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THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY RESEARCH CENTER

SEAT BELT USE
AMONG DRIVERS IN ACCIDENTS
AND
DRIVERS IN THE POPULATION AT RISK

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CHAPEL HILL, NORTH CAROLINA

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SEAT BELT USE AMONG DRIVERS IN ACCIDENTS AND DRIVERS IN THE POPULATION AT RISK

1. Introduction

There is, of course, concern with promoting regular use of seat belts by drivers and passengers on the highways. To satisfy interest in the degree to which motorists wear seat belts, accident reports have increasingly included this information, and statistics have been produced on belt use among accident victims. However, a fuller understanding of seat belt use patterns is possible if variables studied in the accident subpopulation are also studied in the non-accident group (or population at risk).

This report compares seat belt use among accident-involved drivers and drivers not so involved. These two groups are in turn sub-divided by sex of driver, age of car, and probable length of trip.

Results from the accident-involved subpopulation are reported here for the first time. However, the population-at-risk statistics were reported in a previous HSRC monograph*.

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*B. J. Campbell, P. F. Waller, and Forrest M. Council, Seat Belts: A Pilot Study of Their Use Under Normal Driving Conditions. The University of North Carolina Highway Safety Research Center, Chapel Hill, North Carolina. November, 1967.

2. Sampling

Accident Group

As a part of their regular accident reporting procedures, the North Carolina State Highway Patrol indicates, where ascertainable, whether or not accident-involved drivers were wearing a seat belt at the time of the accident. For 10,016 drivers involved in accidents during the summer of 1967, belt status was reported as well as other relevant classifications. These were rural accidents investigated by the North Carolina State Highway Patrol, and reported to headquarters. In headquarters, a special deck of punched cards was prepared for this research.

Non-Accident Group

As reported in the HSRC monograph already cited, a moving truck with observers on board was used during the summer of 1967 to detect and record driver belt use in cars moving along North Carolina highways. A total of 709 observations was made in which belt use and other variables were recorded.

Thus, data on both the accident and non-accident groups cover a variety of North Carolina highways, are principally rural in nature, and were collected during the summer of 1967.

3. Results

The observed samples were classified along three dimensions:

1. Driver sex
2. Car age: older, newer*
3. Car registration: in-state, out-of-state**

Table 1 shows that the two samples were distributed differently according to these three variables. These differences may reflect operation of relevant factors in accident production. Perhaps older cars are more often involved in accidents than would be expected on the basis of their concentration in the population at risk. On the other hand, the non-accident sample included proportionately more observations on four-lane roads than did the accident sample. Thus some of the differences in the two frequency distributions are probably related to sampling differences.

Table 2 shows seat belt use for the strata (or subpopulations, as for example male drivers of older cars with in-state plates) shown in Table 1. If, indeed, the differences in the frequency distributions for the accident and non-accident samples reflect mainly the operation of relevant factors in accident production rather than the influence of sampling differences, the summary statistics of 9.86 percent and 26.52 percent seat belt use in the accident and non-accident samples respectively suggest a sizable difference in belt use in the two populations. On the other hand, if the influence of sampling differences was considerable, the

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* Car age was broken at the year North Carolina began to require seat belts. Thus, "newer" cars (1964 and later models) were required by law to have belts installed -- "older" cars were not.

** It is assumed that, as a group, out-of-state cars observed in North Carolina during the summer months were on longer trips than in-state cars.

Drivers

		Accident Sample		Non-Accident Sample	
		Freq.	%	%	Freq.
OLDER CARS	In-State Plates				
	Male	3693	36.87	18.05	128
	Female	1037	10.35	6.06	43
	Out-of-State Plates				
	Male	427	4.26	2.68	19
	Female	67	.67	1.13	8
NEWER CARS *	In-State Plates				
	Male	2865	28.60	42.74	303
	Female	1062	10.60	15.23	108
	Out-of-State Plates				
	Male	712	7.11	11.57	82
	Female	153	1.53	2.54	18
	TOTAL	10016	99.99	100.00	709

*1964 or later

Table 1: Distribution of accident and non-accident drivers (of known belt status) by sex, car age, and state registration.

		Accident Sample				Non-Accident Sample			
			Wear Belts				Wear Belts		
		Total	Yes	No	%Yes	Total	Yes	No	%Yes
	Male	3693	85	3608	2.30	128	17	111	13.28
In-State Plates	Female	1037	29	1108	2.80	43	6	37	13.95
ER RS									
	Male	427	28	399	6.56	19	4	15	21.05
Out-of-State Plates	Female	67	6	61	8.96	8	0	8	0.00
	Male	2865	472	2393	16.47	303	100	203	33.00
In-State Plates	Female	1062	134	928	12.62	108	19	89	17.59
ER RS									
	Male	712	196	516	27.53	82	35	47	42.68
Out-of-State Plates	Female	153	38	115	24.84	18	7	11	38.89
CARS		10016	988	9028	9.86	709	188	521	26.52

Table 2: Belt Use Among Accident and Non-Accident Involved Drivers by Driver Sex, Car Age, and Probable Length of Trip

belt usage rates should be adjusted by using stratum weights derived from a stated standard frequency distribution for the driving population. In either instance, it would appear that belt use is consistently and considerably greater in the non-accident population.

As a measure of the difference in belt use in the non-accident and accident populations, a weighted average of the observed differences was calculated. The female, out-of-state drivers of older cars were omitted in this calculation as the non-accident sample involves only 8 observations. In this stratum, one additional observation in the non-accident portion would have increased the belt usage percentage by over 11 percent had the driver been wearing a seat belt. At any rate, for the remaining strata, approximately 12 percent more non-accident drivers were wearing seat belts ($\bar{d} = 0.1223$) and this difference was consistent over the strata [$\chi^2 = 6.64$ with a p-value exceeding 0.30 (see the Appendix)].

Furthermore, in the accident group, belt use varies among sample strata from 2 percent to 27 percent, while in the non-accident group (excluding that stratum in which there were only 8 females) the usage factor goes from 13 to 42 percent. In each group (accident and non-accident) belt use was highest among males driving newer out-of-state cars. Though 1964 and later <u>in-state</u> cars are required by law to have belts, there is no guarantee that a 1964 or later <u>out-of-state</u> car was equipped with belts since the law mentioned was a North Carolina law. Thus, belt use among out-of-state drivers whose cars were so equipped was perhaps even higher than indicated by these figures.

Thus, the discouraging (but perhaps really not surprising) result is that belt use is not nearly as prevalent among drivers involved in accidents

as it is among their counterparts in the traffic stream who are not involved in an accident. The very people who need it most seem to use it least! In any case these data substantiate the discontinuity between low belt usage reported among accident victims in contrast to the somewhat higher usage figures among drivers not in accidents.

4. Variation in Belt Use According to Severity of Driver Injury

The 9.86 percent belt use among accident-involved drivers is based on all accidents in the sample -- some resulting in no injury to the driver, some in minor injuries, some serious or even fatal. A trend emerges when drivers are separated according to injury status with belt use shown for each injury group.

Figure 1 and Table 3 show that belt use is reported as a bit more prevalent among drivers classified as not injured, less prevalent among injured drivers, and almost absent among drivers killed. This is some indication of belt effectiveness in reducing injury. Presumably the reason that almost none of the fatal cases was wearing a belt is that the belt tends to prevent wearers from being killed.*

5. Discussion

Regular use of seat belts certainly has not become an accepted practice, and attempts to promote their use have presumably been something

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* A more direct assessment of belt effects in reducing injury is presented in another HSRC paper entitled "Seat Belts and Injury Reduction in 1967 North Carolina Automobile Accidents," dated December, 1968.

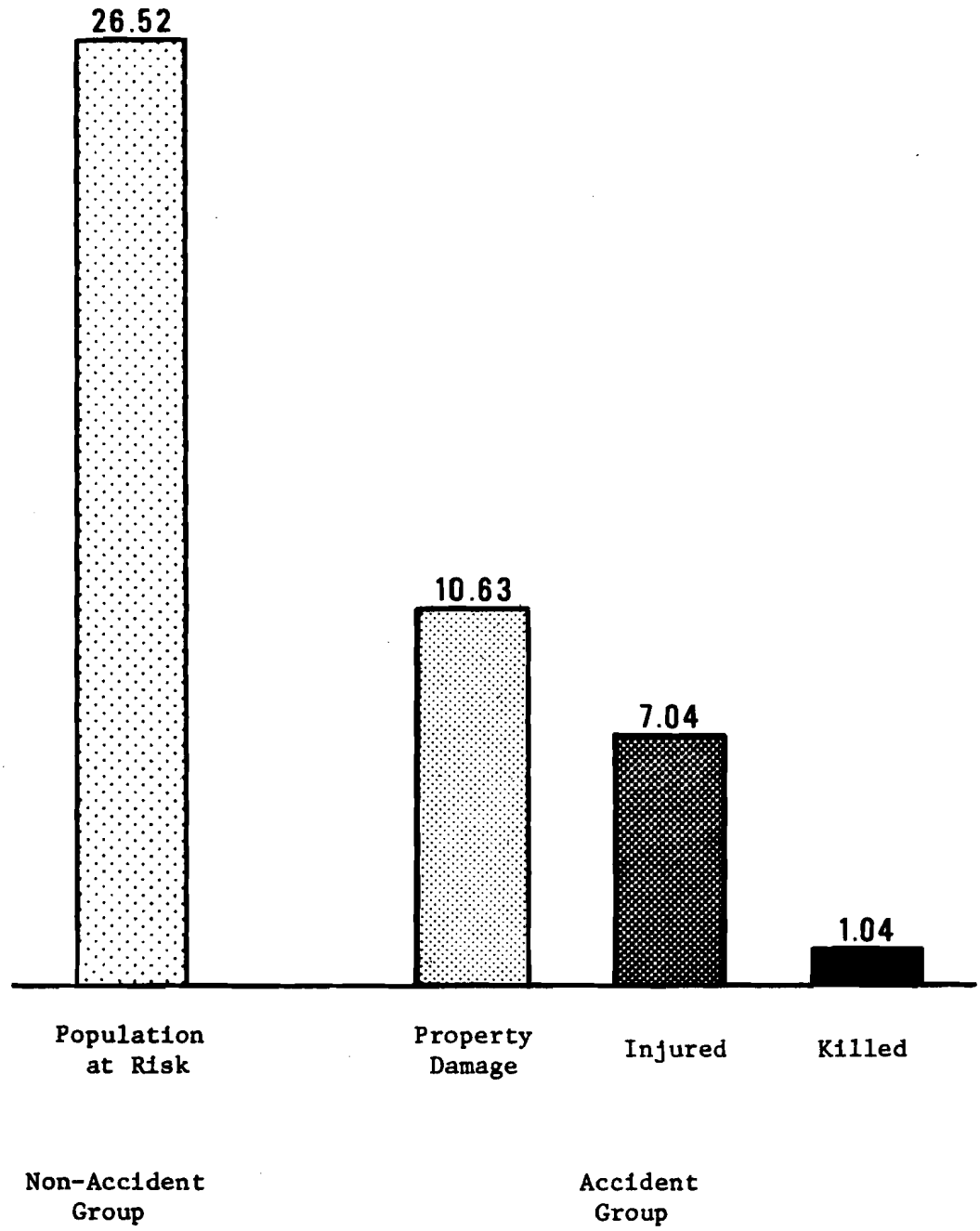

Figure 1: Belt Use Percentage in Accident and Non-Accident Groups

			Wear Belts		
		Total	Yes	No	%Yes
Accident Group	Property Damage	8031	854	7177	10.63
	Injured	1889	133	1756	7.04
	Killed	96	1	95	1.04
	All Accidents	10016	988	9028	9.86
Non-Accident Group		709	188	521	26.52

Table 3: Belt Use Percentage in Accident and Non-Accident Groups

less than an outstanding success. This paper documents the further indication that belt promotion has been even less successful among those who become involved in accidents.

In view of other research indicating that auto accidents seem somewhat more prevalent among socially and educationally disadvantaged persons and among certain age groups, etc., perhaps attempts at seat belt promotion should be aimed directly at these groups, using techniques of persuasion that will have a greater chance of reaching the relevant groups.

(Soon a further study will be released, based on data collected one year later, and it will disclose any changes in belt use among accident and non-accident drivers from 1967 to 1968).

APPENDIX

Let

n_{iAb} = number of belted drivers in the i^{th} stratum of the accident sample $\quad i = 1,2,\ldots,k$

n_{iA} = total number of drivers in the i^{th} stratum of the accident sample

and similarly let n_{iNb}, n_{iN} represent the non-accident sample. Then, assuming that n_{iAb} is binomial (n_{iA}, p_{iA}), n_{iNb} is binomial (n_{iN}, p_{iN}), and that n_{iAb} and n_{iNb} are independent,

$$p_{iN} - p_{iA} = \frac{n_{iNb}}{n_{iN}} - \frac{n_{iAb}}{n_{iA}} = d_i$$

$$\text{var}\,(d_i) = \frac{p_{iN}\,(1-p_{iN})}{n_{iN}} + \frac{p_{iA}\,(1-p_{iA})}{n_{iA}}$$

$$\hat{=} \frac{\frac{n_{iNb}}{n_{iN}}\left(1 - \frac{n_{iNb}}{n_{iN}}\right)}{n_{iN}} + \frac{\frac{n_{iAb}}{n_{iA}}\left(1 - \frac{n_{iAb}}{n_{iA}}\right)}{n_{iN}}$$

$$= V_i$$

and

$$\bar{d} = \frac{\sum_{i=1}^{k}\left(\frac{d_i}{V_i}\right)}{\sum_{i=1}^{k}\left(\frac{1}{V_i}\right)}$$

estimates the percentage by which belt usage in the non-accident population exceeded that in the accident population ($\bar{d} = 0.1223$). To test if this difference is consistent over the population strata, an approximate Chi-square test statistic with (k-1) degrees of freedom is used, namely

$$\chi^2 = \sum_{i=1}^{k} \frac{(d_i - \bar{d})^2}{V_i} = \sum_{i=1}^{k} \frac{d_i^2}{V_i} - \left(\sum_{i=1}^{k} \frac{1}{V_i} \right) \bar{d}^2$$