Pilot Certification, Age of Pilot, and Drug Use in Fatal Civil Aviation Accidents

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INTRODUCTION: This study examined the association between mean age of pilot, pilot license, pilot medical certificate and drug use trends in pilots fatally injured in aircraft accidents. The prevalence of prescription drugs, OTC drugs, controlled drugs and drugs that may be potentially impairing was also examined.

METHODS: This study was a descriptive observational study in which the NTSB Aviation Accident Database was searched from the period beginning January 1, 2012 to December 31, 2014.

RESULTS: During the study period a total of 706 accidents involving 711 fatalities were investigated by the NTSB. This study included 633 of these accidents, involving 646 fatalities. Of these pilots, 42.1% had drugs in their biological samples. The prevalence of prescription drugs, controlled drugs, OTC drugs, opioids, and potentially impairing drugs in the fatally injured pilot population over the study period was 28.9%, 15.0%, 20.1%, 5.1%, and 25.5%, respectively. Pilots with any drugs in their samples were significantly older than those without drugs. Medical certificate held was associated with drug use; pilots who held third class certificates had the highest prevalence at 54.1%. Pilot license was not associated with drug use. In 3.8% of the accidents, drugs were a contributing factor in the cause.

DISCUSSION: Despite current FAA medical regulations, potentially impairing drugs are frequently found in biological samples of fatally injured pilots in the U.S. More education of airmen by aviation medical examiners is needed on the safety of drug use.

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Prescription drug use in the U.S. continues to increase among the adult population.[9] Over the past decade, the percentage of Americans who took a prescription drug in the past month increased by 10% and the use of multiple prescription drugs increased by 20%.[9] The percentage of physician office visits involving drug therapy is 75.1%, and the most frequently prescribed therapeutic drugs in these office visits are analgesics, antihyperlipidemic agents, and antidepressants.[9] The pilot population is a subset of the general U.S. population and hence some of these prescribed drugs may be for pilots.

The use of any illicit drug in the past 30 d in persons ages 12 yr and over in the U.S. shows an increasing trend from 8.3% in 2002 to 9.4% in 2013, and the use of marijuana also increased from 6.2% in 2002 to 7.5% in 2013.[11] Nonmedical use of any psychotherapeutic drug in the same study was decreased from 2.7% in 2002 to 2.5% in 2013.[11]

Over-the-counter (OTC) drugs, especially cough, cold, and nonsteroidal anti-inflammatory drugs are commonly abused by the general population, and pilots may do so as well. The active ingredients of some cold and prescription cough suppressants are psychoactive and some persons may take these drugs in higher doses for their psychoactive effects.[12] The most commonly abused psychoactive cough suppressants contain dextromethorphan (DXM) and promethazine-codeine.[12] DXM when taken in higher doses may produce dissociative effects, euphoria, and hallucinations. Promethazine-codeine containing cough syrups when taken in high doses will produce the opioid effects of codeine (relaxation and euphoria) and the effects (sedation) of the antihistamine promethazine. DXM is abused by young persons as "Robo-tripping" or "Triple-C," and promethazine-codeine cough syrups are abused as "Purple Drank," which are increasingly popular with young people.[12]

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These drugs, if abused by the aircrew population, could pose a risk to flight safety.

The present study examined the prevalence of medication use and drugs of abuse in the biological samples of pilots fatally injured in civil aviation accidents in the United States from 2012 to 2014, and correlated this data with pilot age, type of pilot license, and pilot medical certificate. The study is a follow-on to four previous studies which examined the prevalence of substances found in toxicological studies of pilots fatally injured in the United States. The first three studies were for the 5-yr periods 1994–1998,[2] 1999–2003,[4] and 2004–2008.[1] The fourth study extended from 2009–2013, and compared trends across five 5-yr periods beginning in 1989.[5] This study is different in that it expands on determining prevalence by assessing associations between pilot characteristics and specific types of drugs.

METHODS

Subjects

The study subjects were general aviation pilots involved in fatal accidents in the U.S. from January 1, 2012 to December 31, 2014. The study was reviewed by the Wright State University Institutional Review Board and determined to be exempt from approval.

Procedure

The National Transportation Safety Board (NTSB) conducts objective, precise accident investigations and safety studies.[13] Biological samples from pilots in fatal accidents are sent to the Federal Aviation Administration (FAA) Civil Aerospace Medical Institute (CAMI) for toxicological analysis. This study was a descriptive observational study in which the NTSB Aviation Accident Database was searched from January 1, 2012 to December 31, 2014. All accidents occurring in the U.S., with final reports, for any type of aircraft in which the pilot and/or copilot were fatally injured were included. Demographic information, including age, number of flying hours, pilot certification and medical certificate, and drugs found in the toxicological analysis of biological samples was extracted from the database.

The class of medical certification that the pilots held at the time of the accident was obtained from the NTSB database. Under Title 14 of the Code of Federal Regulations a medical certificate is defined as acceptable evidence of physical fitness and form prescribed by the administration.[17] Medical certifications require physical examination by an FAA-designated Aviation Medical Examiner and are divided into first, second, and third classes. Briefly, first class medical certification is required for airline transport pilots and is valid for 12 mo for pilots under age 40 yr and 6 mo for pilots ages 40 and above; second class is required for commercial pilots and is valid for 12 mo; third class applies to private, student, and recreational pilots and is valid for 5 yr for pilots under age 40, and 2 yr for pilots ages 40 and above. The complete definitions for the classes are available on the Electronic Code of Federal Regulations (e-CFR) website.[17]

Light sports aircraft pilots need either a medical certificate or U.S. driver's license to fly; those without first, second, or third class medical certification were included as a separate class in the analyses of medical certification.

Drugs were classified as prescription, OTC, illicit, controlled, opioids and potentially impairing drugs. Definitions of the categories are shown in **Table I**. The categories are not mutually exclusive; drugs that fell into more than one category were counted in each.

The medical indications of the drugs were also analyzed. Drugs found in the biological samples that were excluded were combustion substances, i.e., carbon monoxide and cyanide, emergency drugs used during cardiopulmonary resuscitation, and ethanol. Ethanol was excluded because some of the ethanol found in pilots was due to putrefaction, and although some were confirmed as due to ingestion, most could not be confirmed as either way. The prevalence of drugs in the pilot population was described and compared with the prevalence of these drugs in the U.S. adult population.

Information about whether the drugs found in the pilots were considered to have contributed to the cause of the accident was extracted from the probable cause field of the NTSB database.

Statistical Analysis

Categorical variables were summarized with frequencies (percent of non-missing data) and age was summarized with means (SD) and range. Associations between pilot characteristics and drug use were determined with Chi-squared tests or Fisher's exact tests, depending on the sample sizes for each comparison. Chi-squared tests for trend were used to determine whether linear trends occurred in drug use from 1994–2014 using data from previously published studies. Age was compared between groups with two-sample *t*-tests. SPSS version 24.0 (IBM Corporation) was used to perform the analyses. P values less than 0.05 were considered statistically significant. Pilot records that were missing data for one or more of the variables age, medical certification, and pilot license were included in the study; therefore sample sizes differed for analyses of these variables.

RESULTS

From January 8, 2012 to December 31, 2014, a total of 706 accidents that involved at least one fatality were investigated by the NTSB. At the time of this study, 73 (10.3%) were still in the preliminary stage of the investigation and hence were excluded. The remaining 633 accidents involved 711 pilot or copilot fatalities. The majority of the aircraft were airplanes (84.7%), followed by helicopters (9.0%), gliders (1.9%), and other types (4.5%).

The mean (SD) age of the pilots was 56 (15) yr, and ranged from 17–92 yr ($N = 698$). Only 175 pilots had data for gender, two of whom were women. The majority of pilots with non-missing data for medical certification (358/696, 51.4%) held third class medical certificates; 90 (12.9%) had first class, 186 (26.7%) had second class, 18 (2.6%) had sport pilot medical

Table I. Classification and Definitions of Drugs.

DRUG CLASSIFICATION	DEFINITION
Prescription	A drug that requires written authorization by a physician or medical practitioner.
Over-the-counter[6]	A drug that can be obtained that does not require authorization by a physician or medical practitioner.
Illicit[6]	A drug that is unlawful, illegal or prohibited. The FAA definition includes drugs that are used illicitly but may also be therapeutic medications, such as amphetamines, methamphetamines, and marijuana.
Controlled substance[16]	A drug regulated by the Federal Government under the Controlled Substances Act of 1970, divided into five schedules.
Schedule I	Substances with no currently accepted medical use in the U.S., a lack of accepted safety for use under medical supervision and a potential for abuse.
Schedule II	Substances with a high potential for abuse which may lead to severe psychological or physical dependence.
Schedule III	Substances with potential for abuse less than substances in schedule I or II, and abuse may lead to moderate or low physical dependence or high psychological dependence.
Schedule IV	Substances with low potential for abuse relative to schedule III substances.
Schedule V	Substances with low potential for abuse relative to schedule IV, consisting primarily of drugs with limited quantities of certain narcotics.
Opioid[3]	Natural or synthetic chemicals that reduce feelings of pain.
Potentially impairing[7,14]	Drugs that have the potential to affect the performance of the pilot.

certificates, and 44 (6.3%) did not have medical certificates. Of 703 with pilot certification data, 46.1% were private, 20.9% commercial, 15.1% airline transport pilot, 9.8% certified flight instructor, 3.3% student, 2.0% sport, and 0.4% foreign; 17 (2.4%) did not have a pilot certification.

Of the 711 pilots, 646 (90.9%) had toxicology performed on biological tissue samples sent to the CAMI toxicology laboratory; 65 did not have toxicology results, either because not enough biological samples could be obtained or the remains could not be recovered. For the 646 pilots with toxicology results, 262 (40.6%) were from 2012, 210 (32.5%) from 2013, and 174 (26.9%) from 2014.

Drugs were found in the biological samples of 272/646 (42.1%) pilots. **Tables II** and **III** show the drug names, classification, and number of pilots with the drug in their samples for nonimpairing (Table II) and potentially impairing drugs (Table III).

For potentially impairing prescription, OTC, and illicit drugs, overlapping classifications as controlled substances and/or opioids are indicated next to the drug name. For each of the three years, prescription drugs were the most common substances. Pilots with data on age who had drugs in their sample ($N = 266$) were significantly older than pilots who did not have drugs in their sample ($N = 371$) (**Table IV**). Ages of the pilots with the different drug categories detected compared to pilots with negative results are shown in Table IV.

Among the 272 pilots with drugs detected, 15 (5.5%) had only illicit drugs in their tissues, 69 (25.4%) had only OTC drugs, and 121 (44.5%) had only prescription drugs. The majority of pilots (47.1%) had one drug detected, but the number ranged up to seven. Some pilots had more than one category of drugs in their biological tissue sample. Six pilots had a combination of illicit drugs and prescription drugs, one pilot had both OTC and illicit drugs, 58 had both OTC and prescription drugs, and two pilots had OTC and prescription drugs as well as illicit drugs.

Of the 646 pilots, 187 (28.9%) had prescription drugs in their sample (68.8% of the 272 with drugs detected). Pilots that had prescription drugs in their sample were generally older than pilots without prescription drugs (Table IV). Metoprolol was the most common prescription drug, found in 27 (14.4%) pilots; amlodipine was found in 26 (13.9%), rosuvastatin in 21 (11.2%), and valsartan in 14 (7.5%).

Table II. Non-Impairing Drugs Found in Pilots' Biological Samples.

DRUG NAME AND CLASSIFICATION	NO. OF PILOTS	DRUG NAME AND CLASSIFICATION	NO. OF PILOTS	DRUG NAME AND CLASSIFICATION	NO. OF PILOTS
		PRESCRIPTION			
Amlodipine	26	Irbesartan	2	Ranitidine	12
Atenolol	9	Labetalol	1	Rosuvastatin	21
Atorvastatin	13	Losartan	11	Tadalafil	1
Benazepril	1	Metoprolol	27	Tamsulosin	6
Carvedilol	4	Minoxidil	2	Telmisartan	1
Clopidogrel	1	Nadolol	1	Terazosin	3
Clorthalidone	1	Naltrexone	1	Ticlopidine	1
Doxazosin	2	Naproxen	10	Triamterene	2
Enalapril	3	Pioglitazone	4	Trimethoprim	2
Hydrochlorothiazide	2	Pravastatin	2	Valsartan	14
Indomethacin	3	Ramipril	1	Verapamil	3
		OVER-THE-COUNTER			
Acetaminophen	23	Famotidine	3	Oxymetazoline	6
Aspirin	28	Fexofenadine	5	Pseudoephedrine	7
Diclofenac	4	Ibuprofen	19	Yohimbine	4
Ephedrine	2	Loratadine	1		

Table III. Potentially Impairing Drugs Found in Pilots' Biological Samples.

DRUG NAME AND CLASSIFICATION	NO. OF PILOTS	DRUG NAME AND CLASSIFICATION	NO. OF PILOTS	DRUG NAME AND CLASSIFICATION	NO. OF PILOTS
		PRESCRIPTION			
Alprazolam (CS-IV)	2	Gabapentin	3	Phentermine (CS-IV)	1
Amitriptyline	2	Glipizide	2	Pramipexole	2
Azacyclonol	2	Glyburide	1	Quetiapine	1
Buprenorphine (CS-II, OP)	2	Hydrochloroquine	1	Quinidine	1
Bupropion	4	Hydrocodone (CS-II, OP)	9	Quinine	1
Buspirone	1	Lamotrigine	1	Rizatriptan	1
Carbamazipine	2	Lorazepam	2	Sertraline	5
Citalopram	13	Methadone (CS-II, OP)	1	Sildenafil	6
Clonazepam (CS-IV)	3	Methylphenidate (CS-II)	1	Tamoxifen	1
Clonidine	2	Midazolam (CS-IV)	1	Temazepam (CS-IV)	3
Cyclobenzaprine	1	Mirtazapine	1	Tramadol (CS-IV, OP)	5
Diazepam (CS-IV)	2	Morphine (CS-II, OP)	3	Trazodone	2
Dihydrocodeine (CS-II, OP)	4	Nortriptyline	1	Valproic Acid	1
Diltiazem	3	Olanzapine	1	Venlafaxine	2
Doxepin	1	Ondansetron	1	Warfarin	9
Duloxetine	1	Oxazepam (CS-IV)	5	Zolpidem (CS-IV)	11
Flecainide	1	Oxycodone (CS-II, OP)	2	Zopiclone (CS-IV)	2
Fluoxetine	4	Paroxetine	6		
		OVER-THE-COUNTER			
Ceterizine	10	Diphenhydramine	38	Pheniramine	2
Chlorpheniramine	3	Doxylamine	8	Promethazine	1
Dextromethorphan (CS-V, OP)	11				
		ILLICIT			
Amphetamine (CS-II)	4	Marijuana (CS-I)	20	Methylone (CS-I)	1
Cocaine (CS-II)	1	Methamphetamine (CS-II)	3		

CS = controlled substance; I = schedule I; II = schedule II; IV = schedule IV; V = schedule V; OP = opioid. Drugs that fall into more than one category are counted in each of the categories they fall into.

OTC drugs were detected in 130/646 (20.1%) pilots. This is almost half (47.8%) of the 272 pilots who had tested positive for drugs. Pilots who had OTC drugs detected were slightly younger than pilots who tested positive but had no OTC drugs (Table IV). Diphenhydramine was the most common OTC drug, detected in 38/646 (5.9%) pilots. Among the 130 pilots that had OTC drugs found in toxicological analysis, 38 (29.2%) had diphenhydramine, 28 (21.5%) had aspirin, and 23 (17.7%) had acetaminophen. Eleven pilots (4%) had dextromethorphan detected. The herbal substance yohimbine was detected in four pilots.

Of the 646 pilots, 24 (3.7%) tested positive for illicit drugs. Pilots with illicit drugs in their tissues were significantly younger than those who did not have illicit drugs (Table IV). Marijuana was the most abused illicit drug, detected in 20 of the 24 (83.3%) pilots with illicit drugs. Four (16.7%) pilots had amphetamine/methamphetamine in their biological samples, one (4.1%) had cocaine, and one (4.1%) had methylone detected.

There were 165 pilots (25.5% of all 646; 60.7% of the 272 pilots with detected drugs) who had potentially impairing drugs detected. Pilots who tested positive for potentially impairing drugs were younger than pilots who did not have potentially impairing drugs. Of the 646 pilots, 74 (11.5%) had controlled drugs detected. Of the 74, 20 (27.0%) had schedule I drugs, 30 (33.8%) had schedule II, 28 (37.8%) had schedule IV, and 11 (14.9%) had schedule V drugs in their tissue samples. Pilots who had controlled drugs detected were generally younger than pilots who did not have controlled drugs detected. Of the 646

Table IV. Ages of 266 Pilots with Detected Drug Types.

TYPE OF DRUG	PILOTS WITH DRUG IN SAMPLE AGE (YR)	PILOTS WITHOUT DRUG IN SAMPLE AGE (YR)	*t* STATISTIC	df	*P* VALUE
Any drug	60.0 (13.0); $N = 266$	52.0 (14.9); $N = 371$	-7.000	635	<0.001
Prescription	63.0 (12.0); $N = 183$	53.2 (12.4); $N = 83$	-6.064	264	<0.001
OTC	58.2 (12.3); $N = 127$	61.5 (13.4); $N = 139$	2.100	264	0.037
Illicit	48.0 (11.0); $N = 23$	61.1 (12.6); $N = 243$	4.795	264	<0.001
Controlled					
Schedule I-II, IV-V	56.3 (12.1); $N = 71$	61.3 (13.1); $N = 195$	2.786	264	0.006
Schedule I	47.4 (11.8); $N = 19$	60.9 (12.6); $N = 247$	2.529	264	<0.001
Schedule II	55.6 (10.1); $N = 24$	60.4 (13.2); $N = 242$	1.719	264	0.087
Schedule IV	61.4 (9.9); $N = 27$	59.8 (13.3); $N = 239$	-0.601	264	0.548
Schedule V	61.9 (12.7); $N = 11$	59.9 (13.0); $N = 255$	-0.512	264	0.609
Opioids	60.0 (10.5); $N = 32$	59.9 (13.3); $N = 234$	-0.184	264	0.854
Potentially impairing	58.4 (12.7); $N = 162$	62.4 (13.0); $N = 104$	2.461	264	0.015
Dextromethorphan	61.9 (12.7); $N = 11$	59.9 (13.0); $N = 255$	-0.512	264	0.609

pilots, 33 (5.1%) had opioid drugs detected (12.1% of 272). There was no difference in mean age between pilots who had opioids detected and pilots who did not (Table IV).

Pain was the most common indication (87/646, 13.5%) for which pilots were taking drugs. The second most prevalent was hypertension, with 78/646 (12.0%) taking antihypertensives. Common cold was the third most prevalent; 71/646 (11.0%) pilots were taking one or more cold drugs. Of the 646 pilots, 39 (6.0%) had antidepressants detected, 2 had schizophrenic drugs detected, and 4 were on anticonvulsants.

Of 635 pilots with non-missing data for medical certificate, 266 (41.9%) had drugs detected in their biological samples. The difference in proportions among the medical certificate levels for all 635 pilots was statistically significant ($\chi^2 = 29.90$, df = 4, $P < 0.001$). Among the 266 pilots, there were no differences between medical certification classes for any of the drug categories.

Of 640 pilots with data for pilot certification level, 268 had drugs detected. The proportions with any drug found were not significantly different among the different pilot certification types ($P = 0.134$, Fisher's exact test). There was a statistically significant difference overall among the pilot certification groups for controlled substances ($P = 0.023$, Fisher's exact test). Proportions ranged from 10% (2/10) for CFIs to 75% (6/8) for those without a pilot license. There were no differences among the 268 pilots for any other drug categories.

In 24 of the 646 pilots (3.7%; 3.8% of the 633 accidents), the drug or drugs found were listed in the database as contributing to the cause of the accident. Diphenhydramine was the most common, found in 10 of the pilots. Marijuana was found in seven pilots, opioids in five, antidepressants in three, and anticonvulsants in two. Four of the pilots had more than one drug found in their samples.

DISCUSSION

Drugs were found in 42.1% of pilots over the study period of 2012−2014. This is similar to the prevalence found by Charturvedi et al.[5] from 2009 to 2013 (45.0%), which the present study overlaps by 2 yr. There has been a statistically significant increase in the prevalence of drugs in pilots in fatal accidents from 1994–2014 ($P < 0.001$) (**Table V**). This may represent a true increase in drug use, but drug trends in a population may be affected by other factors such as regulatory changes, laboratory methods, population dynamics, and administrative factors.[1]

There has also been a significant increase in controlled drugs, prescription and illicit drugs from the 1994–2013 studies (Table V). The use of marijuana more than doubled from 1994–2013. This may be due to legalization of marijuana for medical use in many states.

Prescription drugs are the most used of the three categories of drugs by pilots. About 29% of pilots had prescription drugs in their tissue samples during the study period and 68.8% of pilots in which drugs were found had prescription drugs in their tissue samples. This supports the findings that 75.1% of physician visits involve drug therapy in the U.S.[9] The most prescribed drugs during these physician visits in the general population are analgesics, antihyperlipidemic drugs and antidepressants.[9] This is different from the findings in the pilot population in the present study in which the most prevalent drugs detected were analgesics, antihypertensives and common cold drugs. Antihyperlipidemics and antidepressants were among the top six drugs. This comparison should be interpreted with caution since the CAMI laboratory only screens for a limited number of antihyperlipidemic drugs, which may be why antihyperlipidemic drugs are not among the four most prevalent drugs in the pilot population.

The prevalence of illicit drug use among pilots in the present study is 3.7%, which is less than the prevalence of illicit drugs used by persons ages 12 yr and over in the last 30 d in the U.S. general population of 9.4%.[11] The pilot population is generally more regulated in the use of illicit drugs, and drug use in pilots is expected to be lower than in the general population. Marijuana is the most abused illicit drug in pilots in the present study, and this finding is similar to the general U.S. adult population. Marijuana is used as a recreational drug for its euphoric effect. The effect of marijuana in pilots was shown in a simulator study by Janowsky et al.[10] using 10 certified airplane pilots. Marijuana caused significant deterioration in simulated instrument flying ability for at least 30 min in experienced pilots. All 10 pilots showed

Table V. Prevalence of Selected Drug Types from 1994–2013 from Previous Studies and from 2012–2014 in the Present Study.*

TYPE OF DRUG	1994–1998[2] ($N = 1683$)	1999–2003[4] ($N = 1587$)	2004–2008[1] ($N = 1353$)	2009-2013[5] ($N = 1169$)	2012–2014 ($N = 646$)	*P* VALUE
Any drug	32.0	38.0	42.0	45.0	42.1	<0.001
Prescription	14.3	19.8	29.0	35.0	28.9	<0.001
OTC	17.9	16.3	13.0	16.0	20.1	0.869
Illicit	4.0	4.2	3.3	8.8	3.7	0.002
Amphetamine	0.7	0.7	0.6	1.5	1.1	0.056
Cocaine	0.8	1.0	0.7	0.9	0.2	0.297
Marijuana	2.6	2.5	2.1	6.2	3.1	0.001
Controlled	8.2	19.0	10.0	16.0	11.5	0.023
Opioids	1.6	3.3	2.8	7.7	5.1	<0.001
Potentially impairing	na	na	na	na	25.5	na
Diphenhydramine	na	na	na	8.8	5.9	na

* Values in the table are percent of total sample; na = not available. Illicit drugs include amphetamine/methamphetamine, cocaine, and marijuana. Superscripted numbers in the table are the reference numbers of the previous studies.

a significant decrease in the measurement of flight performance 30 min after smoking active marijuana.[10]

Diphenhydramine is the most common OTC drug detected in tissue samples in the present study. In a study by Sen et al.[15] detailing the prevalence of first generation antihistamines in 5281 pilot fatalities from 1990–2005, antihistamines were found in 338 (6.4%). Of the 338, diphenhydramine was detected in 191 (56.5%). In the present study, 75 of 646 pilots (11.6%) had antihistamines detected; 38/75 (50.7%) were positive for diphenhydramine. The sedative effects of diphenhydramine on pilots are well known and aircrew need to be educated on "do not fly" time, which is five times the maximum pharmacologic half-life of the drug.[8]

Prescription drug users in the present study were older than nonusers. The elderly are more likely to have chronic medical conditions and hence use prescription drugs. This may in part explain our results. Conversely, illicit drug users were younger than nonusers, because younger persons are more likely to engage in recreational drug use.

Drugs as a contributory factor in the cause of air crashes is high in the present study and education of aircrew on the safety implications of diphenhydramine, marijuana, and opioids by aviation medical examiners is necessary. Civil aviation medical authorities may also need to provide more information on the potentially impairing effects of drugs for airmen.

Although the present study found dextromethorphan in 11 pilots, it could not be established if the pilots were abusing dextromethorphan; the concentrations detected in the biological samples of pilots were within the therapeutic limits.

Pilot's medical certificate held was significantly associated with drugs detected in biological samples in the present study. The majority of pilots without a medical certificate had drugs detected in biological samples. Pilots without a medical license had a higher proportion of prescription, OTC and potentially impairing drugs detected. It could be that these pilots had disqualifying medical conditions, and therefore had their medical certificates suspended.

Pilot license held was not significantly associated with medication use or detection in the present study. We expected private pilots to have a high prevalence of substance or medication detection since medical standards for this class of pilots is lower than for airline transport pilot license and commercial pilot license holders.

The study has several limitations. First, data on pilot characteristics were missing for some of the pilots, and toxicology reports were not available for 65 of the pilots. Second, 73 fatal accidents had to be excluded because the investigation was still in the preliminary phase. Finally, the prevalence of the drugs detected in the fatally injured pilots may not be representative of pilots in general.

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