AIRCRAFT ACCIDENTS BY OLDER PERSONS

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FEDERAL AIR SURGEON

October 1967

FEDERAL AVIATION ADMINISTRATION
Office of Aviation Medicine

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I. Introduction

There is no upper age limit for general aviation pilots. General aviation pilots in the United States may continue flying as pilot-in-command so long as they hold a valid medical certificate. Airline pilots are required to retire from air carrier flying at age sixty, but many of them continue to fly in general aviation for years after retirement. During the time covered by this study, the oldest active pilot in the United States was a ninety-three year old physician.

The number of persons over sixty holding valid medical certificates is increasing each year. Between August 1965 and December 1965, the number jumped from 7,401 to 11,317. With the large increases in pilots over the age of sixty, an analysis was undertaken of the accident experience of the older pilot. Their accident experience was then compared with that of pilots in all age groups.

All pilots with a given class of medical certificate meet essentially the same medical standards. There are three classes: Class I, having the strictest physical standards, is primarily for air transport pilots; Class III is for private and student pilots; and Class II, intermediate between I and III in strictness, is designed for commercial pilots (instructors, etc.).

II. Methods and Findings

The pilot population data was divided into four age groups.[1] (See Table I.) These groups start with age 16 since that is the minimum age for soloing powered aircraft. The pilots were also divided according to the type of airman certificate held. In most cases, the student and private pilots hold Class III certificates, commercial pilots hold Class II certificates, and airline transport (ATR) pilots hold Class I certificates. In a small number of cases, a student, private, or commercial pilot will hold a medical certificate of a class higher than that required for the pilot certificate. The converse may also be true of some air transport and commercial rated pilots.

Accident rates (per 10,000 pilots) for the four major classes of pilots and age groupings are summarized in the table of accident rates (Table II). The numerators for the rates are reported accidents by age and rating of the pilot operating the aircraft at the time of the accident. The denominators are the midyear 1965 pilot population figures ranked by age and certification. Because of the special circumstances of student flying, the data are presented showing both the inclusion and exclusion of the student group. It is recognized that the general aviation population is constantly changing in dimensions of certification and age. Thus, a midyear figure of the pilot population was calculated from the FAA Statistical Handbook using 1964 and 1965 year-end figures. The 1965 aircraft accidents which had been received, reviewed, and coded by February 1966 (5,134) were used since data for this year was the most comprehensive available.

Out of a computed midyear population of 450,494 pilots, there were 9,826 (or 2.2%) over 60 years of age. These same pilots had 108 aircraft accidents (or 2.1%) out of a total of 5,134 accidents during that year. As illustrated in Table III, calculations show considerable differences between accidents, certification, and age. Chi-square calculations show that general aviation accidents are associated with both age and certification. Also (it is here noted that all airline accidents were deleted from these data), general aviation accidents are associated with age in the student, commercial, and airline transport rated groups, but not in the private pilot group. Table II shows the same differences. Statistically, a likelihood ratio test of the hypothesis that rating, age, and occurrence of accidents are mutually exclusive gives a chi-square approximation of over 9,550 with 17 degrees of freedom. This is for the 3x4x2 table rating by age of occurrence of accidents. A pertinent statistical hypothesis is that occurrence of accidents is independent of rating and age group of pilots. That is, the rates in the table cannot be regarded as different. We can reject this hypothesis with a significance beyond the 0.005 level (the likelihood ratio list gives the chi-square approximation of 295 on 11 degrees of freedom).

The three pilot groups (private, commercial, and ATR) were examined separately in a 2x4 contingency table (occurrence of accidents by age groups). The calculated chi-square for the private pilot was 1.198 on three degrees of freedom which supports the notion that age was not an important risk factor in this group. In the commercial pilot group the chi-square for the accidents as occurring by age is 150.907 on three degrees of freedom. This is a highly significant result confirming the evident age differences in accidents within the commercial group. To isolate the source of heterogeneity, the total calculated chi-square was partitioned into two additive components: one degree of freedom is attributed to the difference between the rate for those in the 45–59 year age groups against all other (chi-square 51.939); and the remaining two degrees of freedom are associated with differences among the rates in the 16–29, 30–44, and 60+ age groups (chi-square 99.515). We concluded that the accident rate for commercial pilots in the 45–59 age group was significantly lower than the average for the other age groups and the rates for the remaining three age groups are heterogeneous.

The analysis for the 45–59 ATR group versus the other age groups gives a chi-square of 24.230 on one degree of freedom. Comparisons among the remaining three age groups give a chi-square value of 11.640 on two degrees of freedom.

Further analysis was conducted in two parts. One analysis included student pilots and one excluded the students. An expected accident rate by category of certificate and age, assuming no accident relationship with age, was calculated for each pilot certificate and age group based on 10,000 pilots.

Student Pilots Included. Table III shows that the student pilots had more accidents than would be expected in all age groups above 30 years of age. However, the small number of accidents above the expected level in the 60 and over age group proved not to be statistically significant with a chi-square of 2.456 (at 0.05 level of significance with one degree of freedom, the chi-square would be 3.814). Table III shows that private pilot accidents were remarkably consistent among the age groups.

The commercial pilots had a worse record than might have been expected in the 16–29 age group (Table III). We feel it should be mentioned that one cannot obtain a commercial license until he is at least 18 years old. Also, there was no way to separate the agricultural pilots from other commercial pilots by age groups. Thus, the inclusion of this relatively high-risk group of pilots may have distorted the figures somewhat and points up the need for valid "exposure index" data under these circumstances. Among ATR rated pilots, there is an excessive number of accidents over the expected number in the 16–29 age group (Table III), and slightly more than expected in the 30–44 group. Fewer accidents than expected occurred in the 45–59 age group. The over sixty group had identical numbers of observed and expected accidents.

Students Excluded. As in the students included analysis, the table of rates shows considerable heterogeneity which indicates that accidents, certification, and age are associated. When the source of this heterogeneity was tested for the private pilot group, it showed that age was not an important risk factor. However, in the commercial and ATR groups, only the 45–59 age group indicated that age was not an important risk factor. Excluding student pilots (Table II), the total accident rates are higher for all age groups with the exception of the 45–59 year old group.

III. Discussion

If one excludes the student pilots from the analysis, the 60 and over age group appears to be slightly more hazardous than the 45–59, considerably safer than the 16–29, and about as hazardous as the 30–44 year age group. However, when the student group is included, it appears that there is not a significant difference between any of the age groups. Thus pilot certification has more effect on the accident rates than does the age of the pilot. Where individual rates are compared by type of pilot certificate, the rate differences do stand out.

Analysis of the accidents involving pilots over sixty showed that more than 51% of the accidents occurred during the landing phase of op-

TABLE I. Age Distribution of Pilot Population by Airman Certificate. Midyear 1965

	16–29	30–44	45–59	60 and Over	Total
Students	70,416	47,653	10,307	1,582	129,958
Private	34,854	97,358	47,857	5,917	185,984
Commercial	16,110	62,588	31,904	1,944	112,546
Air Transport	336	11,087	10,200	383	22,006
TOTAL	121,714	218,686	100,268	9,826	450,494

NOTE: All figures are calculated by adding year-end figures 1964 and 1965; dividing by 2 for average midyear 1965.

TABLE II. Accidents Per 10,000 Pilots For The Year 1965 By Airman Certificate and Age

Certificate	*16–29*	*30–44*	*45–59*	*60 and Over*	*Total*
Student	60	94	111	82	77
Private	126	118	120	113	120
Commercial	254	146	109	123	152
Air Transport	298	118	59	104	93
TOTAL ACCIDENT RATE	106	121	109	110	114
Totals Excluding Students	167	128	109	115	129

NOTE: This table consists of data based upon the actual accident figures adjusted by division or extrapolation to populations of 10,000 individuals in accordance with the following formula: $\frac{\text{number of accidents}}{\text{subject category for 1965}} \times 10{,}000.$

TABLE III. Observed Versus Expected Number of Accidents By Age and Certification.

	16–29		*30–44*		*45–59*		*60 and Over*		*Total Accidents*	
	Obsd.	*Exptd.*	*Obsd.*	*Exptd.*	*Obsd.*	*Exptd.*	*Obsd.*	*Exptd.*	*Obsd.*	*Exptd.*
Students	426	541	450	372	114	80	13	10	1,003	1,003
Private	440	424	1,148	1,159	575	580	67	67	2,230	2,230
Commercial	409	237	915	950	348	475	24	34	1,696	1,696
Air Transport	10	4	131	103	60	94	4	4	205	205

The observed (Obsd.) number is the actual number of accidents (fatal and non-fatal) experienced by the respective age and certificate groups during 1965.

The expected (Exptd.) number of accidents for each age and certificate group is calculated by dividing the total number of pilots in a given age and certificate group by the total number of pilots within each certificate group e.g.; student, private, etc., (Table I) thus producing a percentage age representation. This calculated figure is then multiplied by the number of accidents yielding an expected number of accidents by age and type of pilot certificate. The expected number of accidents is essentially a pro-rated figure based on pilot population and accidents.

erations. Taxiing accidents comprised 8% and take-off accidents accounted for 15%. Twenty-two percent occurred inflight and were attributed to proceeding into adverse weather, disorientation, fuel exhaustion, and improper flight planning. Approximately 4% were due to undetermined causes.

For purposes of this paper, accidents requiring FAA investigation were included. Approximately ten percent of the total number were fatal.

In the over sixty group, there were four fatal accidents in which cardiovascular problems were cited as contributory. This compares with six such accidents for the under sixty group. There were six pilots over sixty with known cardiovascular conditions involved in nonfatal accidents. The pilots were properly certificated in that it had been earlier decided by competent authority that the specific conditions did not constitute a hazard to aviation safety. None of the six nonfatal accidents were felt related to the pilots' cardiovascular conditions.

In the over sixty group, all but two of the 108 pilots involved in accidents had some kind of limitation on their medical certificates for vision. These visual acuity conditions were not felt to be definitely related to the accidents.

Fatal accidents comprised about 10% of all general aviation accidents. With respect to age, the fatal accidents compared with the nonfatal accidents in the following manner:

Including Student Pilots

1965 Total pilots over 60: 9,826; Fatal accidents: 17; Percent: 0.19

1965 Total pilots under 60: 440,668; Fatal accidents: 526; Percent: 0.12

Excluding Student Pilots

1965 Total pilots over 60: 8,244; Fatal accidents: 16; Percent: 0.19

1965 Total pilots under 60: 312,292; Fatal accidents: 454; Percent: 0.11

Described another way, the older pilot experienced about sixteen percent fatal accidents within all accidents for the over sixty group. For all pilots, the older pilot included, the total fatal accident rate compared to the total accident rate was 10%. However, if the older pilot accident group is subtracted from the total number of accidents (5134−108=5026) and the percent of fatal accidents excluding the over sixty group (543−17=526) is obtained (526÷5026x100) we see a 12% fatal accident rate for the under sixty group.

We see, then, that the fatal to nonfatal accident ratio for the over sixty group is 16%, and for the under sixty group is 12%. These two numbers are sufficiently close for the 1965 accidents to preclude any inferences that older pilots in general are likely to have more fatal accidents in proportion to nonfatal accidents than is the case with the under sixty age group of pilots. For the year 1965, however, pilots over sixty did have a proportionately higher number of fatal accidents. It is possible that the well-known greater ability of younger persons to recover from traumatic injuries, as compared to that of older persons, is reflected in a somewhat lower proportion of fatal accidents within the former group.[2,3,4]

IV. Summary

An analysis of the accident record of older general aviation pilots (over sixty) for 1965 reveals that this age group has an accident record essentially comparable, and in some cases superior, to that of the younger pilot group. Especially for the private pilot group, the age and accidents were not significantly related.

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