JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, March 2012, Vol. 57, No. 2
doi: 10.1111/j.1556-4029.2011.01991.x
Available online at: onlinelibrary.wiley.com

PAPER

TOXICOLOGY

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Toxicological Findings in 889 Fatally Injured Obese Pilots Involved in Aviation Accidents*

ABSTRACT: Prevalence of drugs in fatally injured obese pilots involved in aviation accidents has not been evaluated. Therefore, toxicological findings in such pilots (body mass index ≥30 kg/m^2) were examined in a data set derived from the Civil Aerospace Medical Institute's (CAMI's) Scientific Information System for 1990–2005. Aeromedical histories of these aviators were retrieved from the CAMI medical certification and toxicology databases, and the cause/factors in the related accidents from the National Transportation Safety Board's database. In 311 of the 889 pilots, carbon monoxide, cyanide, ethanol, and drugs were found, and glucose and hemoglobin A_{1c} were elevated. Of the 889 pilots, 107 had an obesity-related medical history. The health and/or medical condition(s) of, and/or the use of ethanol and/or drugs by, pilots were the cause/factors in 55 (18%) of the 311 accidents. Drugs found were primarily for treating obesity-related medical conditions such as depression, hypertension, and coronary heart disease.

KEYWORDS: forensic science, postmortem forensic toxicology, toxicological findings, obesity, pilot fatalities, aircraft accident investigation, Federal Aviation Administration

Obesity in the U.S. general population has been on the rise over the past 25 years and continues to be a public health concern (1–7). In 2007, the prevalence rate for obesity in the United States was ≥30.9% and the dominance for obesity in its counties ranged from 12.4 to 43.7% (median: 28.4%) (2). Individuals with a body mass index (BMI) ≥30 kg/m^2 are considered obese (2,3), and this index is an accepted method for measuring body fat based on height and weight, regardless of age, gender, race, or ethnicity (3–7). Individuals with obesity have patho-physiological potentials to develop a number of medical conditions such as diabetes, hypercholesterolemia, hypertension, coronary heart disease, depression, obstructive sleep apnea, stroke, and arthritis (2,5,8–12).

Because of the growing concern with the medical issues related to obesity, it is important to understand and address this issue in the aviation community, particularly with respect to the airman seeking or maintaining the required medical certificate to fly an aircraft. In a 10-year study, it has been found that commercial pilots who were obese had a 22% higher risk of cardiovascular disease than their counterparts with normal BMI values (13). In the 2008 Aerospace Medical Association panel on diabetes, it was reported that the median BMI in the U.S. civilian pilot population was increasing (14,15). Therefore, it is important that the aviation medical community monitor obesity and its potential implications with respect to flight safety.

At the Federal Aviation Administration (FAA)'s Civil Aerospace Medical Institute (CAMI; Oklahoma City, OK), postmortem samples collected from the fatally injured pilots involved in aviation accidents are toxicologically evaluated. In addition to the toxicological testing, concentrations of glucose in vitreous fluid and urine and of hemoglobin A_{1c} (HbA_{1c}) in blood samples collected from the pilots are determined. This determination is carried out to establish if the disease of diabetic pilots was controlled at the time of the accident and/or to identify pilots with undiagnosed or unreported diabetes (16–18). Findings of these studies concluded that all of the aviators were not aware of, or did not report, elevated glucose levels or the medical condition (diabetes). Concentrations of glucose and HbA_{1c} from fatally injured aircraft accident pilots have been helpful in establishing whether the hyperglycemia-related performance impairment was the probable cause or a contributory factor in the accidents. Aeromedical aspects of obesity and diabetes have been elaborated in the literature (14,15,19), but toxicological findings in obese pilots have not been examined. The present study was conducted to evaluate and discuss such toxicological and hyperglycemic findings in the fatally injured obese aviators. Also, examined in the study were the preexisting medical conditions mentioned in the medical certifications of those pilots and the probable cause/contributing factors in those aviation accidents, as concluded by the U.S. National Transportation Safety Board (NTSB) (20).

Materials and Methods

Scientific Information System Database

The Scientific Information System (SIS) aviation safety database of the U.S. pilot population was developed at CAMI for the period

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*Disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the contents thereof. The work included in this article was conducted in a U.S. Government facility and has been produced as an internal technical report of the Office of Aerospace Medicine, Federal Aviation Administration, U.S. Department of Transportation, Washington, DC (DOT/FAA/AM-10/10).

Received 31 Aug. 2010; and in revised form 19 Nov. 2010; accepted 23 Jan. 2011.

of 1983 through 2005 (14,21,22). Briefly, this database used medical certificate numbers of pilots involved in aviation accidents and linked that information to the CAMI medical certification and the NTSB aviation accident databases to extract relevant medical information of those pilots. This SIS pilot population entailed fatally, as well as nonfatally, injured pilots. The SIS database has not been populated further for additional years after 2005, but the CAMI toxicology database used in this study is current from 1990 to date. Therefore, to be consistent with the database periods, the SIS and the CAMI toxicology databases were used to obtain a population data set of fatally injured pilots spanning the period of 16 years (1990–2005). Obtained by performing a longitudinal analysis of the entire airman population residing in the SIS database, the data set utilized in this study was associated with those aviators who were obese (BMI $\geq$30 kg/m^2) and fatally injured in civil aviation accidents. Thus, the data set for this study consisted of only fatally injured obese aviators.

The entire airman population in SIS consists of aviators who held a first-, second-, or third-class medical certificate. The categories of airmen (pilot) certificates applicable to each medical certificate class are described as (i) first-class: airline transport pilot; (ii) second-class: commercial pilot, flight engineer, flight navigator, crop duster, or air traffic tower operator (not including FAA employee air traffic control specialists); and (iii) third-class: private pilot, recreational pilot, flight instructor, or student pilot (21,23,24). Depending upon the class of the medical certificate and the age of the pilot, the validity of medical certificates varies from 6 months up to 5 years. Details of the types and frequency of physical examinations of pilots for these classes of medical certificates, including special issuance airman medical certificates, can be obtained from the cited resources (21,23,24). For medical certification purposes, urine glucose tests are performed, but no drug testing is conducted. However, certain groups of pilots are randomly tested for drugs and alcohol under the FAA's Drug Abatement Program (25–30).

Toxicology Database

A toxicology database for civil aircraft accident fatalities has been maintained at CAMI since 1990 (31). In this database, toxicological results, including applicable glucose and HbA$_{1c}$ concentrations, are electronically stored (31). Also, incorporated in the database are other relevant data concerning the accidents and the victims (31,32). Such information is obtained from the FAA Administrator's Daily Alert Bulletin, the NTSB web site, the FAA airman and medical certification records, and other sources. The CAMI toxicology database was searched for the 16-year period (1990–2005) for the fatally injured pilots of the obese pilot population data set (see the previous subsection, SIS database) from whom postmortem samples were submitted to CAMI.

Medical Certification Database

The CAMI medical certification database was used to retrieve necessary information from the most recent medical examination pertaining to a particular aviator who was fatally injured in an aviation accident that occurred during 1990–2005. The information consisted of examination date, height, weight, medications used, medical conditions and associated pathology codes, and medical certificate type. BMI was recalculated by height (m) and weight (kg), which were recorded in the medical examination of the aviator prior to the fatal accident, to confirm that the index value was consistent with the criterion for determining obesity (BMI $\geq$30 kg/m^2). The pathology codes documented on the medical examination records were used to identify airmen with medical conditions associated with obesity. Information on the medical certificate types (first-, second-, or third-class) of aviators (21,23,24) was also retrieved from the database.

Aviation Accident Database

The NTSB's aviation accident database was used to obtain accident-related information such as flight categories, probable cause, and contributing factors in the accidents (20).

Biological Specimens

Biological samples collected from pilot fatalities associated with U.S. civil aviation accidents are submitted to CAMI in the FAA TOX-BOX evidence containers for toxicological analyses (31,33). The sample submission is authorized by the NTSB, in coordination with the FAA Office of Accident Investigation (Washington, DC), for the investigation of aircraft accidents. The NTSB is responsible for investigating all civilian aircraft accidents falling within the jurisdiction of the U.S.A. Such investigation includes all types of aircraft. The types of samples generally received at CAMI are blood, urine, vitreous fluid, spinal fluid, brain, lung, heart, liver, kidney, muscle, and other biological samples.

Toxicological Analyses

Following the standard operating procedures of CAMI's laboratory, the submitted samples are routinely analyzed for combustion gases, ethanol/volatiles, drugs, glucose, and HbA$_{1c}$. In most situations, the presence of these analytes is analytically demonstrated by screening, followed by confirmation and/or quantitation.

The combustion gases include carbon monoxide as carboxyhemoglobin (COHb) and hydrogen cyanide as cyanide ion (CN^-); the drugs entail a wide range of prescription, nonprescription, and illegal drugs (31,34). COHb is determined by a spectrophotometric method and confirmed by gas chromatography (GC), and blood CN^- is measured by a colorimetric method and confirmed by high-performance liquid chromatography (HPLC). Ethanol/volatiles are determined by dual capillary column-flame ionization detection by headspace GC. Prescription and nonprescription drugs—acetaminophen, antidepressants, antihistamines, antihypertensives, decongestants, phenytoin, propoxyphene, quinidine, salicylate, theophylline, and other commonly used drugs—are analyzed by fluorescence polarization immunoassay, HPLC, gas chromatography-mass spectrometry (GC-MS), and liquid chromatography-mass spectrometry (LC-MS). Similarly, illegal drugs—amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, methamphetamine, opiates, and phencyclidine—are screened by radioimmunoassay/fluorescence polarization immunoassay and confirmed/quantitated by GC-MS and/or LC-MS (31,32,34–36). Vitreous fluid and urine samples are analyzed for glucose by a hexokinase method using a Du Pont Analyst Benchtop Chemistry Station (Du Pont Company Medical Products, Wilmington, DL) and blood for HbA$_{1c}$ by a latex immunoagglutination inhibition using a DCA 2000+ Analyzer and DCA 2000 HbA$_{1c}$ Reagent Kit (Bayer Corporation, Elkhart, IN) (16–18,34,37). Blood HbA$_{1c}$ is measured only in those fatalities (cases) wherein glucose levels are elevated. Concentrations of glucose >125 mg/dL in vitreous fluid and >100 mg/dL in urine are considered elevated (16,17). Glucose and HbA$_{1c}$ analyses were formally implemented on a routine basis in the CAMI laboratory in 1998 and 2001, respectively. Postmortem blood HbA$_{1c}$ values >6.0% correlate well with a known history of diabetes and with the elevated vitreous fluid and/or urine glucose levels in the fatally injured pilots, and thus, the HbA_{1c} values >6.0% are considered elevated (16–18,38). These toxicological, glucose, and HbA_{1c} evaluations are summarized in a 2009 review (32).

Results

The obtained SIS data set was associated with those aviators whose BMI values were ≥30 kg/m^2 and who were involved in fatal U.S. civil aviation accidents that occurred from 1990 through 2005. The number of pilots who met these parameters was 967 (Fig. 1); this number was reconfirmed by the NTSB aviation accident database. Of the 967 fatalities, postmortem samples from 897 (93%) were submitted to CAMI. With eight aviators, there were discrepancies in the SIS and toxicology databases with respect to the data elements (such as age and gender) and the misclassification of a pilot as to be a passenger, and/or the submitted samples of the pilot were not analyzed. Therefore, these eight pilots were excluded from the 897 data set, and the retrieval of medical, toxicological, and accident investigation information from the databases was limited to 889 pilots (Fig. 1). The number of 889 fatalities translated into the equivalent number of aviation accidents in which pilot fatalities had occurred and their postmortem samples were analytically evaluated. In view of this fact (one pilot per aircraft), "fatalities" and "accidents" are interchangeably used in this study.

Based upon the height and weight values recorded at the time of the most recent aviation medical examination, the BMI values of all of the 889 aviators were reconfirmed that the values were ≥30 kg/m^2 prior to the accidents (Table 1). Therefore, all the 889 pilots were considered as obese prior to the accident. The majority of the aviators in the data set were men—that is, 876 (98.5%) men and 13 (1.5%) women.

Out of 889 aviators, 108 held first-class, 344 second-class, and 437 third-class medical certificates (21,23,24). With respect to flying ratings, 436 pilots held private, 295 commercial, 123 airline transport, and 33 student certificates (23). Two pilots were not certificated.

One hundred and seven (12%) of the 889 aviators had a history of medical conditions that could be linked to obesity. Based on pathological codes that are used to register an aviator's medical history, these 107 aviators reported or were diagnosed with the medical conditions shown in Table 2. More than one medical condition was reported in the records of some of the 107 pilots. The medical conditions—for example, diabetes, hypertension, and coronary artery disease/heart disease—reported in the records were conditions primarily associated with obesity. No obesity-related medical conditions were mentioned in the medical certification records of the remaining pilots.

Of the 889 fatalities (cases), 578 (65%) were determined to be negative; the remaining 311 (35%) were positive cases (Fig. 1). In these positive cases, foreign substances—carbon monoxide, hydrogen cyanide, ethanol, and drugs—were found and/or endogenous substances—glucose and HbA_{1c}—were elevated. In some cases, the presence of more than one foreign substance and the elevation of more than one endogenous substance (glucose and HbA_{1c}) were

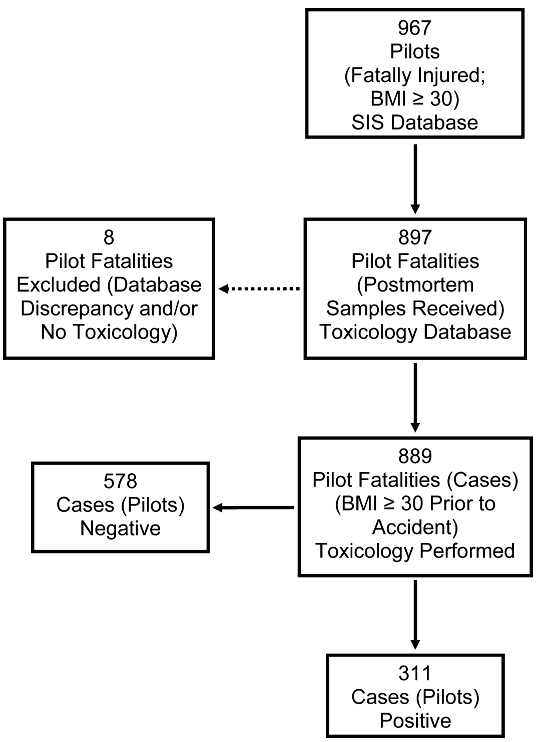

FIG. 1—*A flowchart representation of 889 fatally injured obese civil aviation accident pilots whose postmortem biological samples were toxicologically evaluated.*

TABLE 2—*Medical conditions mentioned in medical certification examination records of fatally injured obese pilots involved in aviation accidents.*

Medical Conditions	Pilots*
Hypertension controlled by medication	51
Calculus-bladder/renal/ureteral	19
Diabetes controlled by diet and/or disturbance of carbohydrate metabolism	11
Labile hypertension	10
Diabetes controlled by hypoglycemic drugs	6
Glycosuria or sugar in the urine	5
Coronary artery disease/heart disease	5
Coronary artery bypass surgery	3
Unspecified cardiac disorder	3
Hardening arteries, arteriosclerosis other than coronary	2
Coronary angioplasty	2
Myocardial infarction	1
Angiography with 50% or less occlusion	1
Other genitourinary condition	2
Renal disease	1

*More than one medical condition was reported in some records.

TABLE 1—*Mean BMI, height, and weight values of fatally injured obese male and female pilots involved in aviation accidents.*

Pilots	BMI (kg/m^2) (SD_n*; Range)	Height (m) (SD_n; Range)	Weight (kg) (SD_n; Range)
Males (n = 876)	33.14 (3.14; 30.02–61.62)	1.78 (0.08; 1.30–2.01)	105.45 (12.32; 71.67–175.54)
Females (n = 13)	34.16 (3.93; 30.10–43.57)	1.69 (0.04; 1.60–1.75)	97.87 (13.84; 77.11–127.01)

BMI, body mass index.
*Standard deviation (SD_n) based on the entire population given as argument—that is, data taken from every member of the population.

observed. Therefore, those cases were counted more than once. Of the 311 fatalities, 11 were positive for COHb and/or CN^- and 302 for ethanol and/or drugs (Fig. 2). In additional 11 fatalities, glucose and/or HbA_{1c} were elevated; ethanol and/or drugs were also found in seven of these 11 fatalities. Along with the concentrations of COHb, CN^-, glucose, and HbA_{1c}, the list of drugs found in the fatalities are tabulated in Tables 3–5. Associated with COHb, CN^-, glucose, and HbA_{1c} cases, the cause/factors in aviation accidents and medical histories of pilots are also mentioned in Tables 3 and 5.

As exhibited in Fig. 3, ethanol was present in 36 aviators. The Drug Enforcement Administration's controlled substances (39) of Schedules I and II were found in 38 pilots and of Schedules III, IV, and V in two. The controlled substances include drugs such as amphetamine/methamphetamine, cocaine, Δ^9-tetrahydrocannabinol (THC), opiates, and benzodiazepines (39). Prescription drugs were present in 203 pilots and nonprescription (over-the-counter) drugs in 303. Considering that more than one substance was present in some of these fatalities, the total number of instances for the presence of substances (ethanol/drugs) was 582. These substances (drugs) ranged from the commonly used prescription drugs—such as narcotic analgesics, benzodiazepines, and cardiovascular medications—to nonprescription drugs—such as antihistaminics, decongestants, nonnarcotic analgesics, and quinine (Table 4).

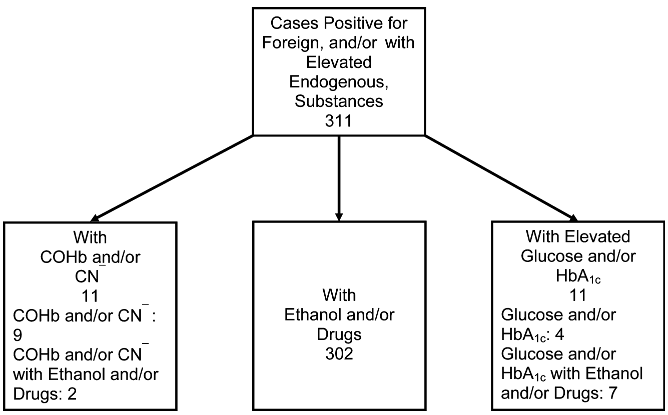

FIG. 2—*The number of pilot fatalities (cases) in which carboxyhemoglobin (COHb), cyanide ion (CN^-), ethanol, and drugs were found, and glucose and hemoglobin A_{1c} (HbA_{1c}) were elevated.*

Of the 311 aviators, 208 had not reported taking any medications to their aviation medical examiners (AMEs), but 103 reported taking medication(s). The medications aviators reported to their AMEs were those used in treating hypertension and diabetes and in reducing cholesterol and stomach acid levels. At least one drug of these four groups of medications was the most often reported by 78 of the 103 pilots.

The NTSB concluded that physical impairment of pilots, including fatal cardiovascular events, was a cause or factor in 23 of the 311 accidents. In 32 of the 311 accidents, impairment of pilots caused by the use of ethanol/drugs was determined to be a cause or factor. Aircraft-assisted suicide was found the cause of four accidents. The remaining 252 accidents in which the aviator was found positive for ethanol/drugs were attributed to adverse weather conditions, mechanical malfunction, and/or pilot error.

Discussion

Biological samples from 93% of the fatally injured obese pilots were submitted to CAMI for toxicological evaluation. This percentage is comparable to that of a previous study (31); accordingly, samples from *c.* 80% (73–92%) of the pilot fatalities of aviation accidents that occurred during the period of 1990–2000 were submitted to CAMI. In general, the spectrum of drugs found in the obese pilots was similar to those reported earlier with civil aviation accident pilot fatalities wherein selective serotonin reuptake inhibitors (40) and antihistamines (41) were present. A similar drug usage pattern was notable in epidemiological studies conducted for the period of 1989–2003 for fatally injured aviators involved in aviation accidents (34,42,43). Findings of the present study were clearly indicative of the obesity-linked medical conditions such as diabetes, depression, and cardiovascular conditions, and the findings were consistent with the medical conditions mentioned in the medical certification examination records of the obese pilots. Obviously, many of the medications were taken for the medical conditions associated with obesity. Medical conditions—such as cardiovascular disease, depression, and diabetes—have been linked to obesity (5,8,9,44).

Drugs, including appetite suppressants and antidepressants (45,46), used for reducing body weight were found in the pilots, as

TABLE 3—*Blood COHb and CN^- concentrations in 11 fatally injured obese pilots involved in aviation accidents.*

Number	COHb (%)	CN^- (µg/mL)	Fire Status	Drugs Found in Biological Samples*	Pilot's Health and/or Medical Conditions as the Cause/Factors in the Accidents as Determined by the NTSB
1	12	0.48	Ground fire	—†	—
2	12	0.71	Ground fire	—	—
3	—	0.50	Ground fire	—	Incapacitation of the pilot in command
4	23	0.34	Ground fire	—	—
5	16	—	—	—	Physical impairment of the pilot‡
6	22	2.22	Ground fire	—	—
7	13	—	Ground fire	—	—
8	33	0.93	Ground fire	Lorazepam	—
9	13	—	Ground fire	—	—
10§	45	—	—	Atenolol Diphenhydramine Pseudoephedrine Triamterene	Failure of the left muffler, resulting in a carbon monoxide leak into the cabin rendering the pilot incapacitated
11§	53	—	Ground fire	—	—

CN^-, cyanide ion; COHb, carboxyhemoglobin.
*Where possible, based upon multi-analyses in at least two different sample types.
†No analysis, negative findings, no drugs found, or no cause/factor.
‡Pilot was a mechanic and had been exposed to running engines in a nonventilated shop the day/evening prior to the accident.
§Hypertension controlled by medication.

TABLE 4—*Drugs and metabolites found in the fatally injured obese pilots involved in aviation accidents.*

Drugs* and Metabolites				
Controlled substances				
Amphetamine	Methamphetamine	Cocaine	Δ^9-Tetrahydrocannabinol (THC)/THC carboxylic acid	
Prescription drugs				
Alprazolam	Amitriptyline	Amlodipine	Atenolol	Atropine
Azacyclonol	Bisoprolol	Bupropion	Butalbital	Carbamazepine
Cimetidine	Citalopram	Codeine	Cyclobenzaprine	Desipramine
Diazepam	Diltiazem	Dihydrocodeine	Donepezil	Fenfluramine
Fluoxetine/norfluoxetine	Gemfibrozil	Hydrocodone	Hydromorphone	Hydroxyzine
Imipramine	Labetalol	Lorazepam	Meclizine	Metoprolol
Midazolam	Morphine	Nizatidine	Nordiazepam	Nortriptyline
Oxycodone	Oxymorphone	Oxazepam	Pantoprazole	Paroxetine
Pentobarbital	Phenytoin	Phentermine	Propranolol	Propoxyphene/norpropoxyphene
Ranitidine	Sertraline/desmethylsertraline	Sildenafil/desmethylsildenafil	Temazepam	Theophylline
Trazodone	Triamterene	Trimethoprim	Verapamil/norverapamil	
Nonprescription drugs				
Acetaminophen	Brompheniramine	Cetirizine	Chlorpheniramine	Dextrorphan
Dextromethorphan	Diphenhydramine	Doxylamine	Ephedrine	Hydrochlorothiazide
Naproxen	Lansoprazole	Lidocaine	Omeprazole	Pheniramine
Phenylpropanolamine	Phenyltoloxamine	Pseudoephedrine	Quinine	Salicylate

*Depending upon the formulation and doses of these drugs in a particular pharmaceutical preparation, some of these drugs may fall in more than one category—that is, a drug may fall in the controlled substance, prescription, and/or nonprescription category.

TABLE 5—*Toxicological findings and medical histories of 11 fatally injured obese aviation accident* pilots with elevated glucose and HbA_{1c} concentrations.*

	Glucose (mg/dL)				
Number	Vitreous Fluid	Urine	Blood HbA_{1c} (%)	Drugs Found in Biological Samples[†]	Medical History
1	45	189	—[‡]	Diltiazem	Diabetes controlled by hypoglycemic drugs
2	147	65	—	Nizatidine	—
3	109	—	4.5	—	—
4	125	—	6.3	Diphenhydramine Chlorpheniramine	Diabetes controlled by diet
5	—	1438	—	—	Diabetes controlled by diet
6	31	333	4.7	Hydrocodone Dihydrocodeine Hydromorphone	—
7[§]	301	6050	12.4	Phentermine	Diabetes controlled by insulin and by oral hypoglycemic drugs
8	16	264	5.3	Midazolam	—
9	—	1750	—	—	Diabetes controlled by diet
10	—	369	5.8	Diltiazem	Diabetes controlled by hypoglycemic drugs
11	—	5700	—	—	—

BMI, body mass index; HbA_{1c}, hemoglobin A_{1c}; NTSB, National Transportation Safety Board.
*In none of these accidents, pilot's health and/or medical conditions were the cause/factors, as determined by the NTSB.
[†]Where possible, based upon multi-analyses in at least two different sample types.
[‡]No analysis, negative findings, no drugs found, or no medical history.
[§]BMI: 39.33 kg/m^2.

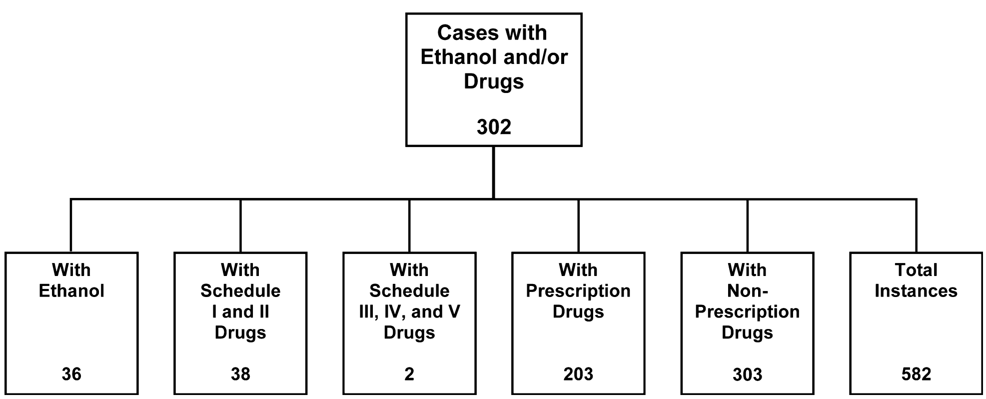

FIG. 3—*Ethanol and drugs found in the fatally injured obese pilots involved in aviation accidents.*

well. For example, phentermine and fenfluramine were detected in four aviators, phentermine in three, and bupropion in two, although fenfluramine has now been withdrawn from the drug markets because of its side effects, heart valve conditions, pulmonary hypertensions, and cardiac fibrosis (47). Other antidepressants—citalopram, fluoxetine, paroxetine, and sertraline—were also found in the obese pilots. As pilots are a subset of the general population, the obesity-related medications taken by the aviators could obviously be the case with any group of obese people.

The presence of anticonvulsants, atropine, lidocaine, and narcotic analgesics in the aviators could be associated with the administration of these drugs by emergency health care providers at accident scenes or at hospitals for pain management, resuscitation, seizure control, and/or surgical procedures. Whereas other substances—ethanol, amphetamine/methamphetamine, antidepressants, cardiovascular agents, cocaine, sympathomimetics, and THC—were taken by the pilots prior to the accidents. Many of these substances influence the central nervous system and can impair performance, including motor skills.

Obesity may cause diabetes (9). This does not necessarily mean that an obese person is diabetic or that the diabetes of an individual may not be controlled by diet, exercise, and medications. The current findings suggested that the number of pilots with elevated concentrations of vitreous and/or urine glucose and/or HbA_{1c} is low—that is, 11 (1.2% of 889)—which is supportive of a previous study wherein also low numbers (3.2% of 1335) of fatally injured pilots of civil aviation accidents (1998–2005) were reported to have elevated vitreous/urine glucose and/or HbA_{1c} levels (17). The drugs found in these 11 obese pilots were a heart medication, a benzodiazepine, antihistaminics, and narcotic analgesics. A weight-reducing drug was found in one case wherein glucose and HbA_{1c} levels were considerably elevated.

It is true that obesity in the general population is increasing with diabetes and continues to be a public health concern (1–3), and this aspect is also true with pilot population (14,15). The obesity-associated obstructive sleep apnea may lead to daytime sleepiness, which in turn may adversely affect neurological functions (11). Another serious medical condition associated with obesity is depression (5,8,9,11,12). These abnormalities may lead to performance impairment. An obese individual may have difficulty in effectively manipulating the controls, particularly in the confined space of a flight deck. The NTSB determined that pilots' health/medical conditions and the use of ethanol/drugs were the cause/contributing factors in 55 accidents, which is 18% with respect to the 311 accidents (positive cases) or 6% with respect to the 889 accidents (total cases); aircraft-assisted suicide was the cause of four accidents. Although this study per se does not clearly reflect upon the prevalence of drugs in obese pilots in comparison with the same group of people in the general public, the findings from this study confirm that obese individuals of any walk of life have the potentials for overweight-related medical conditions and, thus, they naturally use drugs for treating those conditions. The growing concern with the medical issues related to obesity emphasizes the importance of addressing, understanding, and potentially resolving this aeromedical issue. This could be effectively achieved by implementing obesity-related educational programs for aviators and AMEs. The monitoring of obesity and diabetes by the aviation medical community and the understanding of potential implications of these medical conditions with respect to flight safety are also crucial. In the aviation community, the obesity-linked abnormal neurological and cognitive functions represent a potential safety concern.

Acknowledgment

Authors are thankful to Marc S. Davidson for assisting in the extraction of relevant information from the CAMI's SIS data set.

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