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THE 1975 ACCIDENT EXPERIENCE OF CIVILIAN PILOTS WITH STATIC PHY--ETC(U)
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THE 1975 ACCIDENT EXPERIENCE OF CIVILIAN PILOTS WITH STATIC PHYSICAL DEFECTS

J. Robert Dille, M.D.
Charles F. Booze Ph.D.
Civil Aeromedical Institute
Federal Aviation Administration
Oklahoma City, Oklahoma

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16. Abstract

The 1974 aircraft accident experience of civilian pilots with eight selected static physical defects has been examined and reported previously. Three categories--blindness or absence of either eye, deficient color vision with a waiver, and deficient distant vision--had significantly more accidents than were expected on the basis of observed-to-expected ratios. However, pilots with these conditions reported considerably higher median 6-month flight times than did an active airman population sample or accident airmen without selected pathology. Concern was raised about the failure to relate any of the 416 accidents to the pilot's physical condition in the accident reports.

The 1975 accident data have now been examined. Again, the same three groups were found to have significantly more than their expected numbers of accidents. This year the reported recent and total flying times for all airmen with these defects were determined and accident rates were calculated. When the accident experience of airmen with any of these three static defects was compared with the active airman population accident experience per unit of recent and cumulative exposures, the rates for airmen with blindness or absence of an eye were still found to be significantly higher. Rates for airmen with color vision defects and a waiver were somewhat higher but of marginal significance. However, the rates for those with defective distant vision other than blindness or absence of an eye were similar and the difference was not significant. Only one of the FAA accident reports that were reviewed related the accident to the pilot's physical defect.

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THE 1975 ACCIDENT EXPERIENCE OF CIVILIAN PILOTS WITH STATIC PHYSICAL DEFECTS

I. Introduction.

The 1974 aircraft accident experience of civilian pilots with eight selected static physical defects has been examined and reported previously (1). Three categories--blindness or absence of either eye, deficient color vision with a waiver (and no operational limitations), and deficient distant vision--had significantly more accidents than were expected on the basis of observed-to-expected ratios. However, pilots with these three conditions who had accidents reported considerably higher median 6-month flight times at the times of their last physical examinations before their accidents than did an active airman population sample or accident airmen without selected pathology. Determination of the role of exposure by calculation of accident rates was not attempted. More accidents were observed than were expected at night, during landing, and in agricultural operations. The pilot's physical condition was not related to any of the 416 accidents in the accident reports.

Plans were made to calculate accident rates and to examine individual accident reports for 1975 to further explore these observations and determine their significance.

II. Method.

For the 1975 active airman population of 763,793, the numbers were determined who had blindness or absence of either eye (includes uncorrectable distant visual acuity of 20/200 or worse in one eye); contact lenses; deficient color vision but who had taken and passed a signal light gun test and had no operational limitation; deficient color vision but had not taken or passed a signal light gun test and had a restriction "not valid for night flight or color signal control"; deficient distant vision (uncorrected distant vision poorer than 20/100 for first and second class, or vision that does not correct to standards for any class); paraplegia (special controls required on the aircraft); deafness with a restriction prohibiting flying where a radio is required; and amputations (some with a requirement for the use of artificial limb(s) while flying or for special controls on the aircraft). The deficient distant vision category ordinarily includes many who also have lost an eye and some who wear contact lenses, but these were subtracted for this study.

For each of these eight categories, the representation per 1,000 active airmen, expected frequencies for 4,181 total accidents, actual accident experience, ratio of observed-to-expected accidents, and significance by the chi-square test were calculated.

Total and last-6-months civilian flight hours, reported at the times of the most recent physical examinations, were obtained for all active airmen, those with blindness or absence of either eye, those with deficient distant vision, and those with deficient color vision.

Medical record printouts are routinely obtained on receipt of accident notification from field sources. This file provided the medical and exposure source data for the accident-involved airmen. Prevalence data for the population are available annually from computer analyses. Conventional chi-square analysis was applied during the first phase of the analysis in order to identify the static defects showing significant difference at probability level 0.10. Since this project is designed to screen for potential medical factors of importance in the epidemiology of accidents, a higher level of significance was chosen to decrease the chances of wrongly accepting a hypothesis of no difference between the accident experience of those with and without the defect. Accident rates per hundred thousand hours of cumulative and recent flight time were computed for the three static defect categories identified as significant by previous analysis and repeated in this study. Rates for the static defect groups were then compared with population experience by a critical ratio rate test.

Additionally, exposure and defect-specific rates were analyzed for trends. These comparisons were based on a December 31, 1973, population estimate (not specifically obtained for this study) that provided frequencies for exposure intervals of 0-10, 11-50, 51-100, 101-200, and more than 200 hours of recent flight time and 0-10, 11-50, 51-200, 201-1,000, 1,001-2,000, and more than 2,000 hours of cumulative flight time from a sample. Persons having accidents in 1975 would have received medical certification in the time period from January 1973 to December 1975. The December 1973 data, while slightly out-of-phase with the midpoint of this study (July 1974), is not expected to produce appreciable bias because of the stability of the population during this time period. The July 1974 population total was 756,004 versus a December 1973 total of 758,243.

Finally, the records for all accidents involving agricultural operation, a "one eyed" pilot, or a pilot with deficient color vision but no operational limitation were reviewed by both authors to determine if medical conditions had been considered by the accident investigators, visual factors played a significant role in agricultural accidents, or time of day, phase of flight, nature of the accident, or other findings offered any plausible explanation for the increased accident experience of these groups.

III. Results.

The number of active airmen in each of the eight categories and their accident experience in 1975 are shown in Table 1. The 1974 data are included for comparison. Again, the same three categories had more than their expected numbers of accidents--deficient color vision with no restriction (significant

TABLE 1. Airmen and Accident Frequencies for Selected Pathology Categories

Pathology Category		Freq. Active Airmen Pop.	Rate/ 1,000	Expected Accident Airmen	Observed Accident Airmen	No. Observed / No. Expected	Chi-Square Test
Blindness or Absence	(1975)	4,781	6.26	26.2	35.0	1.34	3.01**
of Either Eye	(1974)	4,704	6.17	28.4	45.0	1.58	9.86***
Contact Lenses	(1975)	15,737	20.60	86.1	104.0	1.21	3.80**
	(1974)	14,421	18.91	87.0	99.0	1.14	1.70*
Deficient Color	(1975)	5,690	7.45	31.1	61.0	1.96	28.99****
Vision-No restriction	(1974)	5,157	6.76	31.1	52.0	1.67	14.21****
Deficient Color	(1975)	10,736	14.06	58.8	44.0	0.75	3.78**
Vision-Restriction	(1974)	10,622	13.93	64.1	53.0	0.83	1.95*
Deficient Distant	(1975)	21,464	28.10	117.5	145.0	1.23	6.66***
Vision	(1974)	20,247	26.55	122.1	165,0	1.35	15.55****
Paraplegia	(1975)	160	0.21	0.9	--	--	+
	(1974)	154	0.20	0.9	--	--	+
Deafness	(1975)	79	0.10	0.4	--	--	+
	(1974)	87	0.11	0.5	1.0	2.00	+
Amputations	(1975)	812	1.06	4.4	3.0	0.68	0.47*
	(1974)	745	0.98	4.5	5.0	1.11	+

+ Expected value too small--cannot run X^2

* Not significant at 0.10

** Significant at 0.10

*** Significant at 0.01

**** Significant at 0.001

at 0.001), deficient distant vision (significant at 0.01), and blindness or absence of either eye (significant, we feel, at 0.10). The larger number of observed accidents for contact lens wearers and the smaller number for pilots with deficient color vision and a restriction were also considered significant at the 0.10 level.

When the accident experiences of airmen with each of the three static defects of major concern were compared with the total active airman population accident experience per unit of total (cumulative) and recent (6 months) exposure (see Table 2), both rates for airmen with blindness or absence of an

Table 2. Accident Rates per 100,000 Hours of Civilian Flight Time for Selected Static Defect Groups

Defect	Civilian Flight Hours Last 6 Months	 Cumulative to Date
Blindness or Absence of Either Eye	21.1***	0.7**
Deficient Distant Vision	11.0*	0.4*
Deficient Color Vision	15.0*	0.8***
Total Active Airman Population	11.6	0.4

* Not Significant ** Significant at 0.05 *** Significant at 0.01

eye were found to be significantly higher, the rates for those with deficient color vision were significant when total experience was used but not significant when calculated for recent exposure, and pilots with deficient distant vision had no significant difference in rates.

Since professional pilots are subject to more stringent screening criteria, both medically and for employment, fewer professional pilots are proportionately represented among the blindness or absence of either eye group than are known to exist in the population (2.5 vs. 4.5 percent). Further, since this analysis involved general aviation accidents exclusively, the question arises as to whether the different contributions of recent or cumulative flight hours to the denominator of the rates for the blindness or absence of either eye group versus the population could have had the net effect of artificially separating the rates when in fact no difference existed; i.e., since fewer professional pilots are in the blindness or absence group, less exposure would be contributed to the denominator than would be the case among the general population, thus inflating the former rate and deflating the latter rate.

Analysis was, therefore, carried out with professional pilots excluded from the comparison, and the result was an inflation of rates for both groups as expected. The difference between these was, however, still significant at the 0.05 probability level.

Review of the individual accident records revealed the following information: (i) Only two agricultural accidents involved monocular pilots. One involved fuel exhaustion during a swath run and, in the other, the pilot taxied into another aircraft; both were nonfatal. The FAA accident investigator noted the medical defect in his report of the taxiing accident, advised the Regional Flight Surgeon, and recommended reevaluation of the pilot through medical flight test procedures. (ii) Vision was noted by the authors as a possible causal factor in 7 more of the 35 accidents involving monocular pilots; however, in each case, the FAA investigator documented the defect but did not associate it with the cause of the accident in the narrative report. (iii) Of the 35 accidents involving pilots with blindness or absence of one eye, 9 of 35 were fatal; 3 occurred at dusk; 6 occurred at night; 6 of the 9 fatal accidents occurred under conditions of darkness, fog, rain, or haze; there were no midair collisions; and 14 of the 35 accidents occurred during landing, 3 while taxiing, and 10 on takeoff. (iv) Deficient color vision was not cited in the accident reports or considered a likely cause by the authors in any of the 61 accidents experienced by the pilots with deficient color vision but no restrictions. Of this group, 7 accidents were fatal, 6 accidents occurred at dusk and 7 at night, 22 accidents occurred on approach and landing, and 12 involved agricultural operations; there were no midair collisions. (v) The records for the defective distant vision group were not examined, but it is known from the agricultural operation accident records that 20 of the 144 accidents occurred during ag operations.

IV. Discussion.

Despite additional studies (2,3) and anecdotal evidence that report normal flying performance by monocular pilots, and our findings that the increased accident experience by this group in 1974 might be due to increased exposure, we now find on examining the 1975 accident data in greater depth that these pilots had a larger number of accidents than was expected, possibly because of their defects in some cases, and a significantly higher accident rate that was real and reproducible. Vision was cited as a possible cause in only 1 of the 35 accident reports. Again, as in the previous year, more accidents were observed than were expected at night and on landing. However, agricultural accidents, which were of particular concern in our earlier study, were reduced from six to two for this category. Mayer and Lane (4) have found that monocular pilots in Australia were involved in more hazardous events than were control pilots.

Some statistical artifact may explain the varied findings for the deficient color vision without restriction group. Since review of each of their accident reports failed to find any operational significance for their defect, there seems to be little reason for concern. However, there were more accidents than were expected empirically at night, on approach and landing, and during ag operation.

Deficient distant vision does not appear to be associated with an increased accident rate. This is consistent with another recent study of FAA data (5).

The contact lens group should receive special attention in a study of the 1976 accident data because marginal significance was found on analysis of the 1975 data, exposure data were not programed and accident rates could not be calculated, and, after 1976, this group will not carry a pathology code or require a waiver and thus will be difficult to study.

The accident rates that we have calculated are accidents in 1 year per 100,000 flight hours reported for 6 months and total civilian experience. A more conventional calculation would be accidents per 100,000 flight hours in 1 year, which would give one-half the values shown in our "last 6 months" column (Table 2). However, the relationship between the three pathology categories and the total airman population would remain the same and we feel that fewer problems are associated with this method of analysis than with an arbitrary extrapolation of recent flight time as currently reported.

V. Conclusions.

The increased accident experience of monocular pilots, which was observed in 1974 and again in 1975, appears to be real after analysis of accident rates per unit of exposure and examination of accident reports. Blindness or absence of other eye, contact lens use, and color vision defects with no restriction are deserving of special attention in analyzing the 1976 aircraft accident data, there appears to be little need to pursue the other five pathology categories on an annual basis.

In view of studies that show normal flying performance by monocular pilots and the paucity of accident/defect correlation in accident investigations, no changes in medical policies or standards seem indicated at this time. Further attention through medical flight tests, education, and accident investigation, in addition to data analysis, are planned.

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