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RESTRAINT USAGE AND EFFECTIVENESS ON THE NATIONAL CRASH SEVERITY STUDY



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National Highway Traffic Safety Administration
National Center for Statistics and Analysis**

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THE NATIONAL CRASH SEVERITY STUDY

by

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INTRODUCTION

This report attempts to reconcile the differences between the estimates of restraint usage produced by the Opinion Research Corporation's survey of drivers stopped at intersections in 19 cities and the estimate from the National Crash Severity Study's file of accident-involved occupants. This is done by an examination of the assumptions and conditions which are inherent in the different methods of data collection.

Next, estimates for the NCSS areas are produced for a variety of accident and injury-related factors: occupant sex, age, and injury level; vehicle size and model year; and accident environment as rural or urban.

Finally, crude estimates of the effectiveness of the lap and shoulder system and the lap belt-only system are computed at various injury levels, including fatality.

Since the NCSS and ORC methods of estimation produce estimates of restraint usage rates which are mutually compatible when the differences in data collection are examined, the results of the ORC survey offer the potential to provide insight into exposure which could be a useful background for the urban portion of the NCSS towaway accident file.

SUMMARY

In Part I of this report, the National Crash Severity Study (NCSS) and Opinion Research Corporation (ORC) data collection methods are examined as they relate to the differences in the rates of restraint usage observed from the two sources. It is found that if a similar portion of the NCSS file is considered (drivers of 1964 through 1978 model year passenger cars in urban areas) and is then adjusted to the distribution of model years observed by ORC, the estimate of usage for NCSS is 13.8 percent vs 14.1 percent for ORC. This does not support the widely-held view that the accident-involved population differs significantly from the overall driving population in their rates of seat belt usage.

To compute an estimated restraint usage for the NCSS areas accident population, the entire NCSS file is examined in Part II. It is found that certain groups appear to have higher rates of restraint usage than do others. These include females, people over 24 years old, those in smaller or newer cars, those involved in urban accidents, and those who have suffered less severe injuries.

This last observation leads to the computations of crude effectiveness estimates for the two major classes of restraint systems, in Part III. Unadjusted figures indicate that the lap and shoulder restraint system occupants suffered

over 60 percent fewer serious injuries than did unrestrained occupants; and lap belted occupants had over 40 percent fewer serious injuries than did unrestrained occupants. Similar results are found for higher injury levels. For fatalities there is a lower incremental benefit associated with using a restraint. Still, there are over 50 percent fewer fatalities when using the lap and shoulder belts, and over 20 percent fewer fatalities when using a lap belt, as compared to unrestrained occupants.

Generally, NCSS data seem consistent with ORC data, and with that from two other National Highway Traffic Safety Administration accident files: the Fatal Accident Reporting System (FARS), and the Restraint System Evaluation Program (RSEP), for the estimates of restraint usage and effectiveness which are examined in the body of this report. The greater detail available in the NCSS data, particularly for occupants suffering serious trauma, promise to make this an extraordinarily useful source for studying occupant crash protection.

PART I: COMPARISON OF NCSS ACCIDENT ESTIMATES VS ORC SURVEY
ESTIMATES OF RESTRAINT USAGE

The Opinion Research Corporation has recently submitted preliminary results of its survey of restraint usage to the National Highway Traffic Safety Administration. This project, "Safety Belt Usage: Survey of Cars in the Traffic Population (November 1977-June 1978)," involved observations of restraint usage by drivers in 19 metropolitan areas throughout the country during the period November 1977 through June 1978 (Reference 1). Rates were computed by type of system (lap and shoulder combination, or lap belt only) for a variety of environmental, vehicle, and occupant factors. A secondary aspect of the study involved observation of restraint usage in rural areas.

The results of the survey, based upon approximately 69,000 verified observations, are an estimate of restraint usage for drivers of 1964 through 1978 model year passenger cars, as follows:

RESTRAINT USAGE - ORC SURVEY DATA

Urban:	All types of restraint use:	14.1%
	Lap and shoulder systems:	9.2%
	Lap belt only:	4.9%
Rural:	All types of restraint use:	7%

Because the National Crash Severity Study shows a restraint usage rate of only 8.3 percent, it is important to consider the assumptions which are made in each method of estimation and, if possible, to determine the reasons for the discrepancy.

The NCSS file was designed to collect data for occupants of passenger cars which were towed because of damage. These are referred to as "case vehicle" occupants. In this analysis, only case vehicle occupants are considered because of the large component of missing data for occupants of non-case vehicles. Since severe accidents are over-sampled by NCSS, each case is weighted by the inverse of its sampling fraction. This approximates the total experience of the areas of the study, as if every case had been investigated. It also has the effect of making the file look larger than it actually is by a factor of approximately 5 times the actual number of cases investigated. All NCSS figures in this report represent weighted data for the period January 1977 through March 1978, contained on the NCSS file created in April 1979.

Tables A, B, and C show counts and percentages of restraint usage for various injury levels. These tables are based upon that portion of the NCSS file which is comparable to the survey population of the ORC study: drivers of 1964 through 1978 model year passenger cars in urban areas. The usage rate for drivers at all injury levels was 11.2 percent.

This is composed of 5.9 percent for lap and shoulder systems plus 5.2 percent for lap belt systems. Note the much lower usage rate for fatally-injured drivers (3.8 percent) and for those injured with an Overall AIS* rating of 2 or greater, which indicates at least moderate injuries (4.9 percent). In comparison, those with minor or no injuries, which means an Overall AIS of 1 or less, had a higher than average restraint usage rate (11.9 percent).

The passengers (non-drivers) who were involved in these same accidents are considered in Tables D, E, and F under a variety of injury conditions. These occupants had a much lower rate of restraint usage than did the drivers involved. Overall, only 4.9 percent of the passengers were using any type of restraint system; 2.4 percent were using a lap and shoulder combination, and 2.1 percent were using only a lap belt. Consistent with the results for the drivers, a lower proportion of fatalities (3.4 percent) and moderately-injured occupants, those with an Overall AIS of 2 or greater (2.6 percent), were using a restraint. For passengers with minor or no injuries, Overall AIS of 1 or less, 4.8 percent were restrained.

* AIS = Abbreviated Injury Scale, which measures the severity of injuries on a scale of 0 (no injury) to 6 (currently untreatable). If no AIS data is available, fatally-injured occupants are assumed to have injuries equivalent to an Overall AIS of at least 4. Occupants who were not fatally-injured are assumed to have an Overall AIS of at most 1 if the police reported that there were no injuries, or at most 3 if there were no days in the hospital. (References 2 and 3.)

This explains a large component of the difference in the estimates of restraint usage provided by the ORC survey methods and the NCSS file. Drivers on NCSS were more often belted (11.2 percent) than were their passengers (4.9 percent). The ORC estimate of 14.1 percent usage for drivers is much closer to that for NCSS drivers than for occupants as a whole on NCSS (8.4 percent). About half of the discrepancy can be explained by this one factor.

Table G shows the restraint usage rates by the model year categories which were used in the ORC study for drivers in urban accidents, as described previously. There is some fluctuation, but in general, the newer cars have a higher usage rate. This is important to keep in mind when considering Table H. This table shows the model year distributions for both NCSS and ORC groups. The NCSS vehicles tend to be older than those surveyed by ORC: two-thirds of the NCSS vehicles (66 percent) are pre-1974 as contrasted with one-third of the ORC vehicles (37 percent) which are pre-1974. It may be that older vehicles are more likely to become involved in accidents, are involved in more severe accidents requiring towing, or are more likely to require towing if they are in an accident of a particular severity. In any case, this results in a lower proportion of restraint usage on NCSS than in the ORC survey.

Tables I and J represent an attempt to correct for this bias by weighting the NCSS estimates of restraint usage by the proportion of model years observed in the ORC study. Table I shows the results for all types of restraint usage, and Table J considers lap and shoulder use separately from lap-only use. The estimates are very close to those computed directly from the survey:

RESTRAINT USAGE: ORC AND ADJUSTED* NCSS DATA

	<u>NCSS adjusted</u>	<u>ORC</u>
<u>All restraints:</u>	<u>13.8%</u>	<u>14.1%</u>
Lap and shoulder	9.2%	9.2%
Lap only	4.3%	4.9%
Other types (by subtraction)	0.3%	-

Based upon this result, it appears that the differences between the estimates from NCSS and from ORC can be explained basically as the result of the differences in the sample populations (all occupants vs drivers; all model years vs 1964-1978 vehicles; and all areas vs urban areas) and by differences in accident involvement vs exposure measures of vehicle model year distributions.

* NCSS adjusted figures are the result of weighting the NCSS estimates of restraint usage by the proportion of model years observed in the ORC study.

Table A: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
 Drivers of 1964-1978 Model Year Case Vehicles
 - (Towed for Damage) in Urban Accidents

	<u>Count</u>	<u>Percentage</u>
<u>All Drivers:</u>		
No restraint	22,424	88.79
<u>Restrained:</u>	<u>2,832</u>	<u>11.21</u>
Lap and shoulder	1,494	5.92
Lap only	1,303	5.16
<u>Other type*</u>	<u>35</u>	0.14
Total known usage	25,256	

Known restraint status: $(25,256 \div 30,175) = 83.7\%$

Fatally-injured Drivers

No restraint	100	96.15
<u>Restrained:</u>	<u>4</u>	<u>3.85</u>
Lap and shoulder	2	1.92
Lap only	2	1.92
<u>Other type*</u>	<u>-</u>	-
Total known usage	104	

Known restraint status: $(104 \div 117) = 88.9\%$

*"Other type" restraint includes torso-only belts, air bags, passive belts, and child restraints.

Table B: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
 Drivers of 1964-1978 Model Year Case Vehicles
 (Towed for Damage) in Urban Accidents by Injury Level

	<u>Count</u>	<u>Percentage</u>
<u>Overall AIS <= 1</u>		
No restraint	17,268	88.09
<u>Restrained:</u>	<u>2,334</u>	<u>11.91</u>
Lap and shoulder	1,241	6.33
Lap only	1,059	5.40
<u>Other type</u>	<u>34</u>	0.17
Total known usage	19,602	

Known restraint status: $(19,602 \div 23,144) = 84.7\%$

Overall AIS >= 2

No Restraint	1,153	95.13
<u>Restrained:</u>	<u>59</u>	<u>4.87</u>
Lap and shoulder	27	2.23
Lap only	31	2.56
<u>Other type</u>	<u>1</u>	0.08
Total known usage	1,212	

Known restraint status: $(1,212 \div 1,359) = 89.2\%$

Table C: (Weighted Data)

Restraint Use on the NCSS File of April 1979
 Drivers of 1964-1978 Model Year Case Vehicles
 (Towed for Damage) in Urban Accidents by Injury Level

	<u>Count</u>	<u>Percentage</u>
<u>Injury Category Unknown</u>		
No restraint	4,003	90.12
<u>Restrained:</u>	<u>439</u>	<u>9.88</u>
Lap and shoulder	226	5.09
Lap only	213	4.80
<u>Other type</u>	<u>-</u>	-
 Total known usage	 4,442	

Known restraint status: $(4,442 \div 5,672) = 78.3\%$

Table D: (Weighted Data):

Restraint Use on the NCCS File of April 1979:
 Passengers of 1964-1978 Model Year Case Vehicles
 (Towed for Damage in Urban Accidents)

	<u>Count</u>	<u>Percentage</u>
<u>All Passengers</u>		
No restraint	13,451	95.12
<u>Restrained:</u>	<u>690</u>	<u>4.88</u>
Lap and shoulder	340	2.40
Lap only	296	2.09
<u>Other type</u>	<u>54</u>	0.38
Total known usage	14,141	
Known restraint status: $(14,141 \div 16,484) = 85.8\%$		

Fatally-injured Passengers

No restraint	57	96.61
<u>Restrained:</u>	<u>2</u>	<u>3.39</u>
Lap and shoulder	-	-
Lap only	2	3.39
<u>Other type</u>	<u>-</u>	-
Total known usage	59	
Known restraint status: $(59 \div 69) = 85.5\%$		

Table E: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
 Passengers of 1964-1978 Model Year Case Vehicles
 (Towed for Damage) in Urban Accidents by Injury Level

	<u>Count</u>	<u>Percentage</u>
<u>Overall AIS <= 1</u>		
No restraint	10,505	95.18
<u>Restrained:</u>	<u>532</u>	<u>4.82</u>
Lap and shoulder	244	2.21
Lap only	243	2.20
<u>Other type</u>	<u>45</u>	0.41
Total known usage	11,037	

Known restraint status: $(11,037 \div 12,811) = 86.2\%$

Overall AIS >= 2

No restraint	715	97.41
<u>Restrained:</u>	<u>19</u>	<u>2.59</u>
Lap and shoulder	8	1.09
Lap only	11	1.50
<u>Other type</u>	<u>-</u>	-
Total known usage	734	

Known restraint status: $(734 \div 783) = 93.7\%$

Table F: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
 Passengers of 1964-1978 Model Year Case Vehicles
 (Towed for Damage) in Urban Accidents by Injury Level

	<u>Count</u>	<u>Percentage</u>
<u>Injury Category Unknown</u>		
No restraint	2,231	94.14
<u>Restrained:</u>	<u>139</u>	<u>5.86</u>
Lap and shoulder	88	3.71
Lap only	42	1.77
<u>Other type</u>	<u>9</u>	0.38
Total known usage	2,370	

Known restraint status: $(2,370 \div 2,890) = 82.0\%$

Table G: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
Drivers of Passenger Cars in Urban Accidents
by Model Year

<u>Model Year</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>	<u>All Types</u>
1964-1967	10	201	221
(N = 3,661)	(0.27%)	(5.49%)	(6.04%)
1968-1971	155	377	532
(N = 8,029)	(1.93%)	(4.70%)	(6.63%)
1972-1973	171	495	666
(N = 5,051)	(3.39%)	(9.80%)	(13.19%)
1974	290	53	343
(N = 2,306)	(12.58%)	(2.30%)	(14.87%)
1975	176	43	219
(N = 1,863)	(9.59%)	(2.34%)	(11.93%)
1976	417	98	526
(N = 2,218)	(18.80%)	(4.42%)	(23.72%)
1977	265	32	321
(N = 1,923)	(13.78%)	(1.66%)	(16.69%)
1978	10	4	14
(N = 232)	(4.31%)	(1.72%)	(6.03%)

'All types' includes other types of restraint systems (torso only, passive belt, etc.) not specifically mentioned

'N' is the number of drivers with known restraint status

Table H: (Weighted Data from NCSS):

Comparison of Frequency of Observations by Model Year:
Drivers of Passenger Cars in Urban Accidents

	<u>Count</u>	<u>Percentage</u>
<u>NCSS Model Years</u>		
1964 - 1967	4,275	14.17
1968 - 1971	9,476	31.40
1972 - 1973	6,140	20.35
1974	2,855	9.46
1975	2,242	7.43
1976	2,671	8.85
1977	2,238	7.42
<u>1978</u>	<u>278</u>	<u>0.92</u>
Total 1964 - 1978	30,175	100.00
 <u>ORC Survey Model Years</u>		
1964 - 1967	2,696	3.93
1968 - 1971	10,688	15.56
1972 - 1973	11,813	17.20
1974	8,427	12.27
1975	7,317	10.65
1976	10,676	15.54
1977	12,696	18.49
<u>1978</u>	<u>4,366</u>	<u>6.36</u>
Total 1964 - 1978	68,679	100.00

Table I: (Weighted Data from NCSS):

Restraint Use on the NCSS File of April 1979:
 Drivers of Passenger Cars in Urban Accidents,
 Adjusted by Model Year Involvement of ORC Survey

Adjusted NCSS Restraint Use

Sum (over model years) of (Model Year Involvement in
 ORC x Restraint Use by NCSS Model Years):

All Restraint Types:

<u>Model Year</u>	<u>ORC Involvement</u>	x	<u>NCSS Usage Rate</u>	=	<u>Product</u>
1964 - 1967	3.93%		6.04%		0.24
1968 - 1971	15.56%		6.63%		1.03
1972 - 1973	17.20%		13.19%		2.27
1974	12.27%		14.87%		1.82
1975	10.65%		11.93%		1.27
1976	15.54%		23.72%		3.69
1977	18.49%		16.69%		3.09
<u>1978</u>	<u>6.36%</u>		<u>6.03%</u>		<u>0.38</u>
<u>All restraint types</u>	<u>100.00%</u>				<u>13.79</u>

Table J: (Weighted Data from NCSS):

Restraint Use on the NCSS File of April 1979:
 Drivers of Passenger Cars in Urban Accidents,
 Adjusted by Model Year Involvement of
 ORC Survey by Restraint Type

Lap and Shoulder:

<u>Model Year</u>	<u>ORC Involvement</u>	x	<u>NCSS Usage Rate</u>	=	<u>Product</u>
1964 - 1967	3.93%		0.27%		0.01
1968 - 1971	15.56%		1.93%		0.30
1972 - 1973	17.20%		3.39%		0.58
1974	12.27%		12.58%		1.54
1975	10.65%		9.59%		1.02
1976	15.54%		18.80%		2.92
1977	18.49%		13.78%		2.55
<u>1978</u>	<u>6.36%</u>		4.31%		<u>0.27</u>
Lap and shoulder	100.00%				9.19

Lap Only:

<u>Model Year</u>	<u>ORC Involvement</u>	<u>NCSS Usage Rate</u>	<u>Product</u>
1964 - 1967	3.93%	5.49%	0.22
1968 - 1971	15.56%	4.70%	0.73
1972 - 1973	17.20%	9.80%	1.69
1974	12.27%	2.30%	0.28
1975	10.65%	2.34%	0.25
1976	15.54%	4.42%	0.69
1977	18.49%	1.66%	0.31
<u>1978</u>	<u>6.36%</u>	1.72%	<u>0.11</u>
Lap only	100.00%		4.28

PART II: RESTRAINT USAGE ESTIMATES FOR THE ENTIRE NCSS FILE
OF CASE OCCUPANTS

While the ORC study reported restraint usage as observed at intersections, its findings appear consistent with the NCSS usage as reported by the investigator. It is meaningful to say, based upon ORC results, that about 14 percent of the drivers of 1964 through 1978 model year passenger cars in the 19 cities surveyed were using a belt system. NCSS can extend these results by (1) considering all occupants of the vehicle; (2) considering pre-1964 and post-1978 model year vehicles; (3) considering the overall picture of rural and urban accidents; and (4) considering only the towaway accident population; that is, those who have most needed the restraints.

Tables K, L, and M present restraint usage data by a variety of accident-related characteristics. Keep in mind that because the model year of the vehicle appears to be so highly correlated to restraint usage (in large part because of the year that seat belt standards went into effect), any factors (such as economic considerations) which make it more likely that a person will be using an older car will also mean that they are less likely to be restrained. Thus, these figures cannot be directly converted into an index of personal attitudes towards seat belts. They must be viewed as presenting a picture of who is using restraints, but do not pretend to describe why one group is more likely to be restrained than another.

In Table K, it is shown that more females than males (8.9 percent vs 8.0 percent) used belts in these accidents. Also, fewer of the under 25 year old group (5.8 percent) than either the 25 through 49 year old group (11.6 percent) or the over 49 year old group (10.6 percent) were using any type of restraint during the accident. The ORC study also showed that females and the over 49 age group were more often belted in the areas of the survey. Table L shows restraint usage by size of vehicle, as measured by the wheelbase. The smallest class of vehicle, the up to 101-inch wheelbases, had a much higher restraint usage: 14.8 percent vs 6.9 percent through 8.4 percent for the other size categories. The ORC survey results were consistent with this result: there, 101-inch wheelbases and smaller also had the highest usage rates. The distributions of belt usage by whether the accident occurred in what the investigator considered to be a rural or an urban area are shown in this same table. Fewer occupants of rural accidents (7.0 percent) than of urban accidents (8.7 percent) were belted. Although the ORC gives no breakdown of rural accident descriptors, its figure for rural restraint usage is also 7 percent for drivers. Table M presents data for restraint usage by model year. Generally, the older vehicles have lower restraint usage rates than do the newer vehicles, as was found in the ORC results.

Occupants who were severely injured (Overall AIS of 3 or greater) or who were killed have a much lower restraint usage rate, as shown in Table N. For those injured at the level of an Overall AIS of 0 through 2 (no injury through moderate injuries) the rate is 8.8 percent vs only 4.0 percent for those suffering more severe injuries. Of those who were killed in the crash, only 5.1 percent were belted, as contrasted with 8.4 percent of those occupants who were not killed. This is similar to the estimate from the NHTSA census of traffic fatalities, the Fatal Accident Reporting System (FARS) for the period January 1977 through March 1978 (the months for which NCSS data is currently available). Of FARS occupants of towed vehicles with known restraint usage (for 74 percent of the occupants it was known whether or not they were restrained), 944 out of 22,812 were restrained. This is only 4.1 percent of the fatal accident population. From this it appears that it should be possible to crudely estimate the effectiveness of the systems; this will be covered in the next section.

In summary, on the NCSS file of towaway accidents, those with an observed lower seat belt usage rate include the following groups of occupants: males; younger people (under 25 years old); those in larger cars (over 101-inch wheelbases), rural accident; and older cars; and the seriously injured or killed.

Table K: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
All Case Vehicle Occupants (Known Restraint Status)

<u>Sex</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>	<u>All Types</u>
Male (N = 30,714)	1,294 (4.21%)	1,110 (3.61%)	2,451 (7.98%)
Female (N = 21,864)	975 (4.46%)	897 (4.10%)	1,951 (8.92%)
Unknown (N = 309)	10 (3.24%)	- (-)	10 (3.24%)
<hr/>			
Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)
<u>Age</u>			
Up to 24 (N = 27,493)	711 (2.59%)	773 (2.81%)	1,606 (5.84%)
25 - 49 (N = 17,221)	1,114 (6.47%)	871 (5.06%)	1,989 (11.55%)
Over 49 (N = 7,384)	423 (5.73%)	363 (4.92%)	786 (10.64%)
Unknown (N = 790)	31 (3.92%)	- (-)	31 (3.92%)
<hr/>			
Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)

Table L: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
All Case Vehicle Occupants (Known Restraint Status)

<u>Wheelbase</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>	<u>All Types</u>
Up to 101 inches (N = 4,602)	452 (9.82%)	194 (4.22%)	682 (14.82%)
102 - 111 inches (N = 6,107)	194 (3.18%)	226 (3.70%)	420 (6.88%)
112 - 120 inches (N = 10,492)	407 (3.88%)	432 (4.12%)	878 (8.37%)
Over 120 inches (N = 5,254)	192 (3.65%)	225 (4.28%)	440 (8.37%)
Unknown (N = 26,432)	1,034 (3.91%)	930 (3.52%)	1,992 (7.54%)
<hr/>			
Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)
<u>Rural - Urban</u>			
Rural (N = 12,257)	441 (3.60%)	379 (3.09%)	857 (6.99%)
Urban (N = 40,629)	1,838 (4.52%)	1,628 (4.01%)	3,555 (8.75%)
Unknown (N = 1)	- (-)	- (-)	- (-)
<hr/>			
Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)

Table M: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
All Case Vehicle Occupants (Known Restraint Status)

<u>Model Year</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>	<u>All Types</u>
Pre 1964	1	31	32
(N = 1,525)	(0.07%)	(2.03%)	(2.10%)
1964 - 1967	20	244	266
(N = 7,095)	(0.28%)	(3.44%)	(3.75%)
1968 - 1971	222	535	767
(N = 16,516)	(1.34%)	(3.24%)	(4.64%)
1972 = 1973	267	728	1,000
(N = 10,625)	(2.51%)	(6.85%)	(9.41%)
1974	477	133	621
(N = 4,481)	(10.64%)	(2.97%)	(13.86%)
1975	304	80	481
(N = 3,765)	(8.07%)	(2.12%)	(11.10%)
1976	550	177	756
(N = 4,411)	(12.47%)	(4.01%)	(17.14%)
1977	414	65	514
(N = 4,001)	(10.35%)	(1.62%)	(12.85%)
1978	20	14	34
(N = 458)	(4.37%)	(3.06%)	(7.42%)
Unknown	4	-	4
(N = 10)	(40.00%)	(-)	(40.00%)
Total	2,279	2,007	4,412
(N = 52,887)	(4.31%)	(3.79%)	(8.34%)

Table N: (Weighted Data):

Restraint Use on the NCSS File of April 1979:
All Case Vehicle Occupants (Known Restraint Status)

<u>Injury Severity</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>	<u>All Types</u>
OAIS = 0 - 2 (N = 40,833)	1,881 (4.61%)	1,610 (3.94%)	3,596 (8.81%)
OAIS = 3 - 6 (N = 3,434)	59 (1.72%)	75 (2.18%)	136 (3.96%)
OAIS unknown (N = 8,620)	339 (3.93%)	332 (3.85%)	680 (7.89%)
<hr/>			
Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)
<hr/>			
<u>Fatality</u>			
Yes (N = 434)	9 (2.07%)	13 (3.00%)	22 (5.07%)
No (N = 52,305)	2,260 (4.32%)	1,994 (3.81%)	4,380 (8.37%)
Unknown (N = 148)	10 (6.76%)	- (-)	10 (6.76%)
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Total (N = 52,887)	2,279 (4.31%)	2,007 (3.79%)	4,412 (8.34%)

PART III: RESTRAINT EFFECTIVENESS ESTIMATES BASED UPON NCSS
ACCIDENT DATA

A crude estimate of the effectiveness (E) of a particular restraint system can be defined as the reduction in the injury rate associated with using that restraint. This is computed as follows:

$$E = \frac{\text{injury rate (no restraint)} - \text{injury rate (restraint)}}{\text{injury rate (no restraint)}}$$

This is usually expressed as a percentage reduction in the injury rate; for example, "There were 45 percent fewer injuries associated with using this restraint when compared with using no restraint."

Data from the NCSS file and the computed effectiveness rates are presented in Tables O and P for various levels of injury. There has been no attempt to control for either the severity of the accident or for the characteristics of the occupants involved. It is very important to control for the relevant injury-related factors of the accident in computing an estimate of restraint effectiveness. The interim report prepared for NHTSA by the Highway Safety Research Institute, entitled "Analysis of the National Crash Severity Study", documents the relative incidence of severe injuries by 70 different accident factors (Reference 4). Thus, it cannot be over-emphasized that important biases must be controlled for

by considering whether the unrestrained population contains a different proportion of severe accidents or of more-easily injured people than does the restrained population.

In the interest of simplicity and for comparison with the unadjusted figures from previous studies, the unadjusted figures are used here rather than as a definitive final estimate. As expressed by these injury rates, there were 63 percent fewer moderate injuries (equivalent to an Overall AIS of 2 or greater) for those using lap and shoulder belts, and 45 percent fewer of these injuries for those using lap belts only. The rates for various other injury levels are presented in these tables. In summary, they show the following effectiveness estimates:

UNADJUSTED EFFECTIVENESS - NCSS DATA

<u>Injury Level</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>
OAIS = 2-6	63 %	45 %
OAIS = 3-6	64 %	41 %
OAIS = 4-6	64 %	42 %
Fatality	53 %	24 %

It is not clear whether the lower effectiveness estimates for fatalities represent the effect of the small numbers involved, or whether it is the result of crashes so severe that the belts have less effect. Nonetheless, the results are impressively supportive of restraint systems.

It is interesting to compare these effectiveness rates with those produced from the Restraint System Evaluation Program data file (a project of NHTSA), "A Statistical Analysis of Seat Belt Effectiveness in 1973-1975 Model Cars Involved in Towaway Crashes," Volume 1, page 99 (Reference 5). These estimates, unadjusted for compounding factors, are as follows:

UNADJUSTED EFFECTIVENESS - RSEP DATA

<u>Injury Level</u>	<u>Lap and Shoulder</u>	<u>Lap Only</u>
OAIS = 2-6	61%	39%
OAIS = 3-6	62%	53%

These figures are very close for the lap and shoulder systems: 63 percent for NCSS vs 61 percent of RSEP at the OAIS = 2-6 injury level; 64 percent for NCSS vs 62 percent for RSEP at the OAIS = 3-6 injury level. There is a somewhat larger difference for the lap-only system: 45 percent for NCSS vs 39 percent for RSEP at the OAIS = 2-6 injury level; 41 percent for NCSS vs 53 percent for RSEP at the OAIS = 3-6 injury level. Generally, the results are remarkable close between the two data collection projects.

Table O: (Weighted Data):

Restraint Effectiveness on the NCSS File of April 1979:
All Case Vehicle Occupants (Known Restraint Status)

<u>Restraint Used</u>	<u>OAIS = 0-1</u>	<u>OAIS = 2-6</u>	<u>OAIS = 2-6 Injury Rate*</u>
Lap and shoulder	1,881	59	.03041
Lap only	1,610	75	.04451
None	37,237	3,298	.08136

Effectiveness: Lap and shoulder = 62.8%
Effectiveness: Lap only = 45.3%

<u>Restraint Used</u>	<u>OAIS = 0-2</u>	<u>OAIS = 3-6</u>	<u>OAIS = 3-6 Injury Rate*</u>
Lap and shoulder	1,912	28	.01443
Lap only	1,644	40	.02375
None	38,877	1,641	.04050

Effectiveness: Lap and shoulder = 64.4%
Effectiveness: Lap only = 41.4%

* Each injury or fatality rate is computed as the:
Number of occupants at the injury level
divided by the
Number of occupants with known injury status.

Table P: (Weighted Data):

Restraint Effectiveness on the NCSS File of April 1979
 All Case Vehicle Occupants (Known Restraint Status)

<u>Restraint Used</u>	<u>OAIS = 0-3</u>	<u>OAIS = 4-6</u>	<u>OAIS = 4-6 Injury Rate</u>
Lap and shoulder	2,244	12	.00532
Lap only	1,959	17	.00860
None	46,854	709	.01491

Effectiveness: Lap and shoulder = 64.3%
 Effectiveness: Lap only = 42.3%

<u>Restraint Used</u>	<u>Not Killed</u>	<u>Killed</u>	<u>Fatality Rate</u>
Lap and shoulder	2,260	9	.00397
Lap only	1,994	13	.00648
None	47,925	412	.00852

Effectiveness: Lap and shoulder = 53.4%
 Effectiveness: Lap only = 23.9%

References

1. Opinion Research Corporation; "Safety Belt Usage: Survey of Cars in the Traffic Population (November 1977 - June 1978);" DOT-HS-7-01736; December 1978.
2. "The Abbreviated Injury Scale;" American Association for Automotive Medicine, Morton Grove, Illinois, 1976.
3. Partyka, S.; "Use of the NCSS Computed Injury Variables: (NEWOAIS);" Unpublished report; NHTSA; March 1979.
4. O'Day, J. et al.; "Analysis of the National Crash Severity Study;" DOT-HS-8-01944; December 1978.
5. Reinfurt, D., Silva, C., and Seila, A.; "A Statistical Analysis of Seat Belt Effectiveness in 1973 - 1975 Model Cars Involved in Towaway Crashes;" Volume 1; DOT-HS-5-01255; September 1976.