Blood Alcohol Levels in Hospitalized Victims of Traffic Accidents

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One phase of the action of alcohol in our modern society is its possible role as a causative agent in traffic accidents. This problem may be attacked by ascertaining the presence or absence of alcohol in the breath, blood or other body fluids after traffic accidents, and by establishing whether the incidence of cases with alcohol present is higher than the incidence of individuals with alcohol in non-accident cases.

One of the earliest studies performed to approach this problem was carried out by Hindmarsh and Linde (1934). They determined the blood alcohol level in all traffic accidents hospitalized at a city hospital in Stockholm, Sweden, during the period April 1, 1932 to March 31, 1933. They found that 44% of the hospitalized traffic accidents (i.e. 50 out of 113) had taken alcohol previous to the accident and showed a positive finding of blood alcohol level, and that two-thirds of this group (33 out of 50) had a blood alcohol level of 0.1 per cent or more.

Almost identical figures were established by Heise (1938), who determined breath alcohol by means of the Harger Drunkometer and found that among 270 drivers hospitalized in Evanston, Illinois, during the period 1935-1938, 46.6% had alcohol in their blood and that 13.6% showed a blood alcohol level of 0.15 per cent or higher (Holcomb 1938). By comparison with the incidence of cases with positive tests for breath alcohol in non-accident drivers Holcomb (1938), showed the greatly increased risk for a driver having taken alcohol to run into an accident involving hospitalization. At a blood alcohol level of 0.15 per cent or higher the risk was 55 times as high as that of a non-drinking driver (Holcomb 1938).

Recently two groups of research workers in Toronto, H. Ward Smith and Robert E. Popham in 1951, and G. H. W. Lucas, W. Kalow, B. A. Griffith and H. Ward Smith in 1953, by establishing the incidence of alcohol in accident drivers were able to show the role of alcohol in causing traffic accidents. H. Ward Smith and Robert E. Popham compared the incidence of accidents with alcohol in two groups of drivers viz., those where the “human factor” was responsible for “0-20%” of the accident, and those where the human factor was responsible for “80-100%” of the accident. G. H. W. Lucas and associates compared the incidence of
breath alcohol in accident and non-accident cases. Both groups of researchers were able to ascertain that alcohol intake increased the risk of a driver being involved in an accident. The fact that alcohol intake must be one of the many factors which may cause a traffic accident, is thus well established.

One question to be raised, and which has so far not yet been answered is: Does alcohol play the same role in every person, and is it a random occurrence when a person takes some alcohol and runs into or causes an accident? Or are certain individuals more liable to take alcohol and run into or cause an accident? This question can be put in statistical terms and does thus concern the problem whether persons who after having taken alcohol become involved in a traffic accident are a random sample of the population or differ with respect to one or more characteristics from the rest of the population, among other things with regard to alcohol habits.

In 1951 the Swedish Government published a large survey of the alcohol habits of the Swedish population, comprising a total of some 40,000 individuals studied. This survey provided among other things qualitative and quantitative aspects of the distribution of different alcohol habits among the population, ranging from alcohol addicts, abusers, excessive drinkers to moderate consumers, small consumers and abstainers, and methods and material became available to be used as a basis for other studies of this kind.


The scope of the present study on traffic accidents was to determine the incidence of alcohol intake and distribution of alcohol habits in traffic accidents, brought to a surgical outpatient clinic in Stockholm, Sweden, to determine whether the traffic accidents were a random sample of the general population, or differed with respect to one or the other characteristic, and to establish if there exists any relationship between alcohol habits and presence of alcohol in traffic accidents.

**MATERIAL**

Subjects for this study were all the male accident victims brought to the surgical outpatient clinic of Södersjukhuset one of the city hospitals of Stockholm, Sweden, during a five month period, November 1951 through March 1952.

During the period in study a total of 663 accidents were investigated; out of these 71 were traffic accidents, comprising drivers, passengers and pedestrians. The results of the study on traffic accidents only are given in this report.

**METHODS**

When an accident was brought to the clinic, and taken care of by the appropriate surgical means, one assistant specially assigned for this purpose made a thorough enquiry in order to provide a number of special data for this study.

These data concerned the kind of accident, the conditions under which the accident had occurred, the vehicle(s) involved in the case of a traffic accident, the kind of trauma suffered, possible hospitalization and length of time of treatment, possible previous alcohol intake or signs of
alcohol intoxication etc., the securing of blood alcohol samples and data concerning the sociological background including alcohol habits.

**Blood Alcohol:** Samples for blood alcohol determination were withdrawn in every case, irrespective if there were signs or not of alcohol intake. The samples were taken in triplicate in small glass capillaries (Widmark 1922) from a fingertip, and analyzed by the Widmark micro method (Widmark 1932) at the Pharmacological Laboratory, Karolinska Institute, Stockholm, Sweden. The method allows the determination of blood alcohol concentrations of 0.002-0.500 per cent,* in samples containing 0.10-0.15 ml. blood. The error of the method is 0.002 per cent alcohol in triplicate determinations (Goldberg 1953).

**Sociological Background:** The background with regard to alcohol habits, magnitude of alcohol intake, possible earlier offenses for drunkenness, filing with the local alcoholic boards or other alcoholic institutions, etc., was established through the records of the Central Liquor Control Board (Kungl. Kontrollstyrelsen) and the local State Monopoly Liquor Boards (Systembolagen). By means of these records it was possible to divide the cases in study into six different groups with regard to their alcohol habits: alcohol addicts (group 1), alcohol abusers (group 2), excessive drinkers (group 3), moderate users (group 4), small consumers (group 5), and abstainers (group 6). For details regarding this grouping the reader is referred to the official publication (in Swedish) of the 1944 Royal Swedish Governmental Com-

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*Definition: 0.1 per cent (\%) =1 per mille (0/00) or 1 per per 1000 =100 mg %.

**RESULTS**

**Distribution of Cases and Blood Alcohol Levels:** When determining the blood alcohol content in the samples withdrawn from every single case of traffic accident studied, it was found that a total of 23 individuals out of 71, or 32.4%, had alcohol in their blood. A blood alcohol concentration of 0.01 per cent was assumed as the lower level for a positive finding, the
upper limit of the Widmark micro-method being 0.008 per cent, as established on 200 cases not having taken alcohol (Goldberg 1953). Out of the 23 cases with alcohol in their blood, 3 or 13 per cent had a blood alcohol level below 0.08 per cent. alcohol, 10 or 43 per cent were below 0.15 per cent alcohol, and 13 or 57 per cent had more than 0.15 per cent of alcohol in their blood. This high incidence of alcohol in traffic accidents, 32.4 per cent, is a strong indication that alcohol must play a role in the occurrence of an accident.

Another indication of the close relation between alcohol intake and the occurrence of traffic accidents is the distribution of the traffic accidents on the different days of the week, and the incidence of cases with positive blood alcohol findings on each day. The results are illustrated in Fig. 1. The diagram shows that on Saturdays 70 per cent of all accidents had alcohol in their blood, against 33 per cent on Sundays and 22 to 29 per cent on week-days, thus an obvious correlation with regard to drinking habits.

The same was also true with regard to distribution on the hours of the days, as seen in Fig. 1 (right). Between 8.00 p.m. and 6.00 a.m! 50 per cent of all traffic accidents observed had alcohol in their blood, against 41 per cent from 4.00 p.m. to 8.00 p.m., and 25 per cent between 6.00 a.m. and 4.00 p.m.

These results are consistent with the distribution of cases of drunken driving, as reported later in this volume (L. Goldberg 1955), the peak of drunken driving appearing on Saturdays and in the late hours of the day.

**Alcohol Habits:** Next step in the analysis of the data was to survey the material with regard to alcohol habits. The results are found in Table 1. In column 2 of this table the distribution of different alcohol habits among a central group, the male population of Stockholm, is given, based on a study of 4183 males over 25 years of age, selected at random (S.O.U. 1953: 43). It is evident from the table that 0.9 per cent of the male population were alcohol addicts, 2.6 per cent were alcohol abusers, and 10 per cent were excessive drinkers. Thus a total of 13.7 per cent of the adult male population of Stockholm are registered and known as “mis-users” of alcohol, which is approximately one-eighth of the adult population.

The moderate users comprise 78.6 per cent, and the abstainers 7.7 per cent. The proportion of “mis-users” of alcohol in Stockholm, 13.7 per cent, is higher than the corresponding figure for the total male population of Sweden, this figure being 8.8 per cent (Goldberg 1955, Table 6). Those differences reflect the difference in incidence of alcoholism and excessive use in the urban population as contrasted to the rural population (S.O.U. 1951: 43).

The distribution of alcohol habits among the traffic accidents shows a completely different picture from that of the general population, as seen from columns 3 and 4 of Table 1. The “mis-users” of alcohol comprised a total of 32.5 per cent, of these 2.3 per cent were in group 1, 14 per cent in group 2, and 15.6 per cent in group 3, thus as one group three times as many as in the total population. The moderate users were 54 per cent, the small consumers 7 per cent and
Hospitalized traffic accidents in Sweden. Incidence of cases with blood alcohol out of total number of cases on different days of week (left) and hours of the day (right).

**FIGURE 1**
the abstainers were 4 per cent. One inference from these findings is that the group of traffic accidents is not a random sample of the total population, but shows an over-representation of alcohol abusers, thus showing the same tendency as seen among Swedish drivers convicted for drunken driving (see survey by L. Goldberg in this volume). Among the drunken drivers the alcohol addicts, abusers and excessive drinkers amounted to a total of 45 per cent, against a total of 8.8 per cent in the general population. When considering the different categories of “mis-users” of alcohol, the excessive drinkers, group 3, were found twice as often among traffic accidents as in the total population, and alcohol addicts and abusers (groups 1 plus 2) were found six times as often. These findings are also illustrated in Fig. 2, the diagram clearly bringing out the difference between the distribution of alcohol habits within the general population and within the group of traffic accidents in study.

### TABLE 1

*Distribution of Traffic Accidents in Stockholm with regard to Alcohol Habits in Comparison to General Population.*

<table>
<thead>
<tr>
<th>Alcohol Groups</th>
<th>Male Population in Stockholm (n = 4183)</th>
<th>Traffic Accident Victims</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men over 25 yrs.</td>
<td>No.</td>
</tr>
<tr>
<td>1. “Alcoholic Addicts” during the last 3 years. (Individuals taken care of according to § 1 of Swedish Alcohol Law.)</td>
<td>0.9</td>
<td>2</td>
</tr>
<tr>
<td>2. “Alcohol Abusers” (several severe offenses for drunkenness during the last 10 years).</td>
<td>2.6</td>
<td>10</td>
</tr>
<tr>
<td>3. “Excessive Drinkers” (One or two offenses for drunkenness during the last 10 years).</td>
<td>10.2</td>
<td>11</td>
</tr>
<tr>
<td>4. “Moderate Users”</td>
<td>73.9</td>
<td>39</td>
</tr>
<tr>
<td>5. “Moderate Users” (Small Consumers)</td>
<td>4.7</td>
<td>5</td>
</tr>
<tr>
<td>6. Alcohol Habits Unknown (Mostly abstainers)</td>
<td>7.7</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>71</td>
</tr>
</tbody>
</table>
FIGURE 2

Hospitalized traffic accidents in Sweden. Distribution of alcohol habits among Swedish male population over 25 years of age (left) and among traffic accidents (right).

Designation of groups, see Table 1.
Another comparison of drinking habits is given in Table 2. The distribution of different alcohol habits among traffic accidents not showing positive blood alcohol (Col. 3.) was compared with the distribution among traffic accidents with blood alcohol (Col. 5). The difference between the two groups is clearly brought out in the table. The distribution of the traffic accidents with no blood alcohol conforms to that of the general population, the figures not being significantly different from those for the general population as seen in Table 1, col. 2 (P. 0.2, tested by the $X^2$ method).

The cases with positive blood alcohol levels showed a different picture. Almost 70 per cent of them were alcohol addicts, abusers or excessive drinkers (col. 5). If the percentages are referred to the incidence of moderate consumers in both

### TABLE 2

**Distribution of Traffic Accidents with regard to Alcohol Habits.**  
**Comparison between Accidents with and without Alcohol Intake.**

<table>
<thead>
<tr>
<th>Alcohol Groups</th>
<th>Without Alcohol Intake</th>
<th>With Alcohol Intake</th>
<th>Ratio Alc. Intake Non-Alc. (Col. 5: Col. 3)</th>
<th>&quot;Overrepresentation&quot; (assuming group 4 to be unity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td><strong>1.</strong> &quot;Alcoholic Addicts&quot; (Individuals taken care of during the last 3 years) according to §1 of Swedish Alcohol Law.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>8.7</td>
</tr>
<tr>
<td><strong>2.</strong> &quot;Alcohol Abusers&quot; (Several severe offenses for drunkenness during last 10 years).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2.1</td>
<td>9</td>
<td>39.1</td>
</tr>
<tr>
<td><strong>3.</strong> &quot;Excessive Drinkers&quot; (One or two offenses for drunkenness during last 10 years).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>12.5</td>
<td>5</td>
<td>21.7</td>
</tr>
<tr>
<td><strong>4.</strong> &quot;Moderate Users&quot;</td>
<td>33</td>
<td>68.8</td>
<td>6</td>
<td>26.1</td>
</tr>
<tr>
<td><strong>5.</strong> &quot;Moderate Users&quot; (Small Consumers)</td>
<td>4</td>
<td>8.3</td>
<td>1</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>6.</strong> Alcohol Habits Unknown (Mostly Abstainers).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>48</td>
<td>100%</td>
<td>23</td>
<td>100%</td>
</tr>
</tbody>
</table>
groups, there was an over-representation of alcohol addicts and abusers of 6 times (col. 7), and of excessive drinkers of 4.6 times. These figures strongly indicate that the group of traffic accidents differs in many respects from the normal population.

Blood Alcohol Levels and Alcohol Habits: A survey of the blood alcohol levels found among the different individuals distributed on the different groups of alcohol habits is given in Table 3, and illustrated in Fig. 3. The results clearly indicate that there was a high incidence of blood alcohol among the alcohol addicts and abusers (group 1 plus 2), not less than 92 per cent had alcohol in their blood among these cases (Table 3, Col. 12), and 45 per cent of the excessive drinkers (group 3), as contrasted to 16 per cent of moderate users (groups 4 and 5).

If the three groups (1, 2 and 3) are correct, not less than 70 per cent on an average of the "mis-users" had taken alcohol before the accident.

Among the moderate drinkers only 16 per cent had alcohol in their blood at the time of the accident, and the percentage was no percent, as expected, among those listed as abstainers (Table 3, col. 12).

These figures are a clear indication that alcohol intake must play a role in the occurrence of traffic accidents, this factor increasing in importance, the more liable to excessive drinking or alcohol abuse the individual is.

This is also illustrated by an analysis of another factor, namely the actual blood alcohol levels found, as given in Fig. 4. The blood levels were divided into three groups: 0.01—0.08 per cent, 0.08—0.15 per cent and 0.15—0.30 per cent. The graph clearly brings out that high blood alcohol levels were predominant among alcohol addicts and abusers (groups 1 and 2), and to a somewhat smaller extent among excessive drinkers (group 3), whereas lower blood alcohol levels were observed in those individuals who were moderate drinkers. The actual percentages found are given in Table 3, columns 4, 6, 8, 10.

These results indicate that two out of three alcohol abusers who had a traffic accident had been drinking, and of those who had been drinking two out of three had more than 0.15 per cent alcohol in their blood.

If the incidence of moderate users among the traffic accidents at different blood alcohol levels is designated as 1, alcohol abusers and excessive drinkers with a blood alcohol level of 0.01—0.15 per cent were found six times as often as among moderate users, and a blood alcohol level of 0.15—0.30 per cent was found 45 times as often among alcohol abusers as among moderate drinkers.
TABLE 3
Blood Alcohol Levels in Traffic Accidents.

<table>
<thead>
<tr>
<th>Alcohol* Groups</th>
<th>Total No.</th>
<th>No Alcohol</th>
<th>Blood Alcohol Levels (in Per Cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Per Cent of Total</td>
<td>0.01-0.08% No.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1. &amp; 2. Alcoholic Addicts Alcoholic Abusers</td>
<td>12</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>3. Excessive Drinkers</td>
<td>11</td>
<td>6</td>
<td>55</td>
</tr>
<tr>
<td>4. Moderate Users</td>
<td>44</td>
<td>37</td>
<td>84</td>
</tr>
<tr>
<td>Abstainers</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>48</td>
<td>67.6</td>
</tr>
</tbody>
</table>

* For designations see Tables 1 and 2.
Cols. 4, 6, 8, 10, 12, Per Cent of all in that group, thus 1 out of 12 = 8%, 6 out of 11 = 55% etc.
Blood Alcohol Levels: 0.1 per cent = 1 per mille (0/00) = 1 part per 1,000 = 100 mg. per 100 cc (mg 0/0).

References
H. A. Heise, in Holcomb (1938).
S.O.U. 1951; 43 (Sociological Background and Drinking Habits of Swedish Population).
S.O.U. 1953; 20 (Alcohol and Road Traffic).
*S.O.U. — Statens Offentliga Utredningar ("Official Surveys of the Swedish Government").
Hospitalized traffic accidents in Sweden. Incidence of blood alcohol in traffic accidents with different alcohol habits. Designation of groups, see Table 1.

**FIGURE 3**

**FIGURE 4**

Hospitalized traffic accidents in Sweden. Distribution of different blood alcohol levels among cases with different alcohol habits.

**Blood alcohol levels:** 1 per mille (0/oo) = 1 part per 1,000 = 0.1 per cent (0/oo) = 100 mg per 100 cc (mg o/o).

Designation of groups, see Table 1.