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**DRINKING AND SINGLE VEHICLE
FATAL ACCIDENTS IN NEW JERSEY**

**A comparison between high and low
blood alcohol contents of drivers
who died as a result of single vehicle accidents
by day, hour, age, sex,
and weather and light conditions**

by

**Arthur W. Roberts, III
Senior Engineer**

and

**David W. Gwynn
Supervising Engineer**

**Bureau of Safety and Traffic
Division of Research and Evaluation
New Jersey Department of Transportation**

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A. W. Roberts
D. W. Gwynn

ABSTRACT

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The alcohol contents of all the drivers in New Jersey's single vehicle, non-pedestrian accidents who died within four hours after their accidents were analyzed for the year 1965 by comparing the number of those who had a lower alcohol content (less than .050%, including .000%) with the number of those who had a higher content (.050% or above). The study supports previously-made conclusions that the drivers whose alcohol contents were .050% or above are a disproportionately higher percentage in these accidents than they are in the traffic stream and shows the difference between the higher and lower alcohol content groups' accident distributions for day, hour, age, sex, weather and light conditions.

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Introduction

Fatal motor vehicle accidents occur with wide variation of event sequences. As may be expected, simple stereotyped classifications of accident-event sequence, vehicle condition, causation, etc., cannot be clearly interpreted without many qualifications and exceptions. Much of the information collected in regard to fatal motor vehicle accidents is highly subjective, second-hand or deduced information. Still, there are certain facts that are set forth such as age and sex of driver, day and hour of accident and blood alcohol content of driver. It is possible that any one of these facts may show a changing role that is related to accident causation or responsibility. Recently, much attention has been given to the role that alcohol plays in motor vehicle accidents -- fatal accidents in particular.

From some recent studies that have been conducted relating alcohol and accidents, it is suggested, with qualifications that

(1) the relative probability of involvement in single vehicle accidents is higher for driver blood alcohol levels

above .04%, and that the relative probability of involvement in single vehicle accidents increases geometrically with increasing blood alcohol content above this.¹

(2) an increasingly greater number of drivers responsible for accidents were found to become statistically significant in the .03 to .05 percent blood alcohol content range², and

(3) driving ability, as shown by driving tests, is impaired if blood alcohol content is as low as .032%³, .04%⁴, or .051%⁵.

Fatal accident reports contain a wealth of information, but, as previously stated, much is subjective, second-hand, or deduced. It is possible, however, to make comparisons between blood alcohol content groups and the factors of age, sex, day, hour, etc., in an attempt to determine if any differences exist between the groups for each factor. It should be kept in mind, however, that in coming to meaningful conclusions in any accident study on blood alcohol, the researcher is at a decided disadvantage since he does not know with the slightest degree of certainty the percent of drivers, or their exposure in the traffic stream, who have a blood alcohol content. The only reliable information concerning the drinking driver becomes available when this driver becomes involved in an accident and either dies or is uninjured. It is very infrequent that an

injured driver is tested for blood alcohol content. A reasonable estimate has not been made of the ratio of drinking drivers who are involved in accidents to their population in the traffic stream.

Purpose

The purpose of this study is to investigate the single vehicle fatal accident, exclusive of pedestrian or bicycle fatal accidents. The study will discuss primarily the alcohol levels of drivers involved in these fatal accidents (including those with no blood alcohol content or those who had not been drinking). The available data were qualified as follows: first, only those fatal accidents in which the driver died in four hours or less of the time of accident were considered. The reason for this is that after this period of time, any blood alcohol test would not be considered to give meaningful results.⁶ Second, only the single vehicle fatal accidents were investigated, as this eliminates any opinion as to which driver was at fault, as often must be decided in a multi-vehicle accident. The reason for using only those drivers who died, as opposed to those who didn't die, is that if the driver was injured, the chance was that no alcohol test was made. If uninjured, it was not known how long after the accident the alcohol test was made. The drivers of the vehicles involved in these accidents

were classified into three basic categories for analysis purposes as follows:

Category A: Alcohol content unknown or not tested

B: Alcohol content taken, and within a range of .000 through .049 percent (referred to as lower group)

C: Alcohol content taken, and .050% or greater (referred to as higher group)

Based on a study conducted in Indiana,¹ it will be assumed for this study, that the probability of a driver being involved in an accident is no greater at blood alcohol contents up to .049% than if the content were .000 percent, and that at .05 percent and above, the driver will have had a higher probability of involvement in an accident. For each of the above categories, the following factors were investigated:

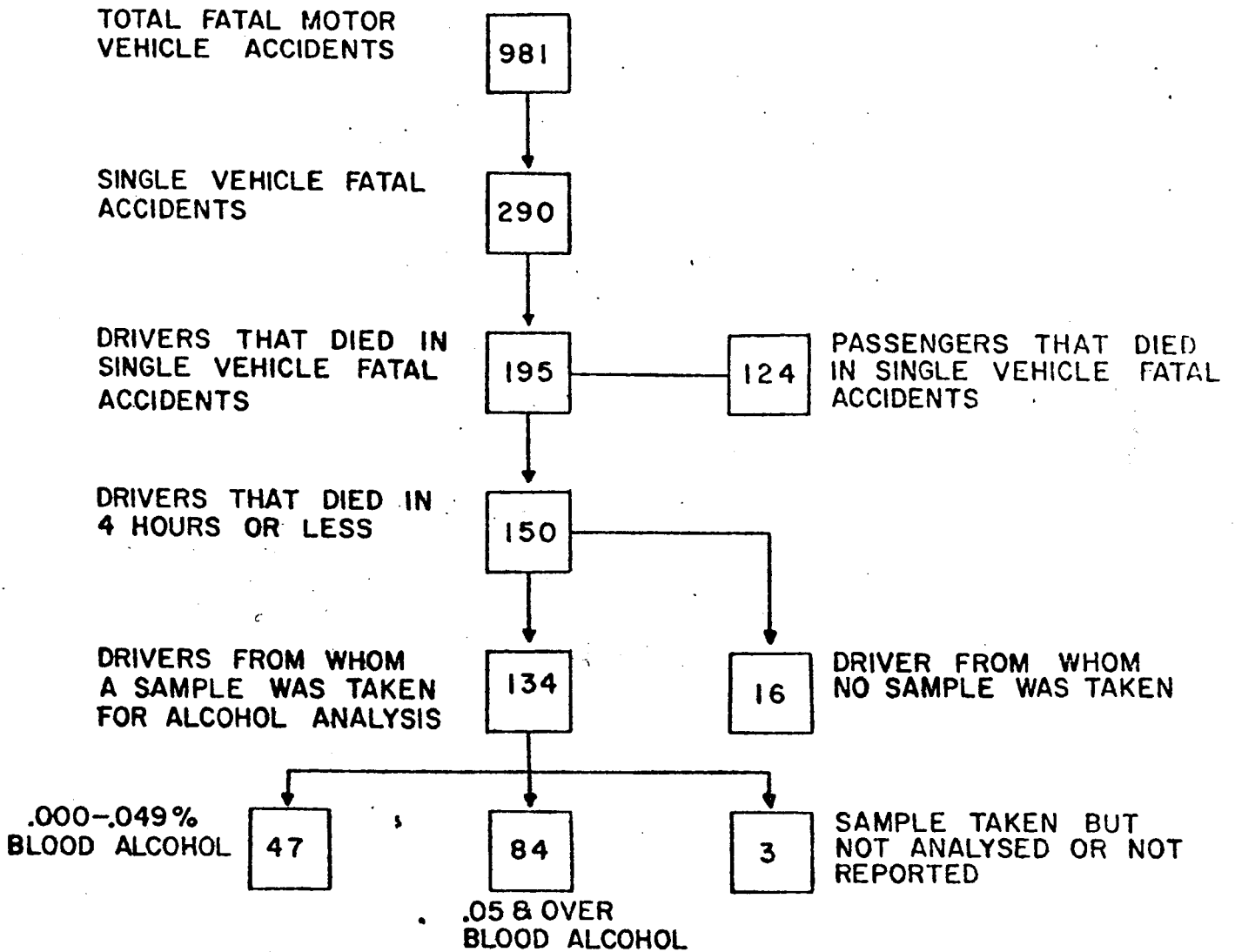
1. Day of week
2. Hour of day
3. Age of driver
4. Sex of driver
5. Weather and light conditions

None of the unknown group, although shown in the analysis, was considered.

Source of Data

The fatal accident data were obtained from the New Jersey Division of Motor Vehicles for the year of 1965 (January 1 through December 31). These reports included all fatal motor vehicle accidents occurring on all roads in New Jersey. There were 981 fatal motor vehicle accidents of all types, 290 were single vehicle accidents and 150 of these accidents were in the category analyzed (driver died within four hours of accident). The information concerning the method of alcohol analysis (shown in the Appendix) was obtained from the New Jersey State Police. Although there were two methods of obtaining the alcohol content of the driver (blood analysis and brain analysis), the alcohol grouping may be referred to as blood alcohol groups. Table 1 is a breakdown of fatal motor vehicle accidents in New Jersey. Of the 195 drivers who died in single vehicle accidents, 150 died within four hours of the accident, and 134 of these had a sample taken for analysis. Forty-seven drivers were in the lower group and 84 were in the higher group. Three had blood taken for analysis, but analysis was not performed, and 16 drivers who died within four hours of accident were not sampled. The above 19 drivers are classified in the "unknown" group. The mean blood alcohol content of the 47 drivers in the .000% to .049% group was .004%, with 37 drivers having .000% blood alcohol. The mean value of the

TABLE I
FATAL ACCIDENTS
NEW JERSEY-1965



<u>BLOOD ALCOHOL CONTENT</u>	<u>AVG.</u>	
.000- .049%	.004%	37 DRIVERS HAD .000%
.050% & OVER	.160%	RANGE FROM .050% TO .380%

blood alcohol content in the 84 drivers with .05% or above blood alcohol content was .16%, with a range of from .05% to .38%.

The following analysis deals with only those 150 accidents in which a driver died within four hours of the accident.

Blood Alcohol by Day of Week

Fig. 1 shows the frequency of single vehicle fatal accidents by day of week. There appears to be a higher frequency of this type accident on Friday, Saturday and Sunday, while Tuesdays appear to be the low point.

Fig. 2 shows the breakdown of frequency of accidents by blood alcohol grouping for day of week. The lower group appears to be fairly constant with day of week, whereas the higher group appears to have much the same trend as the total group with Friday, Saturday and Sunday being the highest days. The difference between one day and another is not large, however, for all days of week, except Wednesday, the frequency of accidents involving a driver in the higher group is greater than the lower group. It appears that if a driver dies in a single vehicle fatal accident, the probability of his having a blood alcohol content of .05% or above is greater than

**DRIVERS THAT DIED IN SINGLE
VEHICLE FATAL ACCIDENTS
(WITHIN 4 HOURS OF ACCIDENT)
BY DAY OF WEEK**

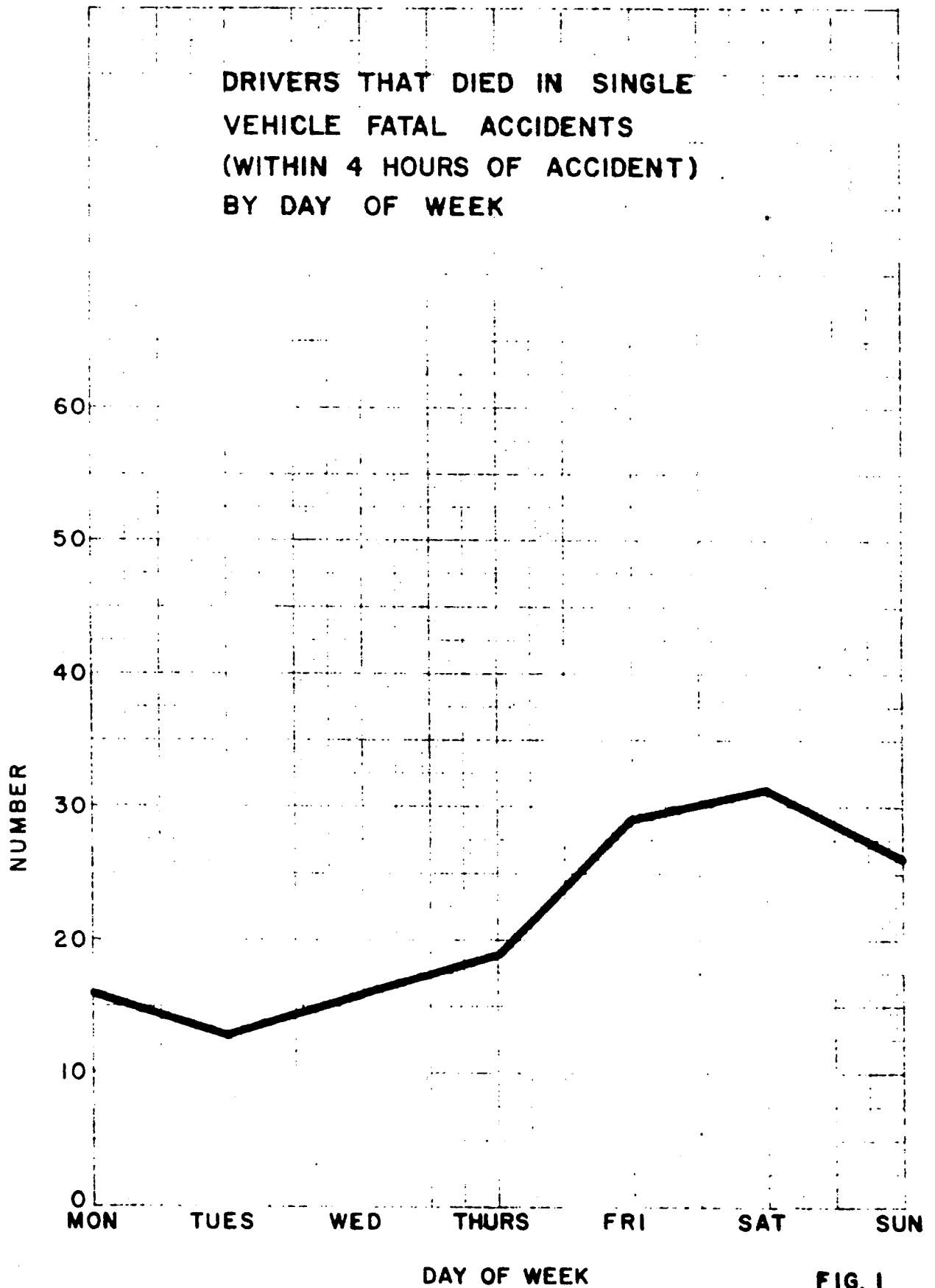


FIG. 1

DRIVERS THAT DIED IN SINGLE
VEHICLE FATAL ACCIDENTS
(WITHIN 4 HOURS OF ACCIDENT)
BY DAY OF WEEK FOR BLOOD
ALCOHOL CONTENT GROUPS

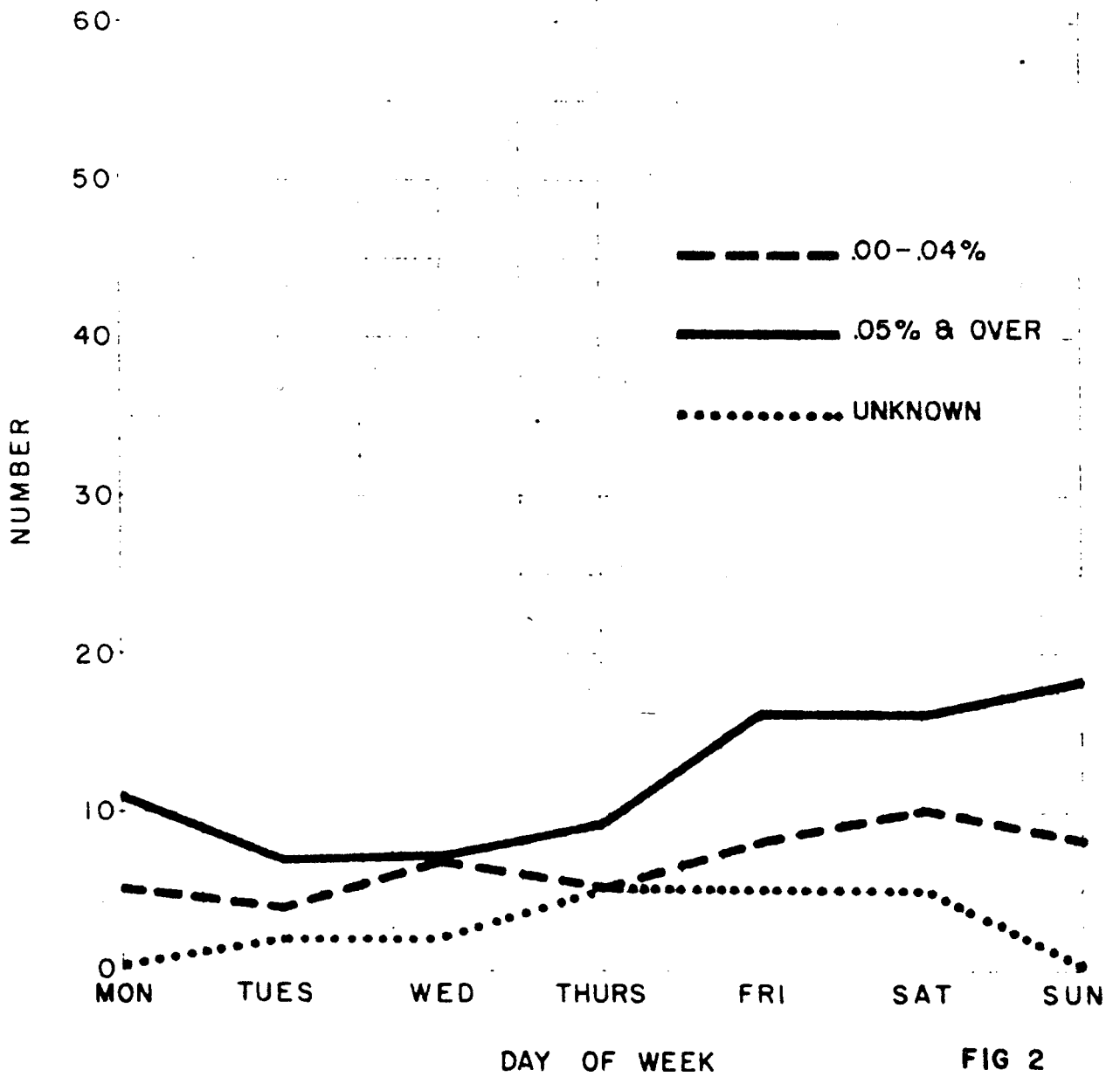


FIG 2

having a lower blood alcohol content, regardless of day of week on which the accident occurred, except Wednesday.

Blood Alcohol by Hour of Day

Fig. 3 shows a frequency of single vehicle fatal accidents by hour of day (regardless of day of week). The frequency distribution takes a "U" shape with highest frequencies during the 10-hour period of 6 p.m. to 4 a.m. with the highest frequency occurring between 2 a.m. and 4 a.m.

Fig. 4 shows the breakdown of single vehicle fatal accidents by blood alcohol groupings for hour of day. Here, as for the day of the week, the lower group is fairly constant with hour of day. The higher group follows much the same trend as the total single vehicle fatal accident group shown in Fig. 3, the high accident frequency hours being between 6 p.m. and 4 a.m. Here it appears that if a driver dies in a single vehicle accident, the probability of his having a blood alcohol content of .05% and above is greater than having a lower blood alcohol content between the hours of 6 p.m. and 4 a.m. Generally, the reverse would be true for other hours of the day.

Blood Alcohol by Driver Age

Fig. 5 shows the frequency of single vehicle fatal accidents by driver age. There appears to be a definite decrease

**DRIVERS THAT DIED IN SINGLE
VEHICLE FATAL ACCIDENTS
(WITHIN 4 HOURS OF ACCIDENT)
BY HOUR OF DAY**

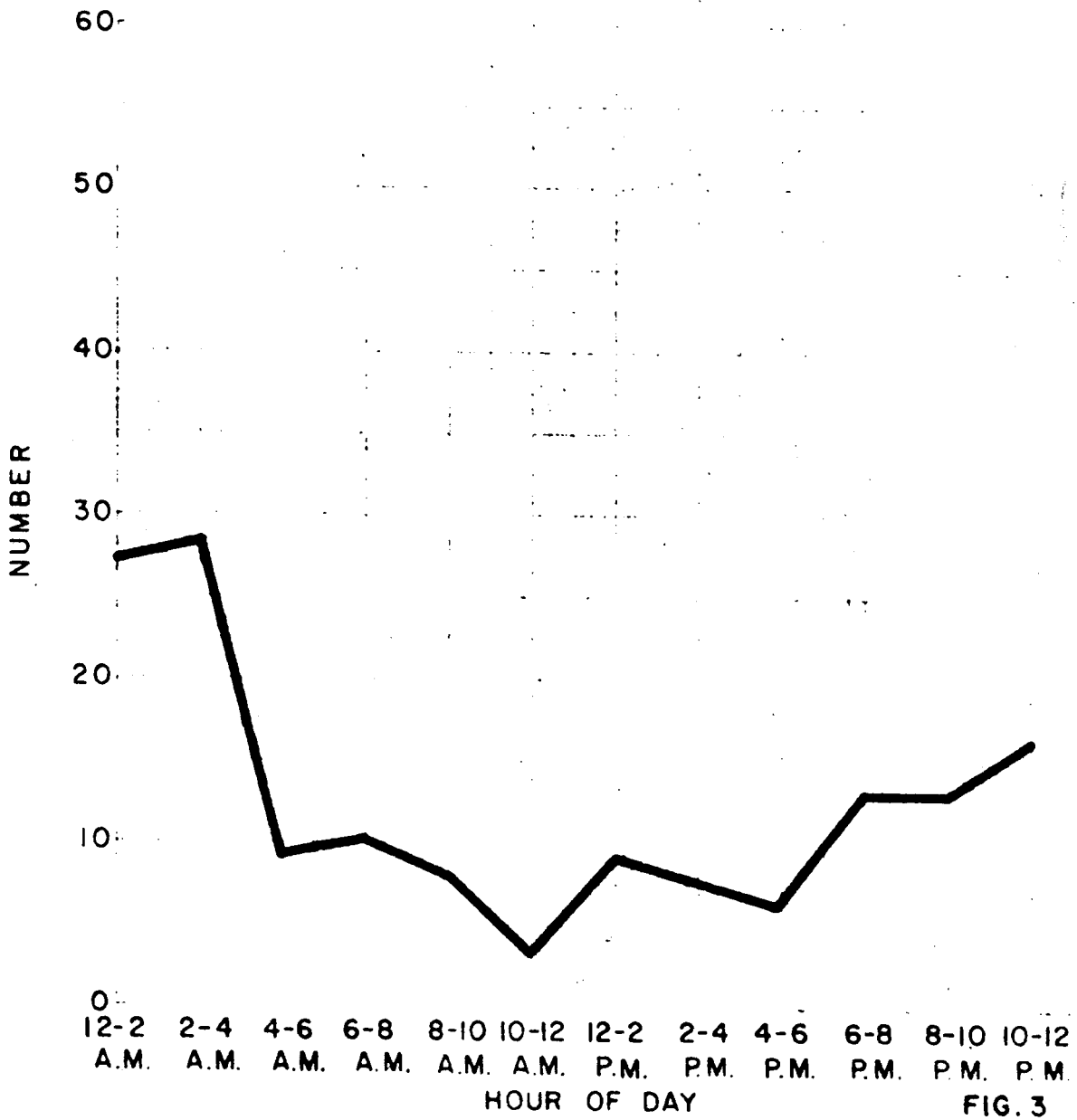


FIG. 3

DRIVERS THAT DIED IN SINGLE
 VEHICLE FATAL ACCIDENTS
 (WITHIN 4 HOURS OF ACCIDENT)
 BY HOUR OF DAY FOR BLOOD
 ALCOHOL CONTENT GROUPS

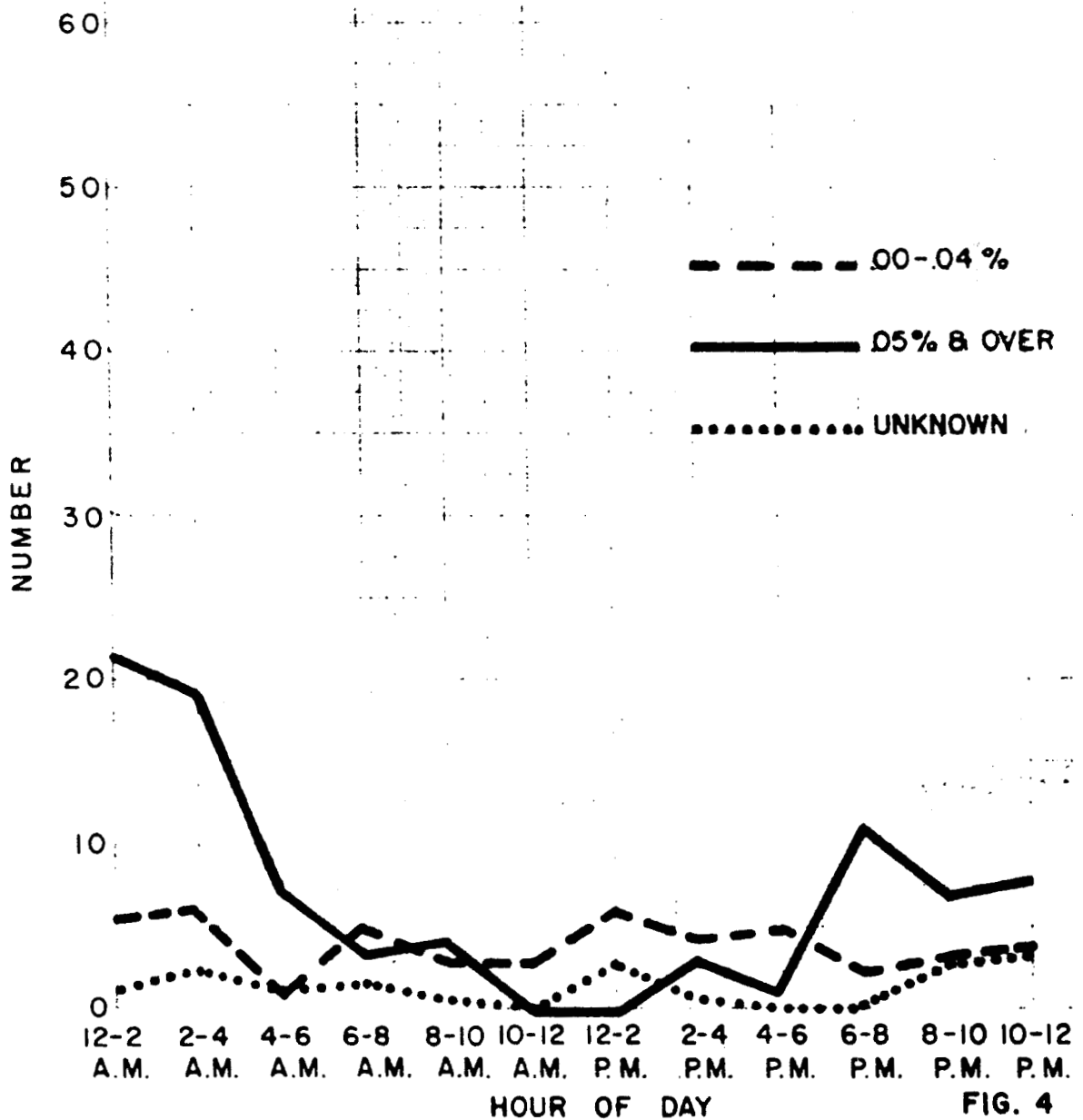


FIG. 4

in the frequency of these accidents with an increase in driver age. Fig. 6 shows a breakdown of frequency of accidents by blood alcohol groups for driver age (10 year groups). The frequency in the lower group appears high for the 17 to 26 and 47 to 56 age group, but is generally constant for other age groups. The .05% and above group has a high frequency of occurrence in the 17 to 26 age group and decreases with increase in age. It appears that if a driver dies in a single vehicle fatal accident, the probability of his having a blood alcohol content of .05% or above is greater than having a lower blood alcohol content if he is between the ages of 17 and 46, but not if he is of an age between 47 and 86.

Blood Alcohol Content by Sex of Driver

Fig. 7 shows the frequency of single vehicle fatal accidents by sex of driver. The male driver is involved in 6.5 times as many single vehicle fatal accidents as female drivers. Fig. 8 shows the frequency of single vehicle fatal accidents by sex of driver and blood alcohol group. The lower group has the ratio of 3.3 to 1 for male to female. The .05% and above group shows a 13 to 1 ratio of male to female frequency. It appears that the probability is greater that the driver in this type of accident will be a male and also if it is a male, the probability is greater that his blood alcohol content will be in the higher group.

**DRIVERS THAT DIED IN SINGLE
VEHICLE FATAL ACCIDENTS
(WITHIN 4 HOURS OF ACCIDENT)
BY DRIVER AGE**

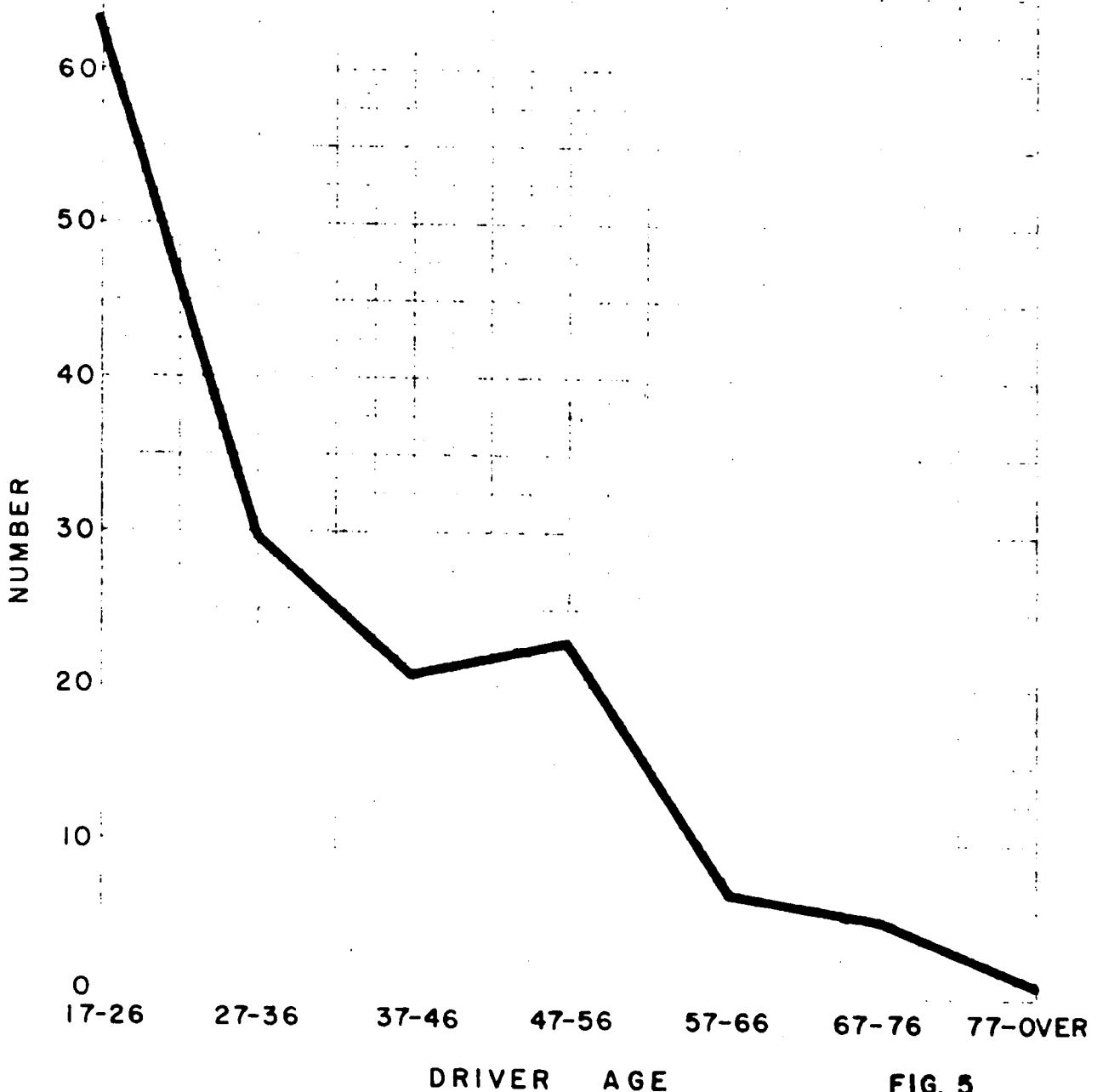


FIG. 5

DRIVERS THAT DIED IN SINGLE
VEHICLE FATAL ACCIDENTS
(WITHIN 4 HOURS OF ACCIDENT)
BY DRIVER AGE FOR BLOOD
ALCOHOL CONTENT GROUPS

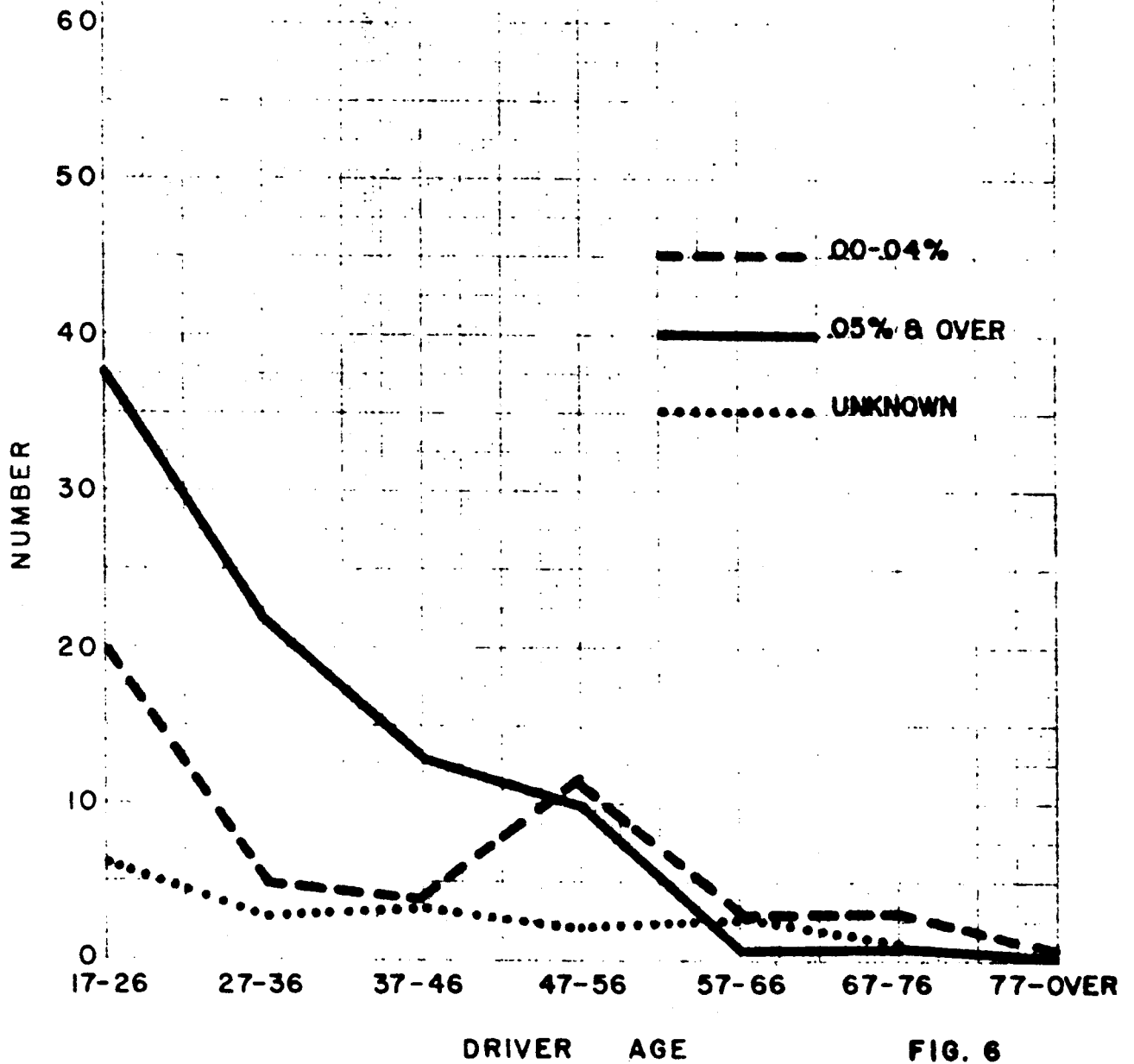


FIG. 6

DRIVERS THAT DIED IN SINGLE VEHICLE
FATAL ACCIDENTS (WITHIN 4 HOURS OF
ACCIDENT) BY SEX

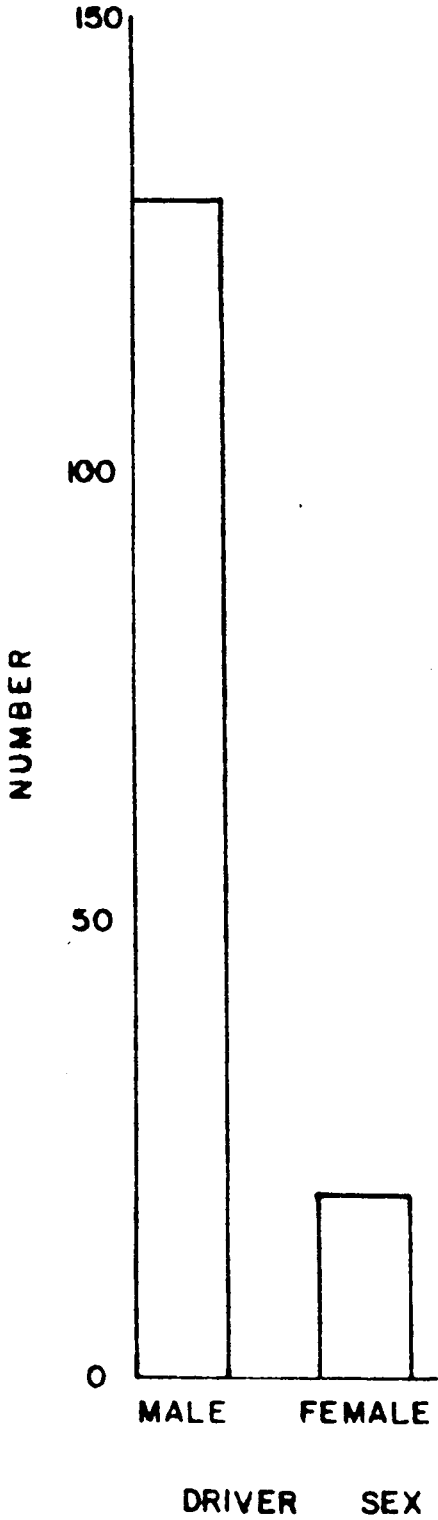
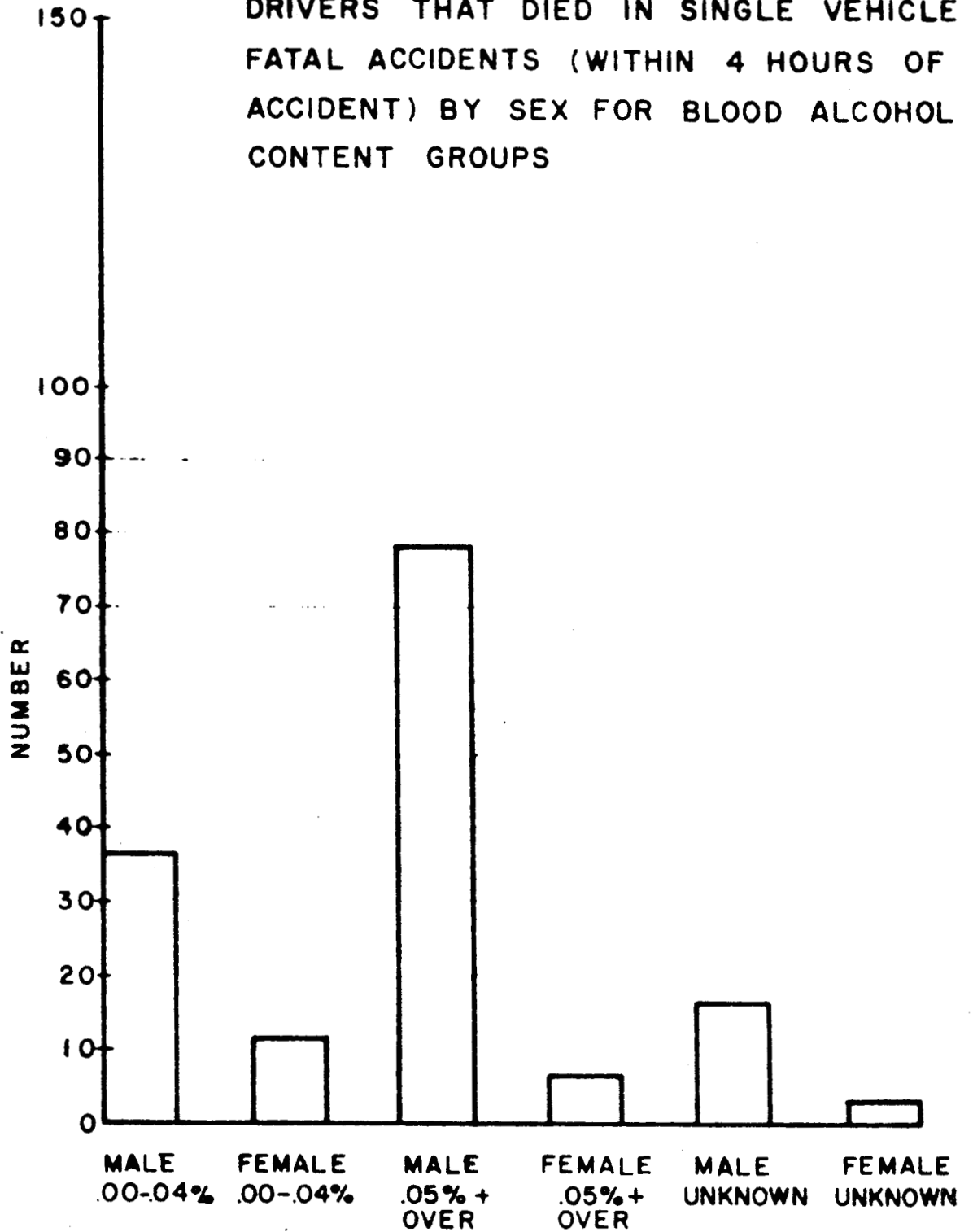


FIG. 7

DRIVERS THAT DIED IN SINGLE VEHICLE
FATAL ACCIDENTS (WITHIN 4 HOURS OF
ACCIDENT) BY SEX FOR BLOOD ALCOHOL
CONTENT GROUPS



DRIVER SEX AND BLOOD ALCOHOL CONTENT FIG. 8

Blood Alcohol by Weather and Light Conditions

Table 2 shows the frequency of single vehicle fatal accidents with weather and light conditions for the blood alcohol groups. For the lower group the frequency of clear-dry-daylight to rain-wet-daylight is 7.7 to 1, while clear-dry-dark to rain-wet-dark is 2.6 to 1. The ratio of light to dark, regardless of weather, is 1.4 to 1. The .05% and above group have a 6.5 to 1 ratio for clear-dry-daylight to rain-wet-daylight and a 7 to 1 ratio for clear-dry-dark to rain-wet-dark. The dark to light ratio, regardless of weather is 4.3 to 1 for this group.

Discussion

From the previous analysis it is inferred that drivers who die in single vehicle accidents more frequently have a blood alcohol content in the .05% or above group (64% of the drivers tested in this study were in this group). When the day of the week was analyzed in relation to alcohol content, it appeared that the so-called weekend days had a higher total of drivers killed in the .05% or above group than the other days. It would seem that due to our social drinking habits, there would be a greater number of drivers with a .05% or above blood alcohol content on the highways during the weekend days. To go further and look at the hours of the day in which

TABLE 2

DRIVERS THAT DIED IN SINGLE VEHICLE
 FATAL ACCIDENTS (WITHIN 4 HOURS OF
 ACCIDENT) BY WEATHER & LIGHT
 CONDITIONS FOR BLOOD ALCOHOL
 CONTENT GROUPS

	% BLOOD ALCOHOL CONTENT	
	.000-.049	.050 & OVER
CLEAR-DRY-DAYLIGHT	23 (49%)	13 (15%)
RAIN-WET DAYLIGHT	3 (6%)	2 (3%)
CLEAR-DRY-DARK	13 (28%)	56 (67%)
RAIN-WET-DARK	5 (11%)	8 (9%)
MISCELLANEOUS (SNOW, ETC.)	3 (6%)	5 (6%)
	<u>47 (100%)</u>	<u>84 (100%)</u>

the .05% and above group had the highest frequency, we see that they were the hours between 6 p.m. and 4 a.m. It may be true that here also is the time of day that the largest number of drivers in this group are on the highway. Also, looking at the age of the drivers in the .05% and above group, we see that the young to middle-aged driver is involved most frequently (17 to 46 year age group). We do not know enough about the percentage of drivers in the various age groups in the traffic stream and their blood alcohol content to speculate for this study.

No reliable statistics are available as to the percentage of male or female drivers in the traffic stream that has a blood alcohol content above .05%. Here many pro and con arguments can be made as to both why more males are involved and why more males, when involved, have .05% or above blood alcohol content. The analyses of weather and light conditions are logical if we assume it is dry more often than rainy (and it certainly is in New Jersey); also, if we assume that due to our social drinking habits, a greater number of drivers in the .05% and above group are on the highway during the hours of darkness.

Many rational or logical arguments may be made to show that alcohol is a contributing factor in single vehicle fatal

accidents. This report tends to support this conclusion. However, a precise conclusion of this report would be that alcohol (.05% and above) is an important factor in these accidents with prevalence that varies with day, hour, age, sex, and weather and light conditions.

It is hypothesized that the blood alcohol content of the driver is not only an important factor in accident occurrence, but a contributing factor and that from this study, its total contribution to accident occurrence varies with day, hour, age, sex, and weather and light conditions.

Conclusions that will be made from this study, since we have no information on exposure of the drinking driver in the traffic stream are:

1. A high percent of drivers in these accidents who died had a blood alcohol content of .05% or above, regardless of day of week on which the accident occurred
2. A high percent of drivers who died had a blood alcohol content of .05% or above, particularly during the hours of 6 p.m. to 4 a.m., while a lesser percentage was in the higher group in the other hours of the day

3. A higher percent of drivers who died had a blood alcohol content of .05% or above in the age groups of 17 to 46; the reverse is true of older drivers
4. A higher percent of drivers who died were male and of these, a higher percent had a blood alcohol content of .05% or above; the reverse is true for females
5. A higher percent of drivers who died had a blood alcohol content of .05% or above during clear, dry, dark conditions

Certain other conclusions or inferences may be made if we are willing to accept an assumption. If we accept the assumption that the percent of drivers in the traffic stream with blood alcohol content below .05% exceed the percent with blood alcohol content of .05% and above, regardless of day of week, hour of day, age, or sex,* then we may conclude that:

The percent of drivers killed in single vehicle fatal accidents with a .05% or above alcohol content composes a disproportionately high percent of the total drivers killed in single vehicle fatal accidents in relation to their percentages in the traffic stream, regardless of day of week, hour of day, sex or age.

* A study in Indiana¹ indicates that for the "control" group as sampled, using past accident time and location, the average percent in the traffic stream with .05% or above blood alcohol content is approximately 2 percent.

Naturally, these assumptions are subject to argument, but if we can accept them, it would appear logical that alcohol consumed by a driver in quantities to produce a blood alcohol content of .05% or above, is a contributing factor in single vehicle fatal accidents and varies in its importance with day, hour, age, sex, and weather and light conditions.

A P P E N D I X

ETHYL ALCOHOL ANALYSIS PROCEDURES USED BY THE
NEW JERSEY STATE POLICE

BLOOD ALCOHOL PROCEDURE

1. A blood sample is received in a tube, physical condition is noted, and a case number is assigned.
2. Five grams of the sample is weighed and analytically transferred to a 100 milliliter graduated cylinder. Then distilled water is added to adjust the volume to 70 ml.
3. Twenty cc. of a saturated solution of Picric Acid is added to precipitate the blood proteins. Once precipitation has been completed, distilled water is added to adjust the volume to 100 ml. and the cylinder is stoppered with a ground glass stopper.
4. The suspension is filtered and collected in a 100 ml. graduated cylinder.
5. Fifty cc. of the filtrate is distilled into a 25 ml. volumetric flask.
6. Two tubes, each containing 10 ml. concentrated Sulfuric acid and 10 ml. of N/10 Potassium Dichromate are prepared.
7. When cool, 10 ml. of distilled water is added to one tube (standard for the day) and 10 ml. of the blood distillate is added to the other tube.
8. Both tubes are placed in a boiling water bath.
9. The standard is analytically transferred to an Erlenmeyer flask using three 50 cc. washings with distilled water.

10. The solution is titrated Iodometrically with Sodium Thiosulfate, and the titration is continued to a "colorless" endpoint.
11. The percent blood alcohol is calculated as in the following example:

Standard for the day ... 41.0 cc. Sodium Thiosulfate used.

Unknown Blood Sample ... 37.0 cc. " " "

Difference ... 4.0 cc.

Combining weight of Alcohol $0.2302 \times 4.0 = 0.9208$

$0.9208 \div 10 = 0.092\%$ Blood Alcohol.

BRAIN ALCOHOL PROCEDURE

1. A brain sample when received is assigned a case number and its physical condition is noted.
2. Two hundred and fifty grams of ground tissue are weighed and put into a steam distillation flask and made slightly acid with Tartaric acid.
3. Two hundred and fifty cc. of the distillate is collected in an Erlenmeyer flask that contains Magnesium Carbonate.
4. The distillate is then filtered and redistilled into a flask containing Sodium Chloride and a 200 cc. volume is collected. Then this distillate is redistilled into a 100 ml. volumetric flask.
5. Two tubes, each with 10 ml. concentrated Sulfuric acid and 10 ml. of N/10 Potassium Dichromate are prepared.
6. When cool, 10 ml. of distilled water is added to one tube (Standard for the day) and an aliquot 0.5 ml. up to a 5.0 ml. of Brain Distillate is added to the other tube, until the solution turns a light brown.

7. Both tubes are then placed in a boiling water bath.
8. The standard is analytically transferred to an Erlenmeyer flask using three 50 cc. washings with distilled water.
9. The solution is titrated Iodometrically with Sodium Thiosulfate and the titration is continued to a "colorless" endpoint.
10. The percent brain alcohol is calculated as in the following example:

Standard for the day = 42.33 cc. sodium thiosulfate used.
Unknown sample = 36.2 cc. sodium thiosulfate used.
Difference = 6.1 cc. " " "

*Brain Distillate used = 0.5 cc.

Combining weight of alcohol $0.2302 \times 6.1 = 1.40422$

$1.40422 \div 1.25 = 1.123$

$1.123 \div 10 = .112\%$ Brain Alcohol

*Amount of Distillate
Added (250 gm. sample)

(100 ml. Volume)

* <u>0.5</u>	<u>1.25</u>
1.0	2.50
2.0	5.00
3.0	7.50
4.0	10.00
5.0	12.50

A. W. Roberts
D. W. Gwynn

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