 records in the DOT file. Type 1 records were merged with Type 2 records, to produce a file of one record per vehicle or pedestrian involved in a crash. The Type 4 records were converted from one record for each 1 to 4 involved persons into one record per involved person (*i.e.*, if there were 4 people involved in a crash, the original file had one Type 4 record but the converted file has 4 records), then merged with the file of involved vehicles and pedestrians. This process produced one record for each involved person, containing all the data describing that person, as well as the specific crash and the specific vehicle. Table 2 categorizes the records contained in the DOT file.

Table 2. DOT MVC File Crash Records, by Category

	Number	Percent of Total
Drivers	132,918	72.5%
Passengers	48,919	26.7%
Pedestrians	1,518	0.8%
Witnesses	3	0.0%
Total	**183,358**	**100.0%**

Hospital Claim Data

The CHIME® database was used for this analysis. Included in the CHIME® database is demographic, clinical and financial information about each patient visit occurring in Connecticut acute care hospitals.

Data were extracted from this database in a two step process. In the first step, an index file containing information about Connecticut hospital ED visits, ambulatory surgery visits, and inpatient stays during 1995 was created for all patients having an ICD-9-CM code ranging from E810 to E819 (motor vehicle traffic crash E-codes), as detailed in Table 3.

Table 3. CHIME® Database Records, by Motor Vehicle E-Code Category

E-Code Category	Number	Percent of Total
Motor Vehicle, Driver	23,219	56.79%
Motor Vehicle, Passenger	11,659	28.52%
Motorcyclist	1,191	2.91%
Other, Unspecified	2,430	5.94%
Pedalcyclist	697	1.70%
Pedestrian	1,687	4.13%
Total	**40,883**	**100%**

In the second step, a medical history file containing the previous year's hospital visit information for those patients having an MVC in the index year was created. There were 40,883 records in the index CHIME® database and 12,280 records in the history CHIME® database.

Mortality Data

Mortality data for victims of motor vehicle crashes were derived from the State of Connecticut Mortality Database (CTMDS). This database is offered to individuals and institutions from the State of Connecticut Department of Public Health, Office of Planning & Evaluation, Vital Records Bureau, and offers a comprehensive view of primary causes of mortality in Connecticut.

There were a total of 390 records selected from the state of Connecticut 1995 mortality database as possessing a motor vehicle crash related cause of death. Table 4 details these records by location of residency and location of crash.

Table 4. CT Mortality Database MVC Records, by Location of Crash and Location of Residency

Residency	Location of MVC	Number	Percent of Total
Connecticut	Connecticut	321	82%
Connecticut	Out of State	51	13%
Out of State	Connecticut	18	5%
Total	**Total**	**390**	**100%**

LINKING /MERGING PROCESS

A proprietary deterministic matching algorithm was developed in the FOCUS language to merge these databases. Key variables used to link the crash and hospital data were date of crash, date of birth, date of ED visit, date of inpatient admission(s), date of death, gender, and towncode of crash. Because passenger DOT records do not specify a gender, three steps of merging were employed. The first step included only driver and pedestrian records, with gender identified in the DOT database. The second step included passenger records from the DOT database, for which gender cannot be used as a linking variable. The third step included all unmatched records from the first and second steps. This algorithm did not allow for fuzzy or probabilistic linking; however, since crash date and ED or inpatient admission date would not always be expected to match exactly, four levels of date window were allowed within each matching step.

One hundred percent complete linkage is not expected when linking the DOT crash database to the CHIME® database; for instance, if a motor vehicle crash occurred outside the state of Connecticut and the victim was taken to a Connecticut emergency room, or admitted to a Connecticut hospital, the patient would be included in the CHIME® database but not the DOT database. Conversely, anyone who had a crash occurring in the state of Connecticut and was admitted to a hospital or ED outside of Connecticut would be included in the DOT database but not in the CHIME® database. The result of this slight disjunction between the underlying pools of subjects is that the maximum linkage rate attainable will be reduced below 100% by an unknown amount, since we do not have a count of persons involved in either out of state crashes, or out of state hospital visits.

The mortality registry contains some records of Connecticut residents who die in other states, dependent on the other state's reporting them. Therefore, similarly to the above, Connecticut residents who die out of state in a crash might appear in the mortality database, but not in the DOT or CHIME® databases. Conversely, a person injured in a crash in Connecticut and admitted to a Connecticut hospital, but who eventually dies out of state, might appear in the DOT and CHIME® databases, but not in the mortality registry. Again, this would reduce the maximum attainable rate of linkage to the mortality registry, by an amount that we are not able to predict.

Table 5 describes the matching steps and levels in the merging algorithm. The output linked-dataset was inspected to verify the quality of the match.

Table 5. Merge Algorithm for DOT and CHIME® Database

Level	Matching Strategy
	First Step: Merge Driver Or Pedestrian Records Which Include Gender
1	Matching variables: birth date, gender, town code date adjustment window of 0 days (date of hospital visit equal to date of crash).
2	Matching variables: birth date, gender, town code date adjustment window of +7 days (date of hospital visit within 7 days after date of crash).
3	Matching variables: birth date, gender, town code date adjustment window of +30 days (date of hospital visit within 30 days after date of crash).
4	Matching variables: birth date, gender, town code date adjustment window of +30/-1 days (date of hospital visit within 30 days after or 1 day before date of crash).
	Second Step: Merge Passenger Records Which Do Not Include Gender
5	Matching variables: birth date, town code date adjustment window of 0 days (date of hospital visit equal to date of crash).
6	Matching variables: birth date, town code date adjustment window of +7 days (date of hospital visit within 7 days after date of crash).
7	Matching variables: birth date, town code date adjustment window of +30 days (date of hospital visit within 30 days after date of crash).
8	Matching variables: birth date, town code date adjustment window of +30/-1 days (date of hospital visit within 30 days after or 1 day before date of crash).
	Third Step: Merge Records With Gender Unknown Or Missing
9	Matching variables: birth date, town code date adjustment window of 0 days (date of hospital visit equal to date of crash).
10	Matching variables: birth date, town code date adjustment window of +7 days (date of hospital visit within 7 days after date of crash).
11	Matching variables: birth date, town code date adjustment window of +30 days (date of hospital visit within 30 days after date of crash).
12	Matching variables: birth date, town code date adjustment window of +30/-1 days (date of hospital visit within 30 days after or 1 day before date of crash).

Studies and Phases

This study was divided into two phases. The first phase analyzed all eligible DOT records to determine the distribution of the variables under examination and identify significant predictors of these variables and their odds ratios. The second phase was restricted to cases that successfully linked or merged, with a primary goal of determining the clinical events after MVCs.

Outcome and Independent Variables

Outcome Variables

The outcome variable for the first phase was the frequency of object struck, evaluating only the first object struck. The outcome variables for the second phase of the study included mortality, total charges, and length of stay.

Total hospital charge was calculated on an unadjusted basis only, due to lack of cost/charge ratio information. Mortality was categorized as died at the crash site, Emergency Department death (died in hospital with zero length of stay), died as inpatient (died in hospital with length of stay equal to or greater than 1 day), and died after discharge.

Independent Variables

Independent variables in this study were drawn from two sources, the DOT data file and the CHIME® database. Those variables included demographic, geographic, subjective, and objective factors, road and weather/season condition, police judgment/investigation, and clinical variables. Demographic variables included gender (female or male). Geographic variables included location of the crash and location of the object struck. Subjective factors included were speeding, following too closely, violating traffic controls, unsafe use of highway by pedestrian, etc. Objective factors included driver illness, vehicle involved in emergency, etc. Road condition included construction and road surface. Weather/seasonal variables included snow and rain. Police judgment/investigation included whether or not the driver had been drinking, and lighting conditions. Clinical variables included having at least one MVC and a hospital visit and admission diagnosis codes within past one year or 6 months. Other variables included type of motor vehicle, collision type, and injury classification. All categorical variables were converted into binary variables, as required for the analysis.

Statistical Analysis

For the first phase of the study, the frequency for each outcome in the studied cohort was determined. The bivariate associations with outcome of road condition, weather/season condition, police judgment/investigation, demographic, geographic, subjective, objective, and clinical variables were evaluated, then a stepwise logistic regression model with a group of independent variables was developed, to find the significant predictors. Candidate independent variables were selected from the variables identified in the bivariate analysis as having an association with $p < 0.10$.

All stepwise models were constructed with an entry significance level of 0.01 and an exit significance level of 0.05, chosen to identify a parsimonious set of independent variables in the models. Partial residual plots were used to evaluate potential problematic areas of fit[3]. Goodness-of-fit was evaluated by comparing fitted probabilities with observed value of dependent variables within deciles of probability, and calculating the corresponding observed chi-square statistic. In addition, an area under the receiver operator curve for logistic models was calculated to evaluate the models' predictive power[4].

An adjusted odds ratio was derived in which each odds ratio was adjusted for all other independent variables listed. An odds ratio less than 1 indicates that a crash event with that characteristic has a lower likelihood of association with the outcome variable than without that characteristic, while an odds ratio higher than 1 indicates that a crash event with that characteristic has a higher likelihood of association with the outcome variable than without that characteristic. For each of the studies, the logistic regression model's odds ratios and 95 percent confidence intervals for predictors were reported. In addition, a chi-square test or non-parametric test was performed for each bivariate analysis.

All calculations were performed using the software systems SAS® 6.12 (SAS Institute, Cary, NC) and STATA® 3.0 (STATA Corporation, College Station, TX).

RESULTS

LINKING AND MERGING

CHIME® Database

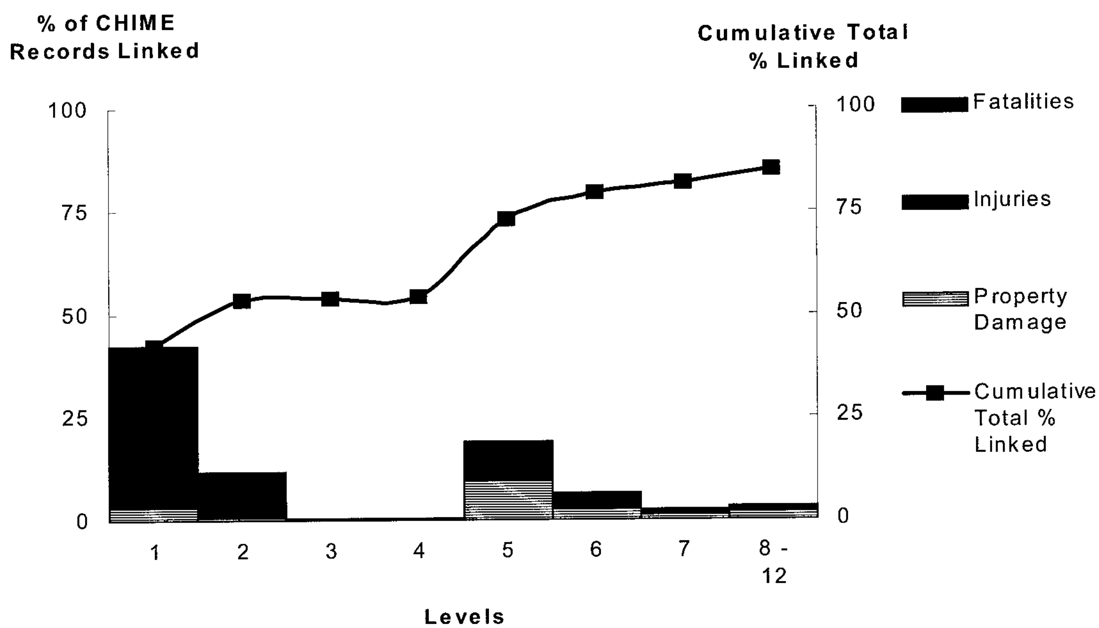
There were 40,883 records selected from the CHIME® data set as having motor vehicle crash related E-codes, as detailed in Table 3. Of these, 35,832 records (87.6%) were linked and merged. After deleting duplicate records (1,054, 2.9%), 34,778 records remained (85.1%). Of these records, 364 (1%) were excluded from future analysis by reason of unreliable key variables.

Table 6 and Figure 1 show the linkage/merging rate of CHIME® records for each of the linkage levels described in Table 5, classified by crash severity index in the Type 1 record of the DOT file. Since gender is such a useful linking variable, levels 1 through 4 link drivers and pedestrians only; levels 5 through 12 link passengers (who do not have gender recorded by the DOT) and individuals with gender unrecorded by reason of incomplete or defective records.

Table 6. Linkage Rates (CHIME® and DOT)

Level	Fatality Records Linked as % of CHIME® Records	Injury Records Linked as % of CHIME® Records	Property Damage Records Linked as % of CHIME® Records	Number Linked	Cumulative Total Linked	Cumulative Linkage Rate (%)
1	0.5	38.1	3.4	17,158	**17,158**	**42.0**
2	0.2	10.7	0.6	4,726	**21,884**	**53.5**
3	0.0	0.4	0.0	144	**22,028**	**53.9**
4	0.0	0.4	0.1	202	**22,230**	**54.4**
5	0.1	9.0	9.6	7,690	**29,920**	**73.2**
6	0.1	3.6	2.8	2,633	**32,553**	**79.6**
7	0.0	1.1	1.2	923	**33,476**	**81.9**
8 - 12	0.0	1.2	2.0	1,302	**34,778**	**85.1**

Figure 1. Linkage Rate, by Linkage Level and Crash Severity



One hundred percent complete linkage is not expected when linking DOT files to all Connecticut hospital and emergency department discharges, since, if a motor vehicle crash occurred outside the state of Connecticut and the victim was hospitalized or admitted to a Connecticut hospital, the patient would be included in the CHIME® database but not the DOT database. Conversely, anyone who had a crash occurring in the state of Connecticut and was admitted to a non-Connecticut hospital or ED would be included in the DOT database but not in the CHIME® database. If both such cases could be eliminated, the final linked and merged rate would be higher than the current 85.1%.

CTMDS File

A total of 329 records (84% of the 390 motor vehicle crash related fatalities) from the Connecticut Mortality dataset were successfully linked and merged with the DOT and CHIME® files.

OVERALL MOTOR VEHICLE CRASHES IN CONNECTICUT

Overall, there were a total of 72,639 motor vehicle crashes reported to the DOT in the state of Connecticut during calendar 1995 (38 records of the total 72,677 were excluded due to duplication), involving 136,165 vehicles and pedestrians and 183,358 individual persons (Table 1 and Table 2); of the total persons involved in a crash, 34,778 (19%) were successfully linked to an ED visit or hospitalization (Table 6), and 329 to a mortality entry.

Figure 2. Percentage of Crashes in Connecticut, 1995, by Town or City

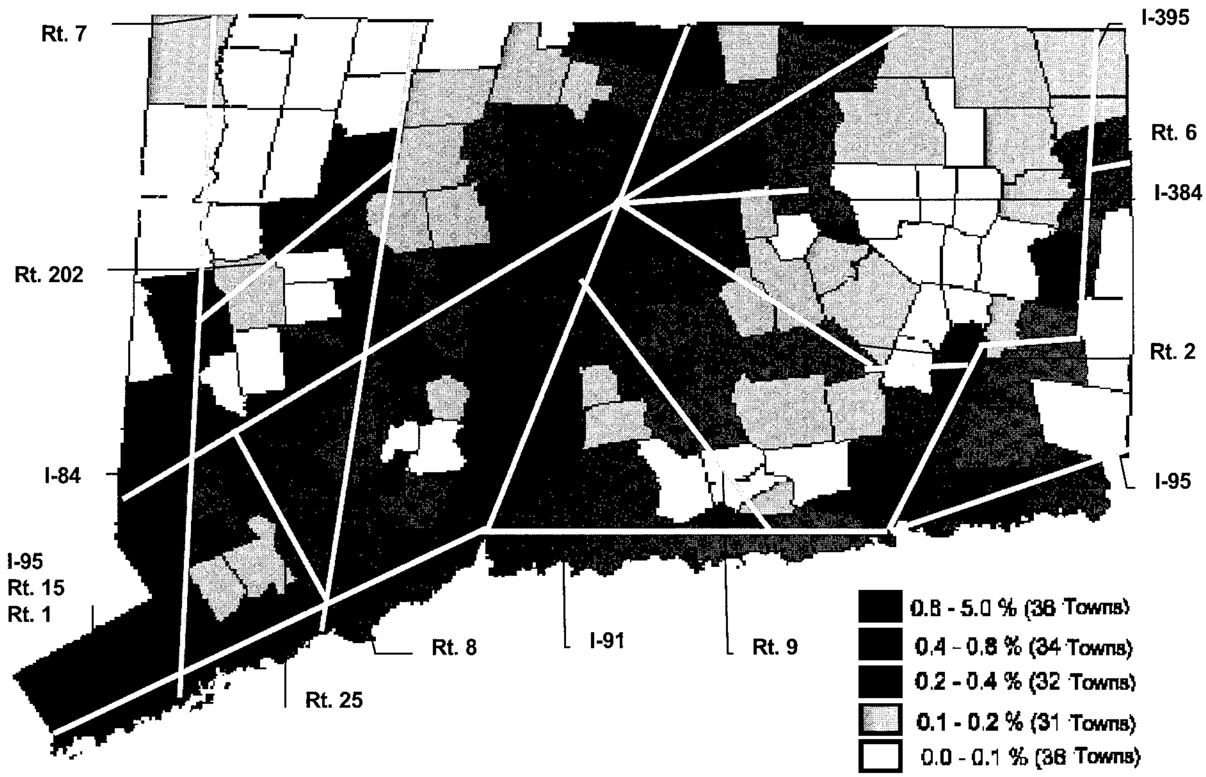


Figure 2 shows a geographical view of the percentage of total crashes by town or city, calculated as the number of crashes in the index town or city divided by total crashes in the state. As can be seen, the highest rates occur in towns and cities surrounding Interstate 91 (I-91), Interstate 95 (I-95) between the New York border and New Haven, Route 15, Interstate 84 (I-84), and Interstate 395 (I-395) between I-95 and Route 6.

There are 169 towns or cities recorded in the DOT files, with crash rates ranging from 0.01% to 5.1%. The five lowest towns or cities were Lyme (0.01%), Warren (0.01%), Colebrook (0.02%), Hampton (0.02%), and Hartland (0.02%), while the five highest were New Haven (5.07%), Hartford (5.00%), Bridgeport (4.81%), Stamford (3.20%), and Norwalk (2.93%). Appendix A details the crash rates by town.

Figure 3. Rate of Injury for CT Motor Vehicle Crashes, by Town or City

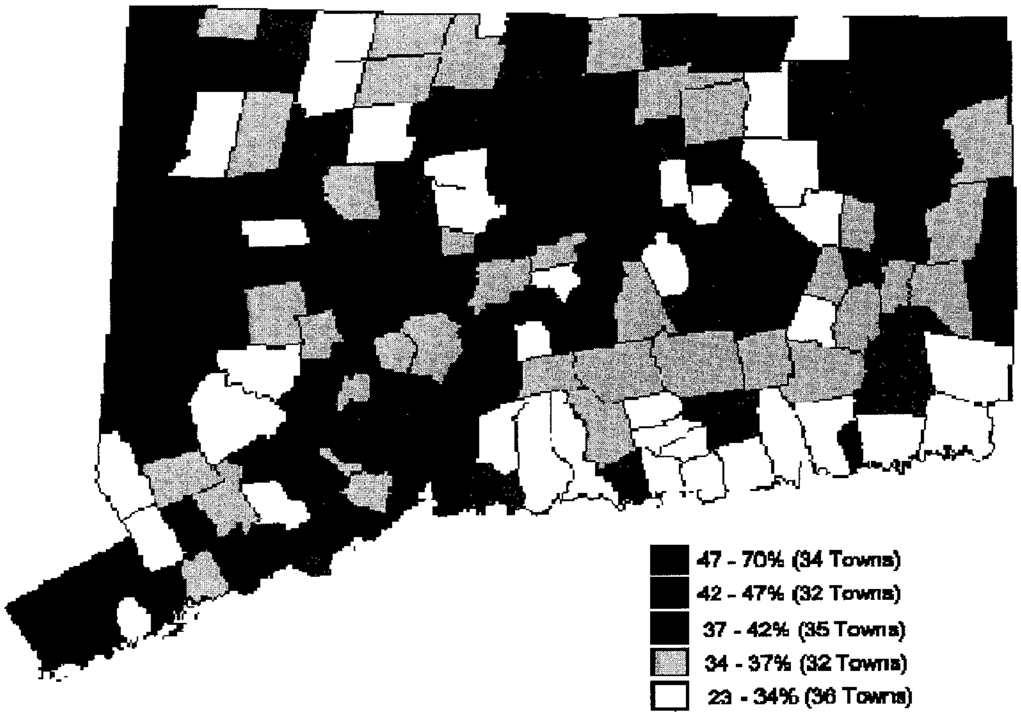


Figure 3 shows the rate of injury by town or city in the state of Connecticut. Presence of injury was determined from the DOT Type 1 record injury severity code, including fatalities or any type of injuries, but excluding property damage only. Rate of injury was determined as number of injuries divided by total crashes in the index town or city.

Overall, the injury rate ranged from 23% to 70%; the five lowest town or cities were Old Lyme (22.89%), Madison (23.71%), Chester (25.00%), Essex (25.25%), and Guilford (27.17%), while the five highest were Sterling (69.57%), Hartford (63.38%), Hampton (62.50%), Windsor Locks (60.81%), and New Haven (59.82%). Appendix A contains detailed data for Figure 3.

Figure 4. Mortality by Position in Motor Vehicle and Place of Death

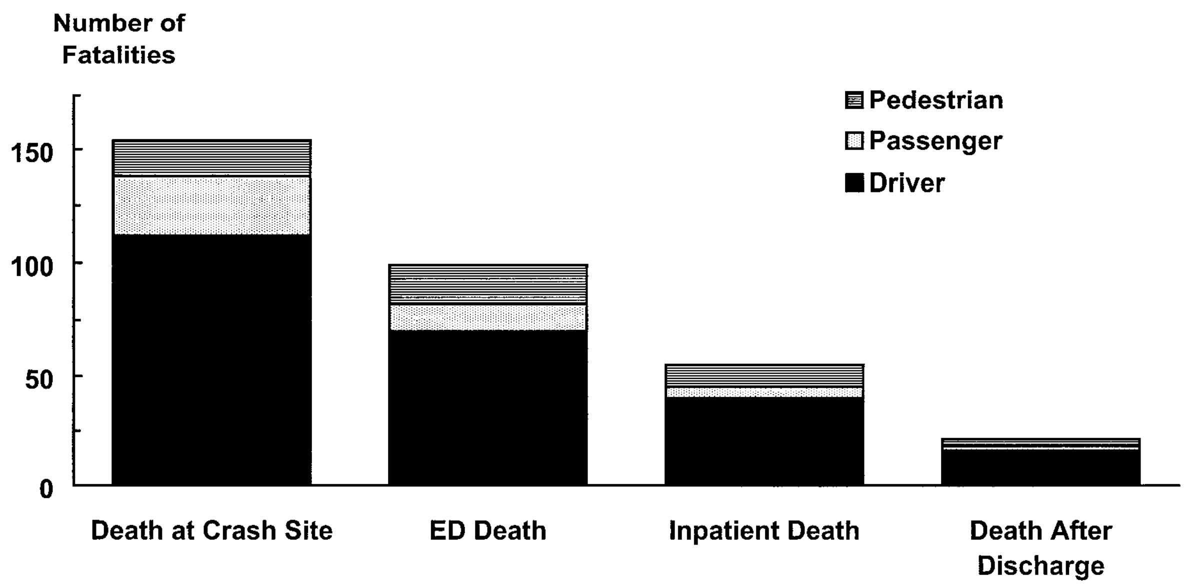


Figure 4 and Table 7 show mortality by position in vehicle (driver, passenger, or pedestrian) and place of death (at the crash site, emergency department [LOS = 0], inpatient [LOS > 0], or after discharge).

Table 7. Mean Age and Mortality by Position in Motor Vehicle and Place of Death

	Death at Crash Site	ED Death	Inpatient Death	Death After Discharge	Total
Driver	112	70	40	16	**238**
Passenger	26	12	5	2	**45**
Pedestrian	16	17	10	3	**46**
Total	**154**	**99**	**55**	**21**	**329**
Mean age	38.7	41.2	53.8	38.5	**42.0**

Figure 5. Mean Age of Fatalities by Place of Death

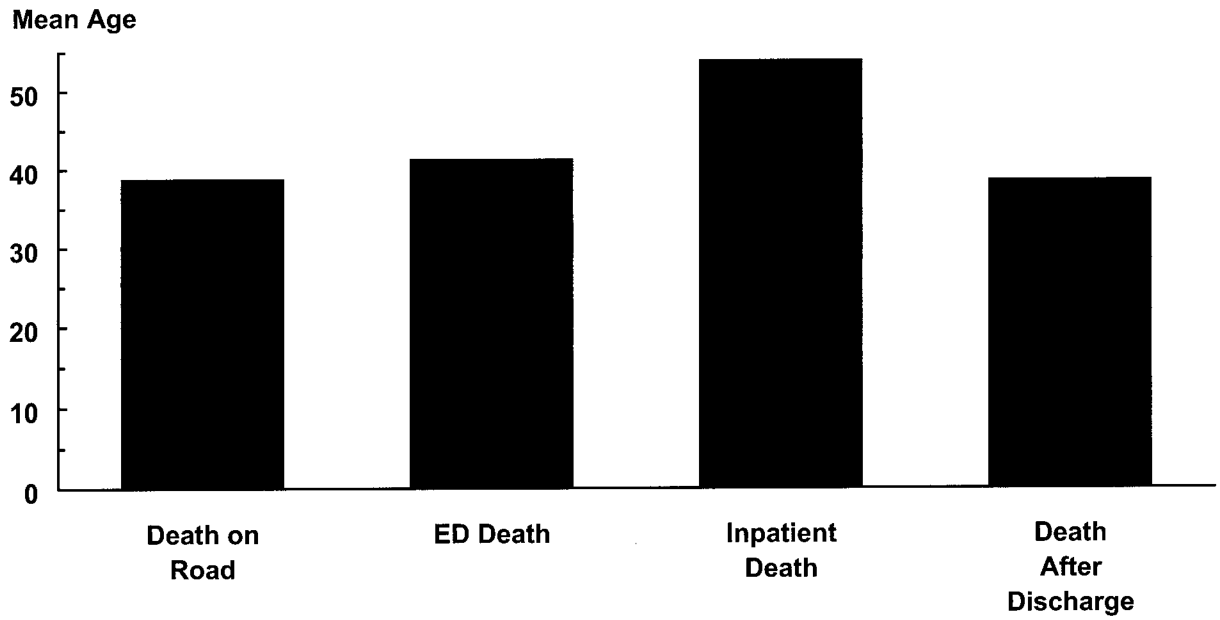


Figure 5 and Table 7 show mean age of fatalities by place of death. Inpatient deaths tended to be older than the other classes of fatalities. There was no significant difference between males and females.

Figure 6. Fatality Rate of Motor Vehicle Crashes by Town or City

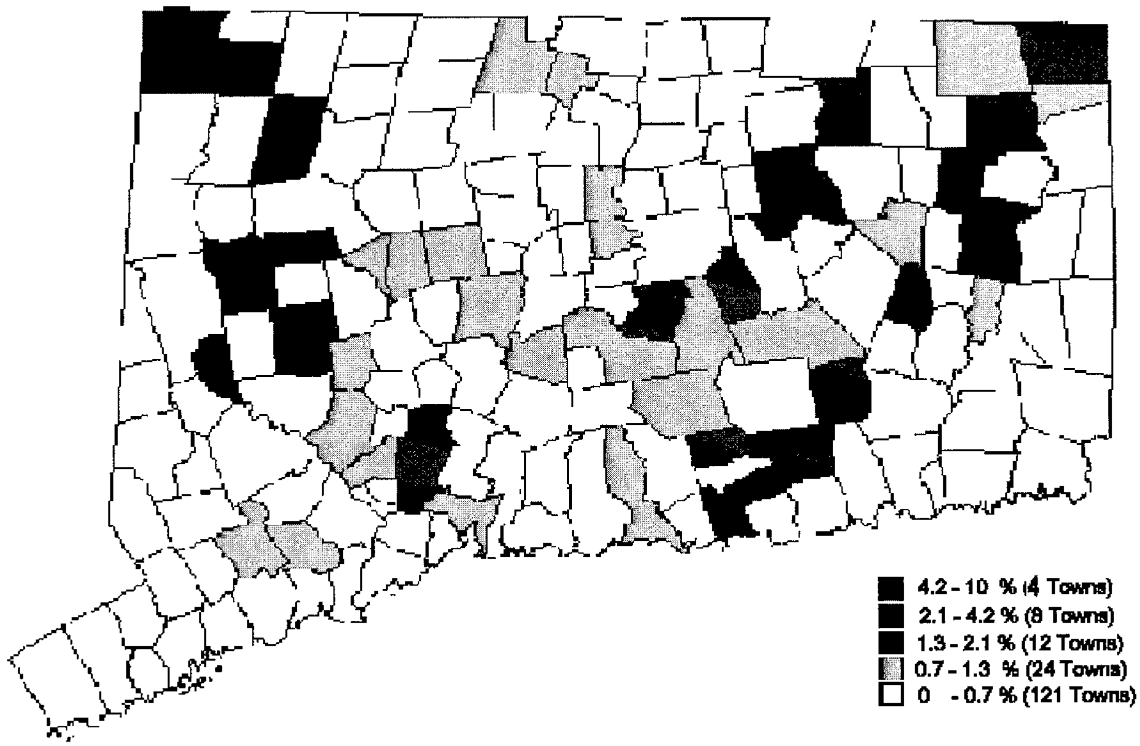


Figure 6 shows fatality rate of crashes by town or city, determined as the number of deaths divided by number of crashes in each town or city. The mortality rate ranged from 0 to 10%, the five highest areas being Lyme (10%, 1 killed in 10 crashes), Hampton (6.25%, 1 killed in 16 crashes), Andover (4.76%, 2 killed in 42 crashes), Pomfret (4.23%, 2 killed in 71 crashes), and Canaan (4.12%, 1 killed in 24 crashes).

Figure 7. Percentage of Total Mortality by Town or City

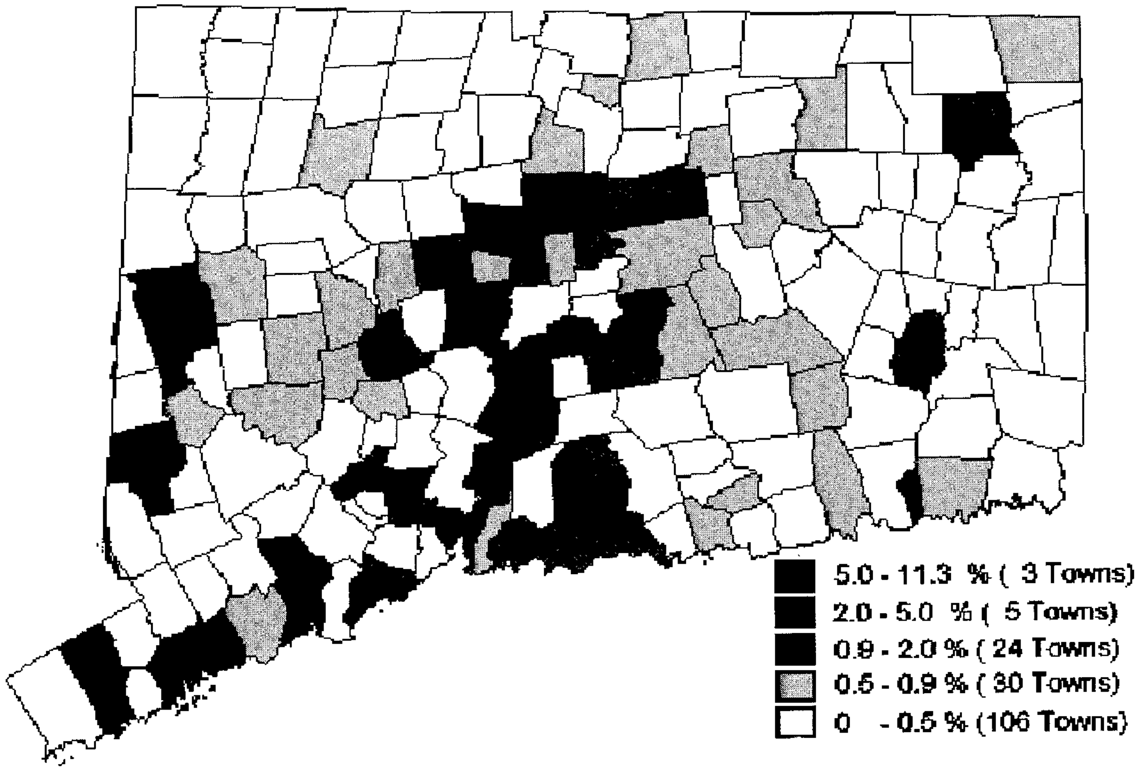


Figure 7 shows mortality by town or city where crash occurred, as a percent of total state mortality. By this measure, Hartford, New Haven, Bridgeport, Waterbury, and Bristol accounted for 29.5% of total state mortality. There were 59 towns or cities where mortality was zero (no one killed by crashes in those areas during 1995).

PHASE ONE

Study Sample

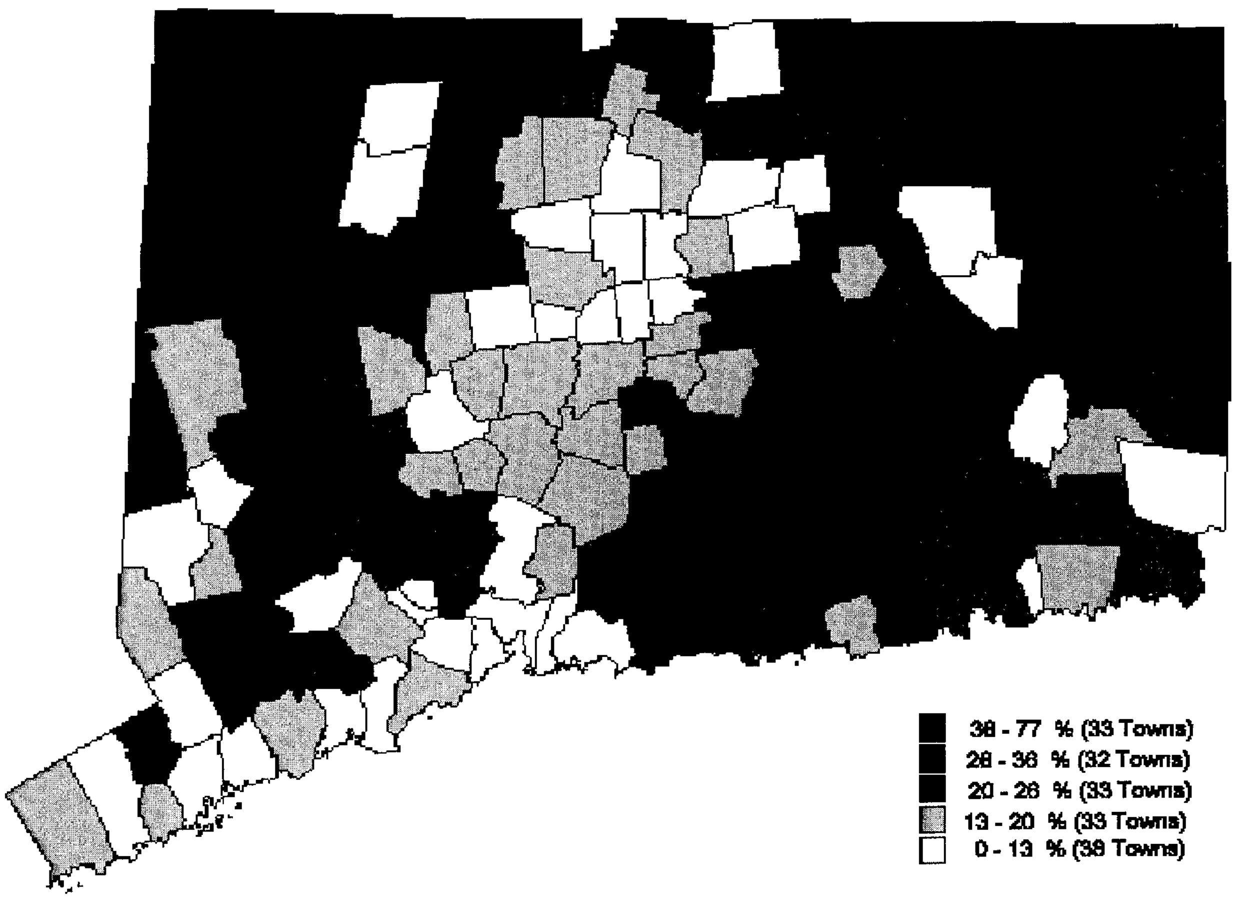
For the study of factors influencing crashes involving a non-vehicular object, the study sample consisted of 132,918 vehicle records. Of these, 14.4% (19,153) had an object listed as first object struck, as detailed in Table 8.

Table 8. Percentage of First Object Struck, by Type of Object

Description	%
Metal Beam Guide Rail	15.6
Wire Rope Guide Rail	11.2
Other	9.06
Curbing	8.82
Utility Pole	8.60
Tree	7.50
Jersey Barrier	7.36
Bank, Ledge, Rock (Off Road)	6.02
Deer	4.92
Highway Sign, Post, Delineator	3.60
Foreign Object on Pavement	2.46
Illumination Pole	2.38
Bridge Structure	1.69
Fence	1.66
Wall	1.55
Vehicle Off Road	1.19
Ditch	1.05
Animal Other than Deer	0.85
Traffic Island	0.73
Fire Hydrant	0.67
Traffic Control Device	0.60
Construction Barricade, Barrel	0.58
Building, House	0.54
Impact Attenuator	0.50
Catch Basin, Manhole	0.37
Underpass Ceiling	0.30
Culvert, Endwall	0.25
Railroad Appurtenance, Track	0.12
Overhead Sign Support	0.01

The mean age of drivers identified as having struck an object was 38 years, with standard deviation of 16.2; 37% were female, 59% male, and 3% with gender unrecorded. There was a large variation between towns in the percentage of crashes identified as having struck an object, ranging from 6.2% to 77.5% of total crashes in each town, as shown in Figure 8. Appendix A enumerates the number of cases with objects struck, by town. As might be expected, the higher frequencies of objects struck appear in towns with lower traffic density.

Figure 8. Rate of Having an Object Listed as First Object Struck, by Town/City



Results

The bivariate analysis of characteristics associated with object struck is detailed in Appendix B; the odds ratios are shown in Table 9.

Table 9. Characteristics Associated With First Object Struck

Characteristics	Lower Confidence Limit	Odds Ratio	Upper Confidence Limit
Contributing factor: driver illness	4.16	5.37	6.92
Vehicle type: automobile	2.48	2.72	2.99
Light condition: dark-not lighted	1.79	2.38	3.17
Vehicle type: truck	1.88	2.10	2.35
Contributing factor: speed too fast	1.93	2.05	2.18
Vehicle type: passenger van	1.64	1.91	2.22
Airbag deployed	1.64	1.82	2.03
Vehicle type: motorcycle	1.38	1.70	2.10
At intersection	1.49	1.64	1.82
Light condition: dawn	1.12	1.55	2.15
Collision type: overturn	0.86	0.92	0.98
Light condition: daylight	0.55	0.73	0.97
Light condition: dusk	0.46	0.64	0.88
Contributing factor: violated traffic control	0.36	0.41	0.48
No indication drinking	0.32	0.36	0.41
Contributing factor: following too closely	0.29	0.34	0.39
Other roadway feature: intersection with private roadway	0.27	0.29	0.31
Collision type: angle	0.23	0.27	0.31
Involved more than 3 vehicles	0.21	0.23	0.26
Other roadway feature: intersection with public roadway	0.18	0.20	0.23
Median barrier: no penetration	0.16	0.19	0.23
Contributing factor: failed to grant right of way	0.11	0.12	0.14
Collision type: turning-intersecting paths	0.11	0.12	0.14
Contributing factor: driving/entered on wrong side of road	0.08	0.09	0.11
Median barrier: no median barrier	0.07	0.09	0.10
Collision type: rear-end	0.04	0.04	0.05

Based on multiple logistic regression with backward stepwise selection

Adjusted odds ratio was derived from a multiple regression analysis in which each odds ratio was adjusted for all other independent variables listed. An odds ratio less than 1 indicates that a crash event with that characteristic has a lower likelihood of being recorded with any first object struck, while an odds ratio higher than 1 indicates that a crash event with that characteristic has a higher likelihood of being recorded with any first object struck.

Driver illness had, by far, the highest correlation with a crash involving an object struck (odds ratio 5.37, 95% confidence interval 4.16 to 6.92), followed by dark conditions (odds ratio 2.38, 95% confidence interval 1.79 to 3.17), and speeding (odds ratio 2.05, 95% confidence interval 1.93 to 2.18).

PHASE TWO

Study Sample

The study sample was limited to the 34,778 persons in the merged file of DOT records that linked with CHIME® database records, less the 364 (1%) which had unreliable key variables and were excluded from future analysis. The mean age of the 34,414 persons examined was 32 years, with a standard deviation of 15.8; 44% were female and 56% male. Since this study focused on medical and financial consequences of crashes, records from all involved persons were included in the analysis, rather than just drivers. Of these 34,414, 25,184 (73%) were drivers, 8,446 (25%) were passengers, and 783 (2%) were pedestrians.

Results

A total of 4,885 (14.2%) of the study sample of 34,414 persons were identified as having been in a crash involving striking at least one object. Table 10 and Figure 9 detail the mean length of stay and total hospital charge by type of first object struck. For crashes resulting in hospital charges, the mean total hospital charge was $3,021 with standard deviation of $11,122 (white bars on Figure 9, axis at bottom of chart). Among crashes that had hospital charges, there was a wide variation by first object struck in the percentage resulting in inpatient admissions, possibly reflecting the underlying variation in severity of impact. For crashes resulting in inpatient admissions, the mean length of stay by first object struck varied from 1.3 days (4 cases) to 16 days (1 case), with an overall mean of 4.87 days and a standard deviation of 5.86 (black bars on Figure 9, axis at top of chart; 4 or more admissions only). Since many of the frequencies in this table are low, the means shown should not be regarded as definitive. The most frequent first objects struck which resulted in hospital charges were metal beam guide rails, 626 (13%) cases with mean charge $3,326, while the highest mean charge, $5,986, was for crashes involving a wall as first object struck. Figure 10 shows total mortality by first object struck. The first objects struck associated with the highest number of fatalities were metal beam guide rails and trees, followed by curbing, and banks, ledges, and rocks (off road).

Once again, this analysis only delineates the relationship between mortality and the first object struck, while the actual cause of the injury and mortality could be a subsequent object. This study is somewhat biased by the possibility that subsequent objects struck could be responsible for the majority of the injury, and consequently the majority of the hospital charge, length of stay, and mortality; this is likely to be the case for several of these objects, such as curbing, and possibly guide rails and off road banking.

Figure 9. Mean Total Charges and Length of Stay by Object Struck

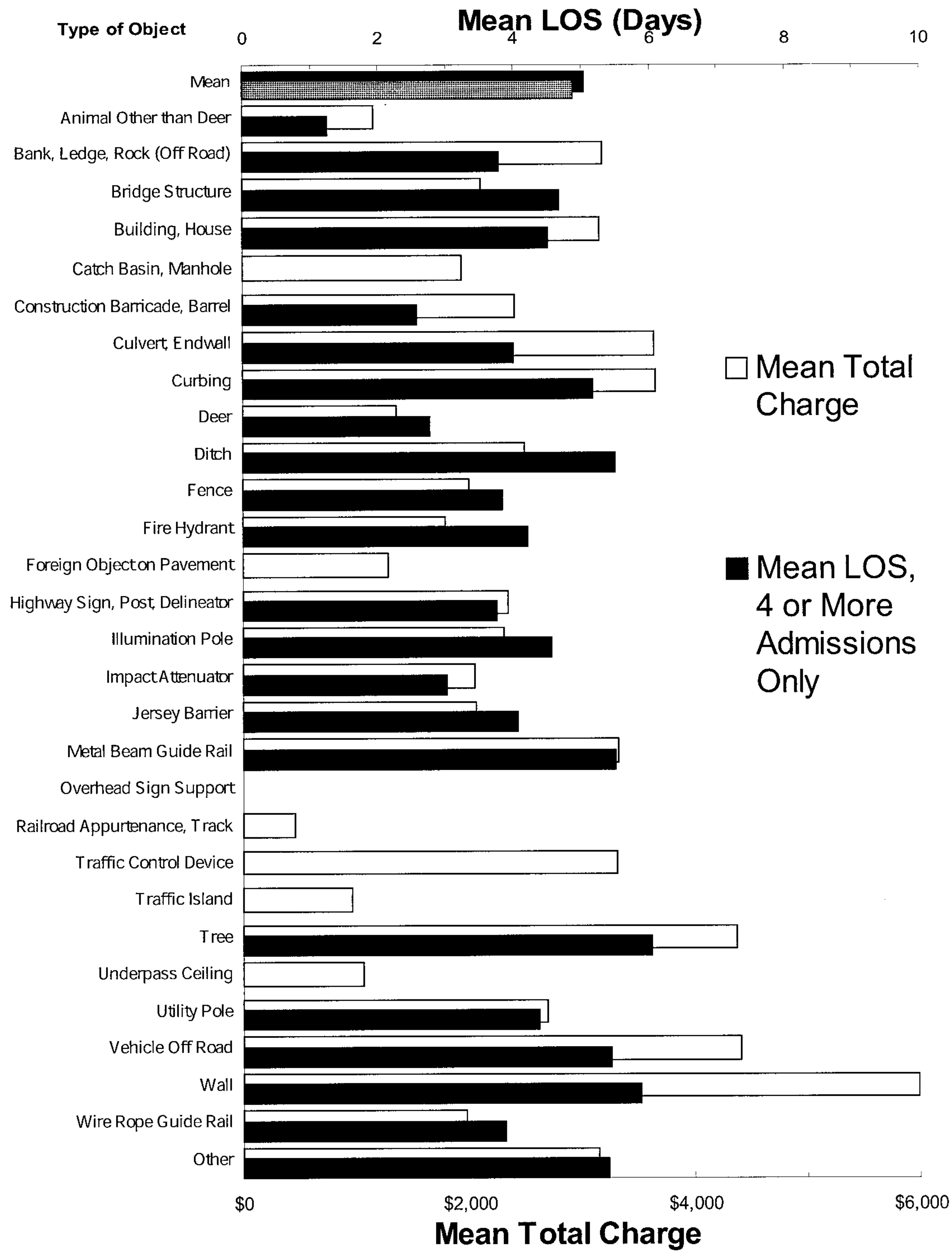
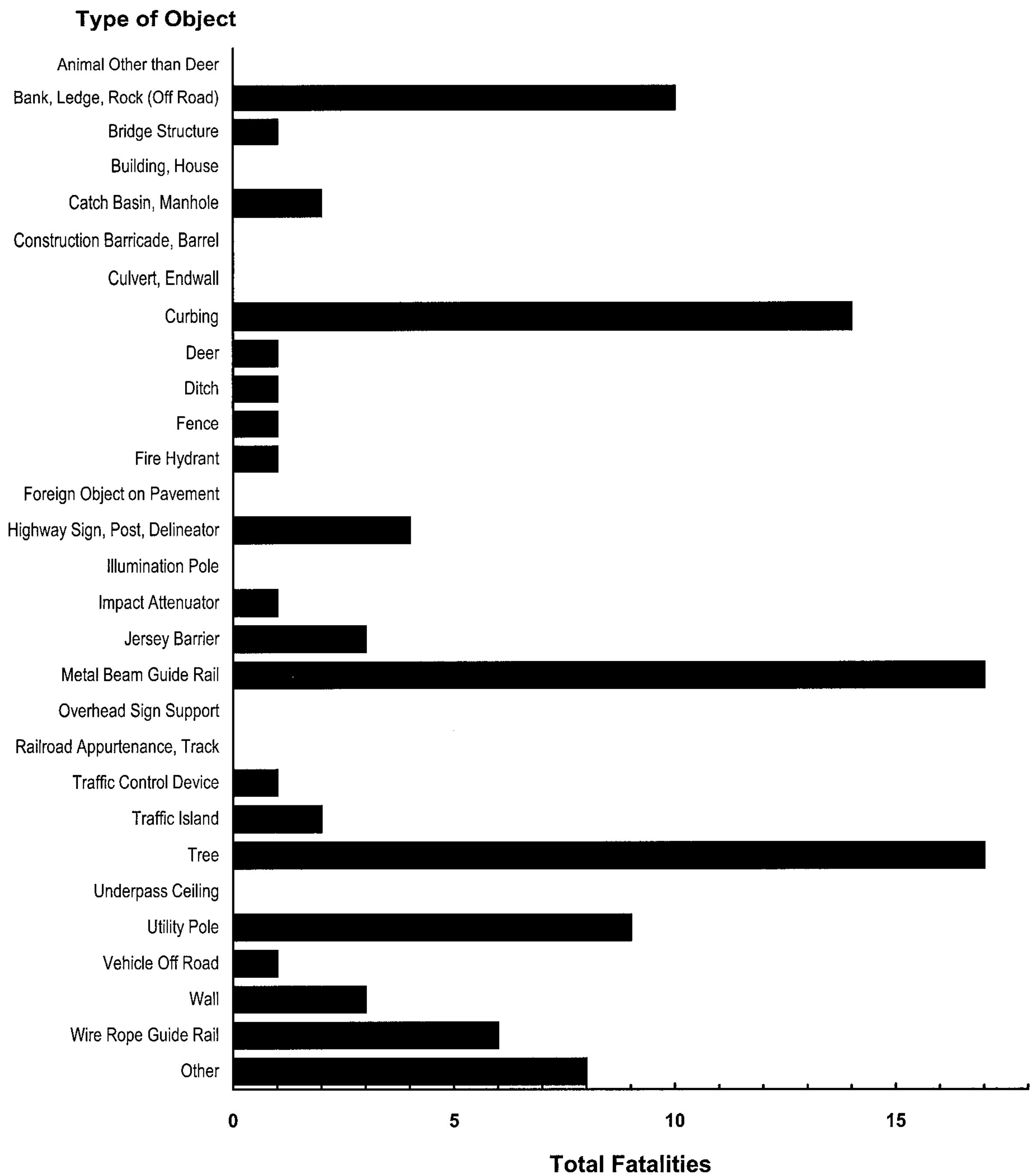


Table 10. Mean LOS and Total Charges by Object Struck

Object Struck	Length of Stay (Days) Mean Days	STD	Number of Cases	Total Charge ($) Mean $	STD	Number of Cases
Animal other than Deer	1.25	0.50	4	1166.15	1734.78	20
Bank, Ledge, Rock (Off Rd)	3.79	4.94	43	3190.49	17427.48	336
Bridge Structure	4.67	5.68	12	2111.30	5881.50	89
Building, House	4.50	4.46	6	3162.08	8718.50	35
Catch Basin, Manhole	7.00		1	1932.68	5100.20	19
Const. Barricade, Barrel	2.57	2.07	7	2405.47	4037.09	22
Culvert, Endwall	4.00	2.71	4	3638.76	6846.08	20
Curbing	5.17	6.60	105	3655.01	10882.75	565
Deer	2.75	1.91	8	1359.81	3137.81	81
Ditch	5.50	4.28	6	2493.58	6102.44	48
Fence	3.82	3.06	11	2002.23	4373.37	83
Fire Hydrant	4.20	3.63	5	1785.39	4144.82	44
Foreign Object on Pavement	5.00	3.61	3	1281.89	3427.76	49
Illumination Pole	4.55	4.06	20	2312.95	4380.50	125
Impact Attenuator	3.00	1.67	6	2055.17	3368.33	28
Jersey Barrier	4.04	5.20	46	2057.51	6735.95	388
Metal Beam Guide Rail	5.50	7.13	90	3326.33	16462.94	626
Overhead Sign Support			0			0
Railroad Appurtenance, Track			0	457.90	432.14	3
Traffic Control Device	16.00		1	3308.34	12383.32	24
Traffic Island	2.00	1.41	2	968.90	1398.00	20
Tree	6.04	6.14	108	4374.29	12444.18	547
Underpass Ceiling			0	1063.97	1727.25	9
Utility Pole	4.36	5.29	92	2693.31	7964.83	642
Vehicle Off Road	5.43	6.44	14	4407.41	11724.01	59
Wall	5.87	7.81	30	5986.32	18508.98	116
Wire Rope Guiderail	3.86	3.78	43	1973.51	5765.34	408
Other	5.39	6.74	54	3143.57	10284.76	322
Mean	**4.87**	**5.86**	**745**	**3020.98**	**11122.14**	**4885**

Length of stay tabulated only for crashes resulting in inpatient admissions. Total charges include inpatient and ED.

Figure 10. Total Mortality by Object Struck



DISCUSSION

Approximately 14% of the motor vehicle crashes and their related hospitalizations studied here involve striking a non-vehicular object. Driver illness, as determined by traffic safety officer at the scene, was strongly associated with crashes involving an object struck, even adjusting for other factors. This finding suggests that drivers should be educated regarding the risks of driving while ill. More detailed study of what kinds of illness and what history of illness are associated with these crashes would be valuable[5]; linkage of the drivers' histories of medication and surgery could identify particular medications which are problematic, or identify general or specific tendencies to release patients for driving too soon after surgery. Other conditions highly correlated with striking a non-vehicular object were darkness, and speeding. Quantifying the costs of speeding, particularly after dark, can justify expending resources on interventions designed to prevent this behavior.

The effects of striking an object varied greatly with the type of object struck. Striking a wire rope guardrail was associated with less severe consequences than striking a metal beam guide rail. Further analysis of the linked data could factor out confounding variables such as differences in average roadway speed, leading to determination of whether there is a general difference in safety between the two types of guard rail, or identifying specific locations which are hazardous. Impact with a tree was also associated with a high degree of severity. Again, using the linked data could determine whether there were any particular locations that were particularly dangerous, or whether this was a general overall risk. Such determinations would allow for informed decisions regarding modifications to existing roadways and design of new ones.

This project demonstrated that the individual data sets (CAAI data, CHIME® database, ED data, and CTMDS data) can be successfully linked together, permitting sophisticated analyses that would otherwise be impossible. The medical database generates useful information on the type and severity of injury to organ systems that have been damaged, as well as the length of stay in the Emergency Department, the Intensive Care Units, and the hospital. The value and utility of the medical database are greatly enhanced by the ability to identify and correlate specific environmental elements, such as road conditions and time of day or night, physical conditions such as type of car and type of object struck, personal conditions such as the use of seat belts or air bags, and specific injuries to the people involved. It is now possible to examine the impact of environmental and physical variables and determine the differences in cost and outcome.

Linked data can make possible substantial progress in the design and safety improvement of motor vehicles and roadways. The relative risks and consequences of the placement and layout of automobile design features and roadway features can be quantified by coupling the data to crash outcomes in terms of personal injury, loss of independence, and cost. Specific injury prevention and public policy recommendations can now derive from carefully performed studies statistically controlled for extraneous environmental and physical factors, using linked data to compare outcomes of different types and severities of crash with reference to mortality, length of stay, ICU stay, rehabilitation, and cost. For instance, the type of evidence presented here regarding the relative risks of differing types of barriers and guardrails can inform the design and decision making process for highway and roadway planners. Similarly, the type and usage of frontal air bags, side air bags, and rear seat restraints, and how these factors interact with various objects struck to affect type of injury, outcome, cost, and rehabilitation, could be very helpful to both legislative bodies and vehicular design and manufacturing interests.

SUMMARY

This data linkage project has demonstrated that large databases from the highway safety domain and the medical domain can be linked successfully. It has shown that mortality, morbidity, cost, and outcome data can be integrated with environmental and physical crash data to yield important information. This information can be helpful in shaping public policy relative to injury prevention.

Crashes with non-vehicular objects make up a considerable fraction of the crash-related morbidity and mortality. Factors influencing the frequency of such crashes, and the types of objects associated with the most severe results, can be identified and action designed to prevent such crashes planned and undertaken. Quantifying the costs associated with these crashes will help allocate the resources required to prevent them.

RECOMMENDATIONS

- Educate people regarding the risk of being overcome by illness while driving.
- Acquire pharmaceutical utilization data and link it with the merged traffic safety and medical/surgical procedure and outcomes data.
- Factor out other confounding variables, in order to identify either any overall high degree of risk represented by certain types of objects (trees, guard beams, etc.), or any specific locations where such objects are especially hazardous.
- Extend the study of type and outcome of injuries by first object struck to include all objects struck.

APPENDIX A

CRASHES, INJURIES, AND OBJECTS STRUCK, BY TOWN OR CITY

Table 11. Crashes, Injuries and Objects Struck, By Town or City

Town or City	Total Crashes	Crashes as Percent of State Total	Injuries	Injuries as Percent of Crashes	Objects Struck	Objects Struck as Percent of Crashes
Andover	42	0.06%	14	33%	8	19%
Ansonia	175	0.24%	99	57%	19	11%
Ashford	77	0.11%	30	39%	26	34%
Avon	305	0.42%	86	28%	32	10%
Barkhamsted	63	0.09%	22	35%	20	32%
Beacon Falls	60	0.08%	21	35%	22	37%
Berlin	475	0.65%	170	36%	77	16%
Bethany	60	0.08%	25	42%	15	25%
Bethel	182	0.25%	101	55%	28	15%
Bethlehem	30	0.04%	16	53%	10	33%
Bloomfield	423	0.58%	181	43%	38	9%
Bolton	118	0.16%	39	33%	27	23%
Bozrah	38	0.05%	11	29%	18	47%
Branford	718	0.99%	274	38%	78	11%
Bridgeport	3,496	4.81%	1,975	56%	263	8%
Bridgewater	39	0.05%	18	46%	16	41%
Bristol	1,263	1.74%	622	49%	101	8%
Brookfield	400	0.55%	190	48%	41	10%
Brooklyn	86	0.12%	39	45%	17	20%
Burlington	86	0.12%	34	40%	25	29%
Canaan	24	0.03%	10	42%	8	33%
Canterbury	37	0.05%	20	54%	20	54%
Canton	229	0.32%	88	38%	42	18%
Chaplin	37	0.05%	17	46%	8	22%
Cheshire	649	0.89%	242	37%	97	15%
Chester	60	0.08%	15	25%	33	55%
Clinton	166	0.23%	64	39%	42	25%
Colchester	249	0.34%	95	38%	69	28%
Colebrook	15	0.02%	5	33%	9	60%
Columbia	82	0.11%	34	41%	20	24%

Table 11 continued. Crashes, Injuries And Objects Struck, By Town Or City

Town or City	Total Crashes	Crashes as Percent of State Total	Injuries	Injuries as Percent of Crashes	Objects Struck	Objects Struck as Percent of Crashes
Cornwall	42	0.06%	12	29%	24	57%
Coventry	138	0.19%	61	44%	38	28%
Cromwell	423	0.58%	131	31%	78	18%
Danbury	1,616	2.22%	707	44%	180	11%
Darien	726	1.00%	240	33%	105	14%
Deep River	57	0.08%	17	30%	17	30%
Derby	421	0.58%	146	35%	50	12%
Durham	113	0.16%	39	35%	24	21%
East Granby	86	0.12%	36	42%	14	16%
East Haddam	92	0.13%	33	36%	37	40%
East Hampton	187	0.26%	64	34%	45	24%
East Hartford	1,229	1.69%	516	42%	167	14%
East Haven	530	0.73%	271	51%	47	9%
East Lyme	355	0.49%	98	28%	70	20%
East Windsor	231	0.32%	99	43%	48	21%
Eastford	32	0.04%	13	41%	14	44%
Easton	107	0.15%	40	37%	42	39%
Ellington	154	0.21%	54	35%	39	25%
Enfield	760	1.05%	286	38%	80	11%
Essex	99	0.14%	25	25%	29	29%
Fairfield	896	1.23%	423	47%	121	14%
Farmington	680	0.94%	210	31%	109	16%
Franklin	56	0.08%	21	38%	16	29%
Glastonbury	374	0.51%	173	46%	100	27%
Goshen	35	0.05%	12	34%	21	60%
Granby	104	0.14%	37	36%	26	25%
Greenwich	1,308	1.80%	513	39%	247	19%
Griswold	199	0.27%	71	36%	52	26%
Groton	872	1.20%	296	34%	159	18%
Guilford	449	0.62%	122	27%	133	30%
Haddam	126	0.17%	43	34%	47	37%
Hamden	1,368	1.88%	618	45%	111	8%
Hampton	16	0.02%	10	63%	9	56%
Hartford	3,635	5.00%	2,304	63%	337	9%
Hartland	11	0.02%	4	36%	7	64%
Harwinton	94	0.13%	33	35%	45	48%

Table 11 continued. Crashes, Injuries And Objects Struck, By Town Or City

Town or City	Total Crashes	Crashes as Percent of State Total	Injuries	Injuries as Percent of Crashes	Objects Struck	Objects Struck as Percent of Crashes
Hebron	92	0.13%	36	39%	26	28%
Kent	45	0.06%	19	42%	25	56%
Killingly	355	0.49%	129	36%	73	21%
Killingworth	55	0.08%	19	35%	20	36%
Lebanon	67	0.09%	40	60%	35	52%
Ledyard	242	0.33%	99	41%	55	23%
Lisbon	91	0.13%	32	35%	38	42%
Litchfield	176	0.24%	74	42%	54	31%
Lyme	10	0.01%	4	40%	5	50%
Madison	291	0.40%	69	24%	106	36%
Manchester	1,037	1.43%	554	53%	108	10%
Mansfield (Storrs)	435	0.60%	153	35%	68	16%
Marlborough	115	0.16%	37	32%	44	38%
Meriden	906	1.25%	470	52%	121	13%
Middlebury	262	0.36%	91	35%	60	23%
Middlefield	117	0.16%	37	32%	21	18%
Middletown	571	0.79%	326	57%	125	22%
Milford	1,386	1.91%	645	47%	188	14%
Monroe	364	0.50%	157	43%	46	13%
Montville	406	0.56%	150	37%	107	26%
Morris	35	0.05%	11	31%	18	51%
Naugatuck	324	0.45%	157	48%	52	16%
New Britain	1,018	1.40%	571	56%	134	13%
New Canaan	294	0.40%	119	40%	66	22%
New Fairfield	129	0.18%	55	43%	36	28%
New Hartford	83	0.11%	28	34%	26	31%
New Haven	3,686	5.07%	2,205	60%	352	10%
New London	605	0.83%	296	49%	64	11%
New Milford	486	0.67%	221	45%	80	16%
Newington	676	0.93%	304	45%	42	6%
Newtown	397	0.55%	130	33%	108	27%
Norfolk	35	0.05%	14	40%	27	77%
North Branford	292	0.40%	91	31%	67	23%
North Canaan	54	0.07%	20	37%	16	30%
North Haven	940	1.29%	377	40%	160	17%
North Stonington	222	0.31%	70	32%	54	24%

Table 11 continued. Crashes, Injuries And Objects Struck, By Town Or City

Town or City	Total Crashes	Crashes as Percent of State Total	Injuries	Injuries as Percent of Crashes	Objects Struck	Objects Struck as Percent of Crashes
Norwalk	2,127	2.93%	955	45%	220	10%
Norwich	1,166	1.60%	438	38%	145	12%
Old Lyme	166	0.23%	38	23%	51	31%
Old Saybrook	270	0.37%	76	28%	41	15%
Orange	797	1.10%	294	37%	85	11%
Oxford	120	0.17%	65	54%	31	26%
Plainfield	280	0.39%	106	38%	74	26%
Plainville	511	0.70%	181	35%	62	12%
Plymouth	232	0.32%	90	39%	37	16%
Pomfret	71	0.10%	33	46%	21	30%
Portland	182	0.25%	70	38%	28	15%
Preston	184	0.25%	70	38%	29	16%
Prospect	96	0.13%	33	34%	18	19%
Putnam	115	0.16%	50	43%	25	22%
Redding	123	0.17%	44	36%	43	35%
Ridgefield	447	0.62%	140	31%	80	18%
Rocky Hill	447	0.62%	168	38%	76	17%
Roxbury	27	0.04%	12	44%	9	33%
Salem	73	0.10%	26	36%	20	27%
Salisbury	65	0.09%	32	49%	20	31%
Scotland	28	0.04%	10	36%	12	43%
Seymour	356	0.49%	149	42%	88	25%
Sharon	45	0.06%	20	44%	20	44%
Shelton	503	0.69%	253	50%	83	17%
Sherman	42	0.06%	20	48%	20	48%
Simsbury	370	0.51%	150	41%	66	18%
Somers	93	0.13%	36	39%	23	25%
South Windsor	292	0.40%	132	45%	37	13%
Southbury	316	0.43%	104	33%	89	28%
Southington	813	1.12%	424	52%	125	15%
Sprague	30	0.04%	12	40%	12	40%
Stafford	178	0.24%	83	47%	48	27%
Stamford	2,327	3.20%	1,254	54%	208	9%
Sterling	23	0.03%	16	70%	12	52%
Stonington	501	0.69%	158	32%	111	22%
Stratford	1,227	1.69%	489	40%	134	11%

Table 11 continued. Crashes, Injuries And Objects Struck, By Town Or City

Town or City	Total Crashes	Crashes as Percent of State Total	Injuries	Injuries as Percent of Crashes	Objects Struck	Objects Struck as Percent of Crashes
Suffield	177	0.24%	80	45%	42	24%
Thomaston	134	0.18%	58	43%	34	25%
Thompson	93	0.13%	44	47%	35	38%
Tolland	210	0.29%	78	37%	56	27%
Torrington	713	0.98%	274	38%	92	13%
Trumbull	392	0.54%	125	32%	81	21%
Union	62	0.09%	21	34%	32	52%
Vernon	610	0.84%	239	39%	51	8%
Voluntown	42	0.06%	21	50%	14	33%
Wallingford	1,056	1.45%	451	43%	164	16%
Warren	6	0.01%	3	50%	3	50%
Washington	62	0.09%	28	45%	24	39%
Waterbury	2,798	3.85%	1,603	57%	342	12%
Waterford	584	0.80%	197	34%	130	22%
Watertown	477	0.66%	195	41%	80	17%
West Hartford	1,154	1.59%	592	51%	98	8%
West Haven	1,070	1.47%	594	56%	108	10%
Westbrook	145	0.20%	47	32%	42	29%
Weston	74	0.10%	33	45%	22	30%
Westport	1,118	1.54%	385	34%	134	12%
Wethersfield	616	0.85%	271	44%	79	13%
Willington	113	0.16%	37	33%	53	47%
Wilton	481	0.66%	157	33%	50	10%
Winchester (Winsted)	277	0.38%	114	41%	43	16%
Windham (Willimantic)	499	0.69%	203	41%	50	10%
Windsor	682	0.94%	277	41%	111	16%
Windsor Locks	148	0.20%	90	61%	34	23%
Wolcott	179	0.25%	89	50%	24	13%
Woodbridge	222	0.31%	104	47%	48	22%
Woodbury	141	0.19%	50	35%	32	23%
Woodstock	85	0.12%	46	54%	27	32%
Statewide	**72,667**	**100%**	**32,882**	**45%**	**10,882**	**15%**

APPENDIX B

Bivariate Analysis of Having Struck an Object

Table 12. Bivariate Analysis of Characteristics Associated with Having Any Type of Object Listed as First Struck

(N=132,918, Driver only)

Characteristic	Total N	Yes N=19206 %	No N=11372 %	P value
Mon.	18280	13.44	13.81	0.179
Tues.	18009	15.17	13.28	<0.001
Thurs.	19343	13.21	14.78	<0.001
Fri.	20775	14.77	15.77	<0.001
Wed	18450	14.92	13.7	<0.001
Weekend	38061	28.49	28.66	0.621
No indication drinking	130853	94.7	99.08	<0.001
At-fault driver	70332	89.15	46.79	<0.001
Female	49672	34.1	37.92	<0.001
Age > 64 years	11212	5.87	8.87	<0.001
Age missing	5946	2.64	4.78	<0.001
At-fault traffic unit #1	77924	89.28	53.45	<0.001
At-fault traffic unit #2	48310	9.94	40.8	<0.001
At-fault traffic unit #3	5268	0.62	4.53	<0.001
Collision type: pedestrian	1385	0.12	1.2	<0.001
Involved more than 3 vehicles	16026	2.51	13.67	<0.001
Involved more than 1 pedestrians	1513	0.31	1.28	<0.001
Collision type: angle	8842	1.7	7.49	<0.001
Collision type: backing	2195	0.08	1.92	<0.001
Collision type: jackknife	113	0.26	0.06	<0.001
Collision type: head-on	1329	0.23	1.13	<0.001
Collision type: overturn	791	2.01	0.36	<0.001
Collision type: parking	827	0.04	0.72	<0.001
Collision type: rear-end	49600	2.65	43.17	<0.001
Collision type: sideswipe-same direction	13376	3.92	11.1	<0.001
Collision type: turning-same direction	5551	0.52	4.79	<0.001

Table 12 continued. Bivariate Analysis of Characteristics Associated with Having Any Type of Object Listed as First Struck

Characteristic	Total N	Yes N=19206 %	No N=11372 %	P value
Median barrier: no median barrier	122315	78.67	94.28	<0.001
Median barrier: no penetration	9487	16.84	5.5	<0.001
Collision type: fixed object	15443	75.26	0.87	<0.001
Construction	2584	2.15	1.91	0.025
Contributing factor: driving/entered on wrong side of road	1921	0.72	1.57	<0.001
Contributing factor: driver illness	449	1.44	0.15	<0.001
Contributing factor: speed too fast	12242	25.9	6.39	<0.001
Contributing factor: violated traffic control	8775	1.64	7.44	<0.001
Contributing factor: failed to grant right of way	24746	2.65	21.32	<0.001
Contributing factor: following too closely	41907	1.74	36.56	<0.001
Collision type: turning-intersecting paths	16370	1.05	14.22	<0.001
At intersection	65651	21.93	54.03	<0.001
Light condition: dark - lighted	25956	25.87	18.46	<0.001
Light condition: dark-not lighted	6980	17.4	3.2	<0.001
Light condition: dawn	1045	1.91	0.6	<0.001
Light condition: daylight	95335	52.78	74.93	<0.001
Light condition: dusk	2919	1.46	2.32	<0.001
Collision type: moving object	2290	10.05	0.32	<0.001
Non collision	117	0	0.1	<0.001
Collision type: sideswipe-opposite direction	2918	0.89	2.42	<0.001
Collision type: turning-opposite direction	11566	1.15	9.98	<0.001
Other roadway feature: intersection with public roadway	55771	16.48	46.26	<0.001
Other roadway feature: intersection with private roadway	30911	11.76	25.2	<0.001
Road surface: other	199	0.3	0.12	<0.001
Road surface: sand/mud/dirt or oil	1129	1.12	0.8	<0.001
Road surface: snow/slush	6361	10.06	3.89	<0.001
Road surface: dry	93540	60.25	72.08	<0.001
Road surface: ice	2921	5.3	1.67	<0.001
Road surface: wet	28134	22.63	20.92	<0.001
Weather: sleet/ hail	737	1.52	0.39	<0.001
Weather: blowing sand/soil/dirt or snow	454	0.48	0.32	<0.001
Weather: fog	955	1.6	0.57	<0.001
Weather: other	785	0.83	0.55	<0.001

Table 12 continued. Bivariate Analysis of Characteristics Associated with Having Any Type of Object Listed as First Struck

Characteristic	Total N	Yes N=19206 %	No N=11372 %	P value
Weather: rain	20349	17.37	14.96	<0.001
Weather: snow	5423	8.26	3.37	<0.001
Weather: severe cross winds	141	0.22	0.09	<0.001
Weather: no adverse condition	103326	69.3	79.16	<0.001
Vehicle type: automobile	109031	84.63	81.59	<0.001
Vehicle type: motorcycle	975	1.27	0.64	<0.001
Vehicle type: truck	12092	8.23	9.24	<0.001
Vehicle type: passenger van	4012	2.3	3.14	<0.001
Airbag deployed	3995	6.42	2.43	<0.001
Injury type: incapacitating injury	3801	4.97	2.5	<0.001
Injury type: non-incapacitating injury	8741	14.95	5.16	<0.001
Injury type: possible injury	20381	15.55	15.3	0.363
Injury type: fatal injury	206	0.64	0.07	<0.001
MVC within past 1 year	1214	1.39	0.83	<0.001
MVC within past 6 months	451	0.53	0.31	<0.001

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