Difference in General Aviation accidents involving Male and Female Pilots

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PARTICIPANTS & METHODS

This research utilized the NTSB aviation accident and incident database (eADMS) from 1982 to 2014 to examine the severity of accidents by gender. Each NTSB finding is coded by events such as occurrences, phases of flight, weather conditions, sky conditions, age and gender of pilot, etc. Of interest in these data were number of flight hours for the pilots, degree of damage to the plane (None, Minimal, Substantial, Destroyed), and degree of bodily injury (None, Minor, Serious, Fatal) (NTSB, 1998).

There were 74,686 entries in eADMS. For this study, commercial (14 CFR part 121 and 135) operations, home built aircraft, and gliders were excluded leaving 61,312 events. There were 56,284 (96.09%) male pilots and 2,287 (3.91%) female pilots. The average age for males pilots was 45.35 (*SD*=14.49) and for female pilots, 39.06 (*SD*=13.74). There was a statistically significant age difference, $t(57,829)=20.22$, $p<.001$. Consistent with the studies by Bazargan and Guzhva (2011) and Li et al. (2003) the variable for age was divided into six categories: younger than 20 years, 20-29, 30-39, 40-49, 50-59, and older than 60 years.

The mean number of flight hours for male pilots was 2,844.04 (*SD*=4,977, *sk*=3.59). For female pilots, the mean was 1,305.13 (*SD*=3395.52, *sk*=6.57). Given skew, difference between male and female pilots flight hours was examined using a Mann-Whitney *U* and was significant, $U(58,571)=4.31$, $p=.001$ (median hours for male pilots was 879, for female pilots 280).

The total number of flight hours was divided into five experience categories based on FAR Part 61 guidance consistent with Bazargan and Guzhva (2011). The five pilot experience categories where: Category I (New Pilots) for pilots with 99 or fewer hours of total flight time, Category II (Moderate Experience) for 100 to 299 hours of flight time, Category III (Fairly Experienced) for between 300 and 1999 hours, Category IV (Very Experienced) for between 2000 and 4999, and Category V (Most Experienced) for pilots with more than 5000 hours.

Differences between male and female pilots were analyzed using the Test for Significance of a Difference Between Two Independent Proportions. Proportional comparisons compensate for disparity in the number of male versus female pilots.

RESULTS

Damage to the plane for males and females combined was examined across FAR Part 61 experience levels. Experience Category (CAT) III had the highest level of incidents/accidents resulting in no damage to the aircraft (34.6%) with CAT I lowest at 8.3%. CAT V had the highest level of minor damage to the aircraft (30.8%) with CAT I lowest at 9.8%. For substantial damage, CAT III was highest (38.3%) with CAT I again lowest at 14.3%. And for destruction of the aircraft, CAT III was again the highest (41.2%) with CAT I lowest at 7.9%.

Injuries were also examined across experience levels for males and females combined. CAT III had the most incidents/accidents with no injuries (36.7%), with minor injuries (41.3%), with serious injuries (40.9%), and with fatalities (41.6%). CAT III was lowest for incidents/accidents with no injuries (15.4%), and CAT I was lowest for minor injuries (11.8%), serious injuries (9.9%), and fatalities (6.8%).

When injury was examined by gender without regard to the experience level of the pilots, females were significantly higher than males (60.7% and 56.8%, respectively) in incidents/accidents with no injuries ($z = 3.718$, $p < .05$). Females were significantly higher than males for incidents/accidents with minor injuries (17.3% and 14.3%, respectively, $z = 3.92$, $p < .05$) and, while not significant, for serious injuries (10.3% and 10% respectively, $z = .36$, $p > .05$). Females, were significantly lower than males in incidents/accidents with fatalities (11.7% and 18.8% respectively, $z =-8.59$, $p < .05$).

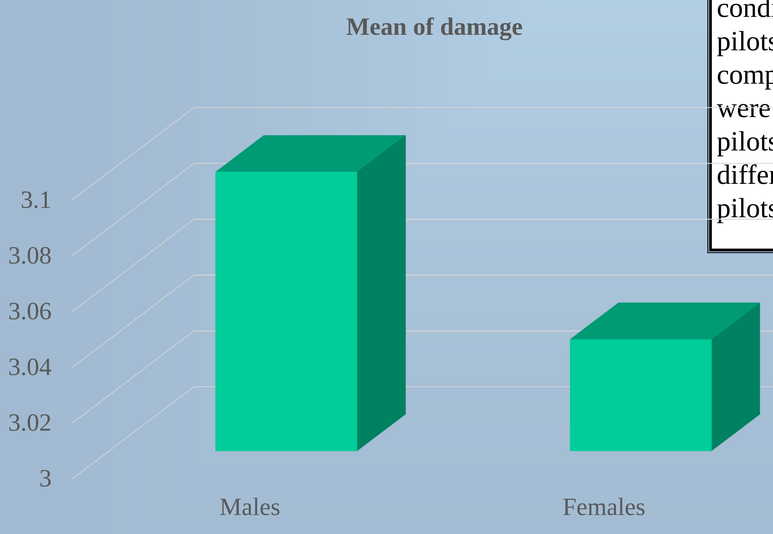
Damage to the aircraft was then examined by gender, based on FAR Part 61 experience levels. Female pilots were significantly higher than male pilots in the proportion of incidents/accidents with no damage to the aircraft through CAT II, then female pilots were significantly lower than male pilots for Categories III and IV and lower, but not significantly, for CAT V. The same pattern was seen for female pilots regarding incidents/accidents that resulted in minor damage to the aircraft--significantly higher than male pilots through CAT II, higher but not significantly so, at CAT III, lower, but not significantly so, at CAT IV, and significantly lower at CAT V. This pattern continued for incidents/accidents with substantial damage to the aircraft -- female pilots significantly higher than male pilots CAT I through CAT III, but significantly lower than male pilots for CAT IV and V. Female pilots were significantly higher than male pilots in destruction of the aircraft at CAT I and II, higher, but not significantly so, at CAT III, and significantly lower than male pilots at CAT IV and V.

The same pattern was seen when genders were examined for injury by FAR Part 61 experience levels. Female pilots had a significantly higher rate of incidents/accidents with no injuries at CAT I and II (34.0 and 20.3%, respectively) compared to male pilots (14.9 and 15.9%, respectively). By CAT III, female pilots were significantly lower than male pilots in the no-injury grouping (31.9 and 37.1%, respectively) and this continued through CAT IV and V for no injuries (female pilots at 7.8 and 6%, respectively compared to male pilots at 15.6 and 16.5%, respectively). Female pilots were also significantly higher than male pilots at CAT I and II in incidents/accidents with minor injuries, serious injuries, and fatalities. By CAT III, female pilots were significantly lower than male pilots in incidents/ accidents with no injuries and minor injuries, and lower, but not significantly so, in severe injuries and fatalities. By CAT IV and CAT V, female pilots were significantly lower than male pilots in the rate of incidents/accidents with minor and severe injuries and fatalities with the exception of fatalities at CAT IV--females were lower than males, but not significantly so.

Since aircraft complexity may be a factor, gender differences were examined for aircraft with two engines and retractable landing gear. Unfortunately, the number of female pilots dropped beyond the level of statistical analysis. When the data were examined for two engines, female pilots were significantly higher than male pilots on substantial damage at CAT I (1.23 and .56%, $z = 1.97$, $p<.05$). At CAT III, female pilots were significantly lower than males pilots on substantial damage (14.81 and 23.12%, $z=4.55$, $p<.05$) and destruction of the aircraft (12.56 and 27.92 %, $z= 4.90$, $p<.05$). There were no significant differences between female and male pilots at any damage level at CAT IV. At CAT V, female pilots were significantly higher than male pilots on substantial damage (53.79 and 45.70%, $z= 3.71$, $p<.05$) and destruction of the aircraft (56.74 and 38.66%, $z= -5.23$, $p<.05$).

When two-engine aircraft were examined for level of injury, female pilots were higher than male pilots at CAT III in incidents/accidents with no injuries (1.79 and 13,49%, $z = 2.60$, $p<.05$). There was a significant difference between male and female pilots for minor injuries at CAT III with males pilots higher (18.12 and 10.10%, $z = 2.01$, $p<.05$). The only other significant differences were with fatalities at CAT III with male pilots higher than female pilots (29.29 and 14.77, $z = 4.76$, $p<.05$) and at CAT V with female pilots higher than male pilots (54.74 and 38.52, $z = -.485$, $p<.05$).

Additional analyses indicated that female pilots at CAT III and above were significantly more likely to fly under Visual Flight Rules (VFR) than male pilots ($z=9.73$, male pilots=42.2% under VFR, female pilots=66.4% under VFR). Female pilots at CAT III and above were significantly more likely to fly under clear weather conditions than male pilots ($z=2.19$, male pilots flying in clear conditions =61.1% with female pilots=63.6%). Female pilots at CAT III and above were significantly more likely to fly under daylight conditions than male pilots ($z=6.77$, male pilots flying under daylight conditions=86.9%, female pilots=91.7%). Male pilots, proportionally, were significantly more likely to fly multi-engine aircraft as compared to female pilots ($z=2.87$, male pilots flying multi-engines=16.8% and female pilots=13.5%) and were significantly more likely to fly retractable landing gear aircraft compared to female pilots ($z=4.98$, male pilots flying retractable gear=35.5% and female pilots = 28.3%). There was no significant proportional difference between male and female pilots at Categories III and above to file flight plans ($z=.486$, male pilots=21.9% and female pilots=22.6%).



Experience Categories (CAT I, II, III, IV, V) by Injury Levels for Male and Female Pilots

Expressed as Percentages

FAR Part 61 Categories	*CAT I*	*CAT II*	*CAT III*	*CAT IV*	*CAT V*
	Male/Female	*Male/Female*	*Male/Female*	*Male/Female*	*Male/Female*
No Injury	14.9/34.0*	15.9/20.3*	37.1/31.9*	15.6/7.8*	16.5/6.0*
Minor Injury	10.9/31.3*	16.3/19.9*	41.8/36.4*	15.1/7.3*	15.9/5.1*
Serious Injury	9.6/16.27*	15.8/30.2*	41.2/37.0	17.1/9.8*	16.4/6.8*
Fatality	6.6/13.8*	15.0/21.3*	41.7/43.3	18.0/13.4	18.7/8.2*

*Significance of the difference in proportion, $z > 1.96$, $p <.05$

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Previous research has not supported, generally, any real differences between male and female pilots particularly in accidents rates by gender (Bazargan & Guzhva, 2011; Caldwell & LeDuc, 1998; Mitchell et al., 2005; Puckett & Hynes, 2011; Vail & Ekman, 1986). However, in this study, differences were found when experience was taken into account with female pilots significantly higher in accidents at lower experience levels as compared to male pilots, significantly lower in accidents at higher experience levels when compared to male pilots. Some research has suggested that these differences are the result of gender--that is, males are likely to be impulsive, take risk, and be less likely to plan the flight as compared to female pilots (Baker et al., 2001; Jonas, 2001). This research did not clarify aircraft accident types by gender as suggested by Baker et al.

These data seem to suggest that female pilots at higher levels of experience do fly under better conditions, i.e., clear skies, VFR conditions, during daylight hours, and during minimal weather, but not significantly more than male pilots. By counter, male pilots at higher levels of experience are flying more complicated aircraft with multi-engine and/or retractable landing gear. There does seem to be some difference between male and female pilots regarding damage or injury when twin-engine aircraft are examined. However, there does not seem to be the clear gender trend noticed in the general data and, indeed, the results seem more sporadic and without a clear pattern. Finally, the trend in the data suggest, in accordance with Baker et al., that female pilots tend to engage in less risky behavior.

The stereotypic beliefs identified by Mitchell et al. (2005) that females are less capable than males at all levels does not appear to be supported by this research, with some equivocation that could be entertained relative to twin-engine aircraft. The twin-engine aircraft data needs further exploration to see if a discernable pattern emerges.

Future research might focus on the age of pilots and the interaction of age and flying hours as an indicator of experience. In addition, future research should examine causes and phase-of-flight factors that might contribute to accidents.