

# Cross-Sectional Analysis of Commonly Prescribed Medications in Military Aviation

Lincoln G. Ropp; Sean P. Haight; Michael B. Prudhomme; Elizabeth L. Ropp

- BACKGROUND:** Medication use by naval aviators, either prescription or over-the-counter, is not always relayed to the flight surgeon, resulting in unsafe flying environments. Many medications have debilitating effects that prohibit their use during aviation. Education and availability of resources on approved medications for flight status personnel is lacking.
- METHODS:** A retrospective search of the Department of Defense Composite Health Care System (DoD CHCS) was conducted from five geographic locations. Basic epidemiological information was obtained to determine the most common medications ( $N = 70$ ) prescribed to active-duty flight status personnel. Analysis determined their medication category, flight status designation, and a generalized location comparison. A similar control medication list for nonflight status personnel was generated from one location.
- RESULTS:** Analysis found that many medications prescribed to aviators are not approved for use in aviation and are similar to those of nonflight status personnel. There were 8 of the top 15 (53%) and 40 of the 70 (57%) most commonly prescribed medications of flight status personnel which were not approved. Similarly, 49% of total prescriptions ( $N = 15,652$ ) were not approved. Little difference was found in medications among nonflight and flight status personnel, as 11 of the top 15 prescription medications (73%) were identical.
- DISCUSSION:** This research demonstrates the need for education regarding certain medications and their prohibited use during flight. Results will provide the Flight Surgeon common medications prescribed to aviators to aid them in providing a safer flying environment.
- KEYWORDS:** non-approved medications in aviation, flight surgeon, unsafe flying, common aviator medications, aviator prescriptions.

Ropp LG, Haight SP, Prudhomme MB, Ropp EL. Cross-sectional analysis of commonly prescribed medications in military aviation. *Aerospace Med Hum Perform*. 2017; 88(12):1129–1133.

Knowledge of an aviator's medication use is one of the primary duties of a flight surgeon. Ideally, aviators would only be prescribed medications that are approved for use in flight; however, this is not always the case. In obtaining routine and specialty care from other physicians, aviators are often prescribed medications that should not be used during flight operations as defined by the U.S. Navy Aeromedical Reference and Waiver Guide (USN ARWG). This information is not always relayed to their flight surgeon for a variety of reasons, creating unsafe flying environments.

Several papers have reported the incidence of drugs in victims of fatal aviation accidents,<sup>10,14,15</sup> including alcohol<sup>4,5</sup> and the popularly prescribed selective serotonin reuptake inhibitors.<sup>2</sup> When an evaluation of post mortem toxicology was compared with reported medical history on Federal Aviation Administration medical applications, it was found that 92% of pilots failed to accurately report medication use. Furthermore, many pilots

were taking medications for specific conditions that had not been documented or reported.<sup>6</sup> In a further study of 1587 pilot fatalities, 830 (52%) were found to have drugs and/or ethanol in their tissue samples at time of death.<sup>8</sup> Another study found that while 86% of pilots generally try to avoid medications, roughly half indicate that they would rather take an over-the-counter (OTC) medication than fly with symptoms the medication is designed to treat.<sup>7</sup> These reports suggest that aviators are not only being prescribed medications that are not approved for aviation, but proposes the reality that aviators whose livelihood

From the Naval Aerospace Medical Institute, Pensacola, FL.

This manuscript was received for review in June 2016. It was accepted for publication in August 2017.

Address correspondence to: Lincoln G. Ropp, 29045 SW Villebois Dr. S, Wilsonville, OR 97070; lincoln\_ropp@yahoo.com.

Reprint & Copyright © by the Aerospace Medical Association, Alexandria, VA.

DOI: <https://doi.org/10.3357/AMHP.4706.2017>

depends on flying resist volunteering their full medical history and medication use. This obstacle must be relentlessly assaulted as it poses a significant danger in flight.

Many of the most prescribed medications are for cold and allergy symptoms and have debilitating side effects prohibiting their use during flight. OTC availability and advertisement dramatically increases the chance of their use without physician consultation. The most commonly used impairing medication is diphenhydramine. Post mortem aviation toxicology evaluation over a 16-yr period (1990–2005) found the presence of first-generation histamine 1 antagonists in 6% of pilots.<sup>11,13</sup> This evaluation solidifies that education and availability of resources on approved vs. nonapproved medications for flight status personnel is lacking in both non-flight surgeon providers and aviators. In addition, an informational survey of 215 working airline pilots concluded that the vast majority were deficient in the knowledge required to make informed decisions on the use of OTC medications.<sup>7</sup> Aviators need to know that they can and should consult their flight surgeon prior to taking any medications, whether it is prescribed by another physician or obtained OTC.

This study was conducted to obtain basic epidemiological information on common medications prescribed to military aviators in order to quantify the degree to which aviators are being prescribed medications not approved for flight status. Furthermore, this study proposes that education and resources regarding approved vs. nonapproved medications for flight status personnel are lacking among non-flight surgeon prescribers and aviators. The results of this study will help serve to better educate this population, along with providing the flight surgeon a better understanding of the common medications prescribed to aviators in hopes that medication-related mishaps might diminish as a result of a safer flying environment.

## METHODS

This study was conducted under an exempt Institutional Review Board protocol through the Navy Operational Medicine Institute. A cross-sectional retrospective search and analysis of a pharmacy database, the Department of Defense Composite Health Care System (DoD CHCS), was conducted on five separate geographic areas with large concentrations of Naval aviators (Naval Hospital's Pensacola, Jacksonville, Portsmouth, Lemoore, and Oak Harbor) to produce a study group. All new prescriptions for active duty flight status personnel were collected over a 2-yr period (1 September 2011–1 September 2013). The resulting list was searched in its entirety for each medication occurrence regardless of dose and brand name in order to find the total number of prescriptions for each generic medication. For example; ibuprofen, Advil, and Motrin in doses of 200 mg, 400 mg, or 800 mg would be categorized under the generic medication name ibuprofen. From this list, the top 70 prescribed medications ( $N = 70$ ) were identified for further analysis. The medications analyzed were designated with either an A (Approved) or N (Not Approved) per the U.S. Navy Aeromedical Reference and Waiver Guide.<sup>1</sup> Additional analysis was conducted

on the medications by grouping them into medication categories, (for example; non-steroidal anti-inflammatory drugs (NSAIDs), opioids, antibiotics, etc.), as well as comparing the lists from five locations for similarities and differences to support common prescribing habits regardless of location. Statistical analysis used an alpha ( $\alpha$ ) level of 0.05 (confidence interval of 95%) as the cutoff for significance. Additionally, a control list was generated from nonflight status personnel from one of the locations, Naval Hospital Pensacola, using the same process as above. This permitted comparison of commonly prescribed medications among flight and nonflight status personnel.

## RESULTS

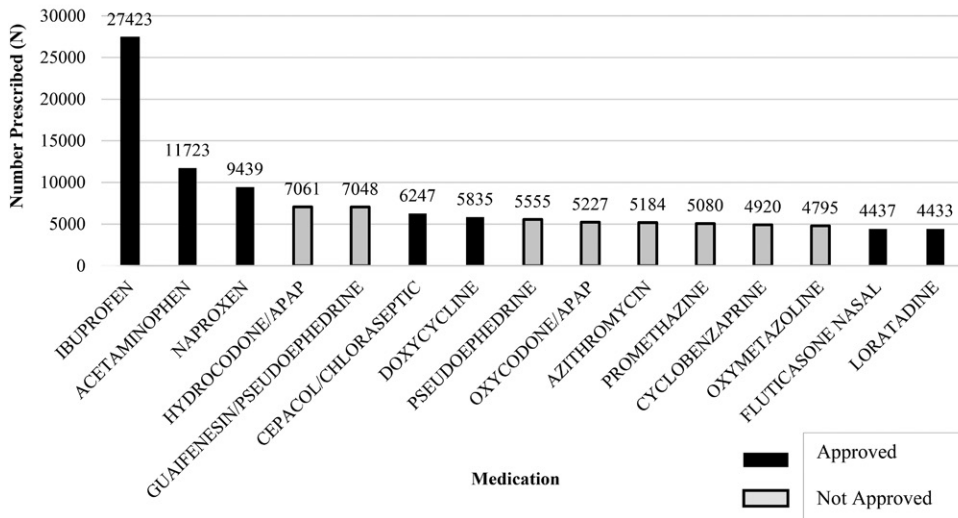
The total number of prescriptions and medication names from the locations was analyzed to determine the top 70 most prescribed medications for nonflight status personnel (Naval Hospital Pensacola; control group) and flight status personnel (study group). Analysis further classified the top 15 medications and medication classes for each group.

The total number of prescriptions for the control group was 220,497 and for the study group was 15,652. Of the total number of prescriptions written for the study group, 49% ( $N = 7669$ ) were Not Approved and 51% ( $N = 7983$ ) were Approved. The 3 most frequently prescribed medications for the control group were ibuprofen ( $N = 27,423$ ), acetaminophen ( $N = 11,723$ ), and naproxen ( $N = 9439$ ) and 8 of the 15 (53%) most commonly prescribed medications were considered Not Approved for flight (**Fig. 1**). The 3 most frequently prescribed medications for the study group were ibuprofen ( $N = 3685$ ), oxycodone/acetaminophen (APAP) ( $N = 1589$ ), and hydrocodone/APAP (1464), and 9 of the 15 (60%) commonly prescribed medications for the study group were Not Approved for flight (**Fig. 2**). Of the total number of medications prescribed to the study group ( $N = 70$ ), 40 (57%) were Not Approved for flight.

Analysis revealed the three most frequently prescribed medication classes for the control group were NSAIDs ( $N = 43,292$ ), upper respiratory infection (URI) relief medications ( $N = 28,635$ ), and antibiotics ( $N = 24,315$ ) (**Fig. 3**). The study group's three most common medication classes prescribed were NSAIDs ( $N = 5788$ ), URI relief medications ( $N = 4327$ ), and opioids ( $N = 3837$ ) (**Fig. 4**).

Examination of the top 70 medications between the aviators and nonaviators revealed a common group of 52 medications that were present in both categories (74.28% match). Nonparametric tests were conducted to evaluate the differences in the prescription frequency of Approved and Non-Approved medication in each of the two groups (three tests run: independent samples median test, Mann-Whitney U test, and Kolmogorov-Smirnov test). All tests showed no statistical difference between the prescription rates. A Spearman rank-order correlation was performed and showed that prescription rates for Approved and Non-Approved medications was similar between Aviation and Non-Aviation personnel ( $\rho = 0.665$  with a shared variance of 28.7%). Medications for pain relief occupied the top four

### Control Group: Top 15 Medications

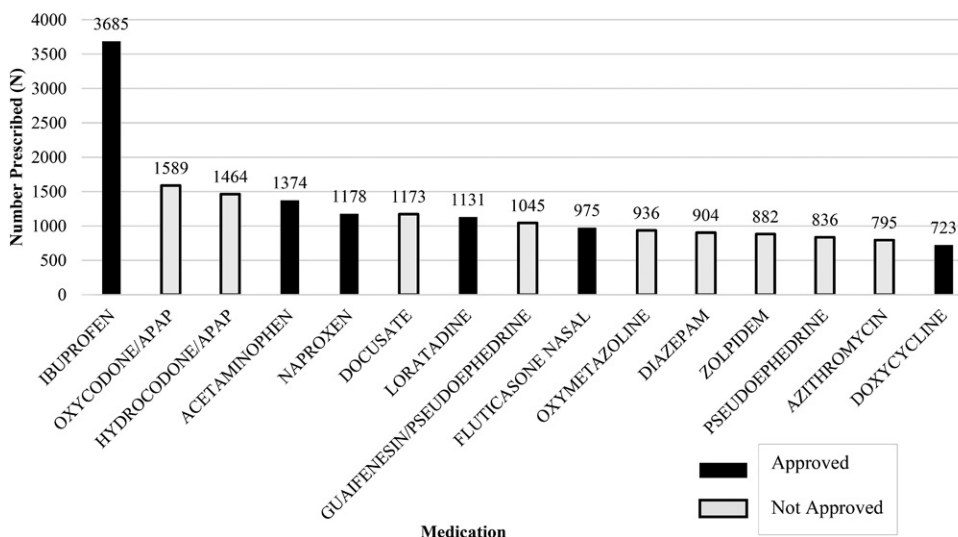


**Fig. 1.** Control group's top 15 medications illustrating the number of prescribed medications for each of the medications (N). Bars in black reference Approved medications and bars in gray reference Not Approved medications. APAP: acetaminophen.

medications prescribed for both the control and study groups (Figs. 1 and 2).

A geographic comparison among the five study group locations revealed subtle differences in prescribing habits. Ibuprofen was the most prescribed medication in all five locations; however, the number two and three positions varied with location. Lemoore's second and third most commonly prescribed medications were loratadine and oxymetazoline, possibly indicating a higher prevalence of environmental allergens.

### Study Group: Top 15 Medications

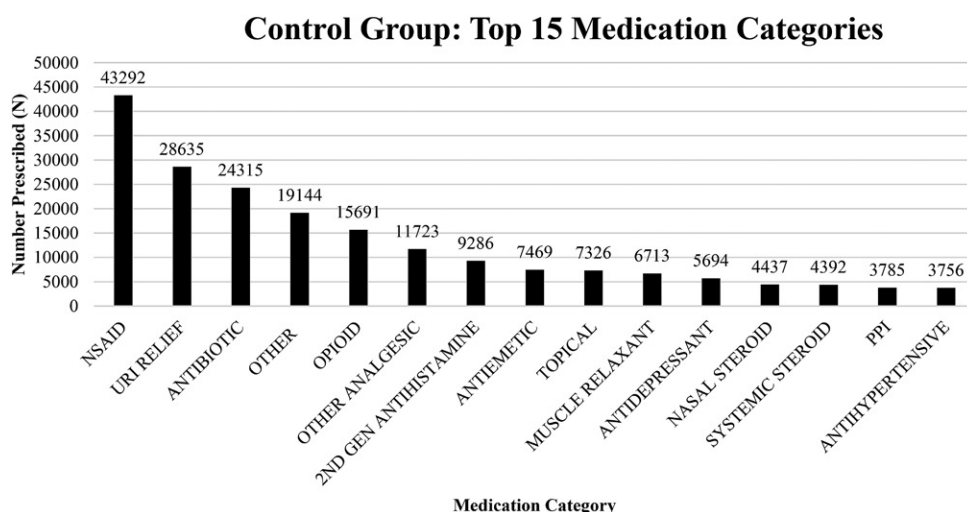


**Fig. 2.** Study group's top 15 medications illustrating the number of prescribed medications for each of the medications (N). Bars in black reference Approved medications and bars in gray reference Not Approved medications. APAP: acetaminophen.

### DISCUSSION

This is a unique study in that it is a retrospective look at medications prescribed to aviators at large Naval hospitals as opposed to a post mortem analysis, as seen in many studies of medications and aviation. The majority of these medications were prescribed to Naval aviators, and are likely similar to aviators in other military services. Thus, the results may reasonably be generalized to all military flight personnel. Medication use likely varies in civilian aviators who would have more varied demographics and possibly more comorbid conditions. Therefore, results of this analysis may not apply to this population of aviators, limiting its usefulness.

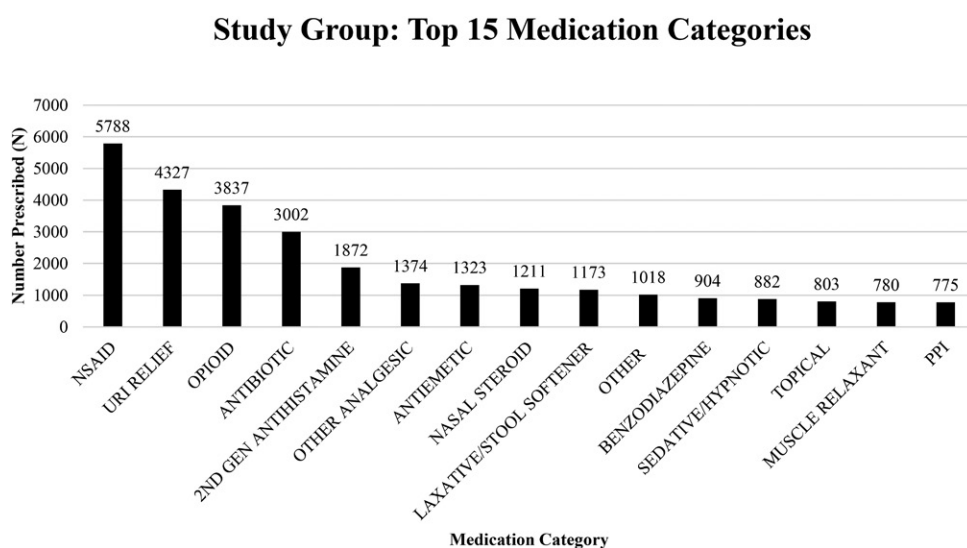
This study was conducted with limited resources. As a result, there are several weaknesses in the design of the study. The pharmacy database used is held locally under each military treatment facility, and it is not possible to conduct single queries for the entire Navy or Department of Defense. Further, it was unfeasible to conduct the study on locations in the Department of Defense since the hospital databases are not interconnected. The primary intent was to query the medications military aviators were most frequently being prescribed. Yet by querying areas with high numbers of Navy personnel, the results included colocated Army, Air Force, and Coast Guard personnel who used the same pharmacies. Each military branch has a different waiver guide with slight differences in which medications are approved for use. For example, pseudoephedrine is approved for aviation duty in the Army, but not in the Navy. Since most of the medications have the same status across all branches of the military, this circumstance would likely have minimal effect on the end results. It was not possible to cross-reference if the aviator was in a temporary non-flying status while prescribed the medication. While it is likely that the majority of the Non-Approved medications were written for temporarily non-flying personnel, this cannot be confirmed and thus it can only be



**Fig. 3.** Control group's top 15 medication categories illustrating the number of prescribed medications in each category (N). NSAID: non-steroidal anti-inflammatory drug; URI: upper respiratory infection; 2<sup>nd</sup> Gen: 2<sup>nd</sup> generation; PPI: proton pump inhibitor.

concluded that aviators are being prescribed Non-Approved medications. Overall as designed, this study provides a generalized idea of prescribed medications in military aviators.

This study found that the majority of medications prescribed were Not Approved for flight in both the control and study group, specifically 57% for aviators from the total of 70 medications analyzed. Even when examined based on the number of prescriptions written, just over half were approved for flight (51%). Interestingly, for the top 15 most commonly prescribed medications in both groups, a higher percentage of non-approved medications were prescribed to aviators compared to nonflight status personnel (60% vs 53%). In addition, each of the top four medications for the control and study groups were analgesics, two of them being narcotics for flight status personnel. Several



**Fig. 4.** Study group's top 15 medication categories illustrating the number of prescribed medications in each category (N). NSAID: non-steroidal anti-inflammatory drug; URI: upper respiratory infection; 2<sup>nd</sup> Gen: 2<sup>nd</sup> generation; PPI: proton pump inhibitor.

studies have examined the links between aviation duty and pain, and show that back pain is a frequent occurrence, especially among helicopter pilots, with a prevalence ranging from 61 to over 80%. This is likely due to biomechanical, ergonomic, and anthropometric factors.<sup>3,9,12</sup> The frequency of medications prescribed to control pain, as seen in this study, is simply more evidence that this is a significant issue in the aviation community and needs to be further addressed, monitored, and investigated. The large number of opioid prescriptions given to aviation personnel is an important and concerning finding, and it must be emphasized

that under no circumstances should an aviator remain in an active flying status if he or she is requiring these medications.

Of the most common classes of medications prescribed to aviators, URI relief medications were second most likely because they are for treating a very common medical condition. However, the availability of OTC decongestants makes this situation especially concerning especially since these are prohibited during naval flight operations. Thus, the flight surgeon must educate all flight status personnel regarding full disclosure of all medications and medical conditions and, as supported by the results of this study, thoroughly investigate and inquire about these specific medications to ensure safe flying.

Overall, prescribed medications were generally similar between nonaviators and aviators. Of the 70 most common medications, 52 (73%) written for nonflight status personnel were the same as those prescribed to aviators. Still, subtle differences were found to exist. Geographic location can affect which medications are most commonly prescribed. For example, Lemoore, located in the central valley of California, is anecdotally notorious for poor air quality and allergens. Thus it is not surprising that loratadine, a histamine blocker used to treat allergies, is the second most commonly prescribed medication. At Oak Harbor, located in Washington State, a relatively high number of antimalarial prescriptions were written. This is likely due to the stationed P3 squadrons and the frequent deployment to high malarial risk



regions. Statins were found more frequently prescribed to aviators (number 27 vs. 40 of the top 70 medications in nonaviators), possibly due to the more stringent screening flight status personnel undergo. Every 5 yr, a lipid panel is performed, which likely increased the detection and treatment for hyperlipidemia.

The use of medications that are not approved for flight status personnel continues to occur in both military and civilian aviation communities. The primary purpose of this medication review and study is to bring attention to those medications that are most frequently prescribed to flight personnel, regardless of authorization to fly. This is important for three essential reasons: awareness that more than half of all medications prescribed to aviators are not approved for use in flight, awareness of the most common non-approved medications aviators are prescribed which may help improve screening forms and questioning by the flight surgeon, and to identify commonly prescribed medications (Bactrim, azithromycin, docusate, etc.) which should be investigated for approval in flight. In conclusion, the flight surgeon plays a vital role in preventing the use of dangerous substances in flight status personnel, including commonly prescribed medications. This begins with gaining the aviator's trust, educating them regarding medication use, and providing resources vital for medication safety. The flight surgeon has a critical role in protecting his or her patients as well as the general population from medication related mishaps. Furthermore, the aviator must understand that they themselves are responsible for honestly disclosing every medication and/or supplement that they have taken. If an aviator fails to comply with this requirement, it would be suggested that swift and stern discipline be enforced by the Command at the recommendation of the unit flight surgeon. This research study and review can help provide the flight surgeon yet another tool to aid in conveying this role.

## ACKNOWLEDGMENTS

We would like to thank Dr. Jeffrey Moore for his technical assistance with the statistical analysis and interpretation.

*Authors and affiliations:* Lincoln G. Ropp, D.O., OHSU Emergency Medicine Residency Program, Portland, OR; Sean P. Haight, M.D., Naval Flight Surgeon, Milton, FL; Michael B. Prudhomme, M.D., M.P.H., Naval Flight Surgeon,

Quantico, VA; and Elizabeth L. Ropp, D.O., no professional affiliation, Wilsonville, OR.

## REFERENCES

1. Acromite MTUS. Navy aeromedical reference and waiver guide. Pensacola (FL): U. S. Navy, Naval Operational Medicine Institute; 2015.
2. Akin A, Chaturvedi AK. Selective serotonin reuptake inhibitors in pilot fatalities of civil aviation accidents, 1990–2001. *Aviat Space Environ Med.* 2003; 74(11):1169–1176.
3. Bridger RS, Groom MR, Jones H, Pethybridge RJ, Pullinger N. Task and postural factors are related to back pain in helicopter pilots. *Aviat Space Environ Med.* 2002; 73(8):805–811.
4. Canfield DV, Fleming J, Berkly M, Hordinsky J. Drugs and alcohol found in fatal aviation accidents between 1989 and 1993. Washington (DC): Federal Aviation Administration. Report No. DOT/FAA/AM-95/9.
5. Canfield DV, Hordinsky J, Millett DP, Endecott B, Smith D. Prevalence of drugs and alcohol in fatal civil aviation accidents between 1994 and 1998. *Aviat Space Environ Med.* 2001; 72(2):120–124.
6. Canfield DV, Salazar GJ, Lewis RJ, Whinnery JE. Pilot medical history and medications found in post mortem specimens from aviation accidents. *Aviat Space Environ Med.* 2006; 77(11):1171–1173.
7. Casner SM, Neville EC. Airline pilots' knowledge and beliefs about over-the-counter medications. *Aviat Space Environ Med.* 2010; 81(2):112–119.
8. Chaturvedi AK, Craft KJ, Canfield DV, Whinnery JE. Toxicological findings from 1587 civil aviation accident pilot fatalities, 1999–2003. *Aviat Space Environ Med.* 2005; 76(12):1145–1150.
9. Kelley AM, MacDonnell J, Grigley D, Campbell J, Gaydos SJ. Reported back pain in Army aircrew in relation to airframe, gender, age, and experience. *Aerosp Med Hum Perform.* 2017; 88(2):96–103.
10. Kuhlman JJ Jr, Levine B, Smith ML, Hordinsky JR. Toxicological findings in Federal Aviation Administration general aviation accidents. *J Forensic Sci.* 1991; 36(4):1121–1128.
11. McKay MP, Groff L. 23 years of toxicology testing fatally injured pilots: Implications for aviation and other modes of transportation. *Accid Anal Prev.* 2016; 90:108–117.
12. Orsello CA, Phillips AS, Rice GM. Height and in-flight low back pain association among military helicopter pilots. *Aviat Space Environ Med.* 2013; 84(1):32–37.
13. Sen A, Akin A, Craft KJ, Canfield DV, Arvind KC. First-generation H1 antihistamines found in pilot fatalities of civil aviation accidents, 1990–2005. *Aviat Space Environ Med.* 2007; 78(5):514–522.
14. Shkrum MJ, Hurlbut DJ, Young JG. Fatal light aircraft accidents in Ontario: a five year study. *J Forensic Sci.* 1996; 41(2):252–263.
15. Soper JW, Chaturvedi AK, Canfield DV. Prevalence of chlorpheniramine in aviation accident pilot fatalities, 1991–1996. *Aviat Space Environ Med.* 2000; 71(12):1206–1209.