DIFFERENCES IN CERVICAL AND TRUNK NEUROMUSCULAR CHARACTERISTICS BETWEEN BLACKHAWK PILOTS AND CREW CHIEFS

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INTRODUCTION

- Military helicopter pilots and crew chiefs have a high prevalence of neck pain and low back pain, due to the physical stress of flight missions/training (prolonged sitting, whole-body vibration, and/or heavy gear)
- Pilots and crew chiefs perform occupationally-specific tasks, potentially causing cervical and trunk neuromuscular characteristics to deteriorate through different mechanisms
- The purpose of this study was to compare cervical and trunk strength and flexibility as well as forward neck/shoulder posture and cervical proprioception between Blackhawk pilots and crew chiefs

METHODS

EXPERIMENTAL DESIGN

- Cross-sectional study design
- Subjects participated in a two-hour test session for assessing cervical and trunk muscular strength and range of motion, posture, and cervical proprioception

SUBJECTS

- A total of 34 US Army Blackhawk helicopter pilots and crew chiefs were recruited and matched based on gender, age, and total flight-hours
- Subject demographics are represented in TABLE 1

	Pilots (N = 17)	Crew Chiefs (N = 17)
Age (years)	30.1 ± 5.3	28.8 ± 5.5
Height (cm)	175.9 ± 9.1	174.2 ± 9.1
Mass (kg)	80.1 ± 11.6	79.4 ± 11.2
Total Flight-hours (hours)	993.5 ± 680.4	847.1 ± 422.3

TABLE 1: Demographics

EQUIPMENT

- Lafayette handheld dynamometer (HHD) and the Biodex System 3 PRO dynamometer (Biodex, Shirley, NY) for strength testing
- CROM 3 (Performance Attainment Associates, Lindstrom, MN) for neck flexibility and forward head posture
- A digital inclinometer (The Saunders Group, Chaska, MN) was used for passive hip and active lumbar spine ROM testing
- A modified 16-inch combination square (Swanson Tool Co., Frankfort, IL) for forward shoulder posture and pectoralis minor length
- Vicon Nexus motion capture system (Vicon Motion Systems, Centennial, CO) for proprioception testing

PROCEDURES

Neck and Trapezius Muscular Strength Testing

- After warm-up trials, subjects performed the maximal isometric contraction against HHD for neck and scapular strength

Trunk, Trapezius, and Hip Muscular Strength Testing

- After warm-up trials, subjects performed the maximal isokinetic contraction for trunk and trapezius strength and isometric contraction for hip abduction strength (FIG1)

Neck, Lumbar Spine, and Hip Flexibility

- For neck flexibility testing, subjects wore CROM 3 and actively rotated neck in each direction (flexion, extension, lateral flexion, and rotation)
- For lumbar extension, flexion, and lateral flexion, and rotation flexibility testing, subjects were in prone, sitting, and standing positions respectively, and actively moved their spine as far as possible (FIG2)
- For hip internal/external rotation flexibility testing, subjects were in prone position with their knees flexed at 90 degrees while the examiner moved their hips as far as possible without any discomfort/pain

Forward Head/Shoulder, Pectoralis Minor Length Testing for Posture

- Forward head posture was assessed in sitting position wearing CROM 3 with forward head attachment (FIG3)
- Forward shoulder posture was assessed in standing position, and the distance from the wall to the anterior tip of the acromion process was measured (FIG3)
- Pectoralis minor length was assessed in supine position, and the distance from the floor to the posterior tip of the acromion was measured

Neck Rotation Joint Position Sense (JPS)

- Cervical left and right rotation JPS at angles of 30˚ and 60° were used as tests of cervical spine proprioception (FIG4)
- Subjects were blindfolded and seated on a wooden chair with hips and knees at 90° of flexion and feet hip-width apart
- Three trials were conducted for each direction (right/left) at 30° and 60° (total 12 trials)

DATA REDUCTION AND STATISTICAL ANALYSIS

- The average of three (five for the trunk and upper trapezius testing) maximal strength values were normalized to their body weight (%BW)
- The average of three flexibility values in degrees (°) and posture testing in centimeters (cm) were used for analyses
- The average of three JPS trials for each direction/position in absolute values in degrees (°) were used for analyses
- Based on the normality of the data, paired t-tests or Wilcoxon tests were used to compare the dependent variables between the groups

RESULTS AND CONCLUSIONS

- Crew chiefs had significantly less ROM on cervical rotation, trunk rotation and extension, and upper trapezius strength, but exhibited increased forward head posture.
- The differences may be explained by the fact that crew chiefs frequently lean forward to scan the area underneath the helicopter
- Clinicians should recognize specific occupation-related differences in neuromuscular characteristics and develop strategies to counterbalance those needs

Strength (HHD)	Pilots	Crew Chiefs	p
Neck Flex	16.8 ± 4.3	19.7 ± 4.7	0.075
Neck Ext	31.4 ± 4.1	32.6 ± 4.1	0.563
R Neck Lateral Flex	25.2 ± 4.6	25.2 ± 5.3	0.973
L Neck Lateral Flex	26.3 ± 5.1	25.9 ± 6.3	0.825
#R Neck Rotation	22.1 ± 4.5	20.6 ± 4.2	0.280
#L Neck Rotation	22.7 ± 5.0	21.8 ± 4.9	0.608
R Middle Trapezius	15.1 ± 3.5	14.3 ± 3.8	0.560
L Middle Trapezius	14.1 ± 3.4	12.9 ± 3.8	0.348
R Lower Trapezius	15.7 ± 3.7	14.6 ± 4.1	0.420
L Lower Trapezius	15.0 ± 3.7	13.8 ± 3.8	0.338
Strength (BIODEX)	**Pilots**	**Crew Chiefs**	**p**
Trunk Flex	235.5 ± 48.7	258.65 ± 52.9	0.233
Trunk Ext	351.1 ± 70.9	390.57 ± 80.7	0.121
R Trunk Rotation	141.2 ± 26.9	141.5 ± 23.0	0.973
L Trunk Rotation	134.7 ± 23.3	130.8 ± 23.2	0.623
R Upper Trapezius	583.0 ± 112.0	495.2 ± 108.6	0.018
L Upper Trapezius	600.5 ± 147.0	457.2 ± 125.1	0.012
R Hip Abduction	149.9 ± 39.8	148.3 ± 16.9	0.859
L Hip Abduction	153.2 ± 40.3	152.2 ± 16.1	0.915

TABLE 2: Strength between pilots and crew chiefs
represents non-parametric analyses

Flexibility	Pilots	Crew Chiefs	p
#Neck Flex/Ext	135.7 ± 11.5	132.3 ± 12.2	0.463
Neck Lateral Flex	109.9 ± 12.6	104.2 ± 12.5	0.239
Neck Rotation	155.3 ± 11.3	146.5 ± 11.6	0.029
Lumbar Flex/Ext	65.7 ± 12.2	58.7 ± 8.1	0.059
Lumbar Lateral Flex	47.7 ± 12.0	44.8 ± 8.1	0.336
#Lumbar Rotation	20.3 ± 6.0	19.0 ± 6.2	0.795
R Hip Rotation	133.1 ± 14.3	109.7 ± 12.2	0.437
L Hip Rotation	112.2 ± 13.0	111.4 ± 12.6	0.864
Posture	**Pilots**	**Crew Chiefs**	**p**
Forward Head	21.0 ± 1.36	21.8 ± 1.1	0.041
R Forward Shoulder	15.8 ± 2.4	16.8 ± 2.0	0.149
L Forward Shoulder	15.3 ± 2.1	16.0 ± 1.4	0.185
R Pec Min Tightness	6.2 ± 1.0	6.8 ± 1.4	0.125
L Pec Min Tightness	5.7 ± 0.9	6.2 ± 1.3	0.208
Proprioception	**Pilots**	**Crew Chiefs**	**p**
JPS R30	2.5 ± 1.3	3.2 ± 1.4	0.147
#JPS R60	2.4 ± 1.1	2.3 ± 1.2	0.586
#JPS L30	2.5 ± 0.6	3.3 ± 1.4	0.107
#JPS L60	2.1 ± 1.1	2.4 ± 1.2	0.286

TABLE 3: Flexibility, Posture, and Proprioception between pilots and crew chiefs
represents non-parametric analyses

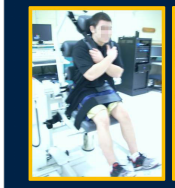

FIG1: Trunk Strength Testing

FIG2: Lumbar Flexibility Testing

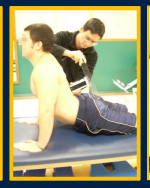

FIG3: Forward Head/Shoulder Testing

FIG4: JPS Testing

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