



ASSESSING THE IMPACT OF FORWARD CENTER OF GRAVITY HELMETS ON THE REPORT OF CERVICAL PAIN AMONGST F-15C PILOTS

Integrity ★ Service ★ Excellence

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Disclosure Information



- ✧ **I have no financial relationships to disclose.**
- ✧ **I will not discuss off-label use and/or investigational use in my presentation.**
- ✧ **The views expressed are those of the author and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense, or the U.S. Government.**



A Century of Development





A Century of Development



The Type B-6 winter flying helmet, with a method of attaching the Type A-9 oxygen mask.





The Move Forward





PURPOSE



- ❖ **Prospectively assess the change in cervical pain reported by F-15C pilots using the Joint Helmet-Mounted Cueing System (JHMCS) helmet**
- ❖ **Assess any risk factor correlations between pilot-reported cervical pain and past history, posture, peak Gz exposure, age, totals hours in high-G aircraft, and duration of sortie.**



Author



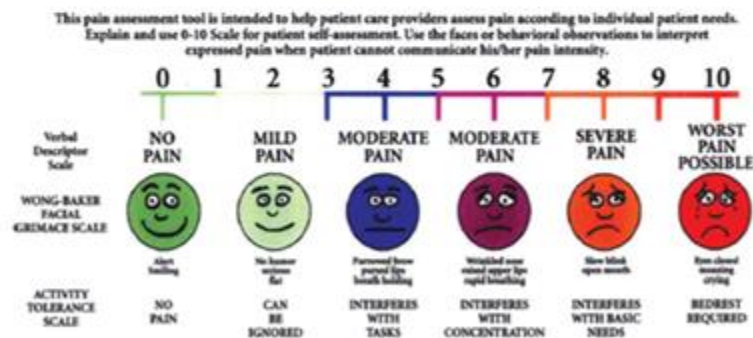
Methods



- ✦ Enrolled 21 full-time F-15C instructor pilots
- ✦ IRB-approved, HIPAA-compliant
- ✦ For 12 weeks, pilots logged
 - Pre- and Post- flight cervical pain using Numerical Rating Scale
 - Whether the Joint Helmet Mounted Cueing System (JHMCS) was employed
 - Maximum +Gz experienced
 - Sortie duration



U.S. Air Force photo by Staff Sgt. James L. Harper Jr.





Methods



- ✧ Also recorded pilot age, total high-G hours and prior neck problems
- ✧ Measured cervical range of motion with dual inclinometry
- ✧ Performed statistical analysis
 - Pain with and without JHMCS was compared using paired t-tests
 - Potential risk factor correlations with Pearson or Spearman coefficients.



Photo courtesy of Jim "Hazy" Hazeltine, High-G Productions



Results



- ✦ **Twenty pilots reported adequate data for inclusion**
- ✦ **Sixteen (80%) of the pilots reported at least one neck issue on the questionnaire.**
 - 71% report prior hx of neck injury (either while flying or other activity)

Variable	Mean (SD)
Age (years)	38 (4)
Time in High-G Aircraft (hours)	2338 (892)



Results



Variable	All Flights Combined	Flights With JHMCS	Flight With Other Head Gear	P-Value
Number of Flights <i>Mean (SD)</i>	25 (10)	13 (7)	12 (6)	0.342
Hours per Flight <i>Mean (SD)</i>	1.3 (0.1)	1.3 (0.1)	1.2 (0.2)	0.193
Max +Gz per Flight <i>Mean (SD)</i>	7.3 (0.4)	7.4 (0.5)	7.3 (0.7)	0.432



Results



Variable	All Flights Combined	Flights With JHMCS	Flights With Other Head Gear	P-Value
Initial Pain <i>Mean (SD)</i>	1.51 (1.02)	1.53 (1.07)	1.50 (1.03)	0.761
Pain After Flying <i>Mean (SD)</i>	2.15 (1.24)	2.26 (1.38)	2.01 (1.11)	0.101
Pain Difference <i>Mean (SD)</i>	0.64 (0.60)	0.73 (0.66)	0.52 (0.53)	0.005



Results

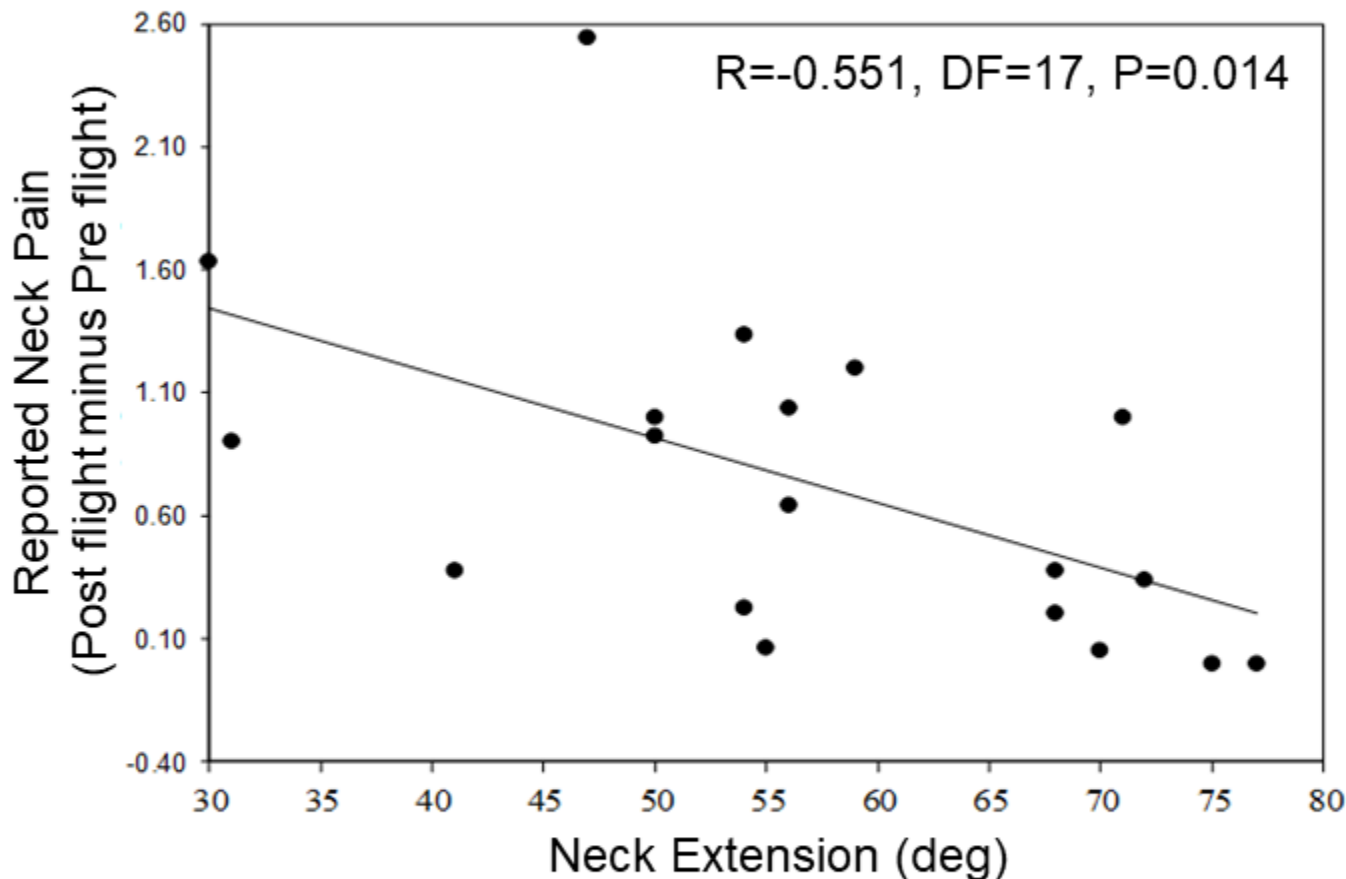


- ✦ **Age, maximum +Gz per sortie, total high-Gz hours flown, and hours per sortie**
 - Showed no significant correlation with the change in neck pain either with JHMCS use or use of other head gear
- ✦ **A significant correlation was found between number of self-reported neck issues (as noted on intake history) and increased neck pain when using JHMCS**

Variable	Neck Pain with JHMCS (Post Flight minus Pre Flight)	Neck Pain with Other Head Gear (Post Flight minus Pre Flight)
Number of Neck Issues		
<i>Spearman r</i>	0.629	0.342
<i>P-Value</i>	0.004	0.139



Results



Neck extension coupled with JHMCS use correlated negatively with increased pain



Discussion



- ✦ In this observational study, mean flight-related pain increased by 0.73 on Numerical Rating Scale with JHMCS and 0.52 without.
- ✦ History of prior neck problems as well as limited neck extension correlated with increased pain when combined with JHMCS use
- ✦ Going forward.... Recommend comparison to other airframes with slightly different missions and equipment



U.S. Air Force photo/Senior Airman John Hughel



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Questions



Photo courtesy of Jim "Hazy" Hazeltine, High-G Productions



References



- Alicsson M, Harms-Ringdahl K, Larsson B, Linder J, Werner S. Neck muscle strength and endurance in fighter pilots: effects of a supervised training program. *Aviat Space Environ Med.* 2004; 75(1):23-28.
- Bertozzi L, Gardenghi I, Turoni F, et al. Effect of therapeutic exercise on pain and disability in the management of chronic nonspecific neck pain: systemic review and meta-analysis of randomized trials. *Phys Ther.* 2013; 93(8):1026-1036.
- Borman P, Keskin D, Ekici B, Bodur H. The efficacy of intermittent cervical traction in patients with chronic neck pain. *Clin Rheumatol.* 2008; 27(10):1249-1253.
- Coakwell MR, Bloswick DS, Moser R Jr. High-risk head and neck movements at high G and interventions to reduce associated neck injury. *Aviat Space Environ Med.* 2004; 75(1):68-80.
- De Loose V, Van den Oord M, Burnotte F, et al. Functional assessment of the cervical spine in F-16 pilots with and without neck pain. *Aviat Space Environ Med.* 2009; 80(5):477-481.
- De Loose V, Van den Oord M, Burnotte F, Van Tiggelen D, Stevens V, Cagnie B, Witvrouw E, Danneels L. Individual, work-, and flight-related issues in F-16 pilots reporting neck pain. *Aviat Space Environ Med.* 2008 Aug;79(8):779-83.
- Hämäläinen O, Vanharanta H, Bloigu R. +Gz-related neck pain: a follow-up study. *Aviat Space Environ Med.* 1994 Jan;65(1):16-18.
- Hämäläinen O, Vanharanta H, Bloigu R. Determinants of +Gz-related neck pain: a preliminary survey. *Aviat Space Environ Med.* 1993 Jul;64(7):651-2.
- Kay TM, Gross A, Goldsmith CH, et al. Exercises for mechanical neck disorders. *Cochrane Database Syst Rev.* 2012 Aug 15;8:CD004250.
- Lange B, Torp-Svendsen J, Toft P. Neck pain among fighter pilots after the introduction of the JHMCS helmet and NVG in their environment. *Aviat Space Environ Med.* 2011; 82(5):559-563.
- NASS Evidence-Based Guideline Development Committee. North American Spine Society evidence-based clinical guidelines for multidisciplinary spine care: diagnosis and treatment of cervical radiculopathy from degenerative disorders. Burr Ridge (IL): North American Spine Society; 2010. [Accessed 28 Jan. 2016]. Available from <https://www.spine.org/Portals/0/Documents/ResearchClinicalCare/Guidelines/CervicalRadiculopathy.pdf>.
- Swezey RL, Swezey AM, Warner K. Efficacy of home cervical traction therapy. *Am J Phys Med Rehabil.* 1999; 78(1):30-32.
- Tucker B, Netto K, Hampson G, Oppermann B, Aisbett B. Predicting neck pain in Royal Australian Air Force fighter pilots. *Mil Med.* 2012 Apr;177(4):444-50.
- Wagstaff AS, Jahr KI, Rodskier S. +Gz-induced spinal symptoms in fighter pilots: operational and individual associated factors. *Aviat Space Environ Med.* 2012; 83(11):1092-1096.
- Wang WT, Olson SL, Campbell AH, Hanten WP, Gleeson PB. Effectiveness of physical therapy for patients with neck pain: an individualized approach using a clinical decision-making algorithm. *Am J Phys Med Rehabil.* 2003; 82(3):203-218.



Background



- ❖ **Cervical pain is a common complaint among fighter pilots**
- ❖ **In-flight risk factors for neck pain**
 - High +Gz
 - Neck rotation under +Gz
 - Flight hours
 - Fatigue
 - Time devoted to physical exercise
 - Prolonged flexed posture
 - Night vision goggles
 - Joint Helmet-Mounted Cueing System



Author

De Loose et al. *Aviat Space Environ Med.* 2008 Aug;79(8):779-83.
Hämäläinen et al. *Aviat Space Environ Med.* 1994 Jan;65(1):16-18.
Hämäläinen et al. *Aviat Space Environ Med.* 1993 Jul;64(7):651-2.
Lange et al. *Aviat Space Environ Med.* 2011 May;82(5):559-63.
Tucker et al. *Mil Med.* 2012 Apr;177(4):444-50.
Wagstaff et al. *Aviat Space Environ Med.* 2012 Nov;83(11): 1092-6.

Alricsson et al. *Aviat Space Environ Med.* 2004; 75(1):23-28.
Coakwell et al. *Aviat Space Environ Med.* 2004; 75(1):68-80.
De Loose et al. *Aviat Space Environ Med.* 2009; 80(5):477-481.
Lange et al. *Aviat Space Environ Med.* 2011; 82(5):559-563.
Wagstaff et al. *Aviat Space Environ Med.* 2012; 83(11):1092-1096.
Thoolen et al. *Aviat Space Environ Med* 2015; 86(11):936-41.