National Highway Traffic Safety Administration (NHTSA) Notes

Marijuana and Alcohol Combined Severely Impede Driving Performance
National Highway Traffic Safety Administration

Commentary: Drugged Driving—Different Spin on an Old Problem
B. Tilman Jolly, MD
Department of Emergency Medicine
The George Washington Medical Center
Washington, DC

Reprints not available from the editors.
47/1/105497

Marijuana and Alcohol Combined Severely Impede Driving Performance

[National Highway Traffic Safety Administration. Marijuana and alcohol combined severely impede driving performance. *Ann Emerg Med.* April 2000;35:398-399.]

A 1996 national survey of drug abuse in the United States shows that more than one quarter of the 166 million drivers age 16 and older occasionally drive under the influence of alcohol, marijuana, or both.[1] According to 2 recently released studies from the National Highway Traffic Safety Administration (NHTSA), alcohol remains the predominant drug in fatal crashes, but marijuana is the next drug most frequently found in crash-involved drivers. Alcohol and marijuana are often found together in drivers involved in motor vehicle crashes, and were shown in these studies to severely impede driving performance when used in combination.

The Institute for Human Psychopharmacology at Maastricht University in The Netherlands performed a series of studies for NHTSA to assess both the separate and combined effects of marijuana and alcohol on driving performance in real driving situations. In one study, 18 subjects between the ages of 20 and 28 who said they smoked marijuana and drank alcohol at least once a month participated in the study. They were all licensed drivers; half were male and half were female.

In this study, each participant received marijuana alone, alcohol alone, a combination of marijuana and alcohol, or placebos. There were 2 levels of Δ^9-tetrahydrocannabinol (THC), the primary psychoactive ingredient of marijuana, tested: a low dose at THC 100 μg/kg of body weight and a moderate dose at THC 200 μg/kg of body weight. A third test of marijuana placebo, containing marijuana leaf from which the THC had been removed, was also run. There were also 2 levels of alcohol tested: an initial alcohol dose sufficient to achieve a blood alcohol concentration (BAC) of approximately 0.07 g/dL and an alcohol-free placebo. Because alcohol concentration declines with time, booster doses of alcohol were given later in the test to sustain BACs around 0.04 g/dL during testing, well below the legal limit for drivers in the United States.

Drivers then participated in 2 on-road driving situations. The "Road Tracking Test" measured a driver's ability to maintain a constant speed of 62 mph (100 km/h) and a steady lateral position between the boundaries of the right traffic lane. The "Car Following Test" measured drivers' reaction times and ability to maintain a distance between vehicles while driving 164 feet (50 m) behind a vehicle that executed a series of alternating accelerations and decelerations. On separate evenings, participants smoked the marijuana or placebo, and drank the alcohol or placebo, and then waited 30 minutes to begin the driving tests. For each test, they drove two 25-mile long segments on real roads with real traffic 2 times, accompanied by a driving instructor in a vehicle equipped with separate dual controls.

Both levels of THC doses alone, and alcohol alone, significantly impaired performances on both road tests compared with the baseline (no alcohol, no marijuana). Performance deficits were minor after alcohol and the low THC dose, and moderate after the THC dose at 200 μg/kg of weight. Combining marijuana with alcohol, however, severely impaired performance, leading to decrements in performance as great as for driving with BACs at 0.09 and 0.14 g/dL, respectively.

Reaction time was measured. With neither THC nor alcohol, the test subjects' mean reaction time was 4.65 seconds. This is the time it takes for an unimpaired driver to *begin* to initiate a response. Reaction time increased to 6.33 seconds under the combined influence of alcohol and THC 200 μg//kg, a 36% performance decrement.

Because the test vehicles were traveling at 59 mph, the delayed reaction time meant that the vehicle traveled, on average, an additional 139 feet beyond the point where the subjects began to decelerate. Even the lower THC dose by itself retarded the subjects' mean reaction time by 0.9 seconds.

Another measure of impairment was the average headway, or distance maintained between the lead and following vehicles. In every dosing condition, the subjects exhibited a diminished ability to perceive and/or respond to changes in the relative velocities of other vehicles, and to adjust their own vehicle speed accordingly.

In the second study, 16 recreational marijuana users (both male and female) were treated with drugs or placebo in a balanced, 4-way, crossover, observer- and subject-blind design. Alcohol doses administered were sufficient to achieve BAC ratings of 0.05 g/dL. As with the previous study, subjects were also tested on roads within the city limits of Maastricht, and in this study visual search frequency (driver checking side streets) was measured by an eye movement–recording system mounted on the subjects' heads. General driving quality was also rated by a licensed driving instructor using a shortened version of the Royal Dutch Driving Proficiency Test.

Marijuana, even in low to moderate doses, negatively affects driving performance in real traffic situations. Although previous research on alcohol effects alone shows that alcohol at a BAC level of about 0.10 g/dL is far more impairing than low or moderate THC doses alone, marijuana does impair driving performance. Under marijuana's influence, drivers have reduced capacity to avoid collisions if confronted with the sudden need for evasive action. The effect of combining moderate doses of alcohol with moderate doses of marijuana resulted in dramatic performance decrements and levels of impairment, as great as observed when at 0.14 g/dL BAC alone.

The second study found that visual search frequency did not change for subjects treated with alcohol or marijuana alone, but driver performance dropped when the subjects were treated with a combination of both alcohol and marijuana. Driver performance on the proficiency test did not differ by treatments. This study concluded that the effects of low doses of THC or alcohol (BAC <0.05 g/dL) were minimal, but the effects were potentially dangerous for driving when taken in combination.

A copy of either report, "Marijuana, Alcohol and Actual Driving Performance" (DOT HS 808 939, 39 pages), or "Visual Search and Urban City Driving Under the Influence of Marijuana and Alcohol" (DOT HS 809, 020), may be obtained by writing to the National Highway Traffic Safety Administration, 400 Seventh Street, SW (NTS-21), Washington, DC 20590, or by sending a fax request to 202-493-2062.

1. Towansend TN, et al. Driving After Drug or Alcohol Use: Findings From the 1996 National Household Survey on Drug Abuse *(DHHS Publication No. (SMA) 99-3273). Washington, DC: US Department of Health and Human Services, and NHTSA, 1999.*

Commentary: Drugged Driving—Different Spin on an Old Problem

[Jolly BT. NHTSA Notes Commentary: Drugged driving—different spin on an old problem. *Ann Emerg Med.* April 2000;35:399-400.]

The current NHTSA reports document in a prospective controlled fashion the detrimental effects of marijuana and alcohol combined on driving performance.[1-3] The mention of marijuana evokes emotional responses of many kinds in our society. Many, including some prominent politicians, are in favor of legalization of this currently illegal substance. Others may favor use of marijuana for medical reasons. Others cite dangers inherent in the drug, along with an association with other drug use, as reasons to support continued treatment of marijuana as an illegal substance. While many things remain unclear, these reports make certain that marijuana has harmful effects on driving, and in ways that are very difficult to detect and prove in the real world.

We must congratulate the investigators for performing a difficult and well-designed study. The investigators went beyond inferences from retrospective data, and even beyond the easier use of driving simulators. Any investigator who has attempted to perform clinical trials can appreciate the difficulty of studying impaired drivers behind the wheel on a 25-mile drive. From this study, there can be no doubt that marijuana use impedes driving performance, and that the effect of combining alcohol with marijuana is even more dramatic. The physiologic problem is defined. Now what do we do about it?

The model for detecting and prosecuting impaired driving is represented by ethanol. Methods for detecting behavioral and task performance abnormalities are relatively well known. More helpful, specific blood alcohol levels are detectable by readily available tests. Although impairment increases with BAC, the increase in crash risk at successive BAC levels is less well defined. By contrast, specific behavioral abnormalities resulting from marijuana use and correlated with poor driving performance are less well defined. Unfortunately, this observational evidence is often all that the law enforcement officer can use, as there is no reliable and readily available laboratory marker for THC impairment as there is for alcohol.

Imagine that you are a police officer on a lonely night in a rural area. You pull over a car that has been weaving, following too closely, and exhibiting other erratic behaviors. When you ask the driver to get out of the car, he does so slowly and carefully, much like an overly cautious drunk. Your Breathalyzer registers zero, but his behavior is inconsistent with the Breathalyzer reading. You are sure that he is somehow impaired. Now imagine trying to prove this in court against a good lawyer.

For just this situation, many states have instituted Drug Evaluation and Classification (DEC) programs. Emergency physicians know from daily clinical experience that those impaired by drugs other than alcohol exhibit characteristic behaviors. Through the DEC programs, officers are trained to be Drug Recognition Experts (DREs). As a DRE, an officer can recognize these behaviors in a standardized way, and document the evidence in a manner that will stand up in court.

The DRE training is not easy. Officers complete 80 hours of classroom training plus supervised field experience. This training pays off, as officers are successful in identifying drug impairment and obtaining convictions for more than 90% of those charged with driving under the influence of drugs.

As with many traffic safety problems, our least experienced drivers may be most at risk. In 1996, Maine reported that 27.6% of its DRE evaluations were conducted on subjects younger than age 21. In the first 5 months of 1996, nearly 30% of DRE evaluations in New York were on subjects younger than age 21.

Where do we fit in? As community providers, emergency physicians can participate in coalitions with law enforcement to evaluate and solve local problems. Accurate data on the effects of drug-impaired driving are lacking. Improved methods for collecting emergency department (not just trauma center) data on injuries related to impaired driving are vital to moving policymakers toward improved intervention programs.

Impaired driving involves more than just alcohol. Whatever else may be true about marijuana, we know that its use, especially in combination with alcohol, impairs driving performance. For law enforcement officials, these are difficult arrests. Emergency care providers must recognize the problem and participate proactively in measures to address it.

1. *National Highway Traffic Safety Administration.* Marijuana, Alcohol and Actual Driving Performance *[DOT HS 808 939, July 1999].*

2. *National Highway Traffic Safety Administration.* Visual Search and Urban City Driving Under the Influence of Marijuana and Alcohol *[DOT HS 809 020]. Washington, DC: NHTSA, March 2000.*

3. *National Highway Traffic Safety Administration.* Presidential Initiative on Drugs, Driving and Youth: Recommendations from the Secretary of Transportation and the Director of National Drug Control Policy *[DOT HS 808 560, March 1997].*