LITTLE IMPORTANCE or attention has been given to the role of alcohol in civil general aviation accidents. Its significance has never been determined. This is evidenced, for example, by most recent authoritative accident statistical reports (2, 3). In these statistical reviews, covering 929 general aviation fatal accidents which occurred in the years 1960 and 1961, only eight cases were identified under the pilot causal factor heading “Operating Under the Influence of Intoxicants,” and only 31 cases were identified under the heading “Related Factors.” Thus, alcohol has been identified in only 4% of all the general aviation fatal accidents for this two-year period.

This paper represents a study of 158 general aviation fatal accidents in which toxicological examinations were performed on the pilots. These 158 cases were part of the total of 477 general aviation fatal accidents which killed 899 people in the year 1963. Thus the study covers over one third of the general aviation fatal accidents which occurred in 1963.

In this paper the term general aviation means civil private, business, corporate, and commercial flying, excluding all air carrier operations, both scheduled and nonscheduled, and excluding military aviation.

In each of these 158 cases blood- and/or tissue-alcohol determinations were performed on the pilots. Reliable laboratories were utilized, including university medical school laboratories, state crime and police laboratories, the laboratories of the A.F.I.P., and private licensed medical laboratories. The laboratory results were carefully reviewed for the possibility of errors from contamination, putrefaction, and laboratory error. (7,8,9). Four doubtful cases were eliminated from the study. Ten cases in which alcoholism was strongly established by history, but not verified by laboratory determinations, were eliminated.

Of the 158 cases which received routine toxicological investigation, the unexpected high number of 56 were positive for blood- and/or tissue-alcohol. THIS REPRESENTS 35.4% OF THE TOTAL GENERAL AVIATION FATAL ACCIDENTS STUDIED! Extrapolation to the total of 477 general aviation fatal accidents for the year 1963 indicates alcohol involvement in 169 cases. Cases in which the alcohol level was less than 15 milligrams per 100 milliliters blood were considered as negative for this study. In the positive-alcohol group the average alcohol level was found to be 145 milligrams per 100 milliliters blood.

Throughout this paper, where comparisons are made between the positive-alcohol 1963 study group and the over-all general aviation fatal accident population, statistics covering the year 1962 (6) are used since these are the latest statistics available for baseline comparison. Where such comparisons have been made in this study, the over-all general aviation fatal accident population did not have the positive-alcohol population subtracted. Had it been possible to eliminate the positive-alcohol group, the comparisons between the two groups would have shown a much larger contrast since the positive-alcohol group comprises one third of the over-all group.

Figure I shows the range of alcohol levels in the 56 positive cases.

![Graph showing range of measured alcohol levels in 56 positive cases](image-url)
The positive-alcohol pilots were found to represent all classes of airmen and all pilot ratings. It is of interest to note that student pilots represented 19.5% of the fatal cases involving alcohol. This contrasts with the 11% incidence of student pilot involvement in all general aviation fatal accidents as reported in Civil Aeronautics Board Statistical Reviews.(2,3)

These 18% CRASHED WITHIN 12 MINUTES OR LESS!

These are unusually short-flight durations. They are significant because a study of a corresponding sample of fatal accidents in which alcohol involvement was definitely ruled out reveals only 26% crashing within 18 minutes after take-offs. Figure IV shows a comparison of these two groups.

An analysis of total pilot flight time in the positive-alcohol group reveals a wide variation of experience ranging from low time student pilots to pilots with almost 9,000 hours. It should be noted that only three pilots in the positive-alcohol group held current instrument ratings. Figure V gives the distribution of flight experience in the positive-alcohol group and shows a comparison with the over-all general aviation fatal accident population. Of significance is the peaking of positive-alcohol group accidents in the low total pilot time range around 300 hours.

Civil Aeronautics Board Statistical Reviews(2,3) reveal that 9.3% of the total general aviation fatal accidents involved...
pilots with a total time of 100 hours or less. In the positive-alcohol group we find that 16% of the fatal accidents involved pilots with 100 hours or less. This is almost twice as many inexperienced pilots killed when alcohol is involved than are killed in the over-all fatal accident population. This correlates with the unusually high per cent of student pilots involved as depicted in Figure II above.

The relationship of the positive-alcohol group with weather factors and time of day is depicted in Figure VI.

![Figure VI: General aviation fatal accidents. Conditions of flight.](image)

This figure reveals that the positive alcohol group has a night accident rate twice that of the over-all general aviation fatal accident group (6).

It is of interest to note that the positive-alcohol fatal group Flight Standards Service Accident Reports reveal that 55% of the accidents involved basic loss of control. Also, while the incidence of stall-spin accidents in the over-all general aviation fatal accident population is 13%, in the positive-alcohol fatal group under study, the incidence of stall-spin accidents was found to be 33%, a two and one-half fold increase. Twenty per cent of the positive-alcohol fatal group involved "struck object" accidents.

**SUMMARY**

This study reveals a much higher incidence of proven alcohol in pilots involved in fatal general aviation accidents than was previously known or reported.

Aksnes (1) has demonstrated that levels far below the commonly accepted legal limit of 150 milligrams per 100 milliliters of blood (7,10) have definite adverse effects upon flying skills. Comparison of his study with studies involving alcohol and driving skills (4) indicates that flying skills are measurably decreased by only one fourth the amount of alcohol necessary to produce measurable decrease in driving skills. The present study adds support to Aksnes' (1) findings that low levels of alcohol adversely affect flying performance.

Student pilots and inexperienced pilots with positive-alcohol have almost twice the fatality rate as the over-all general aviation group of the same category.

Pilot experience per se is no guarantee against the adverse effects of alcohol since high time pilots are found in the positive-alcohol fatal group. It appears, however, that alcohol involvement in the relatively inexperienced group, around the 300-hour total pilot time range, is of much greater significance.

This study is but one example of the great need for medical and human factor studies in civil aircraft accident investigations. Civil aircraft today are well designed and constructed. Structural or mechanical failure is rare when airframe or engine limits are not exceeded. Human and medical factors represent a great unknown area in the man-machine-environment complex. The authors feel that this area holds the greatest promise for reducing the accident, injury, and fatality rates.

Too often accidents are pigeonholed under such factors as "weather," "inattention to pilot duties," "struck object," or "misjudged distance." Alcohol affects pilot judgment, attention (both inside and outside the cockpit), vision, and neuromuscular coordination (5,8,10,11,12). It is not surprising, therefore, to find accidents involving poor flight planning, continuing into unfavorable weather, collision with objects, poor coordination, and stalls and spins.

This paper indicates a need for greater attention to alcohol in general aviation accidents from the investigative, research, and, most important of all, the pilot educational viewpoint.

While this study reveals that alcohol is involved in a very significant per cent of general aviation fatal accidents, it should not be inferred from this study that general aviation pilots are alcoholics. Extrapolating the per cent of alcohol involvement in this study to the total general aviation population reveals less than six tenths of one per cent alcohol involvement in general aviation. The great majority of civil general aviation
pilots are mature, dependable individuals who contribute to the high standards of excellence and safety of civil aviation today in the United States. It is clear that the alcohol associated group is a very small group, but one which exerts an adverse effect on the overall image of civil aviation.

The authors wish to thank the many FAA Aviation Medical Examiners who volunteered to assist in this accident investigation program. These physicians served without remuneration and frequently at great personal and professional inconvenience in order to contribute to the improvement of aviation safety. Without their assistance there would be no factual data available, and studies such as this one would not be possible.

REFERENCES

DISCUSSION

Dr. Mason: Did you find crop dusters more often involved with alcohol or with the organic materials they used?

Dr. Harper: It was not studied specifically. I think they are quite professional. In other words, they are more in a professional group and realize this more than the average private pilot.

Professor Hartmann: Do you have any information concerning any regulations for private pilots and alcohol?

Dr. Harper: No, there is nothing specific right now. There is a proposed study regarding legislation.

Dr. Sunshine: Isn't this a motor vehicle?

Dr. Harper: Yes, but Civil Aeronautics regulates this so there is no specific regulation regarding it.

Dr. Goldberg: I don't think you have laws regarding outside road traffic in almost any country, whereas the air lines themselves have much stronger rules against drinking among themselves.

Dr. Harper: Oh, yes. The air lines have strict rules and I think the problem is quite rare there. This is a study of private aviation, actually.

Professor Vamosi: In Hungary they introduced a study for military pilots. When a military pilot stepped into a machine, he must blow first, and if it were negative he was allowed to fly. This disappeared after 1945 and was introduced for the second time after a crash in 1949. I know some Hungarian people who have been working with this program.

Dr. Harper: This is military aviation.

Professor Vamosi: Yes, military aviation, and they have been told that they have found plenty of drunken pilots.

Dr. Harper: All of your military pilots are governed very carefully?

Dr. Sunshine: Are all pilots tested before they go aboard?

Dr. Harper: Oh, no. They have a strong Union.

Dr. Sunshine: He said they were testing before they got on the plane.

Dr. Harper: That's probably a good idea if you could do it, but in our society, we can't do that.

Mr. Kaplan: In the military, crew members are restricted from drinking 24 hours prior to flying. This is a military regulation and I was wondering if you know what the restriction is on civilian commercial air lines.

Dr. Harper: I couldn't speak for all of the commercial airlines but with United Air Lines it's 24 hours.
Mr. Brown: Was there a correlation made of the time the accidents occur and the making out of an accident report? Are they in favor of the pilot error, or mostly the mechanical area, particularly for the group that has been shown to have alcohol?

Dr. Harper: No. There was no correlation there. This was simply toxicology studies, regardless of pilot error or mechanical area.

Mr. Brown: So, if a man was found to have alcohol in his blood, you didn't check back to see whether there was a mechanical failure?

Dr. Harper: No, I did not. When you have a dead pilot, it's easy to say, "Pilot error."

Question: They tried to correlate the findings in the blood and, on the other hand, to have a kind of score. I wonder if in your case you could have one part of your team trying to score how much is pilot error and so on. Afterwards would knowing the results of your autopsy correlate the results? I can give you the reference of Smith and Hoffman, if you want.

Dr. Harper: That would be very important.