312

A COMPARISON OF ALCOHOL INVOLVEMENT IN PEDESTRIANS AND PEDESTRIAN CASUALTIES

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EXECUTIVE SUMMARY

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

372

EXECUTIVE SUMMARY

A. Introduction

The material that follows presents a summary of a field research study, sponsored by the National Highway Traffic Safety Administration, to investigate the question of whether alcohol consumption by pedestrians is a significant factor in traffic crashes between persons on foot and operating motor vehicles. Specifically, the study had five major objectives. These were:

1. To determine the percentage of adult pedestrian fatal and other injury accidents in which the pedestrian had been drinking alcoholic beverages prior to the crash.

2. To determine if alcohol consumption is "overrepresented" in pedestrian accidents in comparison to the rate of alcohol presence in pedestrians similarly exposed but not struck.

3. If alcohol is overrepresented, to determine if it has a unique causal role; that is, to determine if the presence of alcohol in pedestrians brings about critical behavioral errors which are different from and/or more frequent than errors occurring in pedestrian accidents having no alcohol involvement.

4. To determine through the use of a standard pedestrian accident typology, the types of accidents in which alcohol impaired pedestrians are involved and whether there are any differences in these as compared to sober pedestrian accident types.

5. To identify the characteristics of alcohol involved pedestrian accident victims including their alcohol use patterns and drinker classifications.

B. Background of the Problem

In the United States, annually, there are 8,000 or more pedestrians killed and another 100,000 injured in traffic accidents (1). Primarily during the past 10-15 years, a growing body of data has accumulated which indicates that alcohol consumption by pedestrians may play a contributing role in a sizeable percentage of these events.

The largest body of information on the incidence of alcohol in pedestrian accidents comes from post mortem testing of those who have been fatally injured. These data have been collected and reported either as part of specific highway safety studies or as part of the routine activities of the testing agencies.

A summarization of the findings of nine of these studies or reports (2,3,4,5,6,7,8,9,10) yields the following for 3,237 adult pedestrians who were fatally injured in various U.S. locales and tested for the presence of alcohol:

Blood Alcohol Concentration (Percent wt./vol.)	Number of Cases	Percent of Total
.00	1,822	56%
.01-.04	136	4
.05-.09	146	5
.10-.14	232	7
.15 and above	901	28
Total	3,237	100%

These figures indicate that alcohol was found in 44 percent of the fatally injured victims and that 35 percent had Blood Alcohol Concentrations (BACs) of .10 percent or more. Data from the individual studies varied, however. At the extremes, Haddon, et al., (4) reported the presence of alcohol in 74 percent of the 19 cases they studied, while Waller, et al., (3) found that only 35 percent of 435 fatally injured adult pedestrians had been drinking prior to their accidents.

Results from the post mortem testing of pedestrian victims should be interpreted carefully with regard to the proportion where alcohol has been found. For example, reported figures are for adult victims rather than for all pedestrian victims, including children. If the latter were used as the base, the resulting percentages, of course, would be somewhat lower.*

A second factor to be considered is that even with comprehensive testing programs, not all adult victims are tested for alcohol, with the largest sub-group here being persons who survive their accidents for several hours or more. Studies of fatally injured drivers by Baker and Spitz (11) and Robertson, et al., (12) have indicated that victims who survived over six hours tended to be different from those who died sooner in that the former were more elderly, less likely to have been drinking and frequently succumbed to injuries from which younger people would have recovered.

Similar circumstances may exist among pedestrians. Thus, percentages derived from tested cases may overestimate alcohol involvement in all adult fatalities (the non-drinking elderly victims may be overrepresented in the untested groups).

Given these qualifications, the data from post mortem testing nevertheless indicate that alcohol is frequently present in pedes-

*It has been estimated that approximately one quarter of the pedestrians killed in the U.S. are under the age of 15.

trian fatal accidents. Further, several studies indicate that the majority of drinking or alcohol impaired pedestrians were responsible for their own demise. Waller (13), for example, indicates that among 44 fatally injured pedestrians who had BACs of .10 percent or higher, 52 percent were responsible for the accidents, the driver was responsible in 30 percent of the accidents and fault was not established in 18 percent of the cases.

Marsden (14) found that among 50 fatally injured pedestrians known to have been drinking, the pedestrian was at fault in 66 percent of the cases, the driver was responsible in 12 percent of the cases and there was no fault, or it was unknown who was responsible for 22 percent of the deaths. Also, among 120 adult pedestrians in New Jersey (7) who had a BAC of .10 percent or more, and where responsibility had been determined, 94 percent were classified as either responsible or partially responsible.

Controlled studies of pedestrian accidents (i.e., those which compare the characteristics of pedestrian victims with samples of similarly exposed but non-accident involved individuals) are extremely rare. In the U.S., only the study by Haddon, et al., (4) is known to have been undertaken. In this work, 50 adult pedestrians killed in New York City were compared with site and sex matched controls obtained by visiting each accident site on a subsequent date at the same time of day and day of the week as the accident. Data obtained for the victims included accident investigation records and post mortem testing for alcohol. Data from control subjects were derived from interviews including breath specimens.

Regarding alcohol involvement, these authors conclude,

> that the presence of ethyl alcohol in the blood, particularly in high concentration, was highly associated with such accident involvement, that only a minority of those killed who died within six hours had not been drinking, and that the findings were similar whether the comparison was made with the total control group, with the controls from the same sites, or with the age and sex matched controls. These findings are similar to and consistent with those relative to drivers obtained by other workers using laboratory, field trial and epidemiological methods.

It should be noted that alcohol data were obtained on only 19 of the 50 victims included in the study. Thus, the results are based on a small sample. Also, as noted earlier, Haddon, et al., (4) found alcohol present far more frequently than did other reports based on post mortem examinations.

A recent study in Great Britain by Clayton, et al., (15) used methods similar to those of Haddon, et al., to study adult pedestrians killed over a five year period. In all, usable BAC data were obtained from 344 fatally injured pedestrians and compared with 1,118 control group BACs. The results indicated that, overall, 33 percent of the fatally injured had been drinking compared with 22 percent of the control group.

Alcohol related accidents in the Clayton study were found to cluster in the late night hours (11:00 p.m. - 3:00 a.m.) when 70 percent of the victims had BACs of .08 percent or higher compared with 19 percent of the relevant control group members. Among the fatally injured, 47 percent of the males were found to have been drinking while 15 percent of the females had done so. In the control group, 33 percent of the males and 7 percent of the females had been drinking. The authors conclude that the relative risk of a fatal pedestrian accident increases rapidly at BACs above .12 percent for both males and females.

Existing information on the role of alcohol in pedestrian accidents can be seen to implicate adult pedestrian drinking as an element in many of these events. However, the reported extent of this involvement varies considerably and is limited to fatal accident situations. Virtually nothing has been reported on the extent of alcohol involvement in non-fatal injury accidents. Further, little is known about the behavioral errors made by those who had been drinking and whether these are different by type or degree from the errors made by non-drinking pedestrians who are accident involved. Finally, beyond the study by Clayton, et al., (15) in Great Britain, the topic of possible increased pedestrian accident risk following alcohol consumption has not, heretofore, been addressed.

C. Method

The present study was carried out in the City of New Orleans during a period which extended from early 1975 through early 1976. New Orleans, in the 1970 census, had a population of 593,471 persons. Approximately 55 percent of the citizens are white and 45 percent are black. The population is 47 percent male and 53 percent female.

The city has a large medical facility, the Charity Hospital Of Louisiana at New Orleans, which handles most of the local emergency trauma cases. The willingness of the hospital to participate in the study, and the willingness of the Parish Coroner, the Police Department and other city officials were key factors in the selection of the city as the study site.

The study was based on extensive data collection on adult pedestrian fatal and non-fatal accident cases and the establishment of control groups based on accident and random site sampling.

Specifically, the following groups and data sources were developed:

- Fatal Accident Group -- all pedestrians aged 14 or older who died within 24 hours of a motor vehicle accident in New Orleans (Orleans Parish) between July 1, 1972 and March 31, 1976; 86 cases. Excluded are bicyclists, persons falling from vehicles and accidents occurring during Mardi Gras. Data sources included police accident reports and arrest records and Parish Coroner post mortem testing.

- Injury (non-fatal) Accident Group -- pedestrians aged 14 or older taken to Charity Hospital following a motor vehicle accident occurring between March 1, 1975 and March 31, 1976; 180 cases. Excluded are bicyclists, persons falling from motor vehicles and accidents occurring during Mardi Gras. Data sources included police accident reports and arrest records, BAC tests of blood samples taken in the hospital and follow up subject interviews.

- Accident Site Control Groups -- similarly exposed but non-accident involved pedestrians aged 14 or above passing the site of the fatal and injury accidents within $\pm$ 30 minutes on the same day of week as the original accidents. For the fatal accidents which occurred before the study period, control sampling took place on the same day of the year (e.g., the third Tuesday in June) as the accident. For accidents (fatal and injury) taking place during the study period, sampling took place on the same day of the week within two to four weeks of the accident; 1,208 of 1,469 persons eligible provided a breath test specimen and an interview.

- Random Site Control Group -- 112 street locations chosen at random and sampled for one hour periods with sampling evenly distributed insofar as possible by time of day and day of week; 80 of 94 eligible persons provided a breath test specimen and an interview.

A summary of the study method is shown in Figure 1.

D. Results

1. Degree of Alcohol Involvement

Post mortem BAC results were obtained from 80 of the 86 fatally injured pedestrians while blood samples were obtained from 143 of the 180 injured taken to Charity Hospital. The results of these tests are shown in Table 1.

The figures in the table indicate that for both the fatal and non-fatal groups, approximately one half had been drinking prior to their accidents. (The underlying BAC distributions of the two groups are not significantly different -- $\chi^2 = 6.24$,

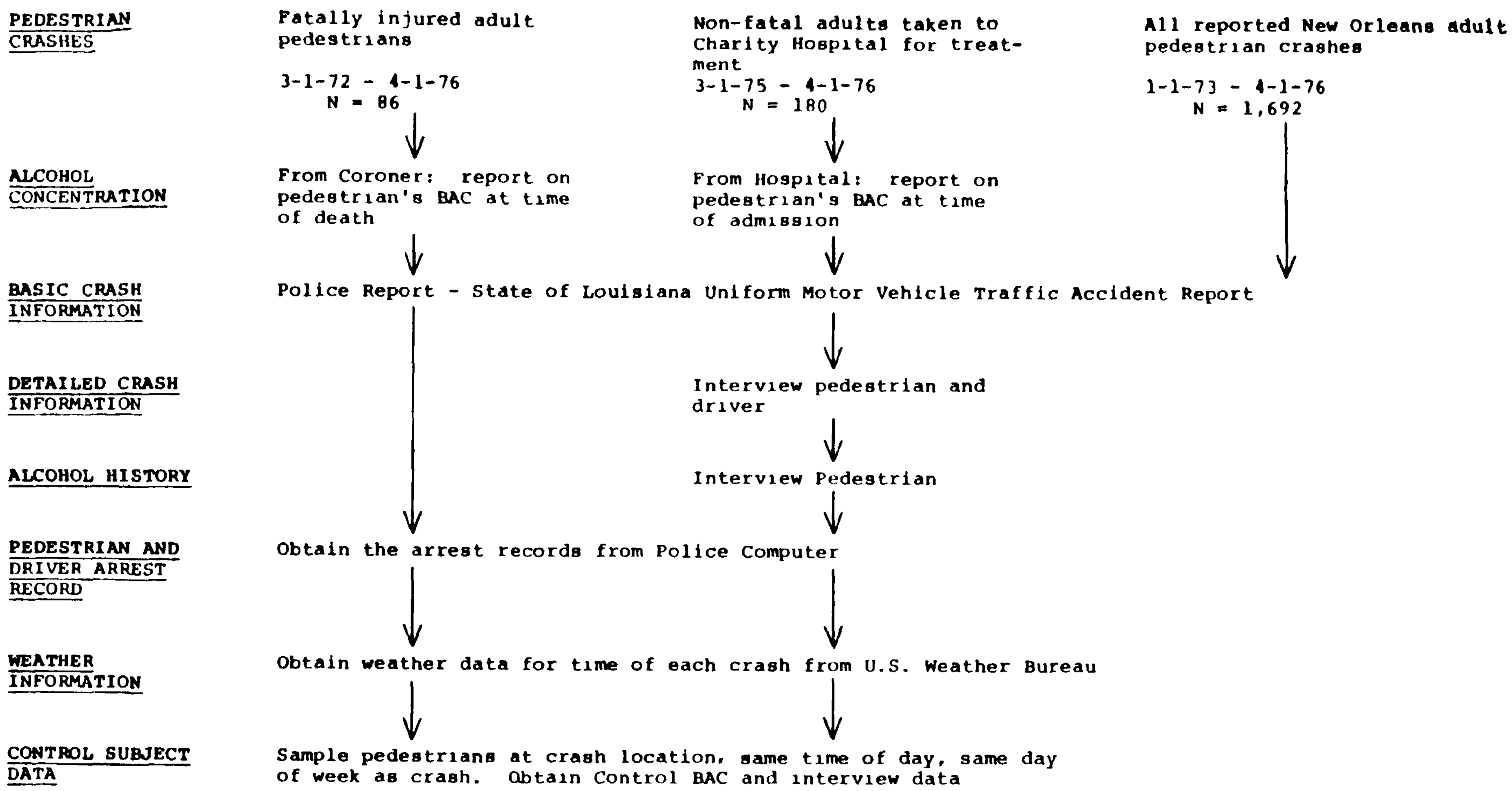

Figure 1. Methods Overview.

Table 1. BAC levels for Adult Fatal and Non-Fatal Crash Involved Pedestrians.

BAC*	Fatal (N=80)	Non-Fatal (N=143)
.000	49%	51%
.001 - .049	2	9
.050 - .099	4	4
.100 - .149	11	6
.150 - .199	8	7
.200 - .249	9	10
.25 +	18	13
	100%	100%

*BAC data throughout this report are given as percent weight/volume.

with 6 d.f.). The results for the fatally injured group are similar to the findings of other reports based on post mortem testing. The present outcome indicates that the degree of alcohol involvement in non-fatal injury accidents (where the pedestrian requires or seeks emergency medical treatment) is as great as in fatal accidents.

2. Overrepresentation of Alcohol and Relative Risk

Accident site control sampling was carried out for 241 of the 266 accidents included in the study.* In all, 1,469 pedestrians were approached at the accident sites, with 1,208 (82%) of these agreeing to participate including providing a breath sample.** The average number of persons participating per site was 5.0. Approximately 93 percent of the sites produced at least one control; 78 percent of the sites produced at least two and 63 percent at least three.

As noted earlier, control sampling was also carried out at 112 randomly selected sites in the city. These sites produced 80 subjects for whom breath alcohol measurements were available. These random sites produced an average of .71 subjects per site as compared with the 5.0 average per site at the crash locations, despite the fact that all sampling was conducted for one hour at every site.

Overall, 13.5 percent of the accident site controls tested were found to have BACs of .05% or higher compared with 43.0 percent of the tested accident involved groups. Among the random site controls, 7.5 percent had BACs of .05% or more.

Males accounted for 65 percent of the accident victims included in the study. Among the accident involved males tested for alcohol (146 of 173), 53 percent were found to have BACs of .05% or higher; among the females tested (77 of 93), 23 percent had BACs of .05% or more.

Males accounted for 59 percent of the tested site controls while females accounted for 41 percent. Twenty percent of these males and four percent of these females had BACs of .05% or more.

Males accounted for 65 percent of the random site controls; 12 percent had BACs of .05% or more. None of the random

*Sampling was not carried out at 25 sites primarily because of clerical problems in matching hospital reports of accidents with police accident reports, e.g., aliases and misspelled names could not be reconclied in a timely manner.

**Breath samples were analyzed on site using the Alco-Limiter instrument. Operationally, this device cannot reliably distinguish very low BACs from negative (zero) BACs. Readings from the device up to .049%, therefore, are considered negative herein.

site female controls had positive BACs.

The figures just noted indicate that adult male pedestrian accident victims are more likely to have been drinking than their female counterparts. Both groups are overrepresented in alcohol consumption in comparison to the accident site and random site controls. Figure 2 summarizes these findings.

Relative risk calculations are one method for comparing crash and control samples and quantifying any increased risk related to BAC level. The basic input data for these calculations are the BAC distributions for the crash and control groups. The equation used for relative risk at each specified BAC level was as follows (after Clayton, et al., 15).

$$\text{Relative Risk (at specified BAC level)} = \frac{\dfrac{\text{\% accident sample at specified BAC level}}{\text{\% control sample at same BAC level}}}{\dfrac{\text{\% accident sample at .00\% BAC}}{\text{\% control sample at .00\% BAC}}}$$

This equation has the effect of setting relative risk at .00% BAC equal to one. Relative risk can be interpreted as a factor specifying the amount, if any, of increased risk of accident involvement associated with a specified BAC relative to .00% BAC. Thus, for example, a relative risk of 10.00 implies that pedestrians with that specified BAC level are ten times more likely to be involved in an accident than pedestrians at .00% BAC.

In developing the relative risk comparisons, three subgroups of the control subjects were employed. These were:

(a) Site Matched Controls -- these controls were selected on the basis of the time of the accident. The group consisted of up to three* control subjects at each accident site whose time of breath testing was closest to the exact time of the accident. In all, 559 control subjects made up this subgroup.

(b) Age/Sex Site Matched Controls -- this group consisted of that one control subject who was the same sex as the pedestrian victim and was closest to the victim in terms of age. In all, age/sex controls were obtained for 193 of the 223 accident sites where victim BAC was known.

*Some sites did not produce three control subjects. In these instances, the one or two available subjects were included. Data from sites where the accident victim's BAC was unknown are excluded.

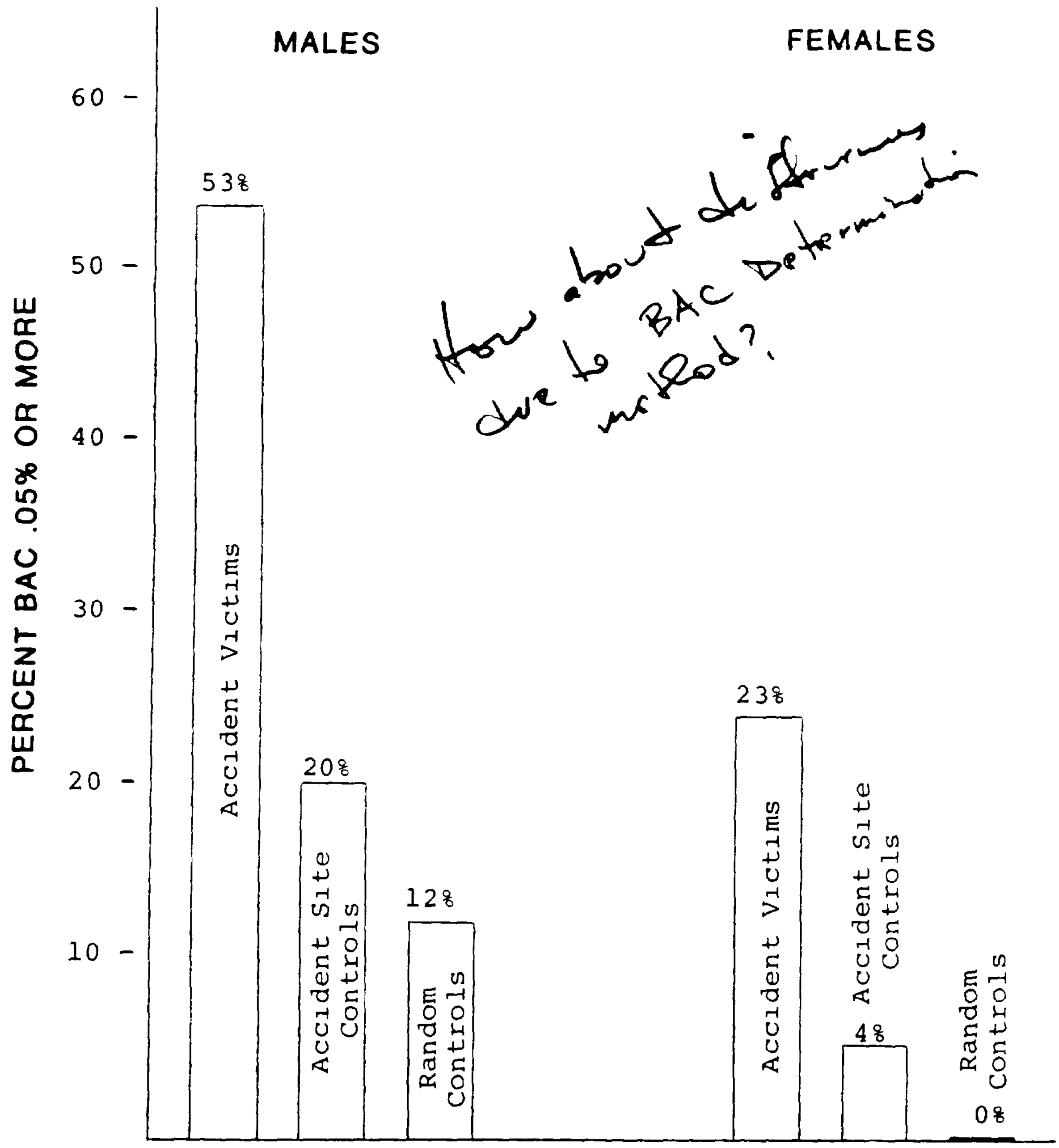

Figure 2. Alcohol involvement of male and female accident victims and controls.

(c) <u>Random Controls</u> -- this group consisted of the 80 subjects tested at the randomly selected sampling sites.

The age/sex site matched controls are believed to provide the most conservative basis for determining relative risk in that the group controls for both demographic and site related variables. It is the most appropriate comparison group to the extent that pedestrian behavior and associated risk are correlated with age, sex, time of day, day of week and location. Comparisons with this group will yield conservative results insofar as the demographic and site variables are correlated with alcohol use irrespective of risk.

The site matched controls provide a less conservative basis for judging relative risk because they control for site variables but not for demographic variables. Finally, the random site group provides comparison with an estimate of the total pedestrian population without control of site or demographic variables.

The results of the relative risk calculations are presented in Table 2 and are shown graphically in Figure 3.

Table 2. Calculated Relative Risk

	Relative Risk at BAC					
Accident Groups in Comparison to:	.00-.049%	.05-.099%	.10-.149%	.15-.199%	.20-.249%	.25% +
Age/Sex Site Matched Controls	1.00	2.08	1.72	2.12	5.19	37.86
Site Matched Controls	1.00	1.04	2.79	5.11	9.04	11.25
Random Controls	1.00	1.91	4.47	----	37.66*	-----

*Calculation is for .15% and higher, insufficient data for further breakdown.

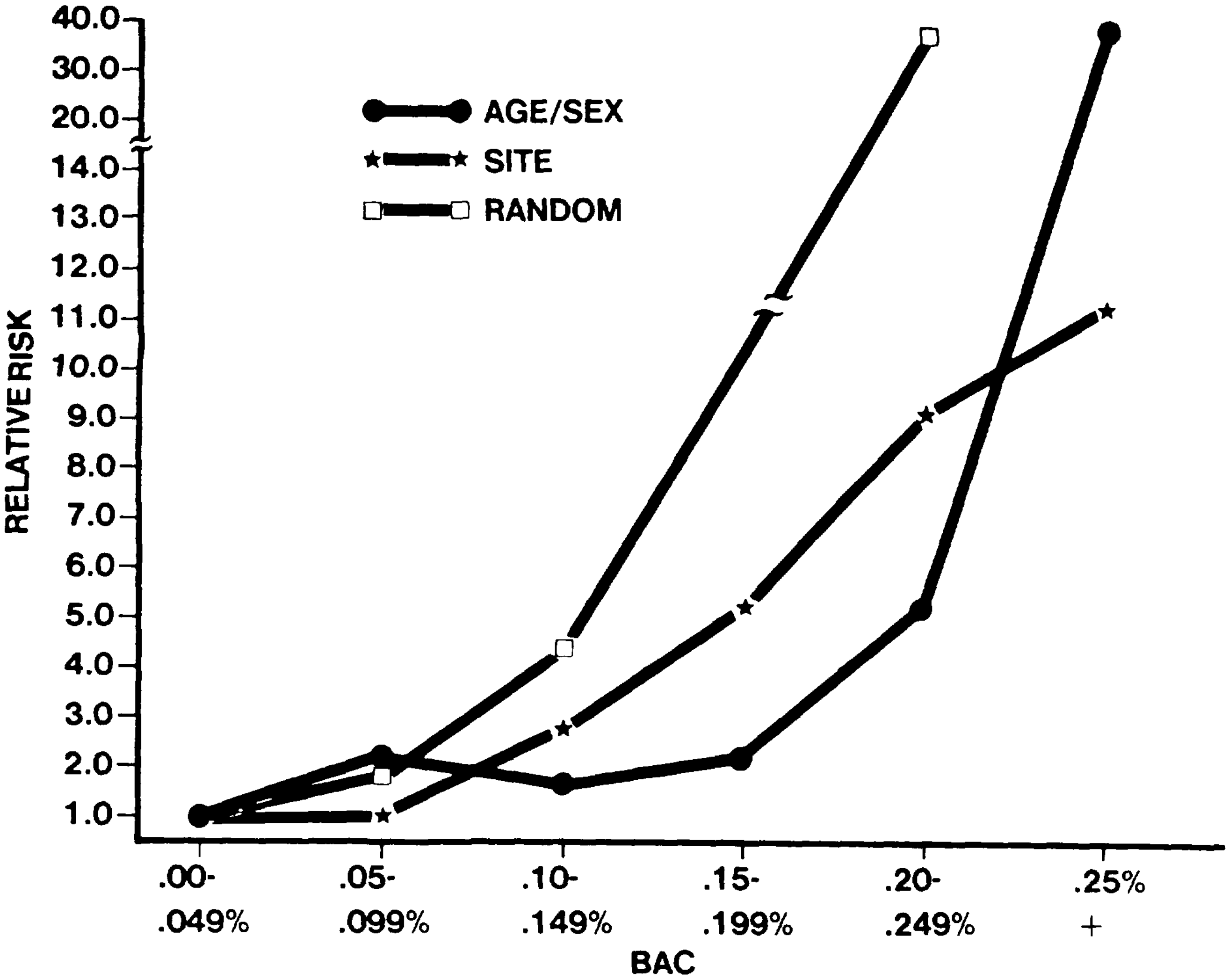

Figure 3. Relative risk of accident involvement by BAC as determined by the three control groups.

From Table 2 and Figure 3, it can be seen that the relative risk of an accident is high at the upper BAC levels, while below .10% BAC any increased risk appears to be minimal. In the middle BAC ranges, .10% to .199%, interpretation of risk depends on which control group is used in the comparison.

Relative risk based on the conservative age/sex matched controls does not show a sharp increase until .20% or higher. When the pedestrian victims are compared to the somewhat less conservative Site Matched Controls, there is a substantial increase in risk at .15%. Finally, comparison with the least conservative Random or population controls highlights a substantially increased crash risk at .10%.

3. Behavioral Errors

The question of whether alcohol may play a unique causal role in pedestrian accidents was examined by classifying the behavioral errors involved in the accident cases included in the study. The method employed included trained judges determining the accident type, the primary precipitating factors, the predisposing factors and culpability for each crash. The judgmental process followed the typology and crash sequence model of Snyder and Knoblauch (16).

(a) Primary Precipitating Factors

Snyder and Knoblauch's (16) crash sequence model suggests that either pedestrians or drivers must correctly perform a sequence of behaviors to avoid an accident. The elements of the sequence are:

- Course (location and negotiation)
- Search (drivers looking for pedestrians; pedestrians looking for vehicles)
- Detection ("seeing" the threat)
- Evaluation (understanding what must be done to avoid a crash)
- Action (performing the required crash avoidance action)

Pedestrian accident analysis seeks to identify the specific errors made within the appropriate elements of the sequence. For example, crossing against the light, is a pedestrian course error.

In the present study, there were 212 accidents in which the pedestrian's BAC was known and for which sufficient information existed for accident typing. A total of 485 precipitating factors were determined in these accidents with 205 of these being judged as "first" or most important factors. Table 3 shows the distribution of these factors as a function of pedestrian BAC. The first three columns show the distribution of "first" factors and the second three columns show the distribution for all factors. The most frequently cited factor grouping was Pedestrian Course-Negotiation which includes such errors as "running" and "short time exposure." The second most frequently cited category was Pedestrian Search followed by Pedestrian Course-Location (covers "unexpected," "unusual," "poor" and "high exposure" locations).

The data in Table 3 provide two indications that there may be behavioral differences between the alcohol and non-alcohol crashes. First, driver errors or factors were less frequently noted in accidents where the pedestrian had been drinking. This is the case for both the first factor and all precipitating factors combined. Thus, pedestrian errors are more prevalent in those accidents where the pedestrian had been drinking.

The second indication of behavioral differences between the alcohol and non-alcohol involved crashes comes from the category Pedestrian Course-Location. As noted in Table 3, this factor was noted as a first primary precipitating factor for only four percent of the crashes where the pedestrian's BAC was zero and for 17 percent of the crashes where the pedestrian's BAC was .10 percent or higher. As a first, second or third factor, it was noted for 9 percent of the .00% BAC crashes and for 25 percent of the .10% or higher accidents. These figures imply that location of crossing or location in the road is more relevant to the alcohol than the non-alcohol accident.

(b) Predisposing Factors

A predisposing factor in a pedestrian accident is defined as a situational, environmental or personal factor which made crash occurrence more likely. In the present analyses, up to three predisposing factors could have been coded for each accident. The results are shown in Table 4 by pedestrian BAC.

The most noticeable finding in the table is that the judges doing the accident analyses (who had knowledge of BAC) believed that alcohol was a predisposing factor in the large majority of accidents in which the pedestrian's BAC was .10% or more. It can also be seen in the table that old age as a pedestrian factor was noted more frequently in the non-alcohol crashes (18 percent of the cases) than in the high BAC accidents (5 percent of the .10% or higher accidents), and that exposure factors (e.g., heavy exposure to vehicle turns) are noted frequently in the non-alcohol and low BAC accidents and almost not at all in the high BAC crashes.

Table 3. Distribution of Precipitating Factors by Pedestrian BAC.

	First Factor			All Factors		
	Pedestrian BAC			Pedestrian BAC		
	.000%	.001-.099%	.10% +	.000%	.001-.099%	.10% +
Precipitating Factor	(N=109)	(N=22)	(N=81)	(N=109)	(N=22)	(N=81)
Ped Course - Location	4%*	18%	17%	9%	23%	25%
Ped Course - Negotiation	48%	41%	40%	79%	73%	70%
Ped Search	13%	14%	14%	32%	23%	26%
Ped Detection	2%	5%	1%	9%	14%	4%
Ped Evaluation	1%	5%	6%	5%	18%	10%
Ped Action	2%	0%	0%	3%	0%	0%
Ped Factor (Not Specified)	2%	0%	5%	25%	18%	31%
All Driver Factors	29%	18%	10%	75%	68%	51%
No First Factor	0%	0%	7%			
	100%	100%	100%	237%	237%	217%

*Entry is percent of cases with that factor, e.g., 4% of the 109 cases in which pedestrian BAC was .000% had Ped Course - Location coded as a first factor.

Table 4. Distribution of Predisposing Factors by Pedestrian BAC.

Predisposing Factor	Pedestrian BAC .000% (N=109)	.001-.099% (N=22)	.10% + (N=81)
Pedestrian Factors			
Old Age	18%*	9%	5%
Alcohol	0	14	88
Other	6	5	14
Driver Factors	6	5	10
Vehicle Factors	4	0	11
Weather	6	9	10
Environment	15	27	12
Exposure	16	23	1
Other	0	5	1
None	28	5	0

*Entry is % of cases at given BAC, e.g., 18% of the 109 cases at .00% BAC had pedestrian old age judged as a predisposing factor in the crash. Up to 3 factors could be cited for an individual case.

(c) Culpability

As a part of the accident analysis process, a judgment was made as to who was culpabale for the accident (in behavioral rather than legal terms). Culpability was defined as the commission of a behavioral error, the elimination of which would likely have resulted in crash avoidance. Judged culpability was assigned to the pedestrian, the driver, both or (in rare cases) to neither. The results are contained in Table 5 by pedestrian BAC.

Table 5. Accident Culpability by Pedestrian BAC.

	Pedestrian BAC		
Judged Culpability	.000% (N=109)	.001-.099% (N=22)	.10% + (N=81)
Driver	23%	0%	7%
Pedestrian	61	59	72
Both	15	41	16
Neither	0	0	1
Not Determined	2	0	4
	100%	100%	100%

The data show that a driver was judged culpable in only about 23 percent of the non-alcohol crashes and even more rarely so in those where the pedestrian had been drinking. Also, the frequency of pedestrian sole culpability was approximately the same in non-alcohol crashes and those with relatively low BACs, but increased where the BAC was .10% or higher.

4. Accident Types

Predisposing and precipitating factors can be thought of specific descriptors of crash causation mechanisms. Another, more global technique for describing what happened in a crash is an Accident Type. In the present study, the typing method of Snyder and Knoblauch (16) was employed. The results for the 212 accidents where BAC was known and there was sufficient information to assess accident type, are presented in Table 6.

The figures show that only two accident types -- "multiple threat" and "pedestrian strikes vehicle" -- vary greatly in frequency when alcohol and non-alcohol related accidents are compared. It can be seen, for example, that just over 10 percent of the non-alcohol accidents were typed as "multiple threat" while only one alcohol related crash was so typed. Regarding "pedestrian strikes vehicle," 11 of 103 alcohol related crashes were assigned this type (all in the high BAC category) while only two of 109 non-alcohol accidents were assigned the type.

By major category, 48 of 109 (44 percent) of the non-alcohol crashes were typed as darts and dashes as were 44 of 103 (43 percent) of those where alcohol was present.

The specific situation types were assigned in 52 of 109 (48 percent) of the non-alcohol crashes and in 33 of 103 (32 percent) of the alcohol crashes. Finally, the "other" category was used in eight percent of the non-alcohol and in 25 percent of the alcohol related accidents. Thus, with regard to accident typing, the darts and dashes do not differentiate alcohol and non-alcohol involved accidents, specific situation types (primarily multiple threat) appear less frequent among the high BAC accidents and the "other" category (pedestrian strikes vehicle, weird and not classifiable) is more frequent in the high BAC crashes.

5. Pedestrian Accident Characteristics

(a) Pedestrian Characteristics

(1) Sex

As noted earlier, 65 percent of the accident victims included in the study were males and 35 percent were females. Table 7 shows the distribution of BACs of the male and female accident victims (percentages are based on the 212 cases where BAC was known).

The figures in the table indicate that two-thirds of the females were alcohol free at the time of their accidents compared with only 41 percent of the males. Almost 31 percent of the males had BACs of .20% or more while just under 12 percent of the females did so. Thus, alcohol involvement was found to be more prevalent among males.

Table 6. Accident Type by Pedestrian BAC.

Accident Type	Pedestrian BAC .000% (N=109)	.001-.099% (N=22)	.10% + (N=81)
Darts and Dashes			
Dart-out First	13.8%	13.6%	7.4%
Dart-out Second	5.5	4.5	9.9
Midblock Dash	2.8	4.5	1.2
Intersection Dash	22.0	9.1	27.2
(Total)	(44.1)	(31.7)	(45.7)
Specific Situations			
Vehicle Turn/Merge	1.8	4.5	0.0
Turning Vehicle	5.5	0.0	2.5
Multiple Threat	10.1	0.0	1.2
Backing	3.7	0.0	1 2
Vendor	0.0	0.0	0.0
Trapped	1.8	9.1	0.0
Disabled Vehicle	0.9	9.1	1.2
Bus Stop	4 6	4.5	0.0
Auto-Auto	4.6	0.0	1.2
Ped Not In Road	4.6	4.5	1.2
Other	10.1	27.3	16.0
(Total)	(47.7)	(59.0)	(24.5)
Other Crashes			
Ped Strikes Vehicle	1.8	0.0	13.6
Weird	0 0	0.0	3.7
Not Classifiable	6.4	9.1	12 3
(Total)	(8.4)	(9.1)	(29.6)

Table 7. Sex by Pedestrian BAC.

BAC	Sex: Males (N=146)	Sex: Females (N=77)
.00%	41.1%	67.5%
.001 - .099%	9.6	13.0
.100 - .199%	18.5	7.8
.20% or more	30.8	11.7
	100.0%	100.0%

(2) Age

The ages of the accident victims by BAC are shown in Table 8 as follows:

Table 8. Age Group by Pedestrian BAC.

	Age						
BAC	14-19 (N=23)	20-29 (N=38)	30-39 (N=30)	40-49 (N=34)	50-59 (N=24)	60-69 (N=33)	70+ (N=41)
.00%	73.9%	47.4%	30.0%	38.2%	29.2%	60.6%	68.3%
.001-.099%	21.7	15.8	20.0	8.8	0.0	0.0	9.8
.100-.199%	0.0	15.8	13.3	14.7	25.0	18.2	14.6
.20% - up	4.3	21.1	36.7	38.2	45.8	21.2	7.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

These data show that the majority of the teen-aged, and persons 60 or more were alcohol free at the time of their crashes. The proportions in the very high BAC category (.20% and above) build up with advancing age until the 50-59 year old group and then decline. It may also be noted that the majority of victims between 30 and 59 years of age had BACs of .10% or more.

(3) Residence

A total of 241 of the 266 accident victims (91 percent) were residents of New Orleans, three percent lived elsewhere in Louisiana, four percent lived in other states and two percent were foreign or residence was unknown. Among cases where BAC was known, 51 percent of the New Orleans resident victims had been drinking compared with 43 percent of the non-city residents. This difference is not statistically significant, however (χ^2 = 0.05 with 1 d.f.).

(4) Arrest Record

Approximately 37 percent of the pedestrians included in the study had one or more arrests (including traffic) recorded in local police files. For those whose BAC was known, the frequency of recorded arrests was as indicated in Table 9.

Table 9. Arrest Record by Pedestrian BAC.

	Number of Arrests		
BAC	None (N=162)	1-3 (N=35)	4 or more (N=26)
.00%	55.6%	48.6%	19.2%
.001 - .099%	9.3	11.4	19.2
.100 - .199%	14.2	8.6	26.9
.20% - up	21.0	31.4	34.6
	100.0%	100.0%	100.0%

These data suggest that the pedestrians involved in accidents who had arrest records were more likely to have been drinking prior to their accidents. At the extreme, over 61 percent of those with four or more arrests had BACs of .10% or higher.

(5) Mortimer-Filkins Scores

Part way into the study period, follow up interviews with the non-fatally injured pedestrians were introduced in order to gain more information about the accident and the victim. Included in these interviews was the administration of the Mortimer-Filkins (M-F) Problem Drinking Screening Questionnaire (17). Because of the late start of this effort and difficulty experienced in locating injured pedestrians, M-F results were obtained from only 49 accident victims (45 percent of those asked to respond). No statistically significant differences were found between respondents and non-respondents in terms of age, sex, race or BAC. M-F data were also obtained from 371 control subjects (of 736 who potentially could have responded). Table 10 shows the distribution of the M-F scores available from the accident group and from an age/sex control group formed by picking for each accident site the one control subject who was the same sex as the victim, closest in age and completed the M-F. These figures show no difference in mean scores between the two groups (t = .80) nor are there major differences in the distribution of scores. Unfortunately, the number of cases available is too small for detailed analyses of BAC by M-F score. Nevertheless, among the non-alcohol involved subjects, the mean M-F score was 9.1 while those who had been drinking had a mean score of 17.6; among the non-drinking controls considered here, the mean score was 13.1 and was 21.0 for the drinking controls. Thus, it appears that M-F score is related to BAC at the time of the crash for the victims and at the time of control sampling for controls.

(b) Accident Characteristics

(1) Time of Accident

The overall distribution of the time period of the accidents included in the study was as follows:

Time Period	Percent of Accidents (N=266)
Midnight - 0359	9.4%
0400 - 0759	7.9
0800 - 1159	15.8
1200 - 1559	18.4
1600 - 1959	27.4
2000 - 2359	21.1
	100.0%

These figures show a pattern fairly typical of pedestrian accidents -- that is, a "build up" of occurrences in the afternoon and evening hours. For example, these data show that almost one half of the study cases occurred between the hours of 4:00 p.m. and midnight.

The distribution by time period of the accidents by pedestrian BAC (when BAC was known) is contained in Table 11. The figures in the table indicate that the alcohol related accidents tend to cluster in the nighttime hours. That is, almost 70 percent of the pedestrian accidents in the study (where BAC was known) that occurred between 8:00 p.m. and 4:00 a.m. involved a pedestrian whose BAC was .10% or higher. By

Table 10. Distribution of Mortimer-Filkins Scores, Part I.

M-F Scores	Accident Victims (N=49)	Age/Sex Controls (N=95)
11 or less	39%	41%
12 - 15	24	17
16 - 19	10	20
20-23	10	6
24 or more	16	16
	100%	100%
Mean Score	14.6	14.2
S.D.	7.8	8.4

Table 11. Accident Time Period by Pedestrian BAC.

	Time Period					
	Midnight 0359	0400-0759	0800-1159	1200-1559	1600-1959	2000-2359
BAC	(N=22)	(N=20)	(N=32)	(N=41)	(N=67)	(N=41)
.000%	13.6%	80.0%	71.9%	63.4%	47.8%	29.3%
.001 - .099%	18.2	5.0	12.5	9.8	16.4	0.0
.100 - .199%	22.7	0.0	3.1	9.8	20.9	22.0
.20% - up	45.5	15.0	12.5	17.1	14.9	48.8
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

contrast, the large majority of accidents during the hours of 4:00 a.m. and 4:00 p.m. involved a non-drinking pedestrian. Nevertheless, it can be seen that 15 percent or more of the crashes in these hours involved a pedestrian whose BAC was as least .10%. Finally, the figures suggest that the hours from 4:00 - 8:00 p.m. are a transition period in that about one half of the accidents included alcohol while the other one half were alcohol free.

(2) Day of Week

The frequency of accidents on the different days of the week was as follows:

Day	Percent of Accidents (N=266)
Sunday	11.7%
Monday	13.5
Tuesday	14.3
Wednesday	15.0
Thursday	14.7
Friday	16.5
Saturday	14.3
	100.0%

Although these data suggest a higher rate on Fridays and a lower rate on Sundays, the underlying distribution is not significantly different from a uniform distribution (38 accidents per day or 14.3 percent per day; $\chi^2 = 1.27$, N.S. with 6 d.f.).

Table 12 shows the distribution of accidents by day of the week for the cases where pedestrian BAC was known.

Table 12. Day of Accident by Pedestrian BAC.

	Day						
BAC	Sun (N=27)	Mon (N=29)	Tue (N=34)	Wed (N=33)	Thu (N=37)	Fri (N=33)	Sat (N=30)
.000%	25.9%	44.8%	67.6%	72.7%	43.2%	48.5%	43.3%
.001-.099%	3.7	6.9	8.8	6.1	10.8	21.2	16.7
.100-.199%	25.9	17.2	14.7	6.1	21.6	6.1	13.3
.20% - up	44.4	31.0	8.8	15.2	24.3	24.2	26.7
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The figures in the table show that the lowest frequency of alcohol related accidents occurred on Tuesdays and Wednesdays and was highest on Sundays. Approximately 54 percent of the accidents on weekends (Saturday-Sunday) involved pedestrians with BACs of .10% or more, compared with about 33 percent of the weekday accidents. However, 48 percent of the accidents on Mondays and 46 percent of those on Thursdays included BACs of .10% or more.

(3) Crash Location

Table 13 summarizes several of the characteristics of the accident sites in relation to pedestrian BAC. It may be seen in the table, firstly, that alcohol related crashes are not more or less frequent at intersections. Accidents on one and two way roads and expressways were more frequently alcohol related than were accidents on two lane, divided roads and other (e.g., parking lots, alleys, etc.) locations.

The frequency of alcohol related crashes was about the same in business and residential locales and was less frequent in other (e.g., open) areas. Alcohol was present more frequently in accidents that occurred where no traffic control device existed. Finally, accidents on roads with speed limits of 30 mph or less were more frequently alcohol related.

E. Discussion

The results of this study clearly lead to the conclusion that alcohol is a causal factor in many pedestrian-vehicle crashes. Approximately half of the adult crashes studied involved a pedestrain who had been drinking, and nearly 25% of all adult crashes involved a pedestrian who was at .20% BAC or higher. Relative risk curves comparing the pedestrian victim's BAC with the control group clearly support the conclusion that the risk of being in an accident increases dramatically as BAC rises. There is no question from these data that BACs of .20% or higher lead to dramatically increased risk and BACs in the range of .10% to .199% are a problem. The risk curves are similar to the curves obtained in driver alcohol research (see, for example, Borkenstein, et al. [18]), though it would appear that greatly increased accident risk among pedestrians is occurring at somewhat higher BAC levels.

The results themselves suggest that the methods employed in this study were valid and appropriate to the research objectives. The extremely low refusal rates for both experimental (4%) and control (18%) subjects leave little chance for major biases as a result of the sample selection process. The incidence of alcohol in the fatal sample from this study is consistent with other studies of pedestrian fatalities as reported above. Therefore, it appears that the study site, New Orleans, was not atypical in terms of the incidence of drinking in the population. Hence, it is believed that the results of this effort can be generalized to

Table 13. Crash Location Descriptors by Pedestrian BAC.

	N	Pedestrian BAC .000%	.001-.099%	.100-.199%	.200%-up	Total
At Intersection						
Yes	118	51.7%	5.9%	18.6%	23.7%	100%
No	105	48.6	16.2	10.5	24.8	100
Type of Road						
One Way	42	42.8%	14.3%	21.4%	21.4%	100%
Two Way	37	40.5	16.2	13.5	29.7	100
Two Way Divided	122	56.6	7.4	11.5	24.6	100
Expressway	16	43.7	12.5	25.0	18.7	100
Other	6	50.0	16.7	16.7	16.7	100
Locale						
Business	155	49.0%	11.6%	14.8%	24.5%	100%
Residential	54	51.9	7.4	14.8	25.9	100
Other	12	58.3	16.7	16.7	8.3	100
Traffic Control						
Light	48	64.6%	12.5%	10.4%	12.5%	100%
Other	16	62.5	0.0	25.0	12.5	100
None	156	44.9	11.5	15.4	28.2	100
Speed Limit						
30 mph or less	38	47.4%	7.9%	18.4%	26.3%	100%
31 mph or more	105	57.1	8.6	12.4	21.9	100

Accident where the BAC or the descriptor are unknown are excluded.

provide a picture of the role of alcohol in pedestrian crashes for other urban areas of the country.

It is felt that the primary findings from this study may be summarized as follows:

- Adult pedestrians, both fatal and non-fatal, were found to have been drinking prior to their crash in about 50% of the studied cases.

- Alcohol is overrepresented among victims as compared to non-accident involved controls. Overrepresentation is greatest when comparisons were made to the Population at Large controls, least when compared to the very conservative Age and Sex Site-Matched controls. In all cases, risk is greatly elevated when the BAC of the pedestrian is .20% or higher.

- BACs of the victims were extremely high.

- Alcohol and, particularly, high BACs were most common among middle aged (30-59) males, at night and on weekends.

- Alcohol was more common among people with prior arrests (all kinds) and higher Mortimer-Filkins scores.

- Alcohol crashes were spread throughout New Orleans with little regard to type of neighborhood or street location.

- Analysis of crash precipitating behavioral errors showed drivers made more errors when the pedestrian had not been drinking than when the pedestrian had been drinking. In other words, driver errors contributed more to the non-alcohol than the alcohol crashes.

- Concerning pedestrians, it was found that the alcohol crashes more often involved the pedestrian error of "Ped-Course Location" which includes lying in the roadway and crossing at a high exposure location.

- Concerning accident type, the alcohol crashes were more often classified as "other," "ped strikes vehicle" and "not classifiable" and less often classified as a specific situation type such as "bus stop," "multiple threat" or "vehicle turn/merge."

- A statistical model was developed using information from the police accident report that was capable of reliably discriminating between the alcohol and no-alcohol crashes.

The primary objective in data analysis was to identify and quantify all of the parameters that differed between the alcohol and non-alcohol involved crashes and all of the parameters that differed between crash and control groups. These comparisons were just as interesting in their similarities as they were in their differences. In many ways, the alcohol involved pedestrian appeared to be making many of the same errors as the non-alcohol involved pedestrian. The errors may have been more common under alcohol and/or more "serious" (i.e., more difficult to recover from) but they were very often the same errors and often in similar traffic situations.

1. Alcohol Specific Accident Types

This pattern of results would seem to preclude the development of any new accident type categories for specifically alcohol related events. If one type did emerge, it would probably be related to lying in the roadway which is currently classified unde "other - non pedestrian activity in roadway." However, this one added type would account for less than 10% of the cases and probably would contribute little to the explanatory power of the data. Nevertheless, from the narrative descriptions of the crashes and from interviewer's comments, it appeared that alcohol was influencing crash occurrence in two different ways:

(a) Psychomotor Impairment (inability to negotiate in traffic)

(b) Risk Taking (diminished judgement)

The first category, Psychomotor Impairment, was judged to account for approximately one quarter of the studied cases for which the pedestrian's BAC was .05% or higher. It was characterized by a breakdown in motor ability and motor coordination to the point where the pedestrian had little control over where he was or where he was going. Mean BAC for these crashes was nearly .25%. The typical case involved a pedestrian who literally staggered into a motor vehicle. The vehicle may have been in full view and possibly even stopped in traffic.

The second category, Risk Taking, was judged to account for nearly half of the cases for which the pedestrian's BAC was .05% or higher. It was characterized by an adult taking unwarranted and unusual chances in the traffic environment. Often, the crashes were caused by behaviors which are more typically found among young children. Mean BAC was approximately .20% in these Risk Taking events. The typical case was a straightforward dart-out or intersection dash in which it was felt that the dart-out behavior would have been less likely were it not for the judgement impairing effects of alcohol.

Neither Psychomotor Impairment nor Risk Taking constitute new accident types. Rather, they should be viewed as descriptions of the mechanism by which alcohol influenced crash occurrence. For Psychomotor Impairment, the mechanism is a breakdown of the individual's ability to perform perceptual, cognitive and motor functions. For Risk Taking, the mechanism involves diminished capacity to make wise judgements concerning safety. Perceptual and motor functions are apparently intact. As descriptive concepts only, these two mechanism descriptions proved very useful in reading and understanding the crash narratives.

2. Alcohol Involved People

Throughout these data are indications that the people involved in the alcohol crashes are not the same people as in the non-alcohol crashes or in the control group. The first finding was that the alcohol events more often involve middle aged males. Further, the alcohol events more often involved pedestrians with one or more prior arrests. However, the most important single result rests in the BAC data. Simply, the median BAC among those who had been drinking was approximately .20%. This clearly implies that many of the alcohol involved pedestrian victims are experienced users of alcohol, since BAC levels above .20% are rarely achieved by occasional drinkers.

A closer examination of the BAC distributions suggests that many of these people can only be described as truly extraordinary drinkers. One individual had a BAC of .55% and another had a BAC of .53%. Four other individuals had BACs ranging from .35% to .399%, 12 others were in the range from .30% to .349% and 15 others were in the range from .25% to .299%. Overall, approximately 50% of those who had been drinking were at or above .20% BAC and 30% were at or above .25% BAC. By any measure, these are extraordinary alcohol levels which would rarely be achieved by someone unfamiliar with drinking. Such levels are likely indicative of personal, emotional or physical difficulties which probably existed for months or years prior to the crash. The pre-identification and treatment of these individuals may provide a basis for developing countermeasures against these crashes as well as helping them avoid other personal difficulties.

A second basis for countermeasure development may be found in the descriptive profile of the high BAC accident victim produced by this study. This profile was also developed as a statistical model based on information in the police accident report. The model goes beyond the question of statistical significance and attempts to quantify the strength of each relationship and variable interaction. The classification achieved using the model was good, and remained good through a validation effort.

The first use of the profile could be as a means to identify those crashes which probably did involve alcohol. While this could be an evaluation tool for alcohol countermeasures, it could also be a mechanism for identifying people who need help with their drinking behavior. These people could be identified through the accident reports and referred to appropriate agencies. This would serve primarily as a mental health countermeasure and only secondarily as a highway safety countermeasure since the repeat involvement in a pedestrian-vehicle crash is an extremely rare event. Also in New Orleans, the model could be used to aid in countermeasure implementation where countermeasures are targetted toward "high risk" locations, people and/or times of day. The model, for instance, can aid in identifying those situations which are associated with alcohol involved accidents and thus countermeasures can be targetted more precisely.

3. Potential Countermeasure Areas

The results of this study did not immediately suggest countermeasures which could be mounted to produce a rapid reduction in pedestrian crashes related to alcohol consumption. However, by utilizing the collected data as input to a creative countermeasure enumeration process, ten promising approaches were identified. These were:

- Community Mental Health--the overall problem of alcoholism and the need for an approach aimed at curing the alcoholic or, if that cannot be accomplished, protecting him from hurting himself and others on the highway.
- Adjudication--the threat of legal sanctions, for example, enacting per se laws for pedestrians that would make them automatically culpable in an accident if their BAC's are above a specified level.
- Economics--making the cost of drinking more expensive through taxation, for example, or by making it more difficult to buy a drink by not permitting use of credit cards for liquor purchases, by requiring exact change for liquor purchases, or making each successive drink more expensive.
- Product--making some change in the product itself, for example, reducing the proof of alcoholic beverages or adding a substance to alcohol that would have an unpleasant effect (e.g., profuse sweating) but not a deleterious one in terms of psychomotor performance at a certain BAC level.
- Case Finding/Detection--locating the high BAC pedestrian and removing him from the roadway, for example, picking up pedestrians who meet the profile of the high risk drinker and giving them free rides home.
- Symptoms--employing the symptoms of high BACs, such as decreased visual acuity or poor motor

coordination, as a preventive measure. For example, developing and installing in bars a strobe light that wouldn't bother sober people but would be so visually disorienting to people at high BAC levels that they couldn't walk.

- Engineering--redesign of the sidewalk or roadway or redefinition of ordinances that affect motor vehicle and pedestrian traffic, such as, reducing the speed of traffic at night, creating pedestrian malls at night in high risk areas, or adding "life-lines" along the sides of buildings.

- Education--Youth/School--starting the alcohol pedestrian education process at the school level. For example, having teachers, coaches and driver education instructors use their influence to promote responsible drinking behavior.

- Education--Mass Media--using newspapers, television, radio, magazines, advertisements, etc., to educate the public to the pedestrian alcohol problem. For example, having a prominent sports figure appear on television and relate an actual experience of being hit by a car while at a high BAC level and appeal for responsible drinking behavior.

- Education--Public Responsibility--urging the public and all its segments (clergy, parents, industry, social workers, physicians, bartenders, police, lawyers, librarians--in fact all citizens) to use their influence to promote responsible drinking behavior. For example, encouraging industry to set up group therapy sessions for employees who drink, encouraging lawyers to promote adequate pedestrian intoxication laws and urging parents to teach their children responsible drinking behavior.

It must be stressed that these approaches are merely ideas which have been subjected to neither detailed development nor critical evaluation. A significant additional research effort would be needed before any of the approaches could be utilized against the identified problem. In some cases, e.g., for various educational approaches, pretesting and field testing would be needed prior to implementation. For others, such as changes in the product, more basic research would have to be undertaken before specific countermeasures could be developed. However, the fact that there are numerous countermeasure ideas suggests that the pedestrian-alcohol problem can be countered in spite of the apparently incorrigible nature of the victims themselves.

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