Alcohol and Non-Motor-Vehicle Injuries

HAROLD W. DEMONE, Jr., Ph.D., and ELIZABETH H. KASEY, M.P.H.

THE CONTINUING toll of injuries, deaths, and economic losses resulting from accidents has stimulated interest in accident prevention research. A series of specific events highlights the development of this interest. In 1951 the Public Health Service, through its National Institutes of Health, established an accident research grants program. As an added stimulus in 1962, the Service's Division of Accident Prevention established a Research Grants Section. Through these and other research activities, the Division of Accident Prevention, the National Safety Council, and other organizations have intensified their studies of the medical, environmental, physical, and behavioral factors in accidental injuries.

Investigators concerned with human beings and their relation to the complex sequence of events leading to injury have considered many factors, including sensory thresholds; motor responses; medical, physical, and sociopsychological conditions; cognitive status; and emotional patterns and stability (*1*). As studies of human factors progressed, more attention was given to the use of alcohol and to substances consumed for stimulation and relief from pain. The relation of alcohol to accidents began to emerge as a potential problem. Although most of the studies have been related to alcohol and traffic accidents, the possible relation of alcohol to other accidents has been suggested repeatedly. The Conference on Alcohol and Accidental Injury, called by the Secretary of the Department of Health, Education, and Welfare in September 1965, indicated the national concern with this problem.

To obtain information on research relating to the use of alcohol in non-motor-vehicle accidents, a detailed, although not exhaustive, review of pertinent literature was made. Although there are discernible limitations in many of the studies, and adequate information on methodology and controls often is lacking, this paper is intended as a report of the research and not as a critical review.

Since the reported studies cover different countries, there is also the problem of semantics. For example, where the term "traffic accidents" appears in the literature, no definition is given as to whether this means pedestrians hit by automobiles, passengers in automobiles, or both. In referring to percent blood alcohol levels, 0.05 percent could mean either 0.05 grams of alcohol in 100 ml. of blood or 100 grams of blood. Often the author did not specify. To avoid errors in interpretation, the terminology used in the research was adhered to in reporting the literature.

To determine some parameters of the subject, the major areas describing the places of occurrence were chosen: industry, home, recreational areas, and public places. In addition, these major areas were divided into the "normal" use of alcohol and alcoholism. This pathological-nonpathological dichotomy should be viewed with some caution. For although it is likely

Dr. Demone is executive director, and Miss Kasey is health education associate, Medical Foundation, Inc., Boston, Mass. *Dr. Demone presented a version of this paper at the Secretary's Conference on Alcohol and Accidental Injury, Department of Health, Education, and Welfare, Washington, D.C., September 1965.*

that drinkers labeled pathological do have serious problems with drinking, we are not certain that the studies focusing on the general use of alcohol do not also include alcoholic persons. This is not an insignificant point. Any intervention program must recognize that alcohol is of special importance to the person suffering from alcoholism and that any control designed for the normal user of alcohol is likely to be of limited value for the pathological user of alcohol.

Industrial Injuries

Pathological use of alcohol. The role of alcoholism in industrial accidents has been explored in three countries: the United States, Germany, and France.

Age and sex differences were found in a U.S. study by Observer (pseudonym) and Maxwell (*2*), using a sample of 48 employees known to be problem drinkers and 2 randomly selected control groups matched for age, sex, length of service, job, and ethnic background. In general, the 32 men suffering from alcoholism lost more time as a result of accidents than did the 16 women with the same illness. Both groups were more likely to lose time than the control groups of nonalcoholics. But alcoholic employees over age 40 were not differentiated from their controls for industrial accidents. Under age 40 the problem drinkers experienced twice as many on-the-job accidents as the controls. For off-the-job accidents, the problem drinking men had a recorded total of 29 accidents and the problem drinking women, 15 accidents requiring an absence of 8 days or more. No off-the-job accidents were recorded for the controls.

In some ways the Observer and Maxwell investigation supplements the study of Trice (*3*). One hundred and sixty-three alcoholic persons, the majority members of Alcoholics Anonymous, were asked by checklist to review their accident history during the early and middle stages of the illness. In general, it appears that absenteeism due to accidents increased as the seriousness of alcoholism progressed. Trice concluded that in cost to management, however, accident rates ranked well below decreased job efficiency.

Jellinek (*4*) estimated that in the United States there were 1,370,000 male alcoholics, skilled and unskilled laborers in industrial pursuits, and that they accounted for 1,500 fatal accidents at work in 1943. He also estimated that they lost 32,400,000 working days because of acute intoxication and various ailments.

A rather interesting study was published in 1936 concerning 40,000 members of the Leipzig Insurance Fund (*5*) for the years 1887–1905. Chronic drinkers had an accident rate three times higher than all fund members and, similarly, lost three times as many days per year because of accidents than did all the members of the insurance fund.

Five studies were published in France after 1952 (*6–10*). The findings were essentially similar. The frequency and seriousness of industrial accidents and the mean number of days lost per accident were greater among alcoholic than nonalcoholic persons.

The most provocative studies were those of Morice (*8*) and Cavalié (*6*). Morice claimed in 1953 that chronic alcoholism was responsible for two of every three industrial accidents. Cavalié, in a study of public transport industry employees, found that industrial accidents were 19 times more frequent among alcoholic employees than among matched-pair nonalcoholic controls.

Nonpathological use of alcohol. For the nonpathological use of alcohol in relation to industrial accidents, a fourth country, Sweden, was added to the list. Studies in Sweden showed that between 1920 and 1929 about 44 percent of fatal accidents to Swedish seamen involved alcohol (*11*). Fifty percent of the accidents to Swedish sailors in 1920 occurred after alcohol had been consumed (*5*).

Of historical interest is a study in the United States, published in 1915. Reviewing Wisconsin and Washington State records on contested accident claims, Myers (*12*) concluded that intoxication is not a frequent cause of industrial accidents and therefore does not require serious consideration in accident prevention programs.

Two studies in Germany are also of "ancient" vintage: one published in 1922 (*13*) and one in 1934 (*14*). Both suggest some relation between the use of alcohol and deaths from industrial accidents. A study published in Germany in 1956 (*15*) found that 9 percent of 215 persons

dying from industrial accidents had blood alcohol levels at autopsy above 0.05 percent. By comparison, the percentage of persons dying from industrial accidents and showing a high blood alcohol level at autopsy was exceeded by that of persons who died from traffic accidents, general accidents among adults, suicide, and suddenly from natural causes.

One of two studies in Germany published in 1959 failed to provide useful information because of research difficulties (*16*). In the other (*17*), alcohol played an essential part in the admission of 7 percent of patients hospitalized because of industrial accidents.

Three studies on industrial injuries in France are available. One 1960 publication reported that all employees injured in 231 accidents occurring between 10 a.m. and 12 noon for 5 weeks in a French metallurgical plant employing 3,500 workers were given blood alcohol tests (*18*). Nonaccident controls, totaling 432 employees, were chosen at random. Thirty percent of the accident victims and 23 percent of the nonaccident controls had blood alcohol levels above 0.05 percent. Controlling for age, type of job, and number of previous accidents, the authors concluded that the comparative data indicated an 11 percent increase in accidents due to alcohol. Two studies published in 1956 (*19*) and 1960 (*20*) suggested that (*a*) alcohol plays a part in 20 percent of industrial accidents, and (*b*) about 10 percent of accidents occur after alcohol has been consumed.

Only 6 of 11 studies on the nonpathological use of alcohol in relation to industrial accidents were conducted after 1952.

Other Injuries

It is significant that although we wished to follow our a priori system in presenting the relation of alcohol to non-motor-vehicle accidents, the lack of available research findings made it impossible. A small number of studies have been conducted in the industrial setting, but major research on alcohol and accidents has been restricted to fatalities and injuries caused by motor vehicle accidents. Apart from these fields of study, research has been limited.

Nonfatal accidents other than motor vehicle and industry. A careful review of available literature revealed only six studies relating to alcohol and accidents other than motor vehicle or industry. Four studies were concerned with alcohol and accidents, and two with alcoholism and accidental injury. None of the six studies provides specific classified data on place of occurrence; for example, home, recreational area, or public place. Most of the studies considered sex as a variable, and three considered both age and sex. The methods for selection of samples varied. Only one study used a comparison group, controlled for age and presence or absence of alcoholism.

Pathological use of alcohol. Amann (*21*) reported a study of cerebra-cranial injury and alcoholism. Of 515 patients with head injuries treated at the surgical and psychiatric-neurological university clinics in Vienna in 1957, 63 percent were under the influence of alcohol, medically and clinically confirmed. Findings for 1957, 1958, and 1959 revealed that 20 to 25 percent of patients with severe head injuries were intoxicated. In less severe head-injury cases, 50 percent of the patients treated were intoxicated, and falling while intoxicated was the most common cause. Traffic accidents accounted for most of the more severe injuries.

Storby (*22*) reported in 1953 a study of accident frequency among 180 alcoholic patients. The 20-year hospital records of such patients under treatment at a hospital in Örebro, Sweden, were compared with records of 180 nonalcoholic patients of the same age and sex. Of the alcoholic patients, 35 percent had been admitted previously because of accidents, and 51 percent had been treated for minor accidents at a clinic. Comparative findings for the controls were 11 and 25 percent. Storby concluded that alcoholics experienced accidents more often in their free time and that their accidents were more serious and more often repeated. Fatal accidents were not included in this study.

Nonpathological use of alcohol. Besson and Redor (*23*) studied blood alcohol levels in 100 patients consecutively admitted with trauma to the surgical ward of Cochin Hospital, Paris, between March and July 1952. Tests of the 100 patients showed that 32 (26 men and 6 women) had more than 1 gram of alcohol per liter of blood, and that 10 of the 32 had between 2 and 3 grams of alcohol per liter of blood. Street

accidents were responsible for injuries to 12 of the 32 persons; fights in cafes, 9; and falls from stairs, 6. Two accidents occurred at work, and the reasons for three accidents were undetermined. The ages of the 26 men were evenly distributed between 20 and 60 years. All six women were over 40 years old, and two were over 60.

In a study by Verhaeghe and Schodet (*24*), published in 1959, the blood alcohol level was determined for all accident patients brought to the regional hospital in Lille and a suburban hospital in Saint Andre-les-Lille, France. Of 759 analyses, 391 showed no trace of alcohol. For 312 accident patients, including 35 women, the blood alcohol concentration was more than 1 gram per liter of blood. Among the men, 44 percent had concentrations above 1 gram; among women, 23 percent. Times of admission and blood alcohol levels were compared. Twenty percent of the nonalcohol accidents occurred between 10 a.m. and 12 noon. Twenty percent of the accidents to patients with alcohol in the blood occurred between 6 p.m. and 8 p.m., and 17 percent between 4 p.m. and 6 p.m.

Schumacher (*25*) reported a 3-year study (1920–22) of records in the accident department of the General Hospital in Vienna to determine the number of accidents caused directly or indirectly by indulgence in alcoholic beverages. The following conclusions were reported: Most of the accidents caused by alcohol occurred Saturday nights and Sundays, totaling as much as the other 5 days of the week. The most common causes, in order of importance, were fights, being run over by a vehicle, falls, and attempted suicide. When age is considered, more than 60 percent of the accidents caused by fights occurred in persons under 30 years old. Persons over 40 years old were more frequently victims of falls. The injuries caused by vehicles occurred chiefly to older persons; only 12 percent were below 30 years of age, and 40 percent were over 40 years of age. No age was given for attempted suicides. The overwhelming majority of all accidents involving alcohol occurred to men.

Mikheikin (*26*), in a study published in 1963, reported that 16 percent of all patients hospitalized for trauma in Leningrad were under the influence of alcohol; of the 16 percent, 91 percent were men. Of the traumas, 77 percent were from everyday causes, and 10 percent were incurred in traffic. The mortality of alcoholic patients was 2.9 percent, or 1.5 times greater than for nonalcoholic patients.

From our summarization of these studies in the literature, it is evident that we found no research specifically designed to determine systematically the relation between the use of alcohol and accidental injuries occurring in the home, in recreational areas, or in public places. Several of the studies pointed to a possible relation, especially the importance of falls as a cause of accidents in those patients found to have alcohol in the blood.

Other Research

In addition to studies of alcohol and nonmotor-vehicle accidents, the authors have included five studies concerned with alcohol and air-transport accidents and alcohol and violent deaths. These findings may have implications for future research even though violent deaths and suicides are not classified as accidents. Of significance could be violent deaths due to burns, drownings, and falls.

Alcohol and general aviation accidents. Harper and Albers (*27*) reported routine toxicological examinations of 158 private pilots involved in general aviation accidents constituting one-third of all such accidents in 1963 in the United States. In 35 percent of the 158 persons, an alcohol concentration of 15 mg. or more per 100 ml. of blood was found.

Wilentz and Brady (*28*), in their study of "violent deaths," reported in 1961 that 6 of 12 deaths from airplane accidents in New Jersey could have been described as "alcohol factor cases."

Violent deaths. We found three studies on the relation of alcohol to violent deaths: one each in Minnesota, New Jersey, and England. In the Minnesota study (*29*) in 1943, 38 percent of 94 cases handled by coroners showed that the victim had a blood alcohol level between 0.10 and 0.40 percent per 100 ml. of blood—sufficient alcohol to impair efficiency and contribute to the fatality. Similarly, for Middlesex County, N.J., Wilentz and Brady (*28*) studied 2,008 violent deaths between 1933 and 1959. Forty-

one percent were described as "alcohol factor cases," ranging from a low of 7 percent for industrial accidents to a high of 69 percent for deaths resulting from drowning.

The third study focused on suicide among alcoholic patients. Kessel and Grossman (*30*) first reviewed the literature and noted that in six previous studies the association between alcoholism and suicide was developed but poorly documented. In their study, published in England in 1961, they found that among 218 chronic alcoholics, 8 percent committed suicide within a few years after being discharged as inpatients.

Discussion

Alcohol and accidents are related. Evidence going back as far as 1887 makes this clear. One can hypothesize that the connection could be traced back further if the recent techniques of behavioral research had been available. As the techniques of behavioral research have been developed and refined, the complexities of the relation of alcohol and accidents have been revealed. Some differentiating variables cited in the studies are the pathological and nonpathological use of alcohol, age, sex, stage of alcoholism, type of industry, occupation, and location of accident. For example, some studies suggested that alcohol is not as important a factor in industrial accidents as it is in other accident locations because of the built-in social controls in the formal industrial setting.

Despite the inference of relative sophistication that could be derived from the previous statement, it is clear that more reliable information is needed. Data from the reported studies tend to be scanty and scattered and varying in quality and quantity. Although some knowledge of the relation of alcohol to industrial accidents could be gained from the research, the status of such information on accidents occurring at home or in recreational areas or public places is vague.

As noted in our review, control samples were seldom built into the research design. For adequate controls, one would need not only information on the persons involved in alcohol-related and nonalcohol-related accidents but also information on the persons similarly exposed but not involved in an accident.

The many limitations in the reported studies and the stress on clinical investigation lend support for major epidemiologic research. As public health researchers, we are hesitant at this time to endorse the development of large-scale preventive programs. Present data do not yet supply us with clear directions. Research and demonstration programs, carefully designed and with built-in methods for evaluation, could, however, be given highest priority. From the standpoint of general safety, the industrial safety engineer and the physician will need to continue taking reasonable steps that tend to decrease the frequency and level of alcohol among persons exposed to hazardous situations.

Summary

The Accident Prevention Division of the Public Health Service, the National Safety Council, and many other organizations have intensified accident prevention research in conjunction with the use of alcohol. Increasingly, the relation of alcohol to accidents has been questioned.

To obtain information on research relating to the use of alcohol in non-motor-vehicle accidents, a detailed, although not exhaustive, review of pertinent literature was made. The relation of alcoholism to industrial accidents in three countries, the United States, Germany, and France, was explored. Although study methodologies varied, the major conclusions were that the frequency and seriousness of industrial accidents and the mean number of days lost per accident are greater among alcoholic than nonalcoholic persons.

Only 6 of 11 studies on the nonpathological use of alcohol in relation to industrial accidents were conducted after 1952. Except for one U.S. study conducted in 1915, the consensus was that a definite relation exists between the use of alcohol and industrial accidents, although the exact degree and extent have not been determined.

Information on the relation of alcohol to nonfatal accidents other than motor vehicle or industrial accidents is seriously lacking. Several general studies have been reported concerning alcohol and accidents and alcoholism and accidental injury. None of the studies provide

specific data on place of occurrence. Studies of the relation of alcohol to aviation accidents and violent deaths also have been reported.

Two facts stand out clearly: (*a*) research on the relation of alcohol to accidents outside the parameters of motor vehicle or industrial settings is limited, and (*b*) well-designed, large-scale research to determine the relation of alcohol to non-motor-vehicle accidents is urgently needed.

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