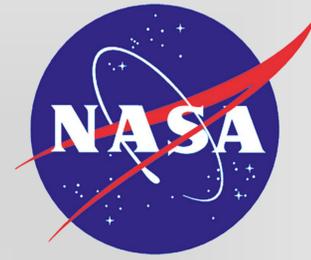




# CEREBROVASCULAR ACCIDENT INCIDENCE IN THE NASA ASTRONAUT POPULATION

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## Introduction

The development of atherosclerosis is strongly associated with an increased risk for cerebrovascular accidents (CVA), including stroke and transient ischemic attacks (TIA). Certain unique occupational exposures that individuals in the NASA astronaut corps face, specifically high-performance aircraft training, SCUBA training, and spaceflight, are hypothesized to cause changes to the cardiovascular system. These changes, which include (but are not limited to) oxidative damage as a result of radiation exposure and circadian rhythm disturbance, increased arterial stiffness, and increased carotid-intima-media thickness (CIMT), may contribute to the development of atherosclerosis and subsequent CVA. The purpose of this study was to review cases of CVA in the NASA astronaut corps and describe the comorbidities and occupational exposures associated with CVA.

## Methods

Cases of CVA were identified from review of NASA's Electronic Medical Record (EMR) and death certificates using ICD-9 codes 434 – 436 and string searches of physician notes for text phrases such as "Stroke," "Cerebrovascular Accident," and "Transient Ischemic Attack" between the years 1959 and 2014. Non-modifiable risk factors (age, family history, race, gender), modifiable risk factors (comorbidities and alcohol and tobacco use), and a variety of occupational exposures in active and retired astronauts were evaluated based on the hypothesis that they may increase the risk for CVA.

## Results

Table 1: CVA Outcomes Case Reports

ID	Event	Age	Family History*	d/x Carotid Artery Disease**
A	Stroke	<50	Significant	No
B	Stroke	<50	Significant	No
C	Stroke	>80	Significant	Yes (endarterectomy)
D	Stroke	70-79	Significant	No
E	Stroke	>80	Significant	Yes (calcification)
F	Stroke	>80	Significant	No
G	TIA	70-79	Not significant	No
H	TIA	70-79	Unknown	No
I	TIA	60-69	Significant	Yes (atherosclerosis)

\*Significant family history defined as ≥ 3 blood relatives with notable cardiovascular disease  
\*\*Potential exists for undiagnosed carotid artery disease in patients who suffered a life-ending stroke

Figure 1: Prevalence of Comorbidities and Risk Factors (n = 9 astronaut stroke cases)

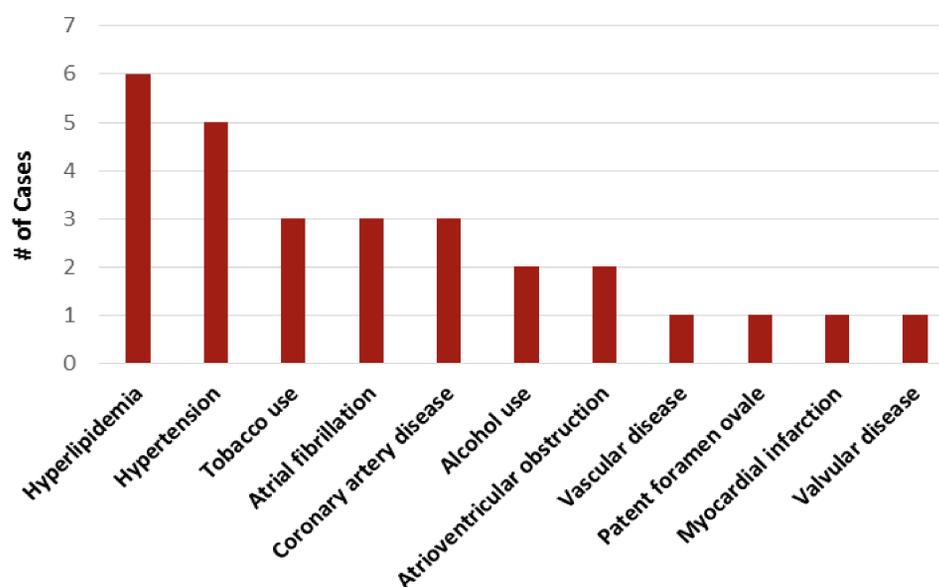
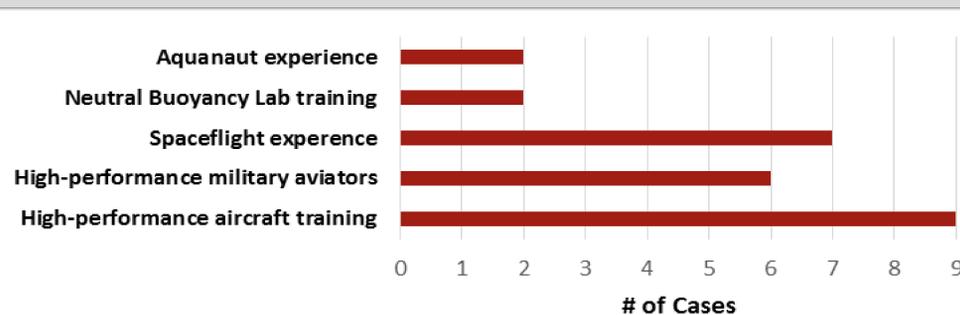


Figure 2: Prevalence of Occupational Exposures (n = 9 astronaut stroke cases)



## Results (continued)

Of 338 NASA astronauts selected, a total of nine CVA events (2.7%) were documented. All cases were Caucasian males with military and/or NASA high-performance aircraft training. Three astronauts suffered a transient ischemic attack (TIA), three suffered an ischemic stroke, and three suffered a life-ending stroke of unknown type (detail not provided on death certificates). All nine CVA occurrences were initial events; none were recurrent. The average age at the time of CVA event was 70 years (range: mid-40 to mid-80s). Common comorbidities encountered in the stroke cases were hyperlipidemia, hypertension, atrial fibrillation, and carotid artery disease.

## Discussion

Current astronaut medical selection criteria and preventive measures help to keep the incidence of CVA low. A study is currently in development that aims to examine the differences between the NASA astronaut corps and a matched cohort of United States Air Force aviators in cardiovascular disease outcomes (including CVA) and comorbidities, which will shed additional light on the risk for developing several types of cardiovascular disease that astronauts face as a result of spaceflight.

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