Prevalence of Neurologic & Mental Health Illness in US Naval Aviators: A Retrospective Cohort Study

G. Merrill Rice, D.O., MPH, Naval Safety Command, Norfolk, VA

Steven Linnville, Ph.D., Naval Medical Research Unit-Dayton, Wright-Patterson Air Force Base, OH

Tina M. Luse, MPH, Defense Health Agency, Defense Centers for Public Health-Aberdeen, Aberdeen Proving Ground, MD

Jonathan D. Erpenbach, M.D., Naval Safety Command, Norfolk, VA

Stephanie A. Larocco, M.S., MSPH, Battelle Memorial Institute, Columbus, OH

INTRODUCTION: Recent media and public attention have linked the naval tactical aircraft accelerative environment to potential neurologic and mental health issues, but epidemiological research on tactical aviators is limited. This study reports the current prevalence of selected neurologic and mental health disorders among naval tactical aviators and non-tactical aviators.

METHODS: A retrospective cohort-designed study was performed on 10,661 active-duty naval aviators identified within the Naval Fleet Training Management and Planning System. Their unique identification codes were associated with all available military electronic health records within the Military Health System Data Repository for certain neurologic and mental health International Classification of Diseases codes from October 2000 through December 2024.

RESULTS: In total 8,593 active-duty naval aviators met inclusion criteria. Compared to tactical aviators, helicopter aviators had higher odds of behavioral health disorders overall (odds ratio (OR) 1.29, 95% confidence limits (CL) 1.10-1.52), adjustment disorders (OR 1.35, 95% CL 1.09-1.68), and post-traumatic stress disorder (OR 1.82, 95% CL 1.02-3.25). Reconnaissance aviators had higher odds of behavioral health disorders overall (OR 1.37, 95% CL 1.17-1.60), adjustment disorders (OR 1.5, 95% CL 1.22-1.85), post-traumatic stress disorder (OR 1.84, 95% CL 1.05-3.22), and anxiety (OR 1.33, 95% CL 1.05-1.70) compared to tactical aviators. No significant differences were observed between these cohorts for selected neurologic conditions.

DISCUSSION: Accelerative exposures in tactical naval aviation differ and are generally far lower than those seen in sports involving repetitive head impacts. Advances in medical imaging and neuro-biomarkers afford aeromedical researchers to examine this population for potential subclinical neurologic changes.

KEYWORDS: Naval Aviation, Prevalence, Cognitive, Neurologic, Mental Health

Recently the neurological and mental health of U.S. Naval jet pilots has come under significant negative media and public scrutiny.[1,2] Despite this growing attention, research on the long-term neurological and psychological effects of repeated exposure to the unique stresses of the tactical aviation environment remains limited. Moreover, the relationship between neurologic function and mental health is complex and deeply interconnected, yet each domain warrants careful, independent investigation within this population to better understand their combined impact on operational readiness and well-being of tactical aviators. For the purposes of this paper, tactical aviation will be defined as those platforms that have a high thrust to weight ratio and are frequently exposed to high and dynamic G-forces in the range of 4-7 G's, such as F/A-18 and F-35's. The following paragraphs will critically examine past and current literature on long-term neurologic and mental health disorders in tactical aviators, providing context for interpreting prevalence data and identifying potential gaps in research.

Broadly, there are numerous environmental hazards while flying tactical jet aircraft that may impact an aviator's acute cognition and neurological health. Hypoxia, acceleration, thermal, radiation, vibration, and noise exposures are well studied for their acute effects on aviators.[3,4] Historical research on the long-term neurologic effects of the tactical jet environment, specifically with regard to acceleration has predominately involved studies evaluating spinal disorders.[5,6] Regarding long-term cognitive deficits, military working groups have previously emphasized the need for prospective longitudinal studies in this population. However, due to the high cost of such research, they have often recommended using cross-sectional designs or retrospective cohort analyses instead.[7] To our knowledge there has yet to be published any research comparing the prevalence of cognitive or neurologic disorders among tactical aviators to their non-tactical counterparts.

Despite limited research in this area of aerospace medicine, evidence suggests that repeated exposure to high altitude and space may elevate inflammatory markers and precursors of neurodegenerative disease.[8] Rhind recently investigated neurological biomarkers in military aviators to assess the potential risk of long-term brain injury and neurodegeneration.[9] Using multiplexed immunoassays, he measured biomarker concentrations in 48 Royal Canadian Air Force pilots and 48 non-aviator Canadian Air Force personnel. Aviators showed significantly elevated levels of Glial Fibrillary Acidic Protein, Neurofilament Light Chain, Peroxiredoxin 6, and total Tau Protein compared to controls ($p < 0.001$), indicating increased glial activation, axonal injury, and oxidative stress. Sarry also reported increased white matter hyperintensities on magnetic resonance imaging (MRI) among Canadian fighter pilots, though these findings were not linked to specific exposures or cognitive decline.[10] To date, these biomarker and magnetic resonance imaging changes have not been correlated with measurable cognitive deficits in tactical aviators. However, these findings underscore the value of longitudinal monitoring of aviators, which could allow early detection of neurologic abnormalities and cognitive decline. Such evaluation may also provide insight into the onset and progression of mental health disorders, informing preventative strategies and interventions. In this context, reviewing previous findings on aviator mental health is crucial for understanding baseline risk and framing of future studies.

Prior research on the prevalence of mental health disorders, primarily in the commercial aviation industry, has generally reported lower risk for aviators compared to the public.[11] In a recent systematic review covering studies from 1980 to December 2021, Ackland found that nearly 80% of the 58 studies reviewed reported lower prevalence rates in pilots. However, prevalence rates were higher when studies used questionnaires—anonymous or interview-based—rather than other protocols. Of the 20 questionnaire-based studies, eight reported higher prevalence of mental health disorders among pilots compared to the public. Six of these involved commercial airline pilots, and the remaining two were foreign studies with mixed pilot populations. Importantly, none of the studies linked pilots' environmental exposures, such as acceleration, to mental health outcomes. This methodological divide highlights the challenge of accurately determining the "true" prevalence of mental health disorders among aviators.

In military aviation research, studies on mental health prevalence have also produced conflicting results, in part due to their different methodologies. For example, Britt et al. used data obtained from the Aeromedical Electronic Resource Office database comparing prevalence rates of depression, anxiety, post-traumatic stress disorder (PTSD), and adjustment disorders amongst three classes of Army aviation personnel.[12] They found that the overall prevalence of depression and anxiety for pilots were 0.7% and 0.8% respectively, far lower than the World Health Organization's general public estimate of 4.4% and 3.6%. The researchers acknowledged this disparity within their discussion stating their results were like those found in Lollis' study,[13] which used a US Air Force Aeromedical Information Management Waiver Tracking System but were low compared to other studies on military aviators, such as Hoge[14], who used questionnaires. Notably, none of these studies attempted to link pilots' specific environmental exposures, such as high acceleration forces, to the onset or prevalence of mental health disorders.

It is not surprising there is a meaningful difference in the prevalence rates between database evaluation of mental health disorders for aviators compared to questionnaire analysis. Fear of disqualification and the potential loss of flying status can carry significant social and financial consequences for pilots and aircrew. In a recent questionnaire-based study, Hoffman et al. found that among 264 military pilots surveyed, 72% reported avoiding health care, and 42.5% admitted to misrepresenting or withholding health information during flight surgeon examinations due to concerns about losing their flying status.[15]

Acknowledging the possibility of health care avoidance for this highly motivated population, and in general the safety and efficacy of new psychoactive pharmaceuticals over the last decade, Department of Navy aeromedical authorities have broadened their tolerance for waiver approval for both neurological and mental health disorders.[16] These policy changes, together with advancements in medical technology, may enable researchers to examine differences in the prevalence of behavioral health and cognitive diagnoses between aviators uniquely exposed to tactical jet environments. Moreover, from an epidemiologic perspective, if the environmental conditions that tactical aviators are routinely exposed to place them at greater risk for certain neurologic and mental health disorders, then one may see higher prevalence data for these conditions within this population compared to their non-tactical counterparts. Accordingly, the primary objective of this paper was to estimate the probability of certain neurological and mental health disorders among tactical and non-tactical naval aviators by analyzing prevalence data extracted from all available military electronic health records.

METHODS

This project was deemed public health support and non-research with the use of human subject information by the Navy and Marine Corps Force Health Protection Command Institutional Review Board on July 29, 2025. As such, informed consent and additional institutional review were not required. This designation allowed the investigators to proceed with data collection and analysis using existing health records while maintaining strict confidentiality and adherence to the Health Insurance Portability and Accountability Act and privacy regulations. Strengthening and Reporting of Observational Studies in Epidemiology guidelines were utilized to ensure high-quality reporting of data.[17]

Subjects

For inclusion into this retrospective cohort, the Naval Fleet Training Management and Planning System database was queried for all US Navy and Marine Corps active-duty officers with Additional Qualification Designation (AQD) codes pertaining to flight duties as of December 2024. For the first data filter, AQDs were subcategorized into flight platforms encompassing tactical aircraft models (F/A-18, F-35, F-16, F-5, AV-8), reconnaissance/logistic (E-2, C-2, V-22, E6B and C-40), and helicopter platforms (H-60, H-1, MH-53). Following this initial filter, there were 2,554 tactical aviators, 4,259 reconnaissance/logistics aviators, and 3,848 helicopter aviators were identified. To ensure this population successfully completed flight training, we excluded training unit identifying codes (UICs) and included only those aviators who had a minimum of one month in an operational aviation UIC by utilizing the Defense Manpower Data Center and Defense Enrollment Eligibility Reporting System active-duty personnel roster as the second filter. Additional individuals were removed from the helicopter and reconnaissance/logistics cohorts if they had operational aviation experience in one of the other cohorts. This secondary filter resulted in a total cohort of 8,589 aviators, consisting of 2,163 tactical, 3,004 helicopter, and 3,431 reconnaissance/logistic naval aviators to compare certain neurologic and mental health diagnosis prevalence (Fig. 1).

Procedure

After filtering the cohort by AQDs and operational platform exposure, we matched each servicemember's unique identifier number to all available electronic medical records within the Military Health System Data Repository. Within this repository, data were collated from the following databases: the Comprehensive/Ambulatory Professional Encounter Record, Standard Inpatient Data Record, Theater Medical Data Store, Military Health System GENESIS, and Tricare Encounter Data. There were seven outcomes tracked among the three cohorts for mental health disorders: adjustment disorder, anxiety disorder, alcohol use disorder, depressive disorder, PTSD, other substance use disorder, and suicide-related behaviors. There were four primary classifications of neurological disorders evaluated: minor neurocognitive disorders, major neurocognitive disorders, migraine, and mild traumatic brain injury (mTBI). To maximize sensitivity, individuals were classified as having an outcome if they received an associated diagnostic code at least once during their time in service from October 2000 through December 2024. All disorders were identified using International Classification of Diseases (ICD) versions 9 and 10. For a complete list of ICD codes queried for each outcome please see Table I.

Statistical Analysis

Logistic regression was used to calculate the odds ratio (OR) and 95% confidence limit (CL) of outcomes in the helicopter and reconnaissance/logistics cohorts, compared to the tactical cohort. The ORs were adjusted for date of birth date and sex. To ensure adequate statistical power, counts of outcomes were added across all three cohorts. Outcomes that did not have at least 17 cases per independent variable, or 51 cases total, were not analyzed further. SAS 9.4 (SAS Institute, Cary, NC) was used for all calculations.

RESULTS

Table II reveals the number of designated naval aviators as of December 2024, divided across four age groups and the three general platforms, helicopter, reconnaissance/logistics and tactical aviators. The three general platforms were confirmed through AQD designation as well as UIC association as described in the methodology. The differences in sex distribution were statistically significant (X2(2, N=8,598)=52.23, p<0.0001) between platform categories as were the differences in age distribution (X2(6,N=8,598)=100.14, p<0.0001).

Of the 8,598 aviators who were on active duty in December 2024, just over 15% had a verifiable mental health diagnosis at one point between October 2000 and December 2024. The leading behavioral health disorder diagnosis found for the entire cohort was adjustment disorder followed by anxiety, depression, alcohol use disorder and PTSD. All other behavioral health diagnoses were identified in less than 2% of the population. Major neurocognitive disorders and minor neurocognitive disorders had numbers too small to report (<10 individuals combined). Both of those categories, along with suicide-related behaviors and other substance use were excluded from further analysis due to low numbers.

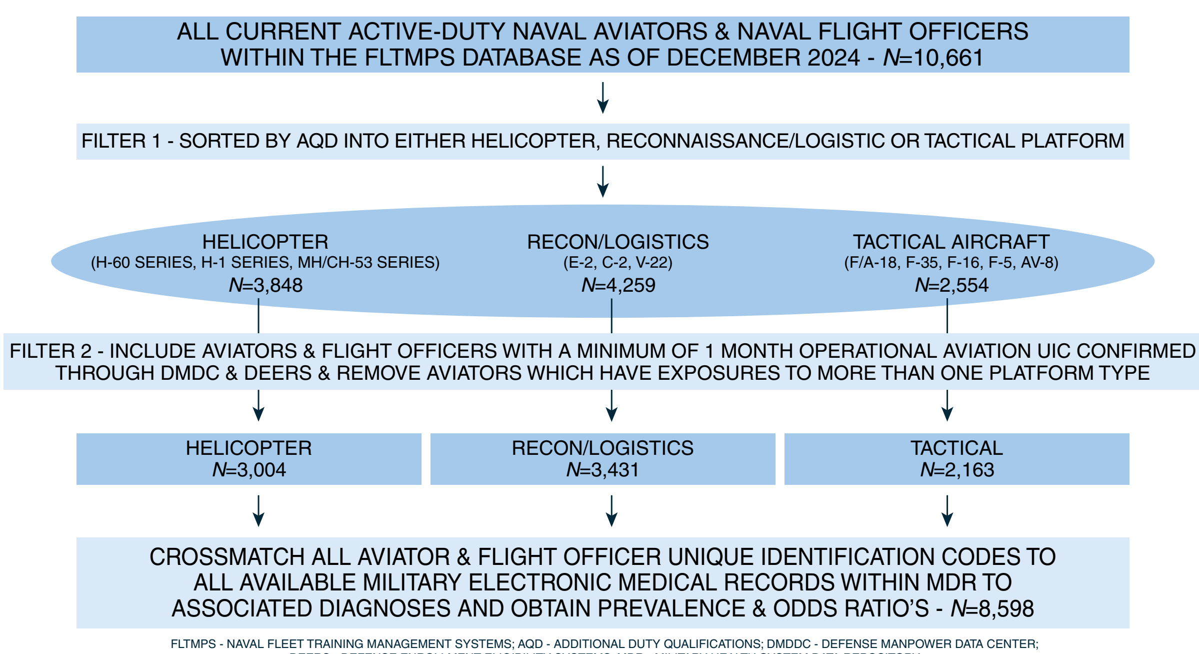

Fig 1. Flow chart for inclusion to retrospective cohort.

Table I. ICD Codes Used in Case Definitions for Outcomes.

OUTCOME	ICD-10 CODES	ICD-9 CODES
Adjustment	F43.2*, F43.8*, F43.9	309.0–309.4, 309.82–309.9
Anxiety	F40*, F41*, F42*	300.0*, 300.2*,300.3*
Depressive	F32*, F33*, F34.1–F34.9, F39	296.2*, 296.3*, 296.82, 296.9*, 300.4
Alcohol	F10.1*, F10.2*	291.0, 291.81, 303*,305.0*
PTSD	F43.1*	309.81
Suicide-Related	R45.851, T14.91*, T36.^X2^, T36.92X^, T37. ^X2^, T37.92X^, T38.^^2^, T39. ^^2^, T39.92X^, T4^.^^2^, T4^.^2X^, T50. ^^2^, X71.0XXA–X83.8XXS, Z91.5*	V62.84, E95*
Other Substances	F11.1*, F11.2*, F12.1*, F12.2*, F13.1*, F13.2*, F14.1*, F14.2*, F15.1*, F15.2*, F16.1*, F16.2*, F18.1*, F18.2*, F19.1*, F19.2*	304*, 305.20-305.93
mTBI	F07.81, S02.110A, S02.112A, S02.113A, S02.11AA, S02.11BA, S02.11EA, S02.11FA, S02.80XA, S02.81XA, S02.82XA, S06.0X0A, S06.0X1A, S06.0X9A	310.2, 850*, 959.01
Major Neurocognitive	F01* and I6*; F02* and G31*; F03*, G30*, I69.31*	290.4 and 438*; 290.0-290.3, 290.8-290.9, 330.0, 330.8, 331.0–331.2, 331.6–331.89, 438.0
Minor Neurocognitive	G31.84	331.83
Cognitive Symptoms	R41*	780.93, 780.97, 781.8, 797, 799.5*

*Group of diagnoses defined by starting characters.
^Group of diagnoses defined by the same character structure, with carets indicating the characters that differ.

Compared to tactical aviators, helicopter aviators had higher odds of behavioral health disorders overall (OR 1.29, 95% CL 1.10-1.52), adjustment disorders (OR 1.35, 95% CL 1.09-1.68), and post-traumatic stress disorder (OR 1.82, 95% CL 1.02-3.25). When compared to tactical aviators, reconnaissance aviators had higher odds of behavioral health disorders overall (OR 1.37, 95% CL 1.17-1.60), adjustment disorders (OR 1.5, 95% CL 1.22-1.85), post-traumatic stress disorder (OR 1.84, 95% CL 1.05-3.22), and anxiety (OR 1.33, 95% CL 1.05-1.70). We found no statistical difference in migraine, mTBI, cognitive symptoms, alcohol use disorder or depression between tactical, helicopter or reconnaissance/logistic aviators (Table III).

DISCUSSION

Recent media reports have proposed that the accelerative exposures tactical naval aviators experience is potentially associated with long-term cognitive decline and increased mental health disorders. This retrospective, cohort-designed study suggests tactical naval aviators, despite their increased exposure to accelerative forces, do not have a higher prevalence of certain neurologic and mental health disorders compared to their non-tactical counterparts. Furthermore, our study found tactical aviators had a lower probability of various mental health disorders compared to their helicopter and logistics counterparts, such as anxiety, PTSD and adjustment disorder. One consideration for this finding, at least for the helicopter cohort, may be the closer proximity to direct combat environments. Yet another consideration for this finding is that health care avoidance patterns for single piloted aircraft in the tactical community may be different than multi-piloted non-tactical aviation platforms, possibly leading to differences in prevalence rates for these potentially career ending diagnoses. Limited data from Hoffman's aforementioned paper does not suggest this however, as approximately the same percentage of tactical pilots (75.6%) reported healthcare avoidant behaviors as military transport pilots (71.2%).[17] Given the limited research on healthcare avoidance behaviors between military aviation platforms, there is a need to identify whether these patterns are significantly different between tactical and non-tactical naval aviation platforms.

Table II. Comparison of Sex and Age Distributions in Aviator Cohorts.

DEMOGRAPHIC	HELICOPTER (*N*=3,004) *N* (%)	RECON/ LOGISTICS (*N*=3,431) *N* (%)	TACTICAL (*N*=2,163) *N* (%)
Sex			
Female	442 (14.71)	417 (12.15)	175 (8.09)
Male	2,562 (85.29)	3,014 (87.85)	1,988 (91.91)
Age Group, yr			
<30	704 (23.44)	968 (28.21)	454 (20.99)
30-34	1,156 (38.48)	1,183 (34.48)	704 (32.55)
35-39	607 (20.21)	565 (16.47)	445 (20.57)
≥40	537 (17.88)	715 (20.84)	560 (25.89)

The overall prevalence of mental health disorders for this cohort of aviators (15%) was higher than previously reported by Britt and other researchers who have relied solely on one database to acquire diagnostic information,[14,15] but lower than questionnaire-based studies involving military pilots who have been exposed to combat operations.[16] This suggests that using data from five different electronic health record systems allowed us to detect more diagnoses than what would typically be captured by official waiver authorities or the medical staff caring for these pilots. Yet, the results may still underestimate true prevalence due to the tendency of some pilots to avoid reporting medical issues in contrast to their non-aviation counterparts. For context, when compared to non-aviation personnel, an internal analysis conducted by Defense Health Agency-Public Health in 2024 revealed significantly higher rates of mental health diagnoses among non-aviator officers (Defense Health Agency-Public Health. Behavioral Health Snapshot, Active Duty Navy/USMC Aviator Officers, May 2023-April 2024). However, no definitive conclusions could be drawn from this comparison because of the inability to control

Table III. Frequency Outcomes for Entire Cohort and Comparison of Prevalence for Certain Neurological and Mental Health Disorders for Tactical, Recon/Logistics, and Helicopter Aviators.

FREQUENCY OF OUTCOMES, ALL COHORTS (AVIATORS *N* =8598) *N* (%)	FREQUENCY OUTCOME BETWEEN COHORTS		
	OUTCOME	GROUP	aOR* (95% CL)
618 (7.19)	mTBI	Tactical	Ref
		Recon/Logistics	1.07 (0.86-1.32)
		Helicopter	1.12 (0.90-1.39)
261 (3.04)	Migraine	Tactical	Ref
		Recon/Logistics	1.17 (0.85-1.61)
		Helicopter	1.06 (0.76-1.49)
210 (2.44)	Cognitive Symptoms	Tactical	Ref
		Recon/Logistics	0.95 (0.68-1.32)
		Helicopter	0.73 (0.51-1.05)
1,301 (15.13)	Behavioral Health Disorder	Tactical	Ref
		Recon/Logistics	**1.37 (1.17-1.60)**
		Helicopter	**1.29 (1.10-1.52)**
719 (8.36)	Adjustment Disorder	Tactical	Ref
		Recon/Logistics	**1.50 (1.22-1.85)**
		Helicopter	**1.35 (1.09-1.68)**
497 (5.78)	Anxiety	Tactical	Ref
		Recon/Logistics	**1.33 (1.05-1.70)**
		Helicopter	1.18 (0.92-1.52)
316 (3.37)	Depressive	Tactical	Ref
		Recon/Logistics	1.30 (0.96-1.76)
		Helicopter	1.32 (0.97-1.80)
290 (3.37)	Alcohol	Tactical	Ref
		Recon/Logistics	1.17 (0.86-1.59)
		Helicopter	1.32 (0.97-1.81)
104 (1.21)	PTSD	Tactical	Ref
		Recon/Logistics	**1.84 (1.05-3.22)**
		Helicopter	**1.82 (1.02-3.25)**

aOR: adjusted odds ratio; mTBI: minor traumatic brain injury; PTSD: post-traumatic stress disorder.
*Odds ratios adjusted for sex and date of birth. Adjusted odds ratios of outcomes by aviator platform cohort. Statistically significant associations are in bold.

key confounding factors, such as enhanced neuropsychologic flight screening for aviators and the previously mentioned tendency for aviation personnel to avoid seeking medical care.

This study relied on all available electronic medical data within the military health systems databases to obtain neurologic and mental health outcomes of naval aviators. Record quality obtained from the various electronic health databases was assumed to be similar across the groups studied, therefore any incomplete, inconsistent or inaccurate information obtained should have been experienced across all groups. Common confounding variables in retrospective cohort studies, such as smoking status, socioeconomic status, and educational level, were assumed to be comparable between groups, although they could not be directly measured or quantified in this analysis. The three platform groups were designed to reflect one another in all but operational platform environmental exposures. Acknowledging this effort, there are instances where platforms within the reconnaissance/logistic group do sustain repetitive catapult shots and trap exposures (equivalent to up to ±4.5 Gx).

Cumulative flight hours were unavailable for the pilots within this cohort. Historically, average flight hours per month between these platforms, obtained through the Sierra Hotel Aviation Readiness Program, reflect that tactical aviators do not have higher flight time compared to their helicopter or reconnaissance/logistic communities. Although the treatment data covered an extended period, aviation personnel rosters were only available for December 2024 at the time of this analysis. This could lead to survival bias, as aviators with disqualifying mental or neurologic health might have already separated prior to the roster month. A retrospective study with longitudinal rosters could eliminate this bias, while taking advantage of the available treatment data.

There is biological plausibility that repetitive accelerative forces may contribute to neurologic disorders, cognitive decline, and increased rates of mental health conditions, as suggested in the sports medicine literature; however, these studies most often involve direct impacts to the head and neck.[18] However, experts in the field of TBI have cautioned comparing these type of direct impacts to the head to accelerative forces experienced in the aircraft as the latter is predominately whole body acceleration with different acceleration/deceleration patterns to the brain.[19] To illustrate this point, Fig. 2 provides a comparative perspective of sustained and peak accelerative forces, both whole body and head, across a variety of sports, aviation and other transport environments[20-29]. From Fig. 2, we can see the reported routine and extreme magnitude of these accelerations for soccer, rugby and American football are far higher than that incurred during routine and extreme tactical naval aviation.

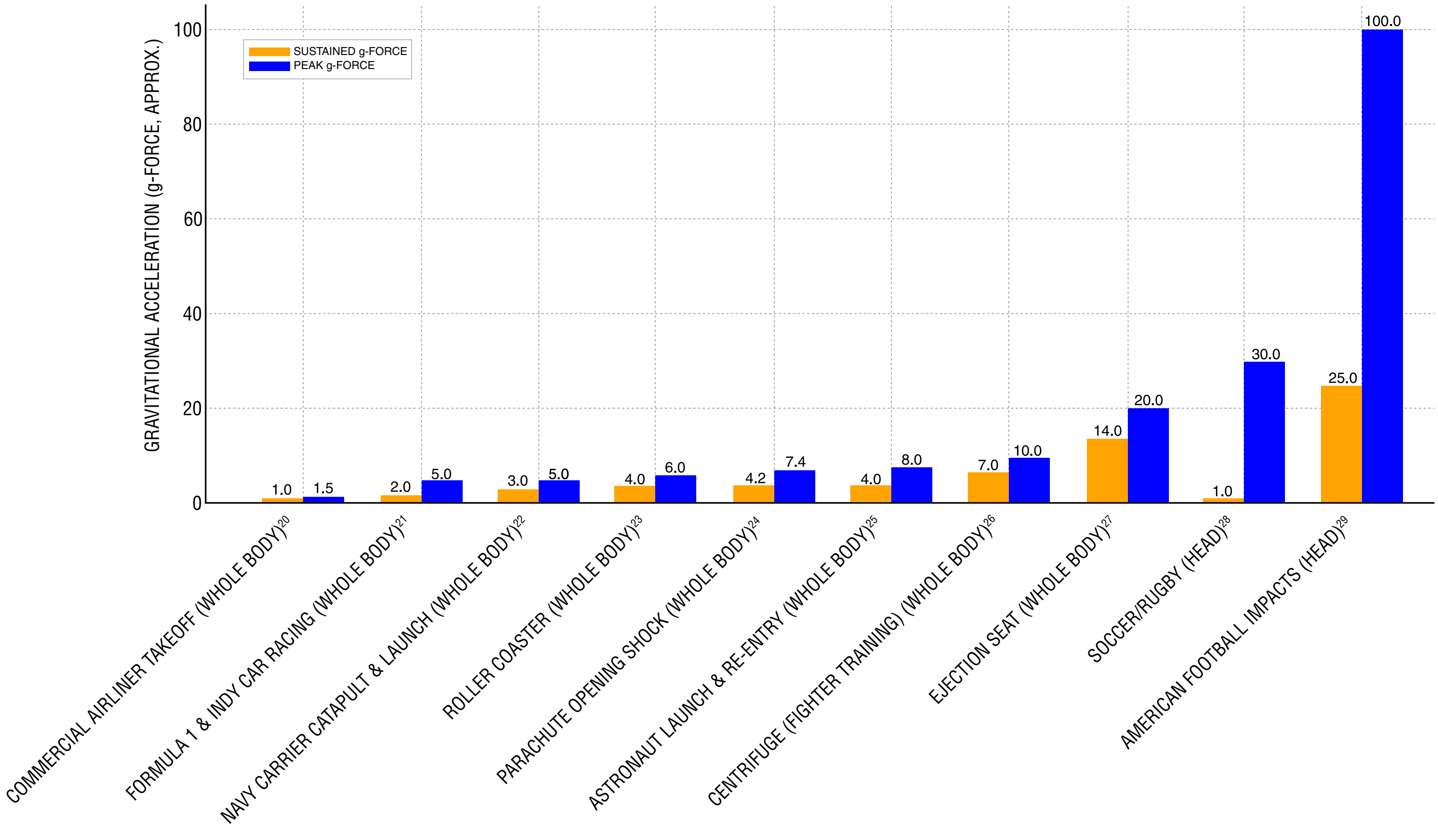

Fig. 2. Comparison of g-forces across aviation, motorsports, sports, and other environments. Values are approximate and represent typical sustained g-forces (>2–3 s) or peak g-forces (<0.3 s). Sustained durations reflect continuous accelerations long enough to produce cardiovascular effects; peak durations represent brief, transient shock pulses. Actual values vary with vehicle, posture, and measurement method. See Refs. 20–29 for category-specific data sources.

The closest sports parallel to the Gx accelerative force exposure our tactical aviator's experience may be the race car driving population and to a lesser degree extreme amusement park rides. The limited reports published on these exposures suggest the highest peak head accelerations modeled have been far below conventional levels that are predictive for head injuries and have not been associated with long-term cognitive decline.[23,30]

As discussed, recent technological advancements with MRI techniques and neuro-biomarker development have shown promise in the early identification of neurological injury and disease. Potentially confounding the interpretation of these new tools is evidence to suggest that early involvement in competitive sports which incur repetitive head contact, such as soccer and American football, result in subclinical brain injury.[31] Subsequently, a thorough past history of repeated head impacts from sports or otherwise for aviators exposed to these unique environments should be considered. Currently there is no epidemiologic evidence to suggest that tactical aviators have higher prevalence of neurologic or mental health disorders than their non-tactical counterparts. Moreover, there is limited empirical evidence that either the imaging changes noted in the above reference studies or the biomarker findings, are associated with long-term cognitive decline in the tactical aviation community compared to age match controls.

Thus, flying tactical jets expose pilots to unique hazards—such as hypoxia, intense G-forces, and hypobaric environments that may affect brain health. Although long-term research remains limited, emerging medical technologies raise legitimate concerns about potential neurological risks. Prospective, longitudinal monitoring of pilots with surveys, biomarker analysis or bioimaging is essential to detect early cognitive changes, track mental health trends, and accurately estimate disorder prevalence. To reliably determine whether repeated exposure to the tactical jet environment increases the risk of cognitive decline or mental health disorders, comprehensive, systematic studies over time are needed—ideally controlling for any history of repetitive head impacts—to safeguard aviator readiness and operational safety.

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