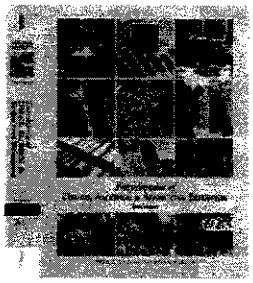

Topic overview

Driving, Alcohol, and Drugs

Encyclopedia of Drugs, Alcohol & Addictive Behavior

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Full Text:

Driving, Alcohol, and Drugs

Injuries, especially from motor vehicle collisions, are the leading cause of death for individuals under age 44. The presence of alcohol is the factor most frequently associated with fatalities in vehicle crashes, drownings, falls, and fire, according to the U.S. Department of Health and Human Services (1987). In the first report of the U.S. Department of Transportation to Congress on traffic safety and alcohol (in 1968), it was concluded that more than 50 percent of fatal traffic collisions and 33 percent of serious-injury traffic collisions were alcohol-related.

EARLY STUDIES AND SUCCESSES

Although the association between alcohol consumption and traffic accidents had been recognized by the beginning of the twentieth century, the magnitude of the problem did not capture public attention until the 1970s, when public tolerance of driving under the influence of alcohol (DUI) decreased sharply. This shift in attitude, combined with increased legal countermeasures, resulted in a significant decline in alcohol-related traffic fatalities (among drivers, passengers, pedestrians, etc.) from a high of 60 percent in 1982 to 40 percent by 1997 of traffic fatalities with victims who had alcohol present. Similarly, the proportion of alcohol-involved drivers in traffic fatalities declined from 41 percent in 1982 to 24 percent in 1997, according to the Department of Transportation's *Traffic Safety Facts 2005.*

Unfortunately, there has been a halt in this decline since 1997, and little progress in reducing alcohol-related accidents and fatalities occurred between the mid-1990s and the late 2000s. This has been reflected not only in the U.S. data but throughout the majority of industrialized nations. Thus, alcohol still remains the single largest factor in traffic fatalities and serious injuries.

BLOOD ALCOHOL CONCENTRATION AND DRIVING

Voas and colleagues (1998) compared the relative frequency of driving under the influence of alcohol in three U.S. nationwide surveys, done in 1973, 1986, and 1996 on weekend nights. Drivers were stopped at random and asked to provide breath samples for alcohol testing. The blood alcohol concentrations (BACs) from the three surveys were compared regarding time, day, gender, age, ethnicity, geographical region, and other factors. Across nearly all population subgroups, the presence of alcohol in nighttime weekend drivers dropped from 36 percent in 1973 to 26 percent in 1986, and then to 17 percent in 1996. However, although the percent of decline for drivers with BACs below 0.10 percent was 54 percent from 1973 to 1996, there was only a 45 percent decline in drivers with over 0.10 percent BAC.

Epidemiological studies have compared the BACs of collision-involved drivers with those of randomly selected drivers passing the collision site at similar times. These studies have demonstrated that the probability of a crash increases with any departure from zero BAC, and that it increases exponentially with increasing BAC levels. By the time BAC levels exceed 0.20 percent (200 mg/100 mL), the probability of a collision increases more than 100 times, or 10,000 percent.

Most areas of human behavior are eventually impaired by increasing alcohol levels. However, the examination of alcohol-related collision data from governmental investigations and police collision reports suggests that information-processing errors are common in the majority of alcohol-related traffic collisions. Information-processing deficits include impairment of attention, visual search, and perception. The second largest category of errors involves errors in judgment, such as speed selection. Failure to control a car because of decreasing motor skills remains a distant third cause of crashes, despite the popular assumption that links driving impairment with the appearance of intoxication and motor incapacitation.

The results observed in epidemiological survey studies are supported by numerous experimental studies in which driver behavior was examined under controlled conditions. Such studies may examine one or two driving relevant behaviors in laboratories, or they may be more complex studies of driving-related behavior using driving simulators or closed-course driving situations that preserve the safety of the driver.

AREAS OF IMPAIRMENT

Moskowitz and Robinson (1988) reviewed 177 experimental studies of alcohol's effects on driving-related behaviors that met criteria of scientific merit. The behavior found to be most affected by alcohol was divided attention, with impairment seen even at alcohol levels below 0.02 percent (20mg/100mL). Divided-attention tasks involve simultaneously monitoring and responding to more than one source of information, which is characteristic of many complex man-machine interactions, such as driving and flying. While operating a vehicle, drivers under the influence of alcohol frequently fail to detect significant potential threats in the environment.

Similarly, studies have indicated that information processing and perception are affected at low BAC levels. Tracking, which is analogous to car-control functions such as maintaining a heading and lane position, has been shown to be impaired at low BACs when performed simultaneously with other functions in divided-attention situations, though this ability is less impaired when the tracking task is performed by itself. Complex reaction-time tasks involving several competing stimuli and responses are impaired at low BACs, whereas simple reaction-time tasks requiring little information processing are more resistant to the effects of alcohol.

Studies of psychomotor skills in driving simulators and closed-course driving studies have shown considerable variation in the BAC levels at which impairment appears. These variations are likely explained by the differences in information-processing requirements among these varied tasks. The

Moskowitz and Robinson review concluded that there is no minimum threshold for alcohol's impairment of complex human-machine tasks. Thus, any reliable measure of alcohol in the human system produces some impairment.

Other areas that have been suggested as leading to alcohol-related accidents include poor judgment and violent and aggressive behavior. Both laboratory studies and epidemiological data, such as the incidents of alcohol in violence, have provided evidence that the effects of alcohol on aggression are significant. On the other hand, because of the difficulties in modeling the behavior, few studies have been performed in the laboratory on the effect of alcohol on judgment. Nonetheless, laboratory studies have indicated significant impairment at low BAC levels, and epidemiological studies have shown increased crash frequency at BAC levels below those at which the majority of the population would exhibit symptoms of intoxication, such as slurred speech and unsteady gait. Thus, the absence of signs of intoxication is not evidence that a driver is capable of operating a motor vehicle or other machinery safely.

In 2000, Moskowitz and Fiorentino updated Moskowitz and Robinson's 1988 report with a review of an additional 112 studies published from 1981 to 1997. Although the main conclusions of the 1988 report were confirmed, this review found more frequent reports of impairments at very low alcohol levels, reflecting improvements in the sensitivity and reliability of scientific investigation. Moreover, new behavioral areas are being explored, such as the tendency to fall asleep at the wheel, which increases significantly even at low BAC levels.

OTHER DRUGS

The major involvement of alcohol in traffic accidents and other injuries is well documented. However, it is a bit more difficult to draw conclusions about the role of drugs other than alcohol in traffic safety. Although laboratory studies on the effects of many drugs are similar to alcohol in demonstrating the impairment of performance skills, there are difficulties in executing epidemiological studies on the effects of drugs in driving. For example, few non-crash-involved drivers volunteer to provide blood samples so that their drug levels can be compared with blood samples obtained from collision victims. This makes it difficult to perform studies comparing blood-drug levels.

While studies have been completed in hospitals comparing blood-drug levels in trauma patients involved in driving collisions with blood-drug samples from volunteers who were in the hospital for

other reasons, serious questions arise regarding the representativeness of the control group. Another problem in relating drug use to vehicle crashes has been the difficulty of evaluating the behavioral significance of blood-drug levels. Unlike alcohol, where levels in venous blood samples or breath samples are essentially equivalent to those from blood in the brain (the site of drug action), for most other drugs there is a complex relationship between blood level and the magnitude of behavioral impairment. Many drugs remain present in the blood for weeks beyond any period in which behavioral effects may be observed. In other cases, drug levels in the blood drop extremely rapidly and become difficult to detect, while behavioral impairment remains. Thus, many epidemiological studies of drugs and driving report the presence of the drug rather than the level of drug concentration.

One technique to circumvent control-group problems has been to assign responsibility or non-responsibility to crash-involved drivers, and to then correlate the presence of drugs with the frequency of crash responsibility. Within the constraints of these epidemiological studies, researchers have often concluded that tranquilizers, antihistamines, and antidepressants are overrepresented in crash-involved drivers. Terhune and colleagues (1992) examined the presence of drugs in blood specimens from 1,882 fatally injured drivers. Both illicit and prescription drugs were found in 18 percent of the fatalities, while marijuana was found in 6.7 percent, cocaine in 5.3 percent, tranquilizers in 2.9 percent, and amphetamines in 1.9 percent.

When crash responsibility was assigned and correlated with drug use, the small number of individuals in each separate drug classification made statistical significance difficult to obtain, despite the fact that several drug categories were associated with increased crash responsibility. Crash-responsibility rates did increase significantly as the number of drugs in the driver increased. Many of the drug users in the Terhune study used several drugs simultaneously, and these drivers had the highest collision rates. Alcohol, meanwhile, was found in 52 percent of the fatalities, with more than 90 percent of the drivers with BACs over 0.08 percent considered responsible for the crash.

MARIJUANA

Since the 1950s, the most frequently used illicit drug in the United States has been marijuana. Epidemiological studies have demonstrated that it is also the drug most frequently consumed by drivers. Bates and Blakely (1999) reviewed the epidemiolog-ical literature for marijuana's role in motor vehicle crashes. They concluded that there is no evidence marijuana alone increased either fatal or serious-injury crashes. However, the evidence is inconclusive whether the presence of marijuana in combination with alcohol increases fatalities or serious injuries over the number produced by alcohol alone. Nor was it possible to determine whether marijuana increases the rate of less serious vehicle crashes.

Baldock's 2007 review of the literature on marijuana and crash risk reached similar conclusions. The many methodological problems involved in obtaining blood samples from crash-involved drivers and from a comparable representative sample of control drivers led the author to conclude that no existing study was conclusive, and that the driving risk associated with marijuana "remains to be determined."

SKILLS PERFORMANCE

In contrast to the ambiguity of scientific information available from epidemiological sources about the role of drugs in causing collisions, numerous experimental studies have been performed to evaluate the effects of drugs on skills performance. Regulatory agencies in many countries have frequently required an evaluation of the side effects of prescription drugs on the performance of various skills, and several governments have supported studies of the effects of illicit and abused drugs on skills performance in the laboratory.

Thus, the evaluation of the effects of drugs on driving and other human-machine interactions has depended primarily on experimental studies in which changes in behavior can be observed as a function of differences in administered doses and the time after administration. However, no other drug has been evaluated in as extensive a range of behaviors as has alcohol. Nevertheless, many drugs have been studied with respect to some important variables required for driving.

The emphasis in these drug studies has tended to be on the evaluation of vision, attention, vigilance,

and psychomotor skills. Driving-simulator studies have also been done on occasion. The psychomotor skill most often examined has been some form of tracking. Reviewing this literature presents considerable difficulties, however, because there are so many differences between classes of drugs, as well as between individual drugs within the same drug classification. For example, many minor tranquilizers, especially benzodiazepines, have been shown to impair attention and tracking in a wide variety of studies. However, newer tranquilizers, such as buspirone, exhibit little evidence of impairment.

Conclusions about impairments in a drug category are likely to change due to the pressures exerted by the drug regulatory agencies on drug companies to develop medicines that do not impair skills performance. Most hypnotics exhibit residual skills impairment the day following use, but new drugs

have been introduced whose duration of effects is shorter, so there will be less residual impairment after awakening.

Another class of psychoactive drugs, the antidepressants, especially amitriptyline, has long been known to impair performance in a variety of skills. Again, recently introduced types of antidepressants do not produce the same degree of impairment. Although narcotic analgesics derived from opium (opiates) have been shown experimentally to lead to decreased alertness, chronic use produces considerable tolerance to some side effects, which may explain why epidemiological studies have not found consistent evidence of differences in crash rates between narcotic users and control groups. Moreover, patients maintained on a stabilized dosage of methadone, a synthesized narcotic, have shown little evidence of impairment in a wide variety of experimental and epidemiological studies.

Another category of drug that shows evidence of impairing skills performance in laboratory studies is the antihistamines, many of which produce impairment of performance accompanied by complaints of drowsiness and lack of alertness. Again, recent pharmacological advancements have produced antihistamine drugs which maintain antihistamine actions but have difficulty crossing the blood-brain barrier and thus produce little impairment. One such drug is loratadine (Claritin).

Of all the illicit drugs, marijuana has had the largest number of experimental studies performed to examine its effects. Many of these studies indicate that marijuana impairs coordination, tracking, perception, and vigilance. It has also been shown to impair performance in driving simulators and on-the-road studies. Yet, epidemiological studies have been inconclusive in demonstrating increased crash risk, perhaps due to the relatively brief duration of elevated blood THC levels or perhaps due to compensatory behaviors as observed in several simulator studies.

Although there has been concern over an increased use of stimulants such as amphetamines and cocaine among drivers, there is little experimental evidence demonstrating driving impairment with these drugs. On the contrary, most studies of these stimulants, as well as of caffeine, indicate an improvement in skills performance. However, with the chronic (long-term) use of stimulants, an increased dose must be taken as tolerance develops. Thus, the dose levels examined in the laboratory may not reflect those found among drivers. In addition, after the stimulation phase, a subsequent depressed phase occurs (called the "crash"), with increased drowsiness and lack of alertness. The stimulant drugs have not been well studied in relation to driving and this needs to be remedied. Further study is needed, both for acute (one-time) use and chronic use.

See also **Alcohol: Chemistry and Pharmacology; Benzo-diazepines; Blood Alcohol Concentration; Cocaine; Dose-Response Relationship; Dramshop Liability Laws; Driving Under the Influence (DUI); Marijuana (Cannabis); Minimum Drinking Age Laws; Mothers Against Drunk Driving (MADD); Opiates/Opioids; Psychomotor Effects of Alcohol and Drugs; Social Costs of Alcohol and Drug Abuse; Students Against Destructive Decisions (SADD).**

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