

Red River Valley Fighter Pilots Association

White Paper

2021 High-G Repetitive Strain Injury Online Survey

Red River Valley Fighter Pilot Association High-G Repetitive Strain Injuries In Military Aviators

The physical forces acting upon the bodies of fighter and attack pilots are different than the forces which bomber, tanker, transport, reconnaissance, and most trainer aircraft experience. While many military aviators fly aircraft capable of subjecting cockpit occupants to acceleration forces ("G" forces), this white paper from the Red River Valley Fighter Pilots Association (RRVA) focuses on the physiological effects and injuries sustained not by all military aviators but those who flew High-Performance Aircraft (HPAs) in the U.S. Air Force, U.S. Navy, and U.S. Marine Corps.

Why focus on the physiological effects of high-G flight among military aircrew who flew HPAs? As a problem statement, the enduring physiological challenges of years if not a career spent flying HPAs left many U.S. military HPA aircrew with chronic neck and spinal pain, substantial use challenges, and range of motion limitations within bodies exposed to the highest G forces of any U.S. military aircraft. Importantly, those injury symptoms are documented in aerospace medicine research literature.

Background.

Concisely, as the F-14, F-15, F-16, and F/A-18 became ubiquitous across the Air Force, Navy, and Marine Corps, the physiological effects of continuous high-G flying also appeared on a broader scale. While many older fighter aircraft such as the F-4, F-8, and the A-7 generated cockpit-G loadings that exceeded sustained loads of +6Gs with peak G-loads at/near +7Gs, newer fighters routinely sustained cockpit-G loads of +7.5Gs with peak G-loads of +9Gs that could be sustained for 30 seconds or more. In the F-15, F-16, and F/A-18, HPA aerodynamic performance could and occasionally did outperform the ability of aircrew to avoid loss of consciousness and the aircraft.

Beginning in the mid-1980s, aerospace physicians began researching the physiological effects of routine high-G flight on HPA aircrew. Studies found that HPA aircrew conditioning helped aircrew fly with added safety at the highest cockpit G-loads. However, improved aviator strength training and aerobic conditioning did not eliminate accelerated physiological wear, injuries, and serial reinjury on joints and muscle groups within the neck and spine. Among typically conditioned HPA aircrew, muscle and joint injury was and remains a common occurrence. As these aircrew spent years in HPA aviation, their bodies manifested a proneness to re-injury of previously injured muscle, nerves, and joints. These patterns and associations continue in the F-22 and F-35.

High-G RSI Survey Description.

In May 2021, RRVA initiated an online survey of previous and current Air Force, Navy, and Marine Corps HPA aircrew to determine their experiences as they pertain to career flying experience, physiological challenges, and medical care. In designing the survey, the RRVA Aviation Medical Issues Committee determined no popular term existed for the basket of physiological symptoms experienced by HPA aircrew. Thus, the RRVA Aviation Medical Issues Committee coined the term High-G Repetitive Strain Injury, or High-G RSI for short. The term High-G RSI puts a commonalized label on the physiological symptoms understandable to laymen military aviators and recognizable to medical providers.

In January 2021, the RRVA Aviation Medical Issues Committee began a five month design period that led to a 30-day beta test. In mid-2021, Aviation Medical Issues Committee completed survey design and improvement clearing the way to rollout. At rollout, the survey contained 17 questions which required an average of 11 minutes to complete. Survey responses were compiled by Survey Monkey servers whose data outputs were response tabulation and mean/mode computation. Each question response was assigned a score value. On May 16, 2021, the RRVA High-G RSI Survey opened; the survey closed December 31, 2021.

High-G RSI Survey Design.

While not a scientific study meeting epidemiological standards, the RRVA Aviation Medical Issues Committee designed the Online High-G RSI Survey to capture deidentified medical condition data that respondents attributed to their High-G RSI, delved into their quality of life, examined treatment of their symptoms, and mapped symptom after-care.

The survey data fulfilled the Aviation Medical Issues Committee's goal that the High-G RSI Online Survey provide objective question criteria to inform subjective self-evaluation to depict a broader story of the symptomology of High-G RSI in the lives of male/female, Veteran and currently serving USAF, USN, and USMC HPA aviators. The survey described High-G RSI as:

A group of symptoms that occur more likely than not, as a consequence of routine exposure to High-G flying in the course of normal duties in an assigned military aircraft.

The survey asked respondents to not consider any personal injuries associated with nonmilitary flying, household injuries, athletic injuries, or other bone/tissue overwork. The mechanism provided to respondents to comply with this measurement restriction was specific recall that associated an injury to a specific incident while flying a HPA. Lack of recall meant that a respondent could not proceed in the survey. For, as the survey stated, "We believe most past and present aircrew do have some sense of if/when their RSI injuries occurred and a sense of their physical limitations potentially to their frequent exposure to continuous high-G military flying in fighter and/or attack aircraft."

There were no control groups built into the survey as the Aviation Medical Issues Committee deemed this design unexecutable within the constraints of an online survey. The survey asked respondents to answer questions based on self-evaluation. No respondent personally identifiable information (PII) was accepted.

High-G RSI Survey Findings.

The final survey response tally was 1,340. Given the design of the survey and response quantity, the survey generated over 81,000 data points. Respondent demographics: 73% Air Force, 25% Navy, 2% Marine Corps. Each respondent flew HPA aircraft as primary assigned flying duty. The exclusion of military aviators who did not fly HPAs was constrained by the goal of the survey to map individual High-G RSI responses informed by aerospace medicine literature that similarly studied the symptomology of aviators who flew the highest-G capable aircraft. The survey did not measure nor did it seek inputs from individuals who flew non-military aircraft of any type nor did it accept responses from aviators of foreign militaries.

Next, the survey measured the flying background of previous and current HPA military aviators. Table 1 depicts the aircraft whose aircrew were qualified to complete the High-G Online Survey.

Gen 3	A-4, F-4, F-5, A-7, F-8, A-37, any Century Series Fighter		
Gen 4	A-10, F-14, F-15, F-16, F/A-18		
Gen 5	F-22, F-35		

Table 1. Fighter/Attack Generation Scheme

Statistically, there was a 50/50 split among respondents who flew Gen 3 and Gen 4 HPAs with a small response set from Gen 5 HPA aviators. Slightly more than half of the Gen 3 aircrew went on to fly Gen 4 aircraft, the highest G-load fighter/attack aircraft ever to be mass produced. When combined with the respondents who only flew Gen 5 HPAs, nearly 7 out 10 survey respondents flew high-G Gen 4 fighters. This large response cluster among Gen 4 HPAs aligns with the broad findings of aerospace physiology findings that correlate heightened physiological symptom occurrence in Gen 4 HPAs.

When the flying time totals reported by respondents are incorporated, there was a quasibell-curve distribution. If the low time respondents (< 500 flight hours) and highest respondents (> 4,000 flight hours) are factored out, the approximate mean of the curve is 600 to 800 flight hours. This may suggest that HPA aviators' High-G RSI symptoms had a higher initial onset frequency within a HPA aviator's first 1,000 flying hours; perhaps less. This could suggest that if personal High-G RSI injury occurs prior to 1,000 flying hours, continued flight beyond 1,000 flight hours may expose HPA aviators to serial re-injury.

The survey touched on the matter of ejection as a correlative to High-G RSI. Of the 1,340 completed surveys, 87 aviators reported at least one ejection. Interestingly, approximately half of the "yes" respondents perceived that their ejection(s) had a cause-effect relationship on their High-G RSI symptoms; these responses offered no further details. Interestingly, this scant data

says more about the reliability of post-Vietnam War era HPAs than it may offer about military aviator health.

Once it established respondent demographics, the survey devoted its main attention to ten areas: individual program of care for High-G RSI sufferers, rating their pain, linkage of pain to quality of life, High-G RSI pain treatment, age at initial pain onset, approximate age at survey completion, treatment while on military flying orders, perceptions of military medicine, granted disability service connection, and disability claim status. Each of these ten areas follows:

- 1. **Program of Care:** responses binned into a five-way split with a significant number who plan to seek no relief for their High-G RSI symptoms. Of the five-way split, the largest cluster of respondents indicated they would seek a medical evaluation of their High-G RSI symptoms. The second largest response group of the five indicated they would seek tailored care for High-G RSI within the VA enterprise. The third and fourth response clusters of roughly equivalent size were in active treatment for High-G RSI symptom treatment, or have been treated in the past for their symptoms. The smallest of these five response clusters indicated they were being actively evaluated for what they perceived as High-G RSI symptoms.
 - a. <u>Insight</u>: two larger trendlines appear in the response data to this survey question: 1) nearly 4 out of 10 respondents are pursuing treatment, 2) 5 out of 10 respondents are unsatisfied with lack of service connection or what they perceive as inappropriate disability award rating. *Veterans are telling us that there is qualifying need, yet the VBA has no tools or approaches to award High-G RSI service connection along with appropriate disability rating(s).*
- 2. **Rating Pain:** 37% of respondents sought specialized medical care provider treatment to decrease pain and restore somewhat normal function/use. Over 18% of sufferers will seek surgical relief or have undergone surgery to decrease pain and restore some degree of function/use.
 - a. <u>Insight:</u> approximately 12 out of 100 respondents indicated that their High-G symptoms imposed no limitations; however, that does not suggest they are necessarily High-G RSI symptom free. Approximately 8 out of 10 respondents experience High-G RSI symptoms they treat with OTC meds or specialized care to include surgery. In other words, 80% of HPA aviators currently suffer pain, limited use, or range of motion limitations. *This data likely re-baselines contemporary understanding of the extent of pain, function, and use limits among USAF, USN, and USMC HPA aviators eligible for service connection.*
- 3. Pain & Quality of Life: the survey asked respondents to plot their pain, function, and use limitations on a straightforward, subjective rating scale: Always, Frequently, Occasionally, Rarely, and Never. Approximately 57% of respondents reported their High-G RSI symptoms always/frequently impact their quality of life (QoL). Approximately 6 out of 100 respondents reported zero QoL impact while another 10 out of 100 reported rare QoL impacts.
 - a. <u>Insight</u>: Slightly more than 8 out of 10 HPA aircrew reported that their High-G RSI symptoms continue to impact their QoL. Over 5 out 10 HPA aviators report not minor but significant, enduring QoL impact. We have no occupational health injury data from other officer specialty codes, particularly those from non-

aviation backgrounds within military service. However, this survey data may put HPA aircrew in one of the most physically impactful military careers, certainly in all of military aviation.

- 4. Pain Treatment: Slightly more than 9% of survey respondents were currently on military flying orders when they completed the survey and reported they did not/do not seek care for what they classify as High-G RSI injury symptoms. Potential explanations for their lack of pursuit of care may lie in other survey data. Elsewhere, 6 out of 10 respondents report they seek care through civilian health care providers. Importantly, these former HPA aircrew are invisible to any future VA/DOD longitudinal High-G RSI study due to HIPAA. Approximately 25% of all respondents seek care for symptom relief within the VA enterprise or in VA-approved Mission Act providers. Interestingly, approximately 12 out of 100 respondents reported that in between military HPA flying tours of duty, they sought care to mitigate symptoms they associate with their High-G RSI injuries and sought this care without disclosure to military medical officials.
 - a. <u>Insight:</u> 1) the 25% of respondents who seek care within VA facilities is in line with current percentages, but any larger study of High-G RSI treatment will be significantly under-counted as over half of all Vet HPA aircrew seek care in private insurance plans, 2) Discounting those still on active duty and others who stated they will not seek care for High-G RSI, 7 out 10 respondents need or are seeking care to manage their High-G RSI. *There is no federal diagnostic code or VBA standard for what we term in this paper as High-G RSI. Currently, affected Veterans are treated for general pain which militates against service connection to High-G RSI. This has the second order consequence of not acknowledging the occupational health impacts of their military aviation service as HPA aircrew.*
- 5. Age at Pain Onset: over 6 out of 10 respondents stated their age of first onset of any High-G RSI symptom was during the prime years of their flying, ages 25-44. Over half of these HPA aircrew experienced their first High-G RSI symptom in the early years (25-34) of their military aviation service.
 - a. <u>Insight:</u> High-G RSI is not an old man's disorder nor is it a disorder attributable to routine aging or the product of mid-life body changes. Here, it is vital to distinguish when injury(s) occurred and when the consequences of those injuries incurred during military service manifested themselves to varying degrees. *This pattern fully fits the norms of service connection and disability award. However, the VBA has no diagnostic code guidance nor claims examination manual (M21-1) criteria fit to this need.*
- 6. Approximate Age At Survey: Over 7 out of 10 respondents fall in the 55+ age range. Of that number, over half of them are 65+. While one could erroneously infer that High-G RSI is indeed an old man's disorder, the previous survey area demonstrates that the age difference from initial onset to age at survey completion is attributable to when we became aware of the problem of High-G RSI in HPA aviator health—not when it occurs.
 - a. <u>Insight</u>: a collateral goal of this body of High-G RSI work is to establish some surface area and depth to the problem of High-G RSI in the lives of Veteran and currently serving HPA aviators. *If this survey is to be taken as a worthy sampling of problem scope, the takeaway is that likely tens of thousands of Veteran HPA aircrew need care and are fully eligible to receive injury-appropriate service connection and disability award.*

- 7. High-G RSI Treatment On Flying Orders: this survey area sought to document why High-G RSI is apparently an issue with virtually zero manifestation in HPA aircrew medical flying records. The overwhelming majority of USAF, USN, and USMC HPA aircrew did not seek formal (on the record) medical advice; e.g., consultations, examination, treatment, etc. However, the survey data show an interesting flip in HPA aircrew perception. That is, approximately half of all USAF, USN, and USMC HPA aircrew sought informal—off the record—advice from an appropriately qualified military medical care provider.
 - a. <u>Insight</u>: the overwhelming sense of survey respondents was that during their respective careers, they could be placed on duty not including flying (DNIF), an extended involuntary break in flying, or be medically disqualified from further flying. Off the record counsel is not the same thing as medical counsel that did not occur. This reality complicates but does not entirely undercut service connection and disability claims for Veteran military HPA aircrew. As former U.S. Secretary of Defense Donald Rumsfeld once stated, "Absence of evidence is not evidence of absence." In other words, Veteran HPA aircrew need new federal diagnostic codes that recognize the occupational characteristics of their military service.
- 8. Sufferer Perceptions of Military Medicine: while not an initiative on military aerospace medicine past or present nor a survey of Veteran HPA aircrew attitudes, HPA aircrew beliefs were captured. As stated in #7, above, this survey data puts meat on the bones of why Veteran HPA aircrew in particular felt they could not discuss their High-G RSI symptoms. The bottom line is not hostile military health care providers; instead, it was an over-arching military medical bureaucracy Veteran HPA aircrew perceived lacked flexibility in approach and acceptance of recurrent treatments to manage their personal High-G RSI symptoms. However, almost 4 out of 10 respondents perceived that their USAF, USN, or USMC medical care provider could not treat their High-G RSI symptoms. No further discussion of these views was elicited in the survey. Elsewhere, formal documentation in a member's military flying records was perceived to be an onramp to significant career penalties of lack of progression, lessened promotion opportunity, and denied leadership track potential. A fifth of survey respondents perceived that they could be subject to a medical evaluation board leading to permanent disqualification from flying and/or involuntary separation.
 - a. <u>Insight</u>: Federal lawmakers and staffers should consider the reasons why virtually all Veteran HPA aircrew lack extensive flying medical record High-G RSI documentation is the weight of circumstances that pressed down on each Veteran. *That Veterans chose to suck it up and do the job should not be the reason why they permanently lack access to service connection and disability award ratings appropriate to their conditions.*
- **9.** Service Connection Success: this phrase is an oxymoron because no such path for High-G RSI service connection and disability rating award exists. The prevailing experience as a norm of Veteran HPA aviators is that nearly 60% of them are unable to successfully argue for even a collateral service connection because of the lack of an enabling federal diagnostic code that underwrites VBA claims examination. Thus any reforms must add new/reworded federal code(s) from which to write relevant provisions in VBA Adjudication Procedures Manual (M21-1). Here, 11% of respondents indicated

they were still on active duty and were ineligible to seek service connection. While a third of respondents asserted they were content with their disability rating for generalized musculo-skeletal injury, we cannot infer that basic work does not yet need to be done. While 30% of survey respondents assert they have a service connection they perceive is adequately connected to their High-G RSI, there are tens of thousands of Veterans who are unable to attain service connection as no path for such qualification exists because High-G RSI has not been dealt with in federal law.

10. Disability Claim Status: survey responses are distributed among 12 responses. However, one third of all respondents report that they either have no plans to initiate a claim or have not yet started such a claim. Likely, these Veterans perceive futility in a claim for which there is no extant service connection basis and disability award criteria. Another 15% of survey respondents report that ratings they received were residuals for general pain that is not tied to nor is appropriate to the scale of their personal High-G RSI symptoms. This survey data is indirectly indicative of unrecognized need among Veteran HPA aviators. *The data indicates that as of this writing, residuals from general pain resulting from function/use limitations attributable to High-G RSI symptoms are criteria for another set of medical issues not appropriate to the experiences of Veteran HPA aircrew.*

High-G RSI Survey Summary Points.

High-G RSI is not imagined. The RRVA Online High-G RSI Survey does not establish the actual number of Veteran HPA aircrew that suffer from symptoms—the High-G RSI population. However, the survey performs a bridge function from numerous aerospace medicine research studies of varying "n". To accomplish this, the survey includes a cross-section of multimilitary generational aircraft in the Air Force, Navy, and Marine Corps that maps common symptomology and experience among Airmen, Sailors, and Marines. We estimate that High-G RSI is an order of magnitude more pervasive than other pressing issues of Veteran military aviator health such as cancer. Importantly, the VBA cannot award connection for a condition which has no name, thus our term of art, High-G RSI—a term with street recognizability.

Needed Legislative Outcomes.

Survey data and the body of aerospace medicine research on the symptoms of chronic high-G flight point to needed rating and qualification criteria within federal diagnostic codes of applicable portions of Title 38 Code of Federal Regulations. Also needed are companion service connection claim decision criteria in Veterans Benefit Administration Manual 21-1. As diagnostic codes and M21-1 criteria are developed, they must recognize the range and type of disabilities incurred by U.S. military HPA aviators in line of duty. The result of these changes must be disability awards which are fair, equitable, and consistent with the injuries the High-G RSI Online Survey captures and aerospace medical literature documents.

The RRVA Aviation Medical Issues Committee produced this white paper. Submit questions to <u>medical@river-rats.org</u>

Appendix A: RRVA Online High-G RSI Survey

Question sets for the May-December 2021 High-G Repetitive Strain Injury (RSI) Survey:

Copy of Welcome To The River Rat High-G RSI Survey

Please Read This Overview Before Beginning The Survey

Introduction: Repetitive Strain Injury (RSI) is a category of physical injuries that occur due to repetitive overuse or improper use. The Red River Valley Fighter Pilot's Association (RRVA) Aviator Medical Issues Committee (AMIC) more specifically describes an aviation related RSI--**High-G RSI** as:

"A group of symptoms that occur more likely than not, as a consequence of routine exposure to High-G flying in the course of normal duties in an assigned military aircraft."

Overview: questions follow that assist the RRVA AMIC in its determination of the High-G RSI experience of respondents. **TO BE CLEAR:** the AMIC is not surveying athletic injuries, household injuries, or other bone/tissue overwork consequences from non-military flying activities, e.g., carpal tunnel syndrome, etc.

<u>Scope</u>: The RRVA AMIC is focused ONLY on what we call High-G RSI; that is, bodily injuries potentially linked to military fighter and/or attack aircraft High-G flight. <u>We are not interested in</u> <u>any flying, personal or professional flying other than your Gen 3, 4, or 5 military aircraft experience</u>. This survey does not collect data on sedentary duties; i.e., headquarters tours at a desk.

<u>Applicability</u>: We believe most past and present aircrew do have some sense of if/when their RSI injuries occurred and a sense of their physical limitations potentially linked to their frequent exposure to continuous High-G military flying in fighter and/or attack aircraft.

Survey Completion Guidance:

1) If you **did fly** the high performance fighter/attack aircraft listed in Question 1, please complete all survey questions.

2) If you **did not fly** the high performance military fighter/attack aircraft indicated below, <u>please exit the</u> <u>survey</u>.

If there is an internet service disruption during your survey completion, we ask you refresh your browser and reattempt; every fighter & attack aircrew response is important.

PRIVACY NOTICE: this survey does not require the disclosure of personally identifiable information (PII) such as *name, gender, SSN, contact information*, etc. **CAUTION:** do not inadvertantly disclose PII in your question responses.

*1. **Your Military Fighter/Attack Branch.** This survey applies to military aviators who flew USAF, USN or USMC high-G aircraft such as "F", "A" or "R" series aircraft sub-divided into Generation (Gen) 3, 4, or 5. The groupings (below) are provided to assist you in your survey response selection. This question identifies the armed service(s) in which you flew any of the specified fighter and/or attack aircraft. Additionally, if you flew a Gen 3/4 equivalent aircraft on an exchange tour with a foreign air force as your primary assigned aircraft, please identify that aircraft in the comments box below.

Gen 3: A-4, F-4, F-5, A-7, F-8, A-37, any Century Series fighter/attack aircraft

Gen 4: A-10, F-14, F-15, F-16, F/A-18

Gen 5: F-22, F-35

NOTE: this survey does not distinguish whether you flew/fly on active duty, within the Air National Guard, or in a Reserve component. The rationale is that High-G military flying exerts the same physical forces on a body regardless of the patches on the flight suit.

Select all the responses that apply: $\, \heartsuit \, 0 \,$

USAF

USN

USMC

- Exchange tour with a foreign Air Force--Please specify the aircraft in comments box
- I flew the following assigned high-G aircraft in an exchange officer role in this foreign Air Force:

2. **Your Fighter/Attack Flying Experience.** Indiciate which (USAF, USN, USMC) Gen military fighter/attack aircraft group you flew/fly:

NOTE: we are not collecting data on <u>mission types you flew</u> in each Gen as the assumption is if the aircraft was capable of high-G flight, you got there.

For the list of fighter/attack aircraft in a specific Gen (generation), see question 1.

Select all that apply: \circ 0

I flew Gen 3.

I flew Gen 4.

I flew Gen 5.

3. **Gen 3 Flying Experience.** Please enter the approximate total flight hours you have in Gen 3 fighter/attack aircraft. If <u>you did not</u> fly Gen 3 aircraft, select the first response and continue to the next survey question.

Even if you did not fly Gen 3 aircraft, this question requires a response: $\circ \circ$

4. **Gen 4 Flying Experience.** Please enter the approximate total flight hours you have in Gen 4 fighter/attack aircraft. If <u>you did not</u> fly Gen 4 aircraft, select the first response and continue to the next survey question.

Even if you did not fly Gen 4 aircraft, this question requires a response: \circ 0

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\$

5. **Gen 5 Flying Experience.** Please enter the approximate total flight hours you have in Gen 5 fighter/attack aircraft. If <u>you did not</u> fly Gen 5 aircraft, select the first response and continue to the next survey question.

Even if you did not fly Gen 5 aircraft, this question requires a response: O 0

\$

* 6. **Ejection.** Have you ever ejected from a Gen 3/4/5 fighter or attack aircraft? If you respond "yes," please describe the ejection(s) in the comment box.

This question requires a response: $\circ \circ$

- O No
- ◯ Yes
- O Please briefly describe your ejection(s): type aircraft, date, relevant injuries, return to flying status:

* 7. Your Program of Care. The purpose of this question is limited to a survey determination of the *general* care program of respondents.

This question requires a response. Select all that apply: $\circ \circ$

I plan to obtain a medical RSI evaluation to document my conditions (pain, range of motion limitations, reduced use, etc).	I am seeking what I believe to be a more equitable VA disability rating for what I perceive are High-G RSI symptoms.
I am currently being medically evaluated for what I perceive are High-G RSI symptoms.	I received medical treatment for what I perceive are High-G RSI symptoms but have no plans to resume treatment
I am being treated for what I perceive is High-G RSI but am seeking further redress; i.e, better care, more effective care, new care, more frequent care, etc.	I have no plans to seek medical treatment for what I perceive are High-G RSI symptoms.

* 8. Living With Potential High-G RSI Symptoms. To answer this question requires only an understanding of your symptoms and the working definition we provide above; <u>not</u> a formal medical diagnosis.

This question requires a response. Select the response that best describes your present condition: $\phi \ o$

- O My RSI imposes no personal limitations.
- $\bigcirc\,$ My RSI imposes some limitations or pain which I treat with over-the-counter products, mindfulness, etc.
- $\bigcirc\,$ My RSI is of a severity that I have sought specialized care: physical therapy, chiropractor, etc.
- I have undergone surgery to seek relief for RSI which I perceive is linked to my military high-G aviation experience.
- I plan to seek surgical relief for RSI that I perceive is linked to my military high-G aviation experience.
- $\bigcirc\,$ Surgery has been prescribed to address my High-G RSI symptoms; however, I opted not to proceed.

* 9. **Rating The Impact of Pain In Your Life.** *How would you complete this sentence*: What I perceive as my High-G RSI symptoms ______ impacts my general physical condition, range of activities, and/or overall quality of life.

This question requires a response: $\circ \circ$

Always	\bigcirc	Rarely	
○ Frequently	\bigcirc	Never	
○ Occasionally			
Other (please specify):			

* 10. **How You Treat Your Pain.** You were or are in treatment for body pain, range of motion, reduced function, etc. that you believe is linked to your military High-G aircraft flying history at one of the following facilities.

IMPORTANT: there is **NO** jeopardy in any of these responses as this survey does not track or otherwise link response to an individual or IP address. However, the responses are carefully constructed as to aid in refuting counter-claims made by external authorities that an *absence of aircrew medical flying records* or any other self-reporting indicates *absence of High-G RSI symptoms* in the individual.

Select all that apply. This question requires a response: $\circ \circ$

	'A facility, i.e., clinic, hospital, medical center. seek care at a VA Mission Act authorized civilian care provider, i.e., chiropractor, physical therapist, surgeon, tc.	I am still on active duty and I am being treated in a MTF (military treatment facility). I sought off-base medical treatment for my RSI while actively flying or awaiting a return to flying (staff job, etc.) but did so without the knowledge of military medical authorities.
	I seek care only through providers that accept TRICARE assignment.	
	I seek care only through private medical health insurance (excludes TRICARE).	I have no plans to seek treatment.

11. Your Approximate Age At Symptom Onset. Your best recollection of your age when you first *perceived* personal High-G RSI symptoms.

This question requires a response: \circ 0

-

12. Your Present Age.

This question requires a response: $\circ \circ$

-

* 13. **Seeking Formal Medical Advice.** While you were flying High-G military aircraft, did you seek **formal on-the-record** advice and/or care for your perceived High-G RSI symptoms from a military (or authorized civilian) medical care professional that **WAS recorded** in your military medical records?

NOTE: Please avoid reading anything into the question. If the YES/NO response structure is inadequate for your situation please describe that in the comment box provided.

This question requires a response: 90

Yes

No

Other (please specify):

* 14. **Seeking Informal Medical Advice.** For the purposes of this survey (and simplicity), did you ever seek **informal medical advice** while you were flying High-G military aircraft for symptoms you perceived were attributable to High-G RSI?

NOTE: Please avoid reading anything into the question. When we say "informal medical advice," the presumption is that the conversation **was NOT** noted in your medical records.

If the YES/NO responses are inadequate for your situation please describe it in the comment box provided.

This question requires a response: $\circ \circ$

Yes

No No

Other (please specify):

* 15. **Perceptions.** This survey does not permit a full evaluation of your perceptions of military medicine. However, of the four responses below, select the response(s) that best describe your perception of military medicine where it met your case and your perception of your High-G RSI.

This question requires a response: 90

I did not believe that my armed service medical provider (Flight Surgeon, etc.) understood High-G RSI and/or could effectively treat me.

My sense was that reporting any personal High-G RSI issues could disqualify me from flying.

My sense was that treatment for High-G RSI would negatively affect my professional qualifications and/or promotion potential.

My armed service (USAF, USN, USMC) might put me on a MEB (medical evaluation board) path to eventual disqualification from flying, up to/including involuntary separation.

* 16. **VA Disability & Compensation.** Do you have a Veteran's Administration (VA) disability & compensation (D&C) <u>rating percentage</u> for condition(s) you attribute to High-G RSI?

NOTES:

A) IMPORTANT: If you are still actively flying a Gen 3, 4, or 5 fighter/attack aircraft, select the third response.

B) If you are receiving VA D&C payments for conditions you attribute to High-G RSI, you have a D&C rating. This questions seeks information only concerning a rating percentage, not the related disability dollar figure.

C) This question <u>does not</u> imply *nexus*; that is, a medically determined cause/effect linkage to any combination of personal physical symptoms for which the VA found you eligible.

Background: the VA currently DOES NOT have a distinct High-G RSI protocol linked to aircrew who disclose that information during their military aviation service.

This question requires a response: $\circ \circ$

Yes

No No

I am still on active flying orders. As of this time this question does not apply to me.

17. Your Disability Claim Status. CAUTION: please avoid reading into the responses. This question seeks information as to the *general* status of your disability & compensation (D&C) claim, if you have one. While there are too many potential claim status combinations to be fully listed here, these are the response scenarios we are measuring in this survey.

NOTE: If you are unsatisfied with the 10 responses below, please concisely outline your situation in the comment box provided.

Select the response that best describes your VA D&C experience.

If you have no VA D&C claim you attribute to High-G RSI, select "This question does not apply to me."

This question requires a response: \circ 0

- I have no plans to seek a D&C claim for what I perceive are High-G RSI symptoms.
 - I believe I may have the basis for a valid VA D&C claim attributable to what I perceive are High-G RSI
- symptoms but have not yet started the VA claims process.
- $\bigcirc\,$ I am currently preparing a VA D&C claim for symptoms $\bigcirc\,$ that I attribute to High-G RSI.
- A l have a D&C claim in initial VA review that I perceive addresses symptoms attributable to my High-G RSI.
- My initial D&C filing for symptoms I perceive are attributable to my High-G RSI was denied. I am appealing the VA's decision.
- My initial D&C filing for symptoms I perceive are attributable to my High-G RSI was denied. I am <u>not</u> appealing the VA's decision.
- O My comments follow:

- My initial D&C filing for symptoms I perceive are attributable to my High-G RSI was denied. I would consider appealing if I had access to legal assistance.
- I am receiving a VA D&C rating for what I perceive to be High-G RSI symptoms. When I consider my symptoms, I believe this VA disability rating was fair and equitable.
 - I am receiving a VA D&C rating for what I perceive to be High-G RSI symptoms. When I consider my symptoms, I do not believe this VA disability rating is fair and equitable. I *will not* appeal it.
 - I am receiving a VA D&C rating for what I perceive to be High-G RSI symptoms. When I consider my symptoms, I
- O do not believe this VA disability rating is fair and equitable. I will appeal it.
- \bigcirc This question does not apply to me.

Appendix B Select Aerospace Medicine Research Papers Related To Aviator Injuries From High-G Flight

Vanderbeek, R.D.

Period Prevalence of Acute Neck Injury in U.S. Air Force Pilots Exposed to High G Forces.

Aviation, Space and Environmental Medicine 1988 Dec; 59(12):1176-80. PMID: 3240219

Abstract. Neck injury is an unquantified clinical and epidemiological problem in pilots exposed to high G forces. The description and assessment of potential deleterious effects on the cervical vertebrae are important aspects of occupational preventive aerospace medicine. This report presents the findings from a prevalence study of acute neck injury, resulting from high G forces, in pilots of high performance aircraft. A sample of 437 pilots from three different aircraft with varying performance capabilities was surveyed by means of an anonymous questionnaire. Stratified sample data were analyzed to determine the strength of association of injury prevalence with pilot age, type of aircraft, and type of flying environment. Of the surveyed pilots, 50.6% stated they had some type of acute neck injury in the preceding 3-month period. Higher aircraft performance was associated with increased injury prevalence. Increased age was associated with increased prevalence of major injury. Preventive strategies may be helpful in reducing injury frequency and avoiding serious injuries.

Knudson R, McMillan D., Doucette D., Seidel M.

A comparative study of G-induced neck injury in pilots of the F/A-18, A-7, and A-4.

Aviation, Space and Environmental Medicine. 1988 Aug; 59(8):758-60. PMID: 3178626

Abstract. The introduction of the high performance F/A-18 into the Navy and Marine Corps units has brought attention to the problem of high +Gx-induced neck pain and injury. Aviators from the Light Attack Wing, Pacific were surveyed and the results were categorized by aircraft type. We found that 74% of F/A-18 aviators surveyed reported neck pain with high +Gz. Out of 37 pilots reporting neck injury, 11 required removal from flight status averaging 3 days. The inability to function effectively during high G flight and the impact of lost pilot days highlight the need for further study into prevalence and solutions for high +Gz-induced neck injury.

Schall DG. <u>Non-ejection cervical spine injuries due to +Gz in high performance aircraft.</u> Aviation, Space and Environmental Medicine. 1989 May; 60(5):445-56. PMID: 2730489

Abstract. The potential for significant neck injuries exists in today's high performance fighter aircraft. The G-loads required to produce injury need not be excessive, nor is experience level necessarily protective. Eight cervical spine injury cases, due to or aggravated by +Gz in F-15 and F-16 aircrew members are reviewed. These include two compression fractures (C5/C7), three left HNP's (C5-6/C6-7), one fracture of the spinous process (C7), one interspinous ligament tear (C6-7), and one myofascial syndrome (C6). Mechanisms of injury and evaluation are discussed. Exercise conditioning may play an important role in prevention and protection. The role of screening X-rays and improving equipment remain as areas where further work needs to be done.

Hämäläinen O, Vanharanta H, Kuusela T.

Degeneration of cervical intervertebral disks in fighter pilots frequently exposed to high +Gz forces.

Aviation, Space and Environmental Medicine. 1993 Aug; 64(8):692-6. PMID: 8368981

Abstract. This study investigated the occurrence and the degree of cervical disk degeneration among senior fighter pilots frequently exposed to high positive G forces, compared with nonexposed controls matched for age and sex. A resistive magnetic resonance (MR) scanner operating at 0.1 T was used to image the cervical intervertebral disks. Sagittal MR images were obtained and disk degeneration was graded 0-6. Both the occurrence and the median degree of disk degeneration were greater among the pilots than among the controls. The greatest difference in the occurrence of disk degeneration (grades 1-6), which also reached statistical significance, was detected for the C3-4 disk: 88% among the fighter pilots and 64% among the controls, respectively. With respect to the moderate degenerative changes (grades 3 and 4) in the C3-4 disk, the difference in the occurrence (88% vs. 36%) was again statistically significant. There was no difference between the other disks. The median disk degeneration between the groups differed (2.0 vs. 1.0), the difference being the most remarkable (3.0 vs. 1.0) for the C3-4 disk. The differences in the median disk degeneration were also statistically significant. These findings suggest that frequent exposure to high positive G-forces may cause premature disk degeneration.

Hämäläinen O, Vanharanta H, Bloigu R.

+Gz-related neck pain: a follow-up study.

Aviation, Space and Environmental Medicine. 1994 Jan; 65(1):16-8. PMID: 8117219

Abstract. This epidemiologic study was aimed at detecting determinants of acute inflight neck pain. It followed a cohort of 66 student fighter pilots from 1 to 3 years. These pilots were frequently exposed to high positive G-forces. The number of flight hours, strenuousness of work, job satisfaction, symptoms suggesting psychologic distress, smoking habits, and the frequency of muscle strength, muscle endurance, and aerobic training were investigated by questionnaires at the beginning and end of the follow-up period. Physical examination, consisting of measurement of height, body weight, body mass index, head and neck circumference, passive cervical range of motion, grip strength, and isometric strength of neck muscles was done only at the beginning of the study. The cumulative incidence of acute inflight neck pain was 37.9%. The number of flight hours was found to be the only significant determinant of acute inflight neck pain.

Voge V.

Findings of a working group on chronic health effects of sustained high-G exposure.

Military Medicine. 1995 Jan; 160(1):26-8. PMID: 7746429

Abstract. A Working Group of scientists from the Armstrong Laboratory, Brooks Air Force Base, met to determine the physiologic effects of repetitive high sustained G exposures over the lifetime of an exposed individual. The literature is mute on this issue. The Working Group concluded that such operational exposures have been present only since the onset of high-G aircraft (F-15/F-16); human centrifuge experience indicates no pathology, although long-term follow-up has not been accomplished; and the index of suspicion of significant clinical pathology is low, based on historical considerations. Considerations for future studies of lifetime G effects include: a determination of what organs to study; the realization that animal studies are probably not valuable; the determination that prospective longitudinal studies are optimal but costly in time and funds; and the opinion that a properly conducted cross-sectional study based on past exposure may be feasible, acceptable, and less costly.

Hämäläinen O, Vanharanta H, Hupli M, Karhu M, Kuronen P, Kinnunen H. Spinal Shrinkage Due To Positive G-Forces.

Aviation, Space and Environmental Medicine 1996 Jul; 67(7):659-61. PMID: 8830946

Abstract. Fighter pilots frequently complain of inflight pain in the cervical or lumbar spine. As to the cervical spine, there is evidence that repeated exposures to high positive G-forces and inflight neck pain may cause premature cervical disk degeneration. Whether inflight lumbar pain caused by high positive G-forces has a similar effect on the lumbar spine has not been studied. The aim of the study was to investigate whether high positive G-forces during aerial combat maneuvering reduces the body height. Investigation to determine whether any long-term degenerative changes occur in the lumbar spine was beyond the scope of this study. The body height of 20 junior fighter pilots was measured before and after 30 min of recumbent rest and after high-G flights. A special measuring device was used. Measurements were also made with the pilots sitting fully equipped in a fighter aircraft on the ground. Maneuvering under high positive G-forces for 40 min caused a 4.9 mm decrease in body height. Recumbent rest before flights increased body height by 2.5-3.5 mm, and sitting in an aircraft returned body height to the values measured before rest. The findings indicate that positive G-forces place a high stress on the spinal column. Therefore, the work of a fighter pilot can be considered to be physically demanding with respect to the spinal column.

Newman DG.

High Positive G-forces-induced neck injuries in Royal Australian Air Force fighter pilots.

Aviation, Space and Environmental Medicine. 1997 Jun; 68(6):520-4. PMID: 9184740

Abstract. +GZ-induced neck injuries are a relatively common occurrence in pilots of high performance fighter aircraft. We surveyed 52 fighter pilots from the Royal Australian Air Force Base at Williamtown via an anonymous questionnaire in order to determine the prevalence and operational significance of these injuries. The pilots flew either the F/A-18 Hornet or the MB326H Macchi. Of the respondents, 44 reported having had a neck injury under +GZ. A higher rate was reported in pilots of the F/A-18. Most of these injuries were simple muscle sprains. There were 20 pilots who reported their neck injury as having interfered with mission completion. Only 12 pilots reported doing any regular neck strengthening exercises, while 33 pilots reported doing preflight neck stretches immediately prior to high +GZ exposure. There were 14 pilots who sought medical attention for their injury, with 9 being taken off flight status for an average of 2 weeks. Air combat maneuvering sorties and the "check six" head position were identified as causal factors by most pilots. This study demonstrates the operational significance of these injuries, and highlights the need for more research into this important aerospace medicine issue.

Burton, R et al.

<u>Cervical Spinal Injury from Repeated Exposures to Sustained Acceleration</u> North Atlantic Treaty Organization RTO-TR-4 AC/323(HFM)TP/9 Research and Technology Organization; 1999 Feb

Abstract. This TW (Technical Watch) noted a very high rate of acute injury to soft tissues (muscles and ligaments) of the neck in fighter pilots that was a result of sustained G exposures. It also reported that in several pilot high sustained G studies there were significantly greater incidences of degeneration of the cervical spine compared with low or no G exposed, age-sex matched controls. These data were obtained from ongoing cross-sectional and longitudinal studies and published reports. Meta-analysis of 8 studies determined that there was a direct relationship between degenerative diseases of the spine and repeated exposures to sustained G. The statistical probability of this analysis was P < 0.001. The following hypothesis was developed. Acute injuries of neck muscles and ligaments commonly occur in fighter pilots. These injured soft tissues of the neck are less able to protect the cervical spine from reoccurring increased G generated external loads. Thus subacute disk injuries occur that eventually lead to spinal degeneration and the development of osteophytes with vertebral strengthening. This Geffect on the spine appears to be an acceleration of spinal degeneration that normally occurs with increasing age in low or non-G controls. Thus it is hypothesized that both populations will eventually have similar levels of cervical spinal degeneration after pilots are no longer exposed to sustained G.

Jones JA, Hart SF, Baskin DS, Effenhauser R, Johnson SL, Novas MA, Jennings R, Davis J.

Human and behavioral factors contributing to spine-based neurological cockpit injuries in pilots of high-performance aircraft: recommendations for management and prevention.

Military Medicine. 2000 Jan; 165(1):6-12. PMID: 10658420

Abstract

In high-performance aircraft, the need for total environmental awareness coupled with high-g loading (often with abrupt onset) creates a predilection for cervical spine injury while the pilot is performing routine movements within the cockpit. In this study, the prevalence and severity of cervical spine injury are assessed via a modified cross-sectional survey of pilots of multiple aircraft types (T-38 and F-14, F-16, and F/A-18 fighters). Ninety-five surveys were administered, with 58 full responses. Fifty percent of all pilots reported in-flight or immediate post-flight spine-based pain, and 90% of fighter pilots reported at least one event, most commonly (> 90%) occurring during high-g (> 5 g) turns of the aircraft with the head deviated from the anatomical neutral position. Pre-flight stretching was not associated with a statistically significant reduction in neck pain episodes in this evaluation, whereas a regular weight training program in the F/A-18 group approached a significant reduction (mean = 2.492; p < 0.064). Different cockpit ergonomics may vary the predisposition to cervical injury from airframe to airframe. Several strategies for prevention are possible from both an aircraft design and a preventive medicine

standpoint. Countermeasure strategies against spine injury in pilots of high-performance aircraft require additional research, so that future aircraft will not be limited by the human in control.

Petren-Mallmin and Linder

Cervical Spine Degeneration in Fighter Pilots and Controls: a 5-year Follow-up Study

Aviation, Space and Environmental Medicine, Vol 72, No 5, 2001May

Abstract. MRI study of low back pain found a significant increase in disk protrusions in all groups, in osteophytes in controls, and in foraminal stenoses in experienced pilots. It concluded that military high performance aircraft pilots are at an increased risk of premature development of degenerative disc degenerative lesions of the same type as are seen in an aging population, as compared to their non-flying peer age group.

Geeves, Julie and Wickes, Simon

Chapter six in <u>RTO Technical Report TR-HFM-083 Review of National Work Programme on</u> the Long Term Effects of Sustained High G on the Cervical Spine

North Atlantic Treaty Organization RTO-TR-4 AC/323(HFM) 083 Research and Technology Organization; 2008 Dec

Abstract. Sixty six percent of all aircrew reported flight-related neck pain at some point during their flying career. Over 80% of FJ (fast jet) aircrew associated flight-related neck pain with high G. Of all aircrew who reported flight-related neck pain, only 26.6% sought treatment for their pain.

Rintala H, Häkkinen A, Siitonen S, Kyröläinen H.

<u>Relationships Between Physical Fitness, Demands of Flight Duty, and Musculoskeletal</u> <u>Symptoms Among Military Pilots.</u>

Military Medicine. 2015 Dec; 180(12):1233-8. doi: 10.7205/MILMED-D-14-00467. PMID: 26633667

Abstract. Although the mechanisms of G-induced stresses on the spinal structure of military pilots are well understood, less is known about relationships between the intensity of physical activity, fitness, occupational musculoskeletal symptoms, and the degree of resulting disabilities. During an aeromedical examination, Finnish military pilots answered a questionnaire on their flying experience, the occurrence of flight duty-related pain, the degree of resulting disabilities, and the intensity of physical activity they conducted. 195 males were selected for further analysis. They were divided into three groups, designated high G, low G, and HQ, according to their current flight duty profile. 93% of pilots who had passed fighter lead-in training reported flight duty-induced musculoskeletal disorders. The high-G group exhibited the highest aerobic capacity (p < 0.001) and muscular fitness scores (p < 0.001). The fittest individuals suffered markedly fewer disabilities than their less fit counterparts (p = 0.005). Flight hour accumulation among the subjects in the high-G group was associated (p = 0.010) with the occurrence of flight duty-induced disabilities. The fittest pilots flew aircraft that induce the heaviest accelerations. They also reported more musculoskeletal pain than the other pilots. Yet they seemed to experience fewer disabilities, which highlights the importance of physical training in the maintenance of operational readiness.

Gomes SRA., Mendes PRF., Costa LDO., Bulhões LCC., Borges D.T., Macedo L.B., Brasileiro J.

Factors Associated With Low Back Pain In Air Force Fighter Pilots: A Cross-sectional Study.

Brazilian Journal of Military Health 2022 Aug; 168(4):299-302. doi: 10.1136/bmjmilitary-2021-001851. Epub 2021 Jul 15. PMID: 34266971

Abstract. Low back pain in military pilots is a frequent condition which constantly leads to absences from work, decreased concentration and performance during flight, as well as changes in work functions. This is a cross-sectional analytical study including 28 fighter pilots who underwent an evaluation comprising muscle strength and fatigue resistance, trunk mobility and application of questionnaires to identify associated clinical factors. It was observed that 68% of the pilots reported low back pain with an average pain intensity of 3.7 at numerical pain scale in the last week. No significant differences were observed regarding the range of motion and trunk muscle strength when pilots with low back pain were compared with asymptomatic pilots. However, lateral right trunk muscle (mean difference=16, 95% CI 0.6 to 33.0]) and lateral left trunk muscle (mean difference=22, 95% CI 1 to 44) fatigue sooner in pilots with low back pain when the two groups were compared (p=0.04 for both). There was a high rate of low back pain complaints among fighter pilots. There was also a significant reduction in fatigue resistance of the lateral trunk muscles in symptomatic pilots when compared with asymptomatic pilots. These factors must be considered in the physical training of this population.