Probability of Driver Injury in Single Vehicle Collisions with Roadway Appurtenances as a Function of Passenger Car Curb Weight

by

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DISCLAIMER

The conclusions and opinions expressed in this document are those of the author, and do not necessarily represent those of the State of Texas, the State Department of Highways and Public Transportation, or the Texas Transportation Institute.

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INTRODUCTION

Since the mid-1970's passenger cars manufactured for sale in this country have undergone a conspicuous reduction in weight. Figure 1 indicates that this phenomenon will continue and that the average weight of the domestic passenger car fleet will decrease from approximately 3400 pounds (in 1978) to 2550 pounds in 1986 (Viner, 1979)

A number of studies published during the last 10 years have considered the safety consequences of this trend toward smaller, lighter passenger cars (Campbell and Reinfurt, 1973; O'Day, Golomb, and Cooley, 1973; Mela, 1974; Mela, 1975; O'Day and Kaplan, 1975; Stewart and Stutts, 1978). The most general finding from this literature is, not surprisingly, that drivers and passengers of lighter cars are more apt to be killed or injured in a crash than are drivers and passengers of heavier cars.

When accident configuration is considered, however, the injury penalty associated with smaller, lighter cars is less clear. Campbell and Reinfurt (1973) suggest that the probability of <u>driver</u> injury (A+K) is greater in a "small car vs. small car" accident than in a "large car vs. large car" accident. O'Day et al. (1973), on the other hand, can find very little difference in <u>occupant</u> injury for these two types of accidents. (Note: Campbell and Reinfurt divide vehicle weight into six categories: 0-2699 lbs., 2700-3099 lbs., 3100-3299 lbs., 3300-3699 lbs., 3700-4099 lbs., and 4100 lbs. or greater. O'Day divides vehicle weight into two categories: 1500-3100 lbs. and 3300-5200 lbs.).

For single-vehicle accidents, O'Day et al. suggest that a higher percentage of occupants is injured in small cars (1500-3100 lbs.) than in large

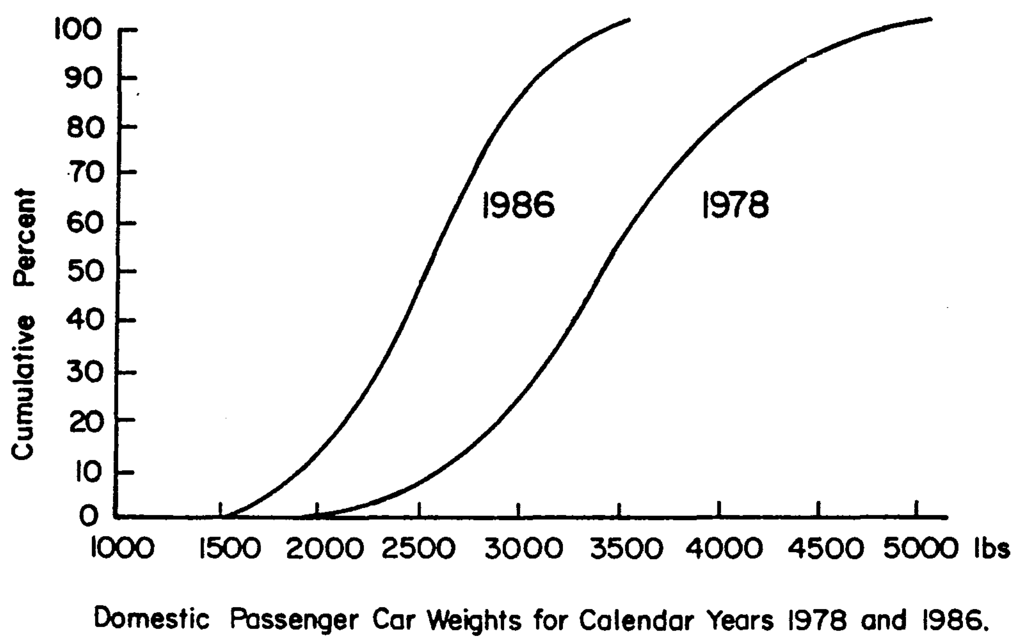


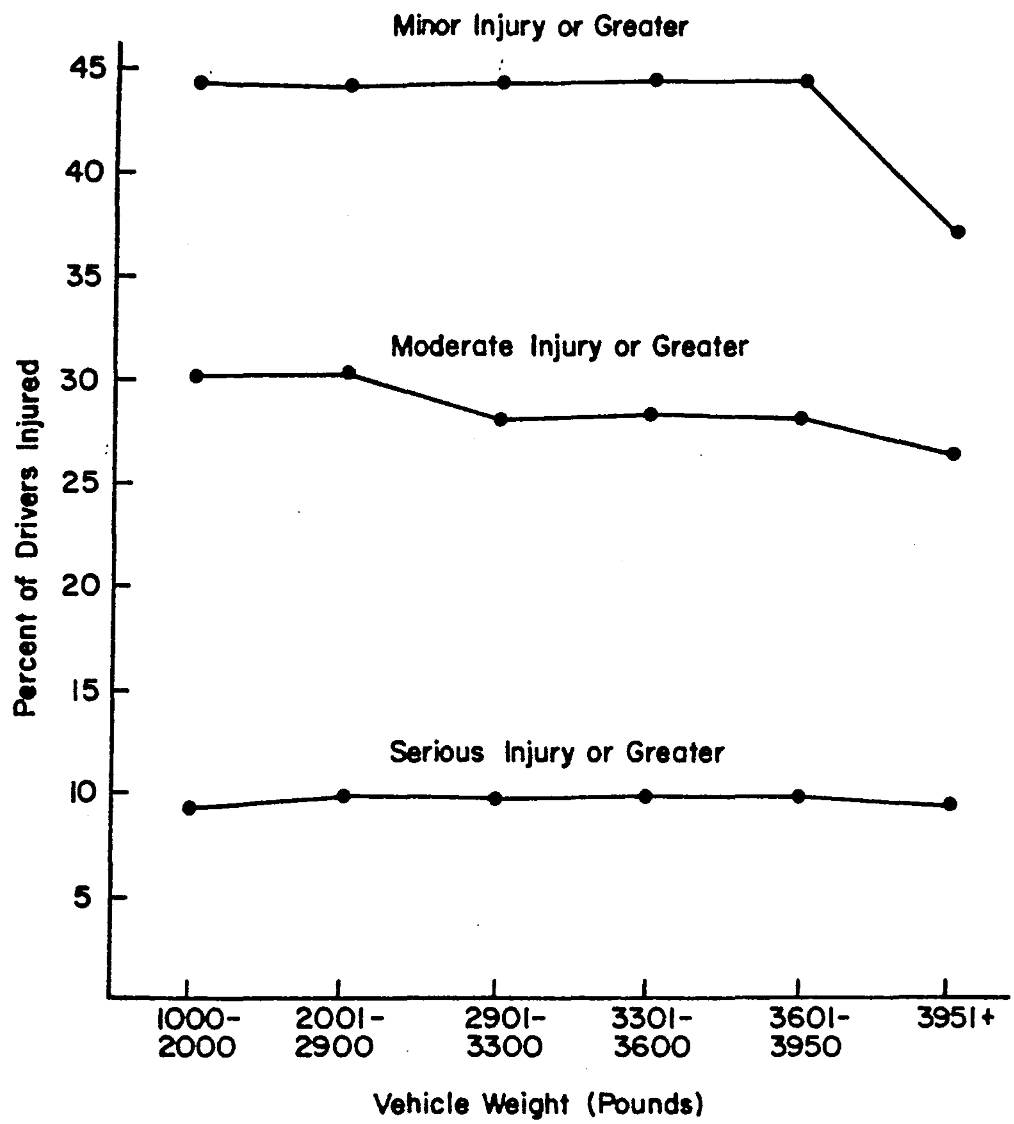
Figure 1: Cumulative Distributions of Weights for 1978 and 1986 Domestic Passenger Cars (after Viner, 1979)

cars (3300-5200 lbs.). 41 percent of the occupants in small cars are injured; 35 percent of the occupants in large cars are injured (O'Day et al. 1973, Figure 7).

For single-vehicle, ran-off-road accidents, Campbell and Reinfurt find only a slight association between passenger car weight and driver injury, i.e., driver injury increases slightly as passenger car weight decreases (Campbell and Reinfurt, 1973, Figures 8-12).

Stewart and Stutts (1978) find little, if any, association between driver injury and passenger car weight in single vehicle accidents. Figure 2 in this report is derived from data presented in Table 2.2 of the Stewart-Stutts report. The upper function in Figure 2 represents the percentage of drivers who received a "minor or greater" injury (C, B, A, or K). The middle function represents the percentage of drivers who received a "moderate or greater" injury (B, A, or K). The lower function represents the percentage of drivers who received a "serious or greater" injury (A or K). All three of these "functions" are basically horizontal, indicating that vehicle weight and driver injury are independent.

The purpose of this paper is to further consider the effects of passenger car weight on driver injury in single vehicle accidents. More specifically, this paper will consider only those single-vehicle accidents which involve collisions with any one of seven different types of roadway appurtenances: highway signs, culverts, utility poles, luminaire poles, curbs, guard rails, or bridge rails.



igure 2: Percentages of Drivers Injured (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Accidents as a Function of Passenger Car Weight Class (after Stewart & Stutts, 1978)

METHOD

Data

The Accident Analysis Division of the Texas Transportation Institute maintains a tape library which contains detailed information on more than 3,000,000 traffic accidents which have occurred in Texas since January 1, 1974. The data recorded on these tapes was originally supplied by the Texas Department of Public Safety (DPS) and the Texas State Department of Highways and Public Transportation (SDHPT).

The analyses contained in this report are based on 1980 data. In 1980 Texas experienced 432,940 traffic accidents (Scott and Hilger, 1981). Of these, 39,580 were classified by TTI as single-vehicle accidents involving passenger cars of known curb weight.

Since the Texas accident report form does not directly call for the recording of vehicle curb weight, an indirect means of calculating this weight was required. Fortunately, the Texas accident report form does call for the recording of vehicle make, model, and year of manufacture. On the basis of this information, and a cross reference file of passenger car curb weights by make, model, and year of manufacture, curb weights for accident-involved passenger cars manufactured after 1969 were derived. Cross referencing was accomplished with the aid of two publications: Passenger Car Specifications (Motor Vehicle Manufacturer's Association of the United States, Inc.) and Automotive News. Of the 531,773 passenger cars involved in accidents in 1980, curb weights were derived for 390,420 (73.4%) of them.

Procedure

The purpose of the analyses in this report is to determine the prob-

All analyses were restricted to single-vehicle collisions involving one of seven different roadway appurtenances: highway signs, culverts, utility poles, luminaire poles, curbs, guard rails, and bridge rails.

Three different definitions were used to specify severity of driver injury. In each case, driver injury is a discrete, binary variable:

Driver Injury Severity	Coding 1	Coding 0
Serious or greater	F,A	B,C,N
Moderate or greater	F,A,B	C,N
Minor or greater	F,A,B,C	N

where: F = fatal injury
A = incapacitating injury
B = non-incapacitating injury
C = possible injury
N = not injured

Passenger car curb weight is a continuous variable recorded to the nearest pound.

In order to obtain the probability of driver injury as a function of passenger car curb weight, standard logistic regression procedures were used (see, for example, Haberman, 1978). Equations of the following form were then generated:

$$Y = \frac{e^{(a+bX)}}{1 + e^{(a+bX)}}$$

where: Y = probability of driver injury
X = passenger car curb weight
a,b = regression coefficients

Maximum likelihood estimates of a and b were obtained using the LOGIST procedure in the Statistical Analysis System (Reinhardt, 1980).

In all, 21 regression equations were produced: three estimates of the probability of driver injury (serious or greater, moderate or greater, minor or greater) by seven types of roadway appurtenances (highway signs, culverts, utility poles, luminaire poles, curbs, guard rails, bridge rails).

RESULTS

Collisions involving highway signs

2102 passenger cars which collided with highway signs are contained in this data set. The smallest of these cars weighed 1512 pounds; the largest weighed 5298 pounds. Mean weight for these vehicles was 3443.18 pounds.

25.78 percent of the drivers of these vehicles received minor or greater injuries. 17.79 percent received moderate or greater injuries; 4.14 percent received serious or greater injuries.

Figure 3 depicts probability of driver injury as a function of curb weight. All three of the curves in this figure have a slight negative slope. However, none of these curves deviates significantly from a horizontal line (χ_1^2 = 2.09, p=0.1480; χ_1^2 = 0.27, p=0.6054; χ_1^2 = 0.14, p=0.7129). Or, in other words, for single-vehicle collisions involving highway signs, the probability of driver injury is independent of passenger car curb weight. (For further detail, see the appendix to this report).

Collisions involving culverts

1063 passenger cars which collided with culverts are contained in this data set. The smallest of these cars weighed 1512 pounds; the largest weighed 5273 pounds. Mean weight for these vehicles was 3482.29 pounds.

55.60 percent of the drivers of these vehicles received minor or greater injuries. 45.72 percent received moderate or greater injuries; 18.91 percent received serious or greater injuries.

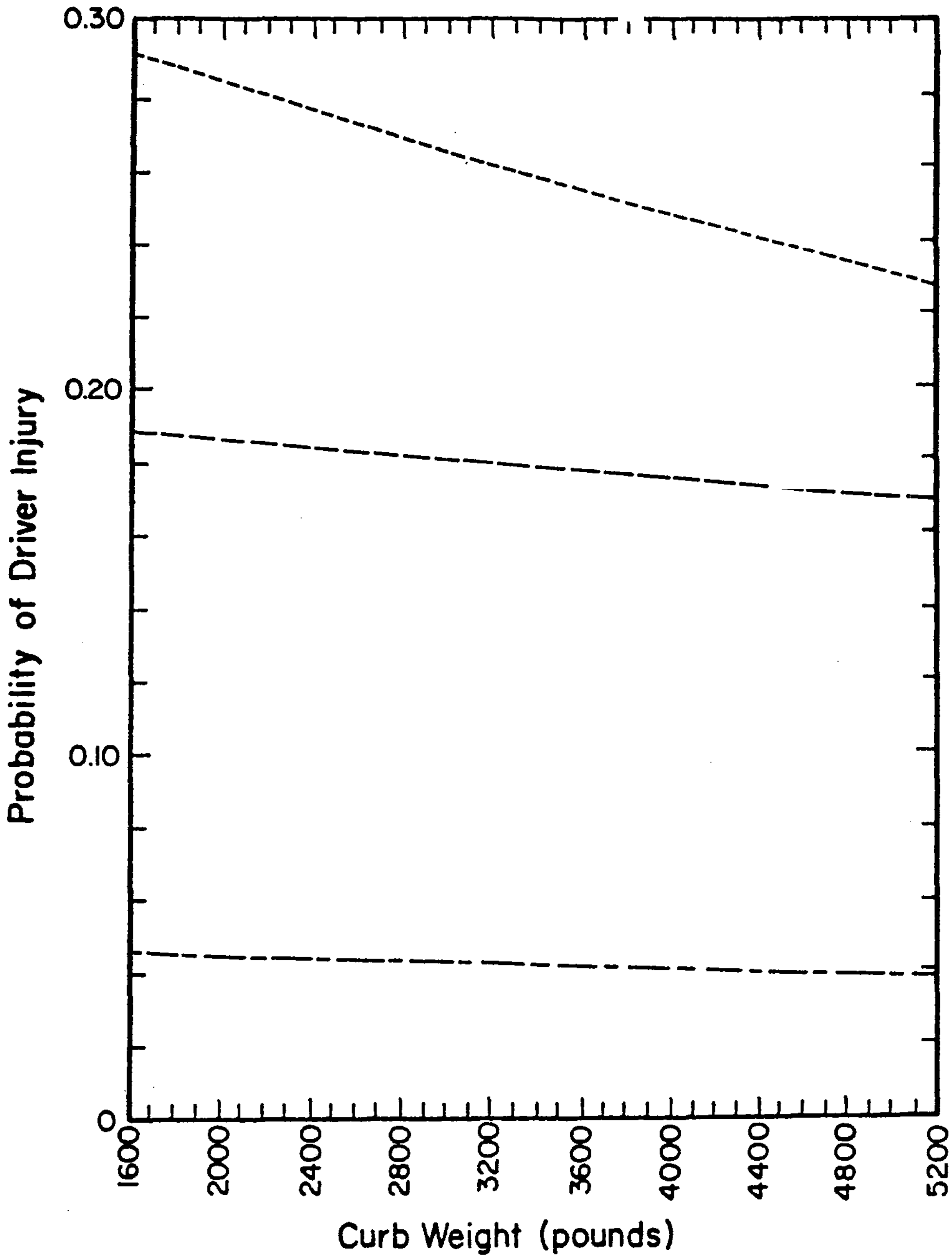


Figure 3: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Highway Signs as a Function of Passenger Car Curb Weight

Figure 4 depicts probability of driver injury as a function of curb weight. The top two curves have a slight negative slope; the bottom curve appears to be horizontal. None of these curves deviates significantly from a horizontal line (χ_1^2 = 0.89, p=0.3463; χ_1^2 = 1.49, p=0.2226; χ_1^2 = 0.00, p=0.9994). For these accidents, the probability of driver injury is independent of passenger car curb weight.

Collisions involving utility poles

4148 passenger cars which collided with utility poles are included in this data set. The smallest of these cars weighed 1512 pounds; the largest weighed 5298 pounds. Mean weight for these vehicles was 3564.26 pounds.

44.65 percent of the drivers of these vehicles received minor or greater injuries. 33.51 percent received moderate or greater injuries; 5.79 received serious or greater injuries.

Figure 5 depicts probability of driver injury as a function of passenger car curb weight. All three of the curves in this figure have sharp, negative slopes. All three of these curves deviate significantly from the horizontal (χ_1^2 = 42.18, p=0.0000; χ_1^2 = 39.90, p=0.0000; χ_1^2 = 40.70, p=0.0000). All three of these curves indicate that the probability of driver injury is highly dependent upon passenger car curb weight. For example, the driver of a 1600 pound car is between 6 and 7 times more likely to receive a serious or greater injury than the driver of a 5200 pound car.

Collisions involving luminaire poles

2080 passenger cars which collided with luminaire poles are included in this data set. The smallest of these cars weighed 1536 pounds; the largest weighed 5273. Mean weight for these vehicles was 3534.12 pounds.

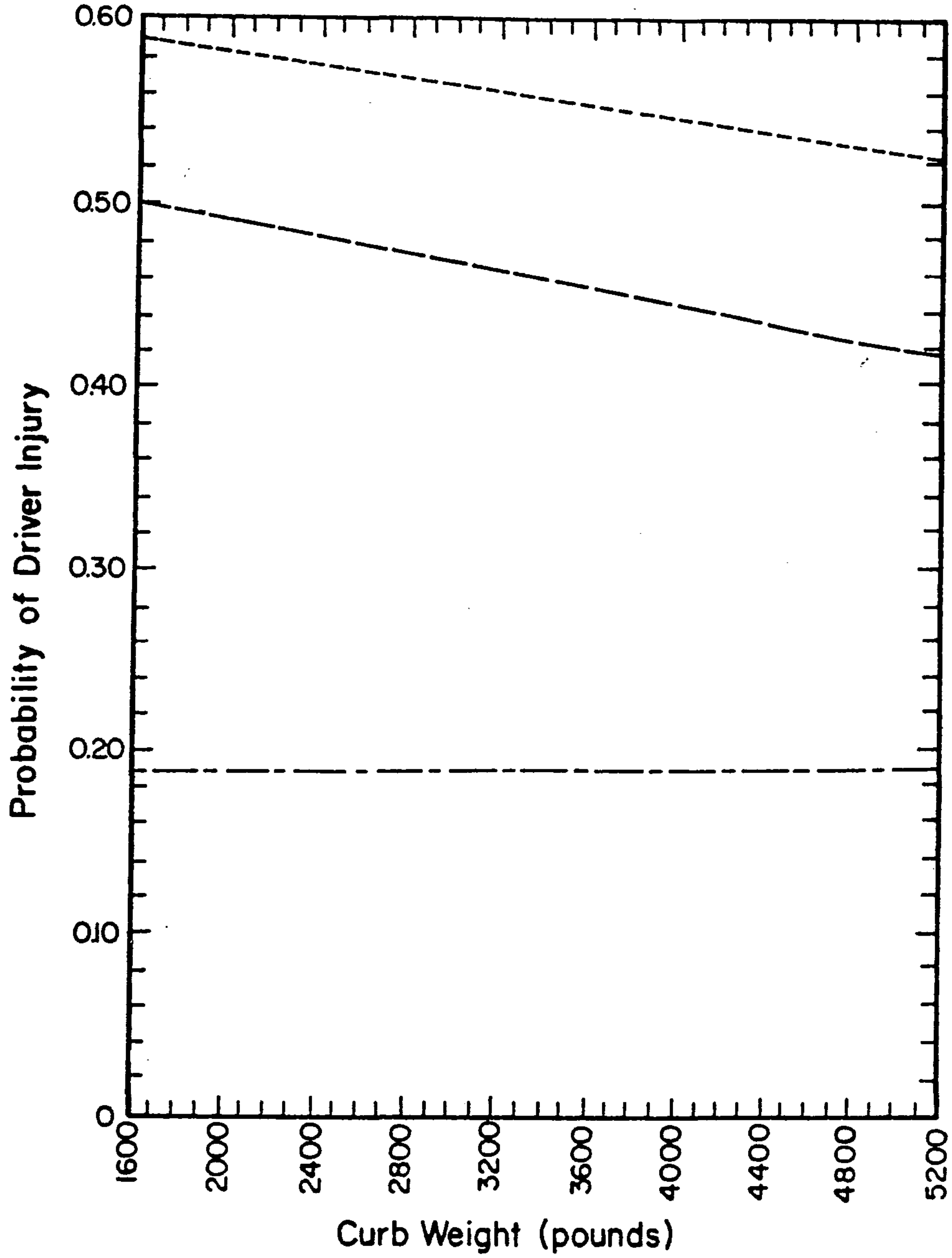


Figure 4: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Culverts as a Function of Passenger Car Curb Weight

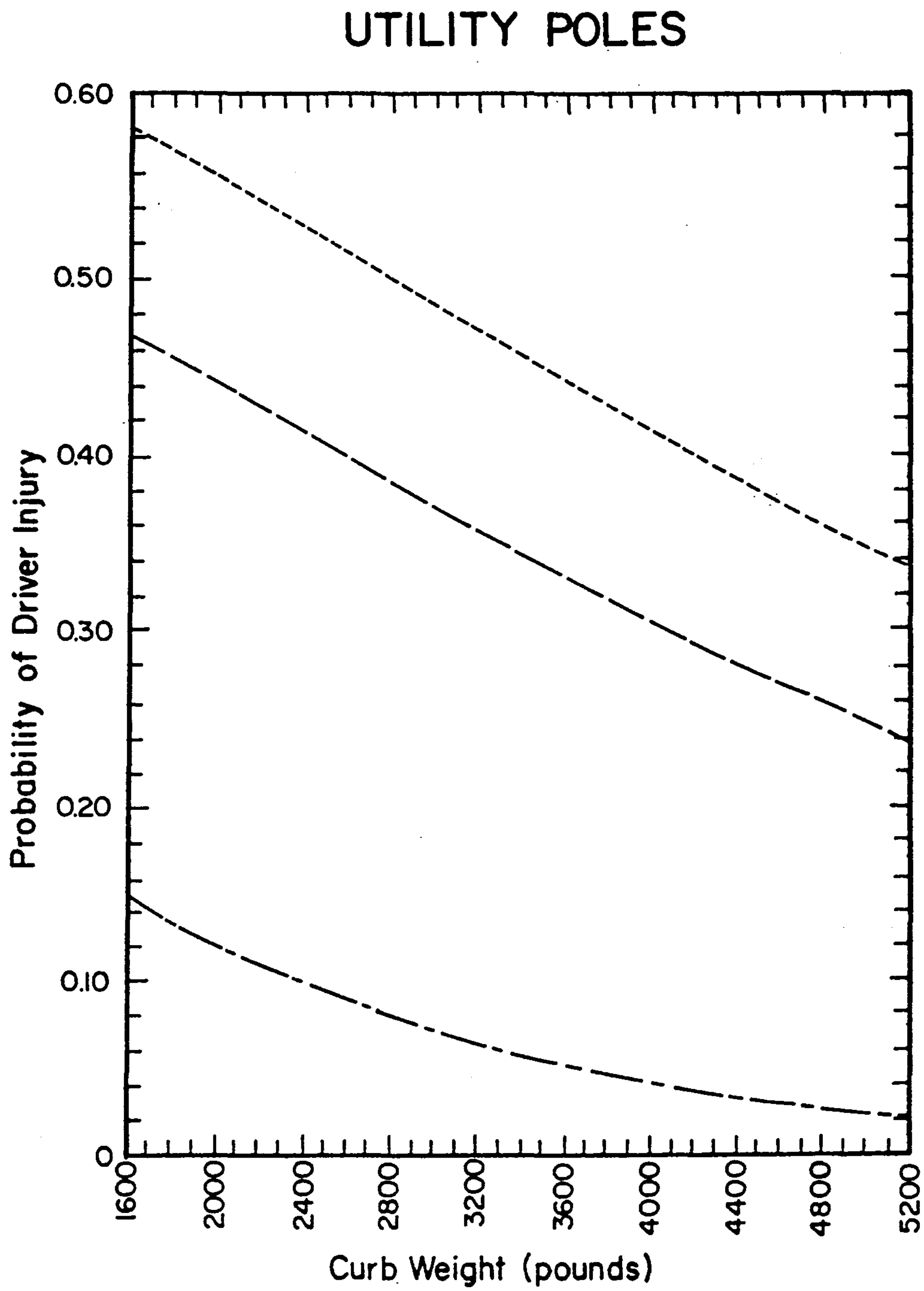


Figure 5: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Utility Poles as a Function of Passenger Car Curb Weight

greater injuries. 31.97 percent received moderate or greater injuries; 6.63 percent received serious or greater injuries.

Figure 6 depicts probability of driver injury as a function of passenger car curb weight. As in the previous figure, all three curves have a sharp, negative slope. Again, all three curves deviate significantly from the horizontal (χ_1^2 = 15.41, p=0.0001; χ_1^2 = 16.37, p=0.0001; χ_1^2 = 16.81, p=0.0000). Probability of driver injury is highly dependent upon passenger car curb weight. For example, the driver of a 1600 pound car is approximately 5 times more likely to receive a serious or greater injury than the driver of a 5200 pound car.

Collisions involving curbs

1027 passenger cars which collided with curbs are included in this data set. The smallest car weighed 1664 pounds; the largest weighed 5386 pounds. Mean vehicle weight was 3101.73 pounds.

23.37 percent of the drivers received minor or greater injuries. 15.68 percent received moderate or greater injuries; 3.51 percent received serious or greater injuries.

Figure 7 depicts probability of driver injury as a function of passenger car curb weight. All three of the curves in this figure have negative slopes. At α = 0.10, the top curve (minor or greater injury) is significantly different from the horizontal (χ_1^2 = 2.85, p=0.0912). The middle curve (moderate or greater injury) is significantly different from the horizontal (χ_1^2 = 6.22, p=0.0126). The bottom curve (serious or greater injury) does not deviate significantly from a horizontal line (χ_1^2 = 0.52, p=0.4700). Thus, there is statistical evidence that the probability of "minor or greater driver

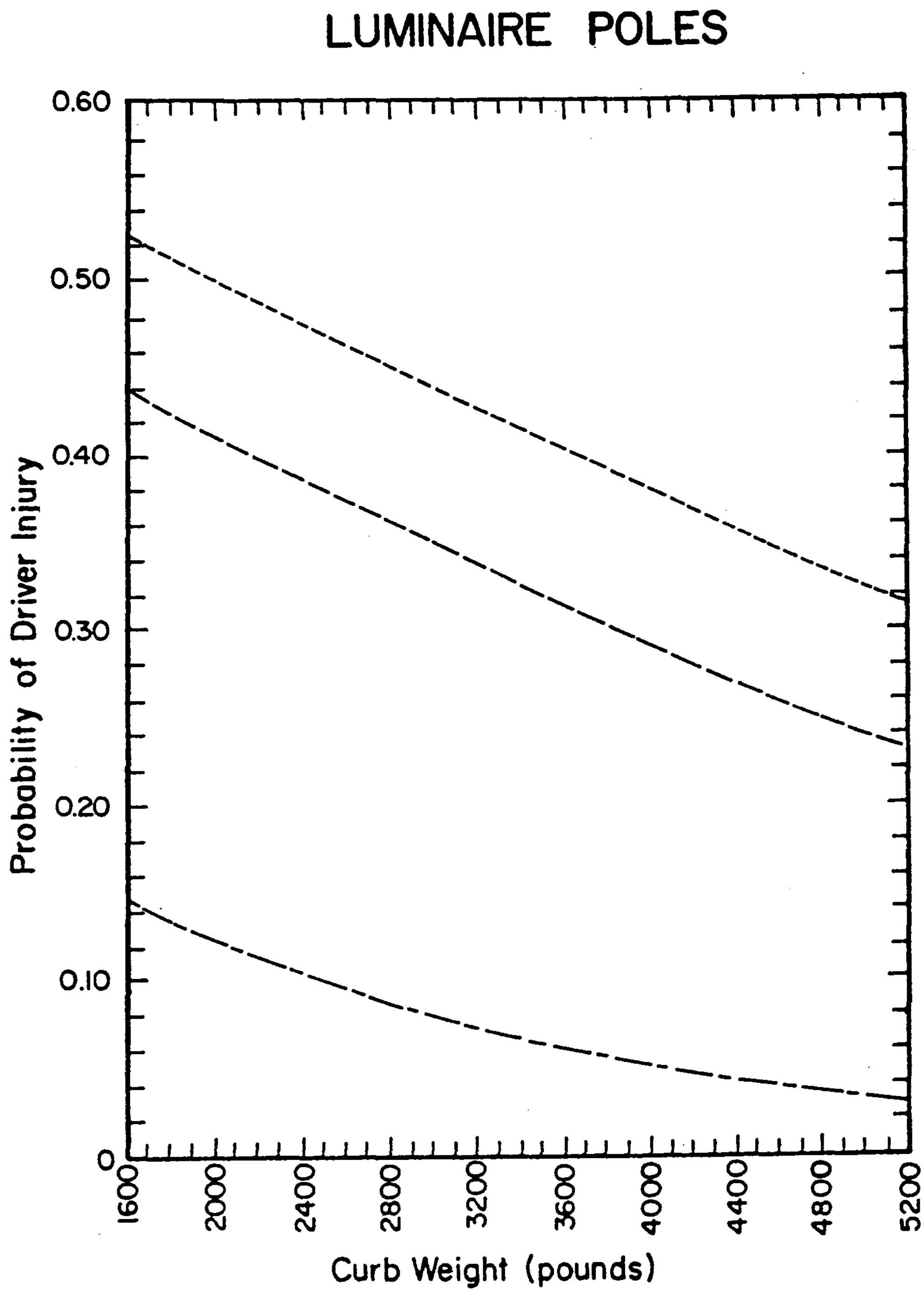


Figure 6: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Luminaire Poles as a Function of Passenger Car Curb Weight

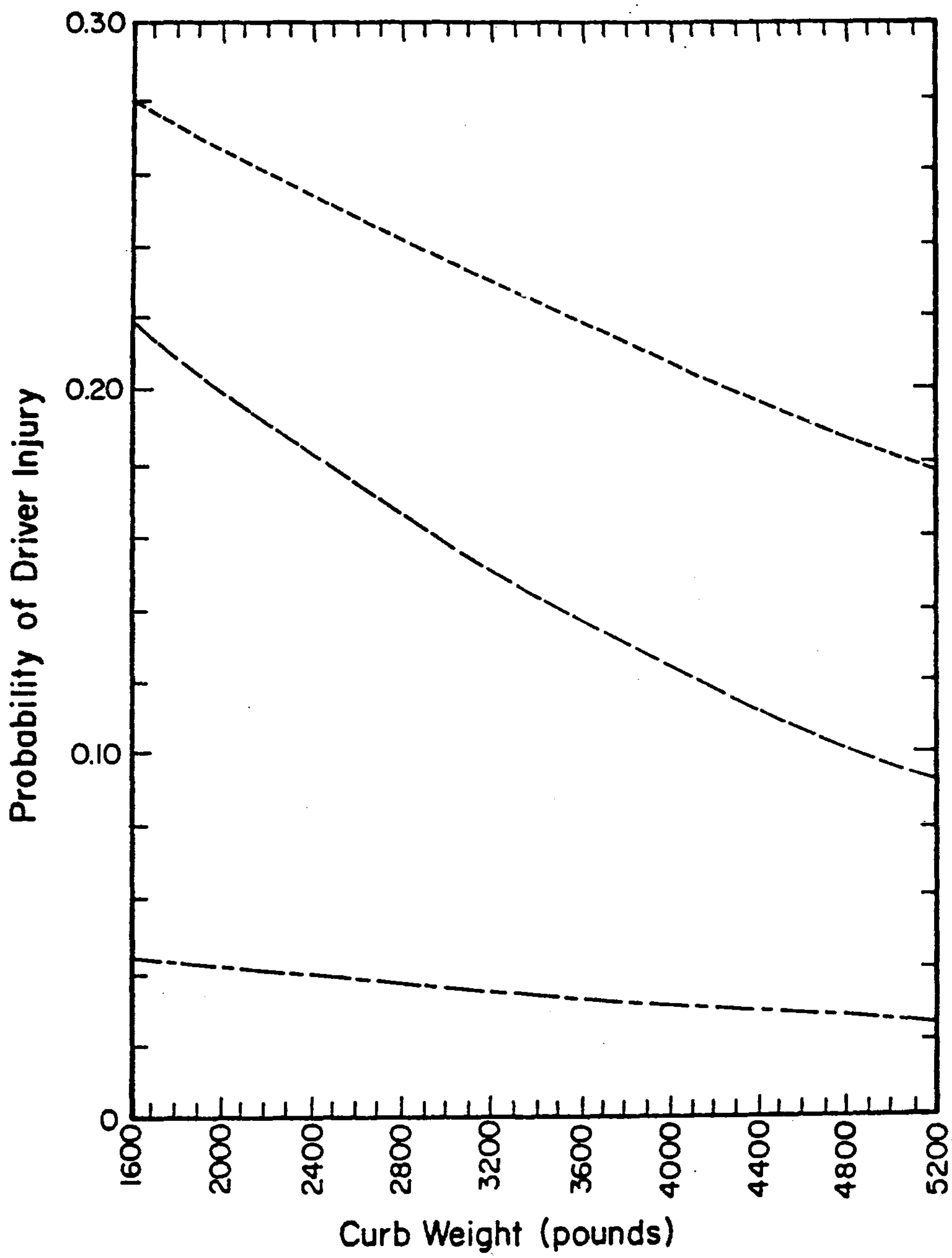


Figure 7: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Curbs as a Function of Passenger Car Curb Weight

injury" and "moderate or greater driver injury" are influenced by passenger car curb weight. There is no statistical evidence to indicate that the probability of "serious or greater driver injury" is influenced by passenger car curb weight.

Collisions involving guard rails

3657 passenger cars which collided with guard rails are included in this data set. The smallest car weighed 1512 pounds; the largest weighed 5386 pounds. Mean vehicle weight was 3389.89.

38.36 percent of the drivers of these vehicles received minor or greater injuries. 28.44 percent received moderate or greater injuries; 7.14 percent received serious or greater injuries.

Figure 8 depicts probability of driver injury as a function of passenger car curb weight. All three curves in this figure have negative slopes. The top two curves (minor injury or greater and moderate injury or greater) deviate significantly from the horizontal (χ_1^2 = 14.52, p=0.0001; χ_1^2 = 11.00, p=0.0009). The bottom curve (serious injury or greater) does not deviate significantly from a horizontal line (χ_1^2 = 1.13, p=0.2870).

Collisions involving bridge rails

1459 passenger cars which collided with bridge rails are included in this data set. The smallest car weighed 1664 pounds; the largest weighed 5359 pounds. Mean vehicle weight was 3420.01 pounds.

38.31 percent of the drivers of these vehicles received minor or greater injuries. 28.31 percent received moderate or greater injuries; 8.91 percent received serious or greater injuries.

Figure 9 depicts probability of driver injury as a function of passenger car curb weight. The top curve has a negative slope; the

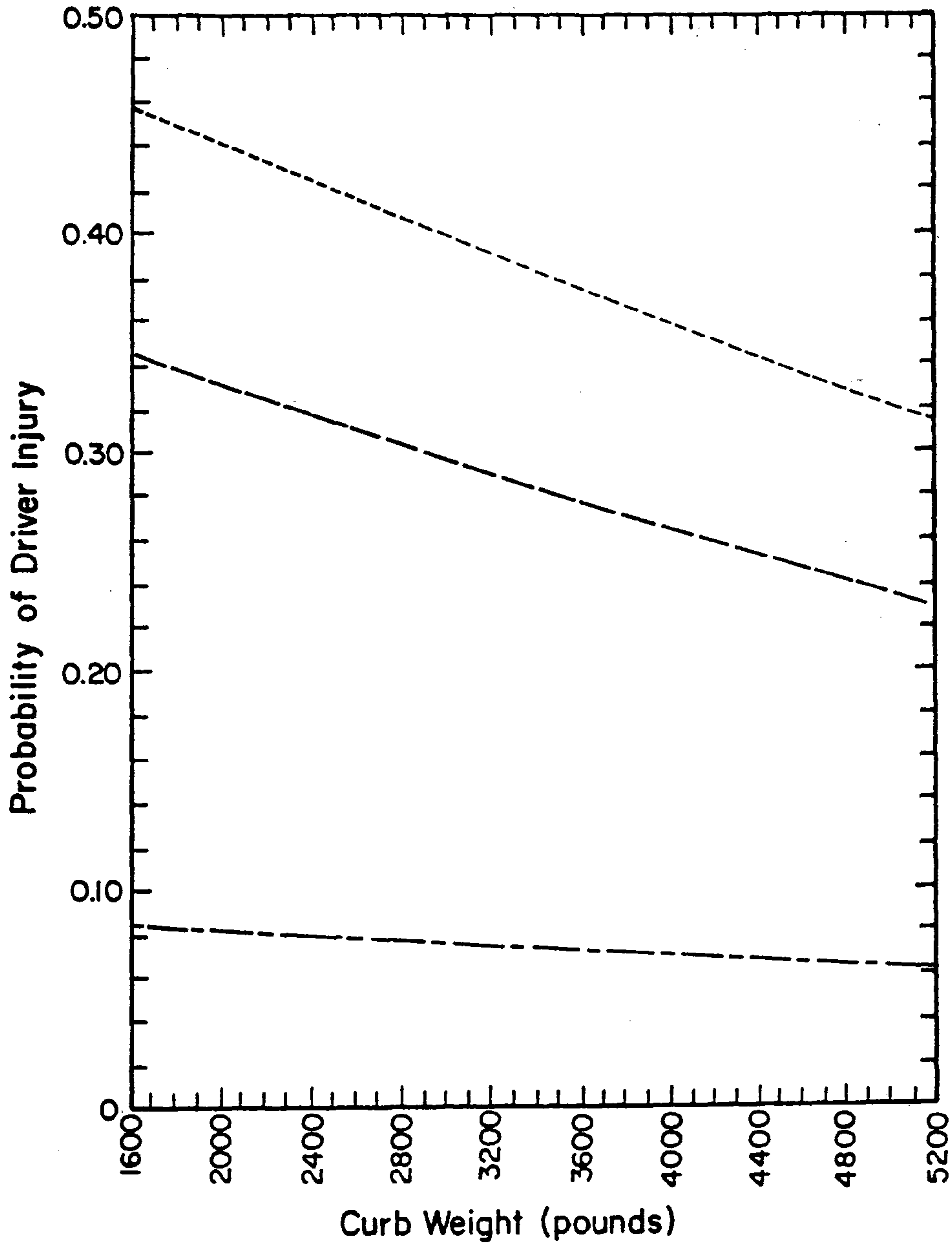


Figure 8: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Guard Rails as a Function of Passenger Car Curb Weight

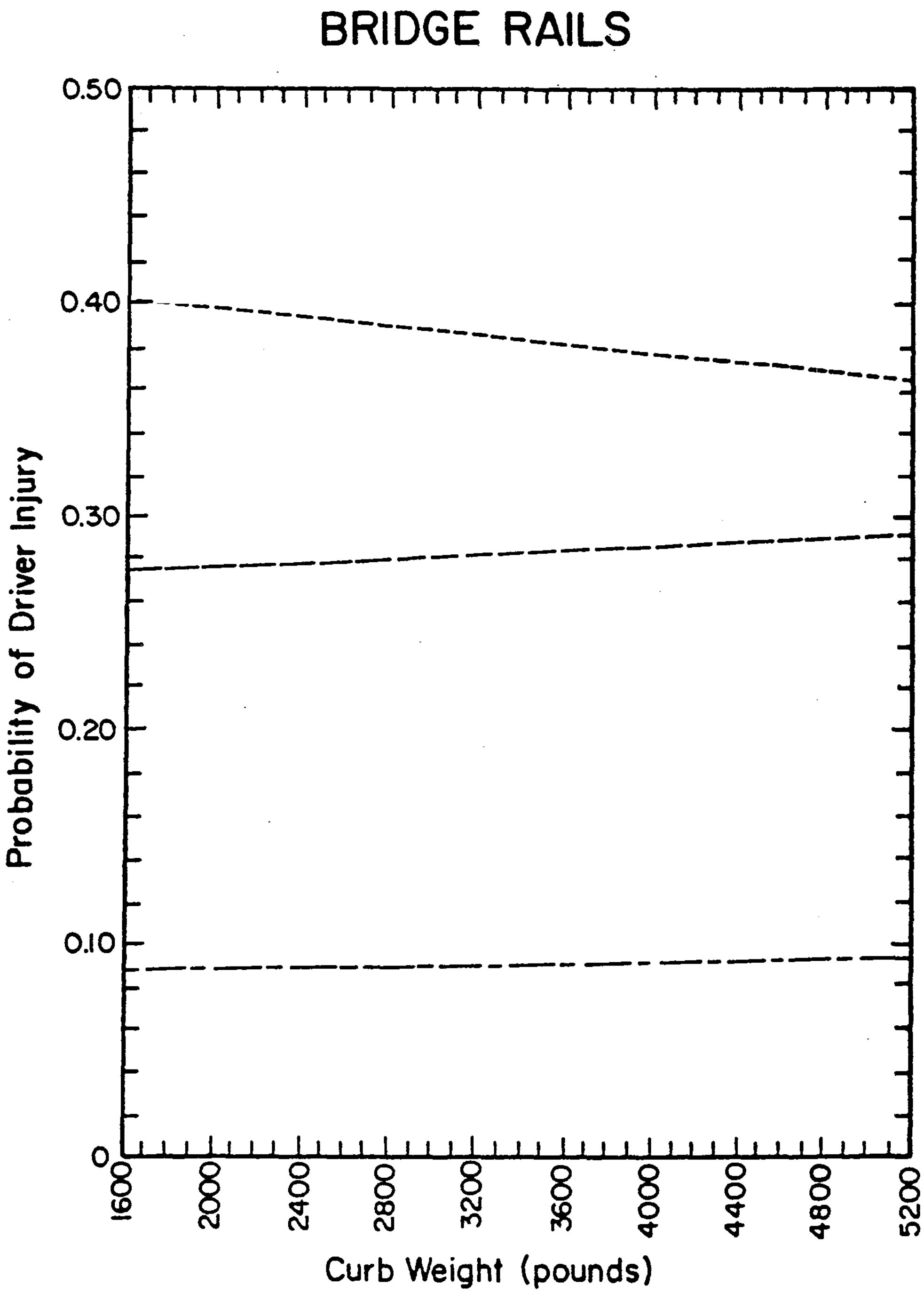


Figure 9: Probability of Driver Injury (Minor or Greater, Moderate or Greater, Serious or Greater) in Single Vehicle Collisions with Bridge Rails as a Function of Passenger Car Curb Weight

significantly from a horizontal line ($\chi_1^2 = 0.38$, $p=0.5390$; $\chi_1^2 = 0.10$, $p=0.7577$; $\chi_1^2 = 0.03$, $p=0.8696$). Or, in other words, probability of driver injury is not influenced by passenger car curb weight.

General findings

The severity of single vehicle accidents is, as expected, highly dependent upon the object struck:

Table 1: Percent of Drivers Injured in Single Vehicle Accidents by Object Struck and Level of Injury

Object Struck	Minor Injury or Greater	Moderate Injury or Greater	Serious Injury or Greater
Curbs	23.37	15.68	3.51
Highway Signs	25.78	17.79	4.14
Utility Poles	44.65	33.51	5.79
Luminaire Poles	40.87	31.97	6.63
Guard Rails	38.36	28.44	7.14
Bridge Rails	38.31	28.31	8.91
Culverts	55.60	45.72	18.91

For the seven different types of object struck, it is noted that mean passenger car curb weight is highly variable:

Object Struck	Mean Curb Weight (Pounds)
Utility Poles	3564.26
Luminaire Poles	3534.12
Culverts	3482.29
Highway Signs	3443.18
Bridge Rails	3420.01
Guard Rails	3389.89
Curbs	3101.73

This phenomenon is better shown in the next figure. Figure 10 depicts the 25th, 50th, and 75th percentile passenger car curb weights for the seven classes of accidents (appurtenances) considered in this paper. The inter-quartile range of weights for vehicles striking curbs is the

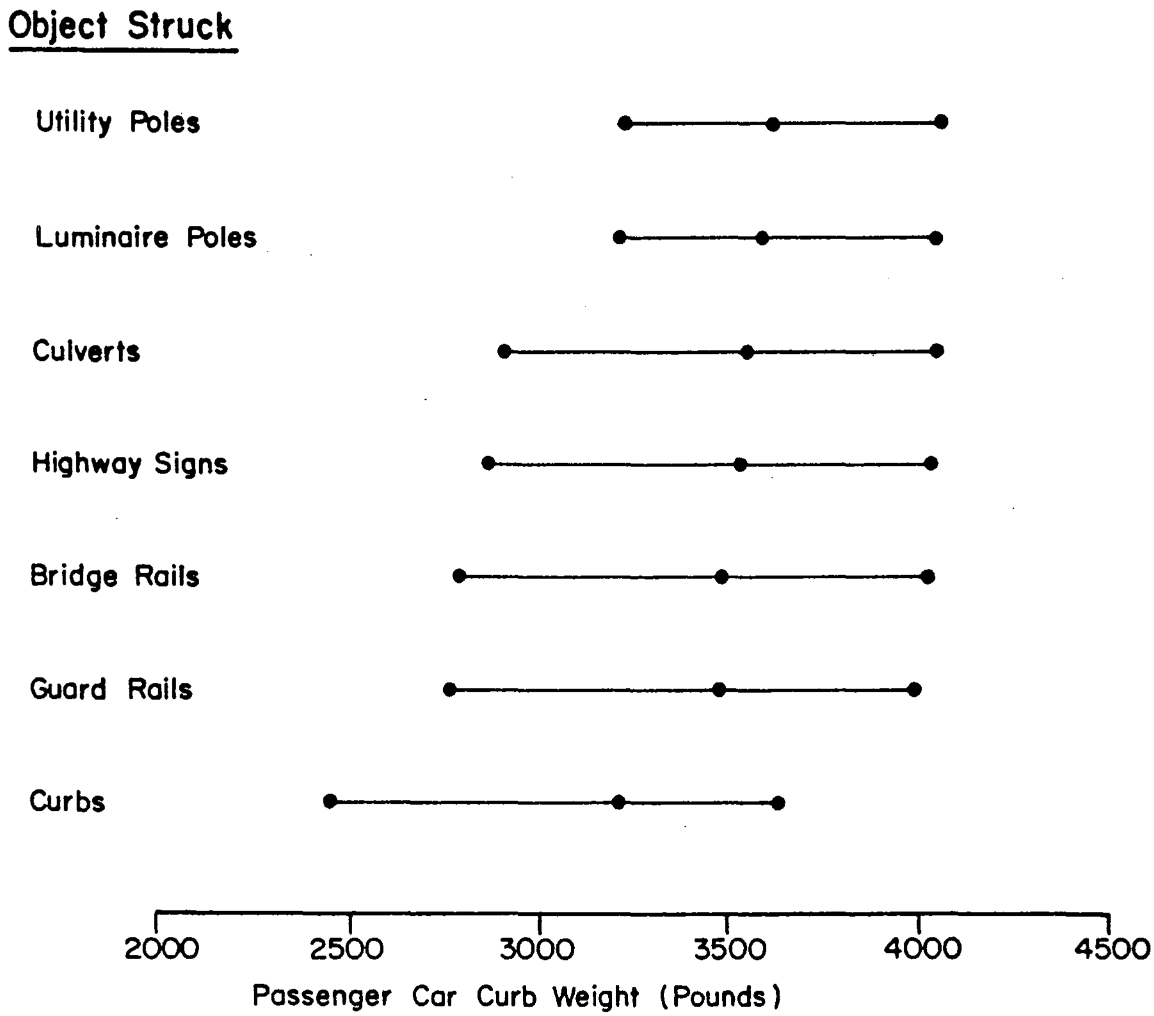


Figure 10: Inter-Quartile Ranges of Passenger Car Curb Weights for Accident Involved Vehicles in Collisions with Different Appurtenances

[illegible] The ranges of weights for vehicles striking utility poles and luminaire poles are highest. The other four ranges (culverts, highway signs, bridge rails, and guard rails) are roughly comparable, and fall somewhere in between.

Finally, Table 2 presents a summary of the information contained in Figures 3 through 9:

Table 2: Does Passenger Car Curb Weight Significantly Affect the Probability of Driver Injury in Single Vehicle Collisions?

Object Struck	Minor Injury or Greater	Moderate Injury or Greater	Serious Injury or Greater
Highway Signs	No	No	No
Culverts	No	No	No
Utility Poles	Yes	Yes	Yes
Luminaire Poles	Yes	Yes	Yes
Curbs	Yes (α=0.10)	Yes	No
Guard Rails	Yes	Yes	No
Bridge Rails	No	No	No

DISCUSSION

In the Introduction to this report, it was pointed out that some studies in the literature (e.g., O'Day et al., 1973) have found an association in single vehicle accidents between occupant injury and passenger car weight. Other studies have not (e.g., Stewart & Stutts, 1978). This study indicates that the probability of driver injury in single vehicle accidents is influenced by passenger car weight in collisions with certain roadway appurtenances, e.g., utility poles and luminaire poles, but not with others, e.g., highway signs and bridge rails.

Four of the appurtenances considered in this report (culverts, highway signs, utility poles, and luminaire poles) might be thought of as "frontal appurtenances," objects which a vehicle typically strikes head-on. Of these four, culverts might be classified as the most resistant to impact while highway signs might be classified as least resistant to impact -- with utility poles and luminaire poles falling somewhere in between. Interestingly, the probability of driver injury is not influenced by passenger car curb weight in collisions with culverts and highway signs, but is influenced by passenger car curb weight in collisions with utility poles and luminaire poles.

Three of the appurtenances considered in this report (curbs, guard rails, and bridge rails) might be considered "lateral appurtenances," objects which a vehicle typically strikes obliquely. For these appurtenances, the association between passenger car curb weight and probability of driver injury is not strong. For single-vehicle collisions with curbs and guard rails, vehicle weight has some influence on the probability of driver injury. For bridge rails, no such influence can be demonstrated.

Figure 10 suggests that lighter passenger cars are more apt to be involved in collisions with curbs. Two explanations of this phenomenon seem plausible:

(1) A small, light car strikes a curb at a given speed and angle - a "curb accident" results. A larger, heavier car strikes a curb at the same speed and angle, but recovers -- an accident is avoided.

(2) A small, light car strikes a curb at a given speed and angle -- a "curb accident" results. A larger, heavier car strikes a curb at the same speed and angle, but travels beyond the curb and strikes a pole -- a "pole accident" results.

Some support for the second explanation can be found in Figure 10. While lighter passenger cars are more apt to be involved in "curb accidents," heavier passenger cars are more apt to be involved in "utility

Since utility poles and luminaire poles are frequently located adjacent to curbs, it seems reasonable to propose that smaller, lighter cars tend to have their accidents on curbs, before they reach a utility pole or luminaire pole. Larger, heavier cars, on the other hand, may be able to successfully negotiate curbs and thus accumulate a disproportionate number of impacts with utility poles and luminaire poles.

As previously stated, both of the explanations offered for "small car curb accidents" are plausible. Neither precludes the other. Both are probably operative.

Finally, it should be noted that the analyses presented in this report are very coarse. Much more work is required to better define the relationship between vehicle weight and driver injury in collisions with roadway appurtenances. Variables such as highway class (interstate highways, U.S. and state highways, farm to market roads, county roads, city streets), population (urban, rural), driver age, driver sex, violation (e.g., speeding), and seat belt usage should all be considered to determine how they affect the basic relationships between probability of driver injury and passenger car curb weight.

While it is almost a cliche to end a technical report with the phrase "more research is needed," in this case, that phrase is appropriate. The passenger car fleet in this country is being dramatically "downsized." Vehicle weights are beginning to fall below the design thresholds of many existing roadway appurtenances. Should the design criteria for these appurtenances be altered? Should the policies for deploying these appurtenances be modified? Rational answers to these questions can be advanced only when the basic relationships so briefly discussed in this report are better understood.

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APPENDIX

HIGHWAY SIGNS

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	542	374	87
Drivers Not Injured	1560	1728	2015
Total	2102	2102	2102
Pr (Driver Injury)	.2578	.1779	.0414
Min. Curbweight	1512	1512	1512
Max. Curbweight	5298	5298	5298
Mean Curbweight	3443.18	3443.18	3443.18

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	-0.73820935	0.22520190	10.75	0.0010
	Curbweight	-0.00009300	0.00006428	2.09	0.1480
Moderate Injury or Greater	Intercept	-1.39984999	0.25864363	29.29	0.0000
	Curbweight	-0.00003802	0.00007358	0.27	0.6054
Serious Injury or Greater	Intercept	-2.96458457	0.49368444	36.06	0.0000
	Curbweight	-0.00005188	0.00014098	0.14	0.7129

CULVERTS

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	591	486	201
Drivers Not Injured	472	577	862
Total	1063	1063	1063
Pr (Driver Injury)	.5560	.4572	.1891
Min. Curbweight	1512	1512	1512
Max. Curbweight	5273	5273	5273
Mean Curbweight	3482.29	3482.29	3482.29

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	0.48390342	0.28214886	2.94	0.0863
	Curbweight	-0.00007434	0.00007894	0.89	0.3463
Moderate Injury or Greater	Intercept	0.16216710	0.28035752	0.33	0.5630
	Curbweight	-0.00009592	0.00007865	1.49	0.2226
Serious Injury or Greater	Intercept	-1.45570034	0.35682176	16.64	0.0000
	Curbweight	-0.00000007	0.00009997	0.00	0.9994

UTILITY POLES

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	1852	1390	240
Drivers Not Injured	2296	2758	3908
Total	4148	4148	4148
Pr (Driver Injury)	.4465	.3351	.0579
Min. Curbweight	1512	1512	1512
Max. Curbweight	5298	5298	5298
Mean Curbweight	3564.26	3564.26	3564.26

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	0.80078573	0.15926854	25.28	0.0000
	Curbweight	-0.00028551	0.00004396	42.18	0.0000
Moderate Injury or Greater	Intercept	0.33918195	0.16450694	4.25	0.0392
	Curbweight	-0.00028932	0.00004581	39.90	0.0000
Serious Injury or Greater	Intercept	-0.85725250	0.29861527	8.24	0.0041
	Curbweight	-0.00056324	0.00008828	40.70	0.0000

LUMINAIRE POLES

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	850	665	138
Drivers Not Injured	1230	1415	1942
Total	2080	2080	2080
Pr (Driver Injury)	.4087	.3197	.0663
Min. Curbweight	1536	1536	1536
Max. Curbweight	5273	5273	5273
Mean Curbweight	3534.12	3534.12	3534.12

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	0.48384462	0.22135884	4.78	0.0288
	Curbweight	-0.00024222	0.00006171	15.41	0.0001
Moderate Injury or Greater	Intercept	0.16286053	0.23028617	0.50	0.4794
	Curbweight	-0.00026153	0.00006465	16.37	0.0001
Serious Injury or Greater	Intercept	-1.00274378	0.39698252	6.38	0.0115
	Curbweight	-0.00047970	0.00011698	16.81	0.0000

CURBS

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	240	161	36
Drivers Not Injured	787	866	991
Total	1027	1027	1027
Pr (Driver Injury)	.2337	.1568	.0351
Min. Curbweight	1664	1664	1664
Max. Curbweight	5386	5386	5386
Mean Curbweight	3101.73	3101.73	3101.73

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	-0.68638498	0.30340525	5.12	0.0237
	Curbweight	-0.00016294	0.00009648	2.85	0.0912
Moderate Injury or Greater	Intercept	-0.81865517	0.35057629	5.45	0.0195
	Curbweight	-0.00028375	0.00011376	6.22	0.0126
Serious Injury or Greater	Intercept	-2.82346114	0.69198765	16.65	0.0000
	Curbweight	-0.00016083	0.00022260	0.52	0.4700

GUARD RAILS

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	1403	1040	261
Drivers Not Injured	2254	2617	3396
Total	3657	3657	3657
Pr (Driver Injury)	.3836	.2844	.0714
Min. Curbweight	1512	1512	1512
Max. Curbweight	5386	5386	5386
Mean Curbweight	3389.89	3389.89	3389.89

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	0.10268364	0.15468946	0.44	0.5068
	Curbweight	-0.00017072	0.00004481	14.52	0.0001
Moderate Injury or Greater	Intercept	-0.38428866	0.16552834	5.39	0.0203
	Curbweight	-0.00015980	0.00004818	11.00	0.0009
Serious Injury or Greater	Intercept	-2.26422565	0.28864997	61.53	0.0000
	Curbweight	-0.00008956	0.00008412	1.13	0.2870

BRIDGE RAILS

	Minor Injury or Greater (A,B,C,K)	Moderate Injury or Greater (A,B,K)	Serious Injury or Greater (A,K)
Drivers Injured	559	413	130
Drivers Not Injured	900	1046	1329
Total	1459	1459	1459
Pr (Driver Injury)	.3831	.2831	.0891
Min. Curbweight	1664	1664	1664
Max. Curbweight	5359	5359	5359
Mean Curbweight	3420.01	3420.01	3420.01

Injury Level	Variable	Coefficient	Std. Error	Chi-Sq.	Pr
Minor Injury or Greater	Intercept	-0.33044878	0.24317471	1.85	0.1742
	Curbweight	-0.00004267	0.00006946	0.38	0.5390
Moderate Injury or Greater	Intercept	-1.00851294	0.26357559	14.64	0.0001
	Curbweight	0.00002315	0.00007504	0.10	0.7577
Serious Injury or Greater	Intercept	-2.39137562	0.41733863	32.83	0.0000
	Curbweight	0.00001948	0.00011870	0.03	0.8696