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Suicide by Aircraft: A Comparative Analysis

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Introduction: Suicide is the 11th leading cause of death in the United States. The objective of this study is to document the characteristics of aviation-related suicides and suicide attempts. **Methods:** Aviation accidents reported by the National Transportation Safety Board between 1983 and 2003 were screened for cases in which suicide was listed as a probable cause. For each suicide case, two accidents were randomly selected as controls, matched on sex of pilot, type of flight, state, and year of occurrence. Mantel-Haenszel summary Chi-square tests were used to compare cases to controls. Conditional logistic regression modeling was performed to assess the association of pilot and flight characteristics with suicide-related crashes. **Results:** During the 21-yr study period, 37 pilots committed or attempted suicide by aircraft, with 36 resulting in at least one fatality. All the cases were men and involved general aviation flights. Toxicological test results revealed that 24% of the cases had used alcohol and 14% had used other illicit drugs. Underlying factors included domestic and social problems (46%), legal trouble (40%), and pre-existing psychiatric conditions (38%). Compared with controls, suicide cases involved younger pilots ($p < 0.05$), were less likely to have another occupant ($p < 0.0001$), were more destructive to the aircraft ($p < 0.0001$), and were more likely to have occurred away from the airport ($p < 0.0001$). **Conclusion:** Aviation crashes caused by suicide differ from unintentional aviation accidents in pilot characteristics, crash circumstances, and outcomes. **Keywords:** human factors, intentional death, self-destructive behavior.

IN 2001, THE NATIONAL Institutes of Mental Health reported suicide as the 11th leading cause of death (30,622 in total), with a death rate of 10.6 per 100,000 persons. In the last 45 yr suicide rates have increased by 60% worldwide. The marked rise in suicide mortality only conveys a portion of the story, as estimates indicate that for every 1 completed suicide there are 8 to 25 attempts (14). Aviation-related suicides have been reported with some regularity over the last 40 yr. The National Transportation Safety Board (NTSB) first documented suicide with the use of an aircraft as early as 1964. Since that time over 70 aviation accidents were reported with suicide as a cause or probable cause of the crash (15).

Early studies included the analysis of six aviation-related suicides by Gibbons et al. (6). Case histories ranged from a woman grieving over a recurrence of cancer, to an individual who received a medical discharge from the military after being involved in a mine explosion. Observed common factors (among at least three of the six cases) included a history or current use of drugs and alcohol and acrobatics prior to the crash. All but one of the cases involved an individual over 40 yr of age. Gibbons and colleagues (6) urged investigators to consider some crashes as volitional acts based on the characteristics among pilot suicides.

Case reports presented by Goldney (7) and Jones (8) furthered understanding of the suicidal pilot. Cullen (3) documented three cases of aviation-related suicide in the United Kingdom from 1970–1996. Ungs (17) detailed a case series of nine aviation suicides in the United States from 1979–1989; all involved men and general aviation flights.

Yanowitch et al. (19) examined the psychology of the self-destructive pilot. The authors emphasized the close relationship a pilot has with his/her plane as a way of presenting the various stresses that lead a pilot to engage in potentially harmful behavior while in flight. Introduction to their argument was made through presentation of an individual case study, in which a 33-yr-old male pilot engaged in self-destructive behavior while flying. Yanowitch et al. (19) argued that the pilot had crashed his plane due to accumulated daily life stress.

Past studies are limited to case reports and small case series and lacked either an internal or external comparison group. The present study examines the characteristics of aviation-related suicides for a 21-yr study period, from 1983–2003, as compared with aviation accidents in which suicide was not the cause of the crash.

METHODS

Aviation crashes involving general aviation (14 CFR 91), major airline (14 CFR 121), and commuter/air taxi (14 CFR 135) flights reported by the NTSB between 1983 and 2003 were screened for cases in which suicide was listed as a probable cause. A cause is defined as an element that played an essential role in the event. The NTSB uses standardized forms (including the Factual Report: Form 6120.4) to report all civilian aviation crashes in the United States. Narratives were also used to obtain contextual information relevant to the crash. Crashes in which suicide was a probable cause in the

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NTSB reports were considered as cases for this study. Only pilot-related suicides were analyzed; suicides involving ground persons and passengers were excluded from the study.

Individual pilot, plane, and environmental characteristics akin to each crash were collected and analyzed. Toxicological test results reported by the NTSB were used to calculate the percentage of pilots who had alcohol, illicit drugs, and prescription medication in their system at the time of death. Pilots' social and cultural characteristics were also collected, including psychiatric conditions, domestic and social problems, legal trouble, and the presence of a suicide note. Such variables are reported by the NTSB in narratives based on information from relatives, law enforcement officials, and physicians.

For each suicide case, two aviation accidents in which suicide was not a probable cause were randomly selected as controls matched on the sex of pilot, type of flight, state, and year of occurrence. Both cases and controls were taken from the same NTSB database. To take into account the matched case-control design, Mantel-Haenszel summary Chi-square tests (9) were used to compare cases to controls at the bivariate level. Variables analyzed included basic weather conditions during the flight, time of the crash, day of the week, month, presence of a fire, damage to the aircraft, location of crash, presence of another occupant, age of the pilot, and whether the pilot was fatally injured.

Univariate conditional logistic regression modeling was performed on variables relating to pilot characteristics and crash circumstances, such as pilot age, month of crash, location of crash, and presence of another occupant. A multivariate model was also constructed using variables that were significant from the Mantel-Haenszel summary Chi-square tests; these included pilot age, month of crash, and location of crash. Presence of a fire, damage to the aircraft, and whether or not the pilot was fatally injured were not included in the multivariate model because these variables were measures of the outcome of the crash. Presence of another occupant was not included in the multivariate model because only one suicide case involved a pilot not flying alone, which made the multivariate model inestimable due to the lack of convergence. Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CI) were used to assess the associations of individual variables with aviation-related suicide.

RESULTS

During the 21-yr study period 36 pilots committed, and 1 attempted, suicide by aircraft (exclusive of EgyptAir Flight 990 on October 31, 1999, as suicide was not listed as a probable cause in any of the NTSB accident reports, and the 4 terrorist attacks on September 11, 2001). An additional 8 suicide events involved passengers and ground persons and more than 10 crashes reported suicide as possible, but results submitted by either the coroner's office, medical examiner, or established by the NTSB were inconclusive. Only the 37 cases of suicide involving pilots were included in this study. Of the 37 cases, all pilots were men and all flights

TABLE I. PERCENTAGES OF AVIATION-RELATED SUICIDES BY PILOT CHARACTERISTICS AND CRASH CIRCUMSTANCES.

Characteristic	No.	%
Age		
15-39	18	48.6
40+	19	51.4
Toxicological test results		
Alcohol	9	24.3
Prescription Drugs	8	21.6
Illegal Drugs	5	13.5
Psychiatric condition		
Yes	14	37.8
No	23	62.2
Domestic and social problems		
Yes	17	45.9
No	20	54.1
Legal trouble		
Yes	15	40.5
No	22	59.5
Suicide note		
Yes	19	51.4
No	18	48.6
Extent of damage		
Destroyed	35	94.6
Substantial	2	5.4
Total number of injuries		
0	1	2.7
1	35	94.6
> 1	1	2.7
Fatality		
Yes	36	97.3
No	1	2.7
Fire		
Yes	8	21.6
No	29	78.4
Location of crash		
On airport	4	10.8
Off airport	33	89.2
Basic weather condition		
Instrument meteorological	1	2.7
Visual meteorological	36	97.3
Month of crash		
October-March	23	62.2
April-May	14	37.8
Time of crash		
7:00 AM-6:59 PM	26	70.3
7:00 PM-6:59 AM	11	29.7
Day of week		
Saturday-Sunday	15	40.5
Monday-Friday	22	59.5
Seats		
1-2	14	37.8
3+	23	62.2
Second pilot		
Yes	1	2.7
No	36	97.3
Plane taken unlawfully		
Yes	9	24.3
No	28	75.7

were general aviation (Part 91) flights, with 36 resulting in pilot fatality and 1 resulting in death to a passenger.

Toxicological test results revealed that 24% of the pilots were positive for alcohol, 22% for prescription drugs (e.g., citalopram, diazepam, fluoxetine, diphenhydramine, coumadin, and temazepam), and 14% for illicit drugs (e.g., cocaine and marijuana) (Table I). Pre-existing domestic and social problems were noted as a contributing factor in 46% of cases, followed by legal trouble (41%), and psychiatric conditions (38%). Of 19 cases with domestic and social problems, 14 in-

TABLE II. COMPARISON OF SUICIDE CASES AND NON-SUICIDE CONTROLS.

Characteristic	Suicides		Non-suicides		Mantel-Haenszel p-value
	No.	%	No.	%	
Basic Weather Condition					
Instrument meteorological	1	2.7	5	6.8	
Visual meteorological	36	97.3	69	93.2	0.3754
Pilot age (yr)					
≤ 39	18	48.6	21	28.4	
≥ 40	19	51.4	53	71.6	0.0358
Time of Crash					
7:00 AM-6:59 PM	26	70.3	63	85.1	
7:00 PM-6:59 AM	11	29.7	11	14.9	0.0652
Month of crash					
October-March	23	62.2	28	37.8	
April-September	14	37.8	46	62.2	0.0150
Presence of another occupant					
Yes	1	2.7	44	59.5	
No	36	97.3	30	40.5	< 0.0001
Day of week					
Saturday-Sunday	15	40.5	31	41.9	
Monday-Friday	22	59.5	43	58.1	0.8921
Fatality to pilot					
Yes	36	97.3	12	16.2	
No	1	2.7	62	83.8	< 0.0001
Aircraft damage					
Destroyed	35	94.6	15	20.3	
Substantial	2	5.4	59	79.7	< 0.0001
Location of crash					
On airport	4	10.8	42	56.8	
Off airport	33	89.2	32	43.2	< 0.0001
Fire					
Yes	8	21.6	9	12.2	
No	29	78.4	65	87.8	0.1941

involved marital and relationship troubles, including denied marriage proposals, failed marriages, and extra-marital affairs; distress over the death or health of a relative was reported in 3 cases; 2 included problems with one's employer/employment; and 1 case noted familial estrangement. Indications of legal trouble were also varied. "Criminal investigation" or "illegal activity" was reported in four cases and familial disputes in three. Individuals were also implicated in or charged with the following criminal activity: felony theft, a pyramid scheme, "lewd and lascivious conduct with a minor," arson, and a fatal hit-and-run car accident. Detailed information was available for only 5 of 14 pilots with psychiatric conditions: 4 had depression and 1 had a substance abuse disorder.

Of the 37 pilots studied, 51% left a suicide note (Table I). Damage to both pilot and plane in all 37 crashes was extensive. Suicide cases occurred throughout the year, though the majority occurred between October and March (62%). Locations of suicide crash sites were varied (e.g., buildings, water, open fields, mountains, and cliffs) as 89% occurred off airports. All but 1 of the 37 pilots flew alone and 9 of the planes used for suicide were taken unlawfully or without adequate permission (Table I).

Several pilot characteristics were significantly associated with aviation-related suicides (Table II). Compared with accident controls, suicide cases involved younger pilots ($p < 0.05$), were less likely to have another occupant ($p < 0.0001$), had more serious damage to the aircraft ($p < 0.0001$), were more likely to have

occurred away from the airport ($p < 0.0001$), and to have occurred between October and March ($p < 0.05$). Differences between cases and controls in basic weather conditions and other variables were not statistically significant.

The association between flight-related variables and a suicide crash was also assessed through conditional logistic regression (Table III). The absence of another occupant was the strongest predictor of suicide cases, with an odds ratio of 38.67 (95% CI = 5.20–287.36). The odds of suicide for crashes involving pilots younger than 40 yr old were five times the odds for crashes of pilots 40 yr old and over (OR = 5.19, 95% CI = 1.28–21.07). Crashes occurring off the airport were over 15 times as likely to result from suicide as those occurring on the airport (OR = 15.54, 95% CI = 3.87–62.40).

DISCUSSION

Characteristics specific to the life of the pilot, including one's mental health history and past domestic and social relationships, are important variables in determining crashes as suicide-related. Aviation-related suicides differ from other accidents in pilot characteristics, crash circumstances, and outcomes, such as age of the pilot, crash location, and absence of another occupant. Characteristics specific to the life of the pilot, or activities taken on just prior to or during the flight itself were revealing. General literature on suicide notes similar qualities to those presented by pilots who committed suicide (11,16). For example, 25% of all suicides may be

TABLE III. CRUDE AND ADJUSTED ODDS RATIOS (ORs) OF SUICIDE-RELATED AVIATION CRASHES AND 95% CONFIDENCE INTERVALS (CIs) FROM UNIVARIATE AND MULTIVARIATE CONDITIONAL LOGISTIC REGRESSION MODELS.

Characteristic	Crude OR	95% CI	Adjusted OR	95% CI
Pilot age (yr)				
≥ 40	1.00		1.00	
≤ 39	2.45	1.05–5.72	5.19	1.28–21.07
Month of crash				
April–September	1.00		1.00	
October–March	2.84	1.20–6.72	2.61	0.75–9.05
Location of crash				
On airport	1.00		1.00	
Off airport	10.46	3.09–35.39	15.54	3.87–62.40
Presence of another occupant				
Yes	1.00		—	
No	38.67	5.20–287.36	—	—

attributed to alcoholism (13). The risk of suicide among individuals who abuse alcohol is 60 to 120 times that of the general population (4). In the present study we were unable to assess the association of alcohol and illicit drug use with aviation-related suicide because compatible toxicological data were not available for the control group, as 84% of the pilots in the control group survived the crashes.

The National Institutes of Mental Health (14) indicates that 90% of suicides are committed by individuals suffering from some form of mental illness. A far fewer percentage of aviation-related suicides reported a history of a psychiatric condition. Gibbons et al. (6) has shown that pilots concealed important mental health information on their medical examination form. Some pilots went to great lengths to distance themselves from physicians and health practitioners who had overseen prior psychiatric treatment. Concealment may serve as a protective measure, allowing the pilot to continue flying, as well as a means of avoiding the social stigma surrounding suicide. Mental well-being is an important measure of a pilot's fitness for flight, and diagnosed psychiatric problems may present sufficient reason to restrict pilots from flight activity. A history of attempted suicide or suicidal behavior can be grounds for disqualification of a pilot's medical certification by the FAA (5).

Domestic and social problems were also observed in a number of cases. Rates of suicide have been shown to be higher among those never married, divorced, or widowed, as compared with those who were married (20). Mitigating factors, such as the impact of post-divorce legal proceedings, may also strengthen the relationship between domestic problems and suicide (12). Although the relationship between suicidal behavior and social and psychiatric issues has been well studied, far fewer have noted the impact of legal troubles on the decision to end one's life. In this study 41% of pilots were implicated in a legal matter.

The finding that all but one suicide crash occurred in flights without any occupant other than the pilot indicates the pilot's intention to hurt himself and not others. For many pilots the act of suicide was extremely private, as the majority of pilots crashed in non-pedestrian areas, choosing instead to crash in remote waters, mountains, and open fields. The decision of where to crash one's plane appeared to be an explicit choice;

while speaking to a controller, a pilot stated, "I prefer water. . . As you might have guessed I have not had a good day. . . I'm going swimming tonight" (15).

Misconceptions, social stigma, impact on survivors' and insurance benefits, and lack of evidence surrounding crash events may have led to underreporting of suicide by aircraft. Suicidal individuals often disguise their actions, and friends and relatives are often unable to recognize the reality of suicide. The use of alcohol and other drugs in flight may serve to mask an individual's intentions of death. The plane itself may also be used as a tool to conceal a suicide. Unconscious self-destruction, in which one lives carelessly and dies, is generally not defined as suicide.

Although most completed suicides are well planned, there is evidence that suicides can be contained by external factors. In the United States, states with more stringent firearm control laws report significantly lower rates of suicide (1,2). Higher rates of suicide have also been reported in homes where there is ready access to firearms, as opposed to those where access is limited (10). The use of an aircraft as a means of killing oneself may also be a matter of access. In the present study 24% of the crashed planes were taken illicitly. The function of restricting access is medical, related to an individual pilots' mental and physical health, and environmental, related to the setting of the plane and airport. Intensive scrutiny of pilots' medical certificates, advocating for closer watch of small airports, and of pilots training on general aviation aircraft, may serve to decrease numbers further, and also aid in reducing other aviation-related injuries.

The United Nations (18) promotes four steps (limiting means, treating mental illness, promoting social networks, and changing social norms) toward preventing suicide. The freedom of flying should be balanced with the safety of individuals at risk of suicide. While the aviation suicide is a single act, it is representative of a set of distinct behaviors over a longer period of time. Understanding behaviors—the psychological stressors and cultural factors—as they are applied to the use, or potential misuse of an airplane, is important for supporting individuals who may be contemplating suicide, and could lead to more effective means of reducing mortality and injury associated with suicide.

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