# TECHNICAL NOTE

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# Drug and Alcohol Use in Fatally Injured Drivers in Washington State

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**ABSTRACT:** Blood and/or urine from fatally injured drivers in Washington State were collected and tested for the presence of drugs and alcohol. Drug and/or alcohol use was a factor in 52% of all fatalities. Among single vehicle accidents, alcohol use was a factor in 61% of cases versus 30% for multiple vehicle accidents. Drugs most commonly encountered were marijuana (11%), cocaine (3%), amphetamines (2%), together with a variety of depressant prescription medications. Trends noted included an association of depressant use with higher blood alcohol levels, while marijuana use was associated with lower blood alcohol levels. Marijuana use was noted to be most prominent in the 15–30 year age group, stimulant use in the 21–40 year old group, and prescription depressant use was more prevelant in the 45+ age group. Drug use demographics in this population are consistent with those noted in other jurisdictions.

**KEYWORDS:** forensic science, forensic toxicology, alcohol, drugs, fatality, death, driving, blood, urine

The use of psychoactive drugs is widespread, and their inevitable abuse by drivers is a particular concern because of the impact of these drugs on driving performance. Urine drug levels show only recent drug use rather than intoxication, while blood drug or alcohol levels can be used to more reliably estimate the presence and extent of any likely intoxication. Documenting the extent of drug use is important in establishing and enforcing laws to control it. In spite of the great variability in drug use demographics, similar patterns in drivers have been documented worldwide. Drug use by tractor-trailer truck drivers was evaluated on a voluntary basis in a 1988 study (1), and in fatally injured tractor trailer drivers in another study (2). Alcohol and other drug use in fatally injured drivers has been investigated in North Carolina in 1978–1981 (3), Alabama in 1980–1984 (4), and in California in 1982–1983 (5). States with drug recognition technician (DRT) programs also occasionally report statistics in their arrestee population (6). In spite of the differences in each of these studies, the drugs of abuse, marijuana, cocaine, and the amphetamines, repeatedly emerge as the most frequently encountered drugs. Few of these studies are controlled to allow an assessment of whether the fatally injured population is any different in terms of their drug use than the general population (7), however those which have, including one comprehensive study in Tasmania (8) produced convincing evidence that any psychoactive drugs can contribute to increased risk of traffic accident involvement. Other controlled studies have found similar results (9).

This study was conducted to evaluate whether the patterns of drug and alcohol use in fatally injured drivers in Washington State were consistent with those reported in other jurisdictions, and to determine patterns that might assist in traffic accident investigation or drug-impaired driving enforcement.

## Study Population

Blood, and when available urine, was collected from fatally injured drivers who died within four hours of a traffic accident in Washington state during the period September 1992 through August 1993. Specimens from these cases are required by law to be provided to the State Toxicology Laboratory, and during the study there was a compliance rate of approximately 92%. During the period of the study there were 550 traffic deaths in Washington of which 347 (63%) were automobile drivers. Of these, 74% were male, with an average age of 39 (range 15 to 92). The average age for females was 44, (range 17 to 83). Sufficient quantities of sample were available to permit drug testing on 318 (92%) of these cases.

## Materials and Methods

Blood was tested for alcohol in all cases, using headspace gas chromatography (10). Urine samples were tested using enzyme multiplied immunoassay (EMIT) (Syva, Palo Alto, CA) procedure for amphetamines, opiates, barbiturates, cocaine metabolite, and cannabinoids, followed by thin layer chromatography (TLC), using the Toxilab A system (Toxi-Lab, ANSYS, CA).

Blood samples were analyzed by EMIT for the presence of opiates (cutoff 50 ng/mL), cocaine metabolite (cutoff 50 ng/mL), and cannabinoids (cutoff 50 ng/mL) following a dimethyl formamide (DMF) protein precipitation procedure (11). The assay was calibrated using standards prepared in expired blood bank blood. When urine was not available, blood was further analyzed for basic drugs using a butyl chloride extraction procedure followed by gas chromatography (12), and for weak acid and neutral compounds using a batch solid phase extraction procedure, followed by gas chromatography (13).

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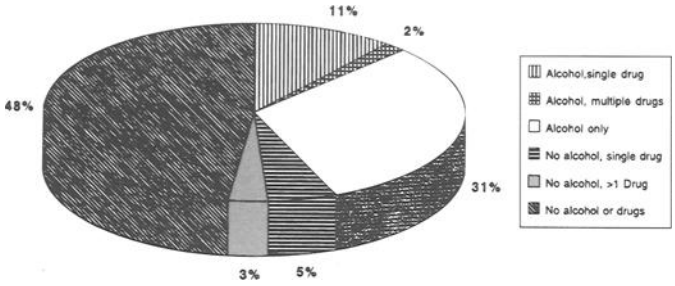


FIG. 1—*Status of drivers by drug and alcohol use.*

## Results and Discussion

### *Blood Alcohol Results*

Examining the blood alcohol data, 159 (46%) of all fatally injured drivers had blood alcohol concentrations (BAC) greater than 0.01 g/100 mL (ave. = 0.18 g/100 mL). The distribution is shown in Fig. 1. The mean is similar to the average breath alcohol concentration of 0.16 g/100 mL found in DUI arrests in Washington, suggesting that the two populations, those being arrested for DUI, and those killed in traffic accidents, are similar with respect to BAC. We found that 37.2% of all drivers, and 87.8% of alcohol positive drivers, had blood alcohol levels above 0.10 g/100 mL, the illegal *per se* limit in the state of Washington.

Of particular interest were single vehicle collisions, and of the 347 drivers killed, 134 (39%) were known to be involved in this type of accident. When the total study population is divided into single vehicle and multiple vehicle accident groups, 60% of those drivers killed in single vehicle collisions had positive BACs (that is, greater than 0.01 g/100 mL), compared to 31% of drivers killed in multiple vehicle collisions. This strongly suggests that in cases where culpability can be assigned with most confidence, alcohol use is a significant factor.

Impairment due to alcohol use has been established as appearing at levels as low as 0.03 g/100 mL, and progressively worsening to the point where by 0.08 g/100 mL all individuals have a degree of impairment to the point where their driving skills are affected (14,15).

### *Drugs Screen Results*

Drug screens for illicit and prescription drugs were conducted as described above, on the available samples from 318 drivers.

For the purposes of further discussion, each drug was classified as insignificant (no significant central nervous system effect), stimulant, or depressant. The active component of marijuana, delta-9-tetrahydrocannabinol is a euphoriant with mild hallucinogenic and sedative effects. Marijuana was therefore considered separately. Thirty seven different drugs were identified, and are listed in Table 1 together with their classification and incidence of detection. Table 2 lists those cases in which drugs with significant central nervous system effect were encountered, together with the type of sample tested and the blood alcohol concentration.

A pie chart showing drug and alcohol status by the deceased drivers is shown in Fig. 2. Of drivers tested, 38% were negative for drugs or alcohol, 37% tested positive for alcohol only, 10% tested positive for alcohol and at least one drug, and 15% were free from alcohol but positive for at least one drug. The drugs encountered with greatest frequency, were cannabinoids, cocaine metabolite, and amphetamines, all of which are illicit drugs. These patterns are consistent with those observed in other studies noted above. Comparative summary data for the incidence of alcohol, cannabinoids, cocaine and amphetamines in this and other studies is given in Table 3.

Thirty five cases (11%) were positive for cannabinoids in either blood or urine, indicating marijuana use. Twenty two (63%) of cannabinoid positive cases were also positive for alcohol. In five of the cases of combined marijuana and alcohol use, the alcohol level was under the state's legal limit (0.10 g/100 mL). Marijuana use can have a marked effect on the skills required for driving (16,17), however since cannabinoids can persist in the blood and urine for several days following marijuana use, the specific role of marijuana in accident causation cannot be established in the above cases. Moreover, a recent study by Robbe and O'Hanlon (18) suggests that low level marijuana use has only a moderate effect on driving skills compared to, for example, a blood alcohol level of 0.04 g/100 mL.

Further examination of combined drug and alcohol showed cannabinoids being more frequently encountered with low level alcohol use (see Fig. 3), while other depressants, including prescription medications, were more frequently combined with higher BACs. Sixty percent of cannabinoid positive cases, 25% of stimulant positive cases, and 27% of other depressant positive cases were positive for alcohol also.

The illicit stimulants cocaine and methamphetamine were encountered in 3% and 2% respectively of all cases. Amphetamine

TABLE 1—*Reports of alcohol and illicit drug use in driver populations.*

| Study | Year | Population | Location | % positive | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ethanol | Marijuana | Cocaine/ BE | Amphetamines |
| Cimbura et al., 1980 (21) | 1978 | Fatally injured drivers | Ontario, Canada | 55 | 12 | ... | ... |
| Mason et al., 1984 (3) | 1978–81 | Fatally injured drivers | North Carolina, USA | 79.3 | 7.8 | 0.3 | 0 |
| Fortenberry et al., 1986 (4) | 1980–84 | Fatally injured drivers | Alabama, USA | 63 | 20 | ... | ... |
| Williams et al., 1985 (5) | 1982–83 | Young males—fatally injured drivers | California, USA | 70 | 37 | 11 | 3 |
| McLean et al., 1987 (8) | 1983–84 | Fatally injured drivers and pedestrians | Tasmania, NZ | 50 | 10 | 0 | 0 |
| Garriott et al., 1986 (20) | 1985 | Fatally injured drivers | Texas, USA | 52 | 38 | 0.8 | 0.8 |
| Lund et al., 1988 (1) | 1985 | Truck drivers (voluntary) | Tennessee, USA | <0.1 | 16 | 2 | 3 |
| Crouch et al., 1993 (2) | 1987–88 | Fatally injured truck drivers | Various, USA | 12.5 | 12.5 | 8 | 7 |
| Kirby et al., 1992 (22) | 1988 | Traffic trauma victims | Tennessee, USA | 37 | 32 | 5 | 2 |
| Robb et al., 1990 (6) | 1990 | Drug impaired driving suspects | New Mexico, USA | 85 | 17 | 8.5 | 1.7 |
| This study | 1992/93 | Fatally injured drivers | Washington, USA | 46 | 11 | 3 | 1.9 |

... not tested for, or no data available.

TABLE 2—*Drug and alcohol test results for all subjects testing positive for one or more drugs.*

| Subject | BAC | Samples tested† | Drugs detected |
|---|---|---|---|
| 1 | —* | B/U | Diphenhydramine |
| 2 | —* | B/U | Cannabinoids |
| 3 | —* | B/U | Cocaine, benzoylecgonine |
| 4 | —* | B | Cannabinoids |
| 5 | —* | B | Opiates, meperidine |
| 6 | —* | B/U | Cannabinoids |
| 7 | —* | B/U | Propoxyphene, norpropoxyphene, amoxapine |
| 8 | —* | B/U | Opiates |
| 9 | —* | B/U | Cannabinoids |
| 10 | —* | B/U | Hydrocodone, nordiazepam |
| 11 | —* | B/U | Amphetamine, methamphetamine, cannabinoids |
| 12 | —* | B/U | Benzoylecgonine, cannabinoids |
| 13 | —* | B/U | Opiates |
| 14 | —* | B | Cannabinoids |
| 15 | —* | B/U | Cannabinoids |
| 16 | —* | B/U | Cannabinoids |
| 17 | —* | B | Amitriptyline, nortriptyline |
| 18 | —* | B | Doxylamine, nordiazepam |
| 19 | —* | B/U | Cannabinoids |
| 20 | —* | B/U | Cannabinoids |
| 21 | —* | B | Brompheniramine |
| 22 | —* | B/U | Benzoylecgonine, diphenhydramine |
| 23 | —* | B | Nordiazepam |
| 24 | —* | B/U | Opiates |
| 25 | —* | B | Cannabinoids |
| 26 | —* | B/U | Amphetamines, benzoylecgonine, morphine |
| 27 | —* | B/U | Benzoylecgonine |
| 28 | —* | B/U | Doxylamine, opiates |
| 29 | —* | B/U | Methamphetamine, benzoylecgonine, cannabinoids, amphetamine |
| 30 | 0.03 | B/U | Cannabinoids |
| 31 | 0.04 | B | Cannabinoids |
| 32 | 0.06 | B/U | Cannabinoids |
| 33 | 0.09 | B/U | Cannabinoids |
| 34 | 0.10 | B | Cannabinoids |
| 35 | 0.12 | B/U | Cannabinoids |
| 36 | 0.12 | B/U | Cannabinoids |
| 37 | 0.13 | B/U | Cannabinoids |
| 38 | 0.15 | B/U | Cannabinoids |
| 39 | 0.15 | B/U | Cannabinoids |
| 40 | 0.15 | B/U | Amphetamine, methamphetamine, cannabinoids |
| 41 | 0.16 | B | Cannabinoids |
| 42 | 0.16 | B/U | Cannabinoids |
| 43 | 0.17 | B | Diazepam, nordiazepam |
| 44 | 0.17 | B/U | Morphine |
| 45 | 0.18 | B/U | Cannabinoids |
| 46 | 0.18 | B/U | Cannabinoids |
| 47 | 0.19 | B | Cannabinoids |
| 48 | 0.20 | B | Cocaine methamphetamine |
| 49 | 0.20 | B/U | Cocaine, benzoylecgonine |
| 50 | 0.21 | B/U | Cocaine, benzoylecgonine |
| 51 | 0.21 | B/U | Cannabinoids |
| 52 | 0.22 | B/U | Morphine |
| 53 | 0.22 | B/U | Methamphetamine |
| 54 | 0.23 | B | Cannabinoids |
| 55 | 0.23 | B/U | Imipramine, desipramine |
| 56 | 0.23 | B/U | Cannabinoids |
| 57 | 0.25 | B/U | Cannabinoids |
| 58 | 0.25 | B/U | Cannabinoids |
| 59 | 0.29 | B/U | Benzodiazepines |
| 60 | 0.31 | B | Cannabinoids |
| 61 | 0.32 | B/U | Amphetamine, methamphetamine, codeine, morphine |

*less than 0.02 g/100 mL.
†B = blood, U = urine.

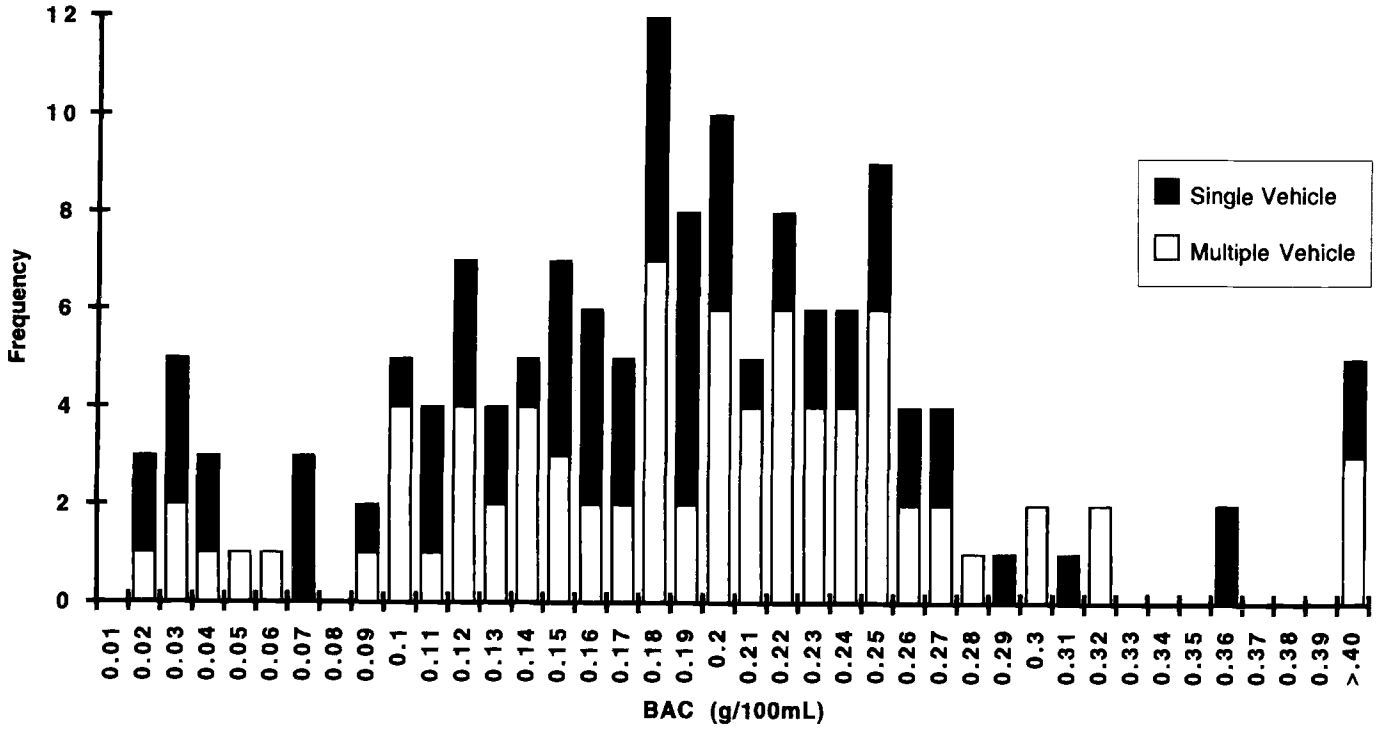


FIG. 2—*Distribution of drivers blood alcohol concentration, in single vehicle and multiple vehicle accidents.*

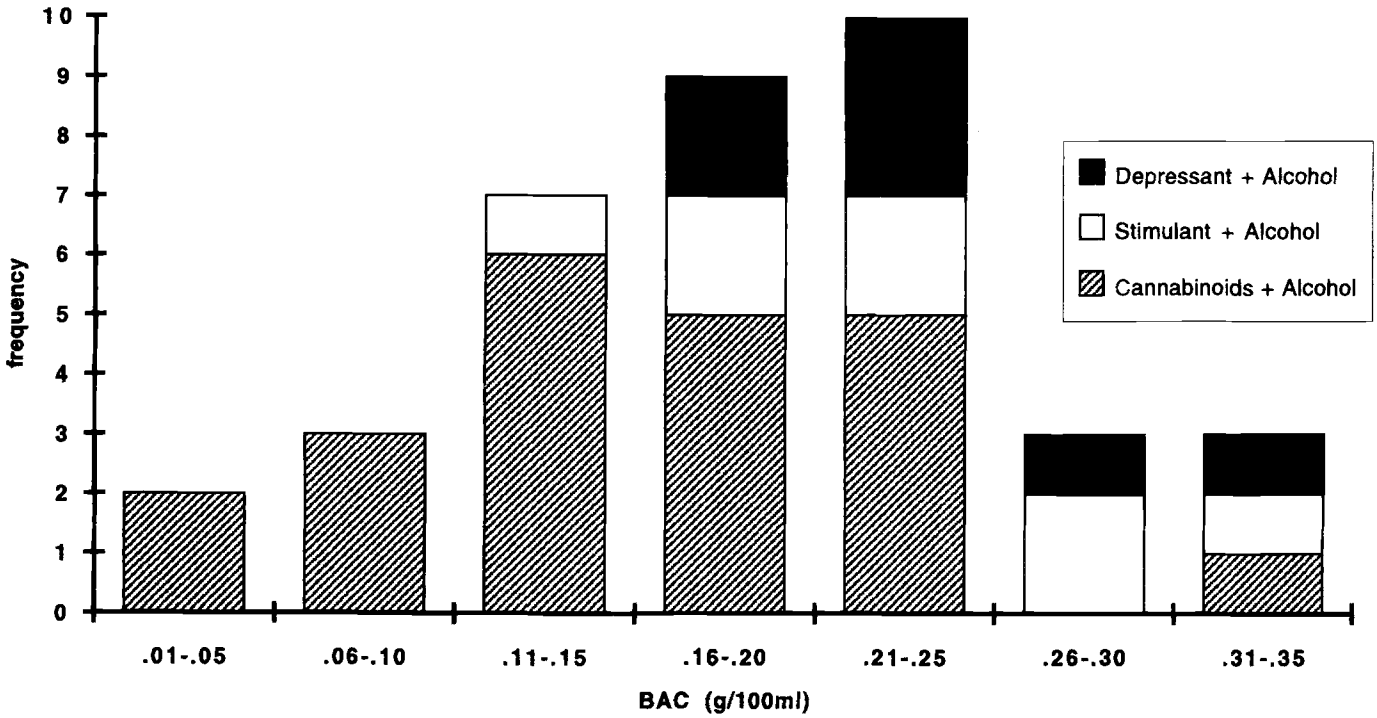


FIG. 3—*Drug use demographics in fatally injured drivers as a function of blood alcohol concentration.*

use was commonly associated with other stimulant or marijuana use, and infrequently with alcohol use. Stimulant use has been shown to improve reaction time, particularly where reaction time has been impaired through alcohol use or fatigue (19,20). There is no reliable data however to suggest that performance in divided attention tests is improved, or that decision making ability, and judgment or reasoning skills are enhanced (20). In fact, the increased self-confidence associated with stimulant use may lead to irrational behavior and increased risk taking. Disruption of sleep patterns which often accompany stimulant use, can lead to diminished attention and control during the withdrawal phase, even while the drug persists in the blood or urine (19,20).

Also detected with some frequency were drugs with CNS depressant activity including morphine, diazepam, and propoxyphene

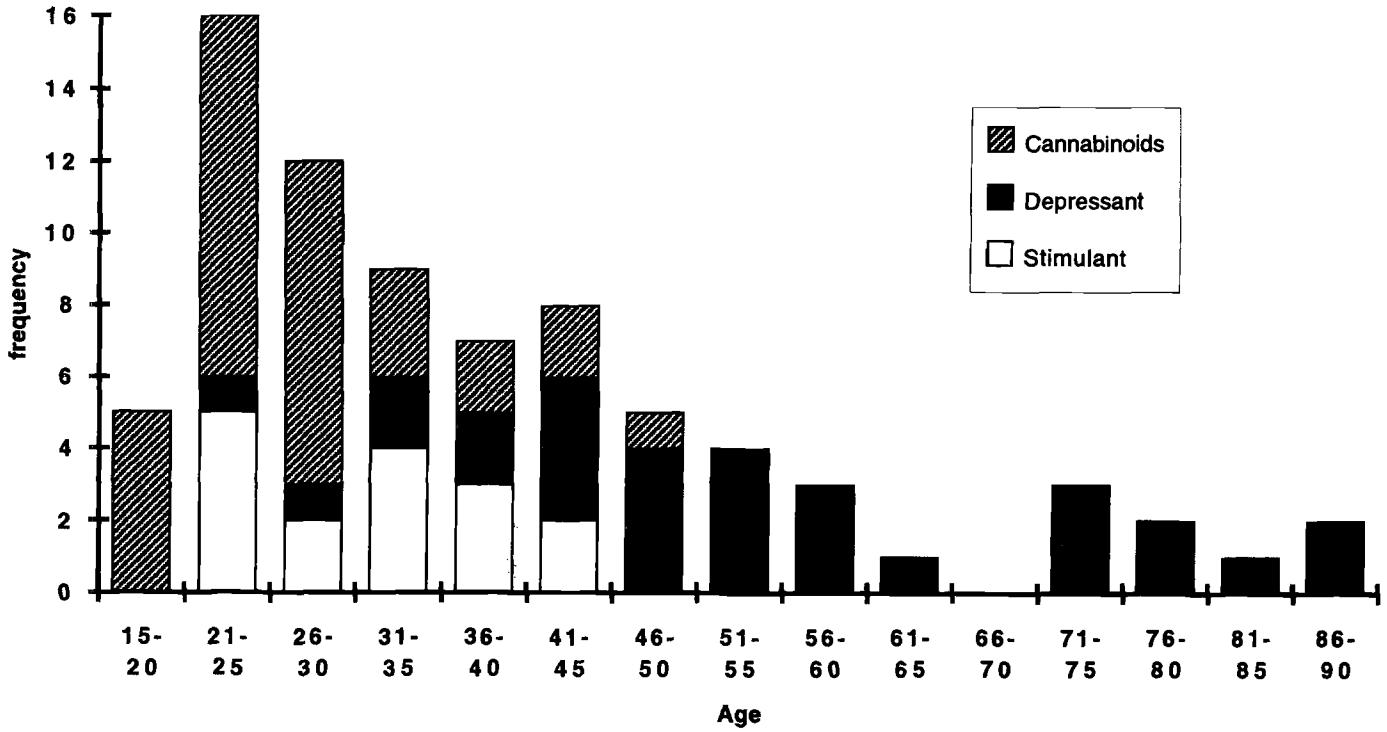


FIG. 4—*Drug use demographics in fatally injured drivers as a function of drivers age.*

(see Table 1). Reliable information was not always available regarding post-accident therapeutic intervention, and some of these drugs may have been administered during treatment. Other drugs found included meprobamate, quinidine, diphenhydramine, fluoxetine, hydrocodone, imipramine, amitriptyline, phenobarbital, and several over-the-counter medications. One or more depressant drugs were found in 30 cases (9%), of which 8 (27%) showed combined alcohol and depressant use.

There were distinct patterns of drug use associated with different age groups as illustrated in Fig. 4. Marijuana and stimulant use was more common in the lower age groups (mean age 28.5, and 30 respectively), while depressant use was more common in the older age groups (mean age 47).

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