ALCOHOL IN RELATION TO TRAFFIC ACCIDENTS

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SYNOPSIS

By means of the newly developed chemical tests, the amount of blood alcohol was determined for 270 drivers involved in personal injury accidents and for 1,750 drivers selected at random It was found that 47 per cent of the personal injury drivers had been drinking, that 12 per cent of the sample of general drivers had been drinking, and that only 2 per cent of the general sample had imbibed enough alcohol to impair their driving ability, which shows that drinking drivers are involved in accidents far out of proportion to their number in the general population of drivers

Equal percentages of drinking drivers were found in the accident group and in the general population group at a point near 0 5 part of alcohol per 1,000 parts of blood, indicating that above this amount susceptibility to accidents increases

The highest percentages of drinking drivers in the general population sample were found in the early morning hours and over the week ends

With the coming of the motor car, the importance of alcohol as a causative factor in accidents has become increasingly apparent Driving a motor car calls for quick thinking, rapid and coordinated operation of the controls of the car and accurate judgment With the increase in speed of motor cars, coupled with increased congestion on highways and streets, the problem of the drinking driver has become more and more acute

The most important aim of this study is to show at what concentration alcohol in the human system becomes a factor in accidents Data to be presented will show how increase in blood alcohol is related to increase in accident liability and will cover certain secondary factors such as extent of drinking, time of drinking, as to hour of the day, day of the week, and age and sex of drivers drinking

With the research value of newly developed chemical tests for alcohol in mind, the Evanston Police Department, the Northwestern University Traffic Institute, then known as the Northwestern University Traffic Officers Training School, the Evanston Hospital Association, the St Francis Hospital, the National Safety Council and the Chicago Motor Club, with Dr Herman A Heise as consultant, began on February 1, 1935, an investigation to determine the amount of drinking involved in accidents which resulted in hospitalization. Urinalyses for alcohol were made for 270 drivers over a period of three years. A representative cross section of all drivers involved in injury accidents was obtained

This experiment produced a figure which represented the percentage of drivers involved in serious accidents who had been drinking It was a first step in the determination of alcohol as a causal factor in accidents Not until the next step was taken, however, would this figure assume significance For example, if it was found that 46 per cent of drivers involved in personal injury accidents had been drinking and then it was found that 46 per cent of all drivers had been drinking, the alcohol consumed would seem to have no bearing on accidents However, if only 12 per cent of all drivers had been drinking and yet 46 per cent of the drivers involved in accidents had been drinking, it would appear that the drinking drivers were suffering more than their share of mishaps, and drinking would seem to be a causal factor in accidents

Therefore a study was initiated by the Northwestern University Traffic Institute for the purpose of determining the extent of drinking among drivers, of

obtaining, in other words, a "normal group." The "drunkometer," recently developed by Dr. R. N Harger of the Indiana University School of Medicine for use in court, made such a study possible With this device a rapid and accurate analysis for alcohol can be made In brief, the test is based on the bleaching of an acid solution of potassium permanganate by the alcohol in the alveolar air, which, of course, is part of the normal breath.

The sample to be tested was collected in a specially constructed balloon. The apparatus was set up in a trailer, thus allowing it to be readily moved from location to location throughout the area which approximated that in which the accidents of the first part of the study occurred. Tests of the breath of 1,750 subjects were made in the course of a week

A uniformed police officer stopped all cars in a purely chance order determined by the rate at which the experimenters doing the analyses could work As soon as the police officer had stopped the car, he immediately retired from the picture so that there would be no hesitancy on the part of the subject through fear of prosecution No attempt was made to explain the nature of the test to the drivers unless they showed active, intelligent interest in the test and testing procedure Newspaper publicity was avoided.

Because some difficulty was anticipated in gaining the cooperation of the drivers, a technic was very carefully worked out to obtain the samples of breath. Cooperation was readily gained from the drivers approached with the exception of 24, who refused to be tested

The balloon full of air was then taken to the trailer laboratory, where one of the testers immediately made a qualitative test on about 1,000 cc of the breath to determine whether or not alcohol was present. In the event that alcohol was present a quantitative analysis was made on a standard "drunkometer "

These tests resulted in the establishment of a control group giving an accurate picture of the amount of drinking among drivers in the general population. Analyses were made on the basis of time of day, day of week, sex, age and amount of alcohol present

The sample of the general population tested showed that about 12 per cent of all the drivers on the road had been drinking and that about 2 per cent of the drivers on the road had been drinking so much that their blood contained 1 part of alcohol to 1,000 parts of blood (or 0.1 per cent), or enough to impair their driving ability About one driver in every 250 had been drinking to such an extent that his blood contained 1 5 parts of alcohol to 1,000 parts of blood (or 0 15 per cent), enough to place him unquestionably under the influence of alcohol

The hospital figures show that 47 per cent of the drivers involved in personal injury accidents had been drinking, 25 per cent of the drivers so involved had over 1 part of alcohol to 1,000 parts of blood and 14 per cent had over 1 5 parts of alcohol to 1,000 parts of blood.

The relationship between the proportions of drivers in each blood alcohol group (1 5 parts per thousand, 1 4 parts per thousand and so on) for the general driving population compared with the accident group is the most significant contribution of this research. It will be discussed in detail later

The study of the accident group and the control group on the basis of the number of drivers drinking is very interesting A bi-modal curve with peak at about 6 p.m. and 12 midnight occurs in both groups The six o'clock peak is accounted for by the large volume of traffic on the highways at that time. The twelve o'clock peak is accounted for by both a relatively large volume of

traffic still on the roads and a relatively high percentage of drivers on the roads who had been drinking In other words, twelve midnight is a time at which a maximum of drinking driving occurs

When these same data are studied on a percentage basis a somewhat different picture is found. Here there is only a single peak which occurs at about two to four a m At this time, eighty per cent of the drivers in the accident group are drinking and fifty per cent of the drivers in the control group are drinking. That would mean four out of five drivers in accidents at two to four o'clock in the morning have been drinking to some extent and every other driver on the street has been drinking.

The expected occurs when these data are examined on the basis of day of the week Sunday is the peak day for drinking Sunday drinkers, of course, would include the late Saturday night group. The data show that 67 per cent of drivers involved in accidents on Sunday have been drinking and that 21 per cent of drivers on the road on Sunday have been drinking to some extent The curve for percentage of drivers drinking by day of the week reaches its peak early Sunday morning, drops off sharply Monday, and begins a gradual rise A peak is again reached over the period of the week-end, followed again by the sharp drop-off Monday

Unfortunately the ages of the drivers in the personal injury accident group were not secured. However, the results of an age tabulation in the control study are of interest. A definite peak showing over 28 per cent of drinking drivers is found at the age level from 25 to 30 which is followed by a gradual decline. The extreme age limits were not determined, but the lower limit was probably about 16 or 17 and several persons in the 70's were tested.

Little comment is needed on the significance of this curve. It follows quite closely the expected. It is an accurate indication of the relation between age and driving after drinking.

Since there are many more men drivers than women and women do most of their driving during the day, a much smaller percentage seemed to have been drinking However, when the figures are analyzed on the basis of percentage drinking by hour of the day there is little difference between the curve for men and that for women The peak reached by women at 4 and 5 a m is probably spurious and due to the small number of cases, as very few women proportionately were driving at that time

There are 33 times as many drivers whose blood contains 1 5 parts per thousand of alcohol in a group of drivers involved in personal injury accidents as in the general driving population There are 10 times as many whose blood contains 1 3 parts per thousand as there are in the general population Presented graphically, these are two points on a regularly descending curve that approaches a ratio of 1 to 1 at some point near 0 5 part per thousand The correlation between alcohol in the blood and accident expectancy was worked out on the basis of the data of this study at 0 76 (plus or minus 0.07).

The point in the alcohol content of the blood at which this 1 to 1 ratio is reached, that is, the point at which the same percentage of drivers appears in the personal injury accident group as in the general population, is of considerable significance. There has been much discussion of the relation between alcohol in the blood and intoxication, based both on observation and on the use of objective tests, in an attempt to set a point at which the drinking driver should be removed as potentially dangerous These data go far toward showing where this point occurs, for, as soon as more drinking drivers appear in the personal injury accident group than in the general popu-

lation, the ratio goes over 1 to 1 Alcohol can be considered as causing this increase in accidents over the expected From these data it would appear that this point is about 0 5 to 0 6 part of alcohol to 1,000 parts of blood Additional cases are needed here to obtain a smoother, more reliable, curve.

Thus a concomitant variability is demonstrated. It has been shown further that there are several times as many drinking drivers in accidents as in the general driving population But does a causal relationship exist? In other words, is this increase in alcohol actually the cause of the increased accidents?

A number of causes for accidents other than alcohol occur at the times when alcohol is most prevalent Among these are darkness, increased speeds, fatigue Data presented in the report "Alcohol in Relation to Traffic Accidents," Journal of the American Medical Association, September 17, 1938, volume 111, pages 1076-1085, show that these causes can be quite definitely discounted when compared to alcohol as a cause Unless experimental evidence is presented to prove otherwise, it seems logical to accept the fact that not speed, not darkness, not inherent proneness to accidents in drivers who drink, but rather alcohol, with its demonstrable effect is the major cause of a high proportion of personal injury accidents in the hours after midnight The part of these other factors, though, should not be forgotten Additional work is needed to determine their relation to the accident problem They unquestionably exist and in themselves do cause accidents. It must be further remembered, however, that alcohol will definitely heighten the effect of any or all of these factors Thus poor visibility because of darkness is even poorer when the driver has been drinking, increased speeds become more hazardous after alcohol has increased reaction time, drivers prone to accidents become more so after the depressive effects of alcohol release their inhibitions; the effects of fatigue are increased by drinking

If alcohol is a general, basic, underlying cause of personal injury accidents, two things would be expected.

1 As alcohol varies, personal injury accidents should vary. That is, an increase or decrease in the percentage of drinking drivers should be accompanied by an increase or decrease in the percentage of drivers involved in personal injury accidents

2 As alcohol varies, personal injury accidents involving alcohol should vary That is, an increase or decrease in the percentage of drinking drivers should be accompanied by an increase or decrease in the percentage of personal injury accidents in which one or more of the drivers had been drinking

The first statement is proved by a correlation between the percentage of drinking drivers by two hour periods with the percentage of drivers in personal injury accidents, corrected for traffic, of 0 68 plus or minus 0.08 In other words, it is demonstrated that there is a rather close correlation between drinking and personal injury accidents

The second statement is proved by a correlation between the percentage of drinking drivers by two hour periods and the percentage of drinking drivers involved in accidents of 0 73 plus or minus 0 07

One more significant fact pointing toward alcohol as a causative factor must be noted As personal injury accidents increase over the expected, drinking drivers increase similarly. It seems entirely logical to place the responsibility for this increase in accidents with alcohol A definite concomitant variability has certainly been demonstrated, and evidence has been given to show that a causal relationship must exist

CONCLUSIONS

1 The highest percentage of drinking drivers are present in the early morning hours and over the week-end

2 The largest number of drinking drivers are present in the early evening and over the week-end.

3 The peak age for drinking drivers is from 25 to 30

4 Women drink and drive as much as men when the number of women driving at various hours of the day is considered.

5 The percentage of drinking drivers in the general population varies as does the percentage of drinking drivers in the personal injury accident group but falls considerably lower at all times

6 The percentage or number of drivers involved in personal injury accidents varies as does the percentage or number of drinking drivers

7. As the blood alcohol content increases, the number of drivers appearing in the personal injury accident group increases out of all proportion to the number in the general driving population

8 As alcohol increases, accidents increase and at a rate somewhat proportionate to the increase in alcohol

9 Equal percentages of drinking drivers are found in the accident group and in the general population group at a point near 0 5 part of alcohol per thousand parts of blood, indicating that alcohol in that amount is not necessarily a significant cause of accidents

10 It has not yet been objectively and conclusively proved just how important a causative factor alcohol is, and because of the complexity of the whole accident problem, it may never be proved The data gathered in this study, however, point in one direction only They confirm a self-evident fact, that alcohol is a major cause of automobile accidents

These data, aside from the general interest, have made one important contribution They have shown the blood-alcohol point at which alcohol begins to become an accident causative factor, and show the curve for increased accident liability as alcohol concentrations increase

Data to date have shown that not all people, however, will be affected at the blood alcohol concentration at which accidents increase over the expected Additional research is needed to determine the percentage of the population showing a definite impairment at each blood alcohol point up to that where 100 per cent of the population will show definite impairment Coupled closely with this research concerning the individual should be an extension of the technique just presented so that results suggested by the data of this study will be verified and extended Such research should follow the lines of the study just presented Tests should be made, however, in a variety of areas, such as large cities, small cities, rural highways, and should be made in a number of different states in which a variety of liquor control systems are in use The study of individual tolerance is most important from the law enforcement standpoint Data should be gathered which will form the basis for present prosecution and for future legislation It is hoped that we may be able soon to test a large number of subjects with varying amounts of alcohol in their blood A variety of tests should be used A number of laboratory tests dealing with such things as reaction time field of vision, depth perception, etc , should be made on each individual Tests should also be made under actual driving situations The development of dual control automobiles would make it quite safe to take persons under the influence of alcohol, or suspected as being under the influence, into situations that might otherwise be unsafe Laboratory tests, coupled with tests which more closely follow the situation in question would allow the setting-up of a blood

alcohol point above which all individuals would be unquestionably under the influence.

It is hoped that if such a point were definitely and unquestionably established it might serve as the basis for legislation that would require the use of these chemical tests in court cases In such a case, then, a person would automatically be proved guilty if his blood alcohol concentration was above the proscribed limits Similar limits have been set: for example, in the case of automobile brakes, and have proven very effective. Chemical tests for intoxication have been proven reliable I can see no reason why they should not have the same wide application that tests of the motor vehicle now enjoy

Two valuable subsidiary effects would result from this research The extension of the method previously described where samples of the actual driving population were tested would give valuable evidence as to the best system of liquor control by the state as regards drinking driving. Locations could be chosen that were identical except for the factor of different systems of control. Tests to determine the amount of drinking driving in each of these locations would show the most effective system of control. A second very valuable effect would be the popularization of these chemical tests. Resultant publicity would have a beneficial effect in having these tests accepted by the general public It would allow for a thorough-going validation of the test and the data gathered should go far in molding public opinion to their acceptance in court

As speeds of motor cars increase, finer judgments are required for their operation Alcohol dulling these judgments as it does, is becoming an increasingly serious problem Through the use of carefully controlled research we may hope for a solution of this problem

DISCUSSION ON THE ALCOHOL PROBLEM

DR H M JOHNSON, *Tulane University*. Has any test been made to determine the amount of drinking a normal person must do before he is affected?

LIEUTENANT KREML Most of what we know about this has come to us from laboratory tests We think, however, that a laboratory type of test does not necessarily apply directly to the several operations of an automobile. It is for that reason that I suggested in the conclusion of this paper that it would be desirable to make some study of that point. If we could simulate driving conditions without bringing the driver up to some higher degree of efficiency than normal, the resulting data would be most reliable

QUESTION In order to obtain 0.5 parts of alcohol to 1000 parts of blood, how much would one have to imbibe?

LIEUTENANT KREML. It is so variable that it is difficult to give a general answer However, if the individual is in good health and has about a normal rate of metabolism, that would represent one to two ordinary cocktails

DOCTOR JOHNSON I think that in planning a study of the affects of moderate doses of alcohol on motor skills, one should be prepared for the finding that there is not a close correlation between the two. There are so many ways in which an individual can compensate and still give a normal performance in the test that he may maintain a normal performance long after he has really been impaired.

LIEUTENANT KREML: I am skeptical as I indicated when I read the paper. The use, for instance, of the dual control car is immediately apparent to the subject

and brings him up to a level of efficiency which he normally would not have

Unless the driver is very drunk, I think you will find that his performance is good nearly all the time So is a normal person's performance good nearly all the time, but the partially intoxicated driver will make occasional slips a little more frequently than the normal and make them at unfortunate times and places

QUESTION· Have the courts decided whether it is legal to take urine or breath tests? Do these require persons to testify against themselves?

LIEUTENANT KREML I refer you to a pamphlet by Mr. Fred Inbau of Northwestern University of Law School, on self-incrimination It became quite apparent from the decisions he cites that the taking of breath or urine for the purpose of making these tests did not amount to self-incrimination and the subject would, therefore, be deprived of the apparent defense of that constitutional provision.

MR. FRED E SWINEFORD, *Ohio Highway Department.* May a driver accused of drinking ask for a test to prove that he has not been drinking?

LIEUTENANT KREML. We feel that a chemical test is not only insurance for the innocent individual but is quite a reasonable assurance to the State and the public that the defendant if he has been drinking to the point of becoming incompetent and, therefore, intoxicated under that legal term, would be convicted The Indiana State Police have been using chemical tests for two years. They find that about 95 per cent of the persons presenting themselves for trial plead guilty when this kind of information has been secured