NECK MUSCLE ACTIVATION IN HELICOPTER LOADMASTERS DURING INTENSIVE NIGHTFLIGHT OPERATIONS

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INTRODUCTION
Neck injuries are a common complaint of military aviators which often result in lost workdays, reduced functional performance in flight situations and may restrict or prohibit aviators furthering their flight careers [1]. These injuries have been mainly attributed to the high accelerative (+Gz) loads experienced during routine flying activities and the additional weight of flight helmets and helmet mounted night vision goggles (NVG) [2]. Electromyographic (EMG) readings collected from aviators in-flight from various muscle sites have been used to estimate neck muscle activation states, strain and fatigue. These studies have concentrated on fixed winged military aviators and have shown that aviators experience high and possibly unsafe loads on their necks during aerial combat manoeuvring [3]. There has been little study into the stresses placed upon the necks of military aircrew, especially military transport helicopter loadmasters, who routinely have to utilise NVG and scan flight paths whilst having their heads outside the aircraft thus being exposed to strong headwinds. The aim of this study was to quantify the level of neck muscle activation encountered by a loadmaster during repeated, intensive training exercises.

METHODS
EMG activity was recorded bilaterally from eight sites around the neck at the C4/C5 level from a loadmaster operating on the starboard side of the aircraft during two training exercises. EMG data was recorded by a portable data logger at 1000Hz from the left and right sternocleidomastoid (LSCM, RSCM), the left and right levator scapulae (LLSC, RLSC), the left and right cervical erector spinae (LCES, RCES) and the left and right upper trapezius (LUTR, RUTR). Prior to the commencement of the training exercise, the subject performed several maximal isometric contractions (MVIC) for data normalization purposes [4]. EMG was collected during simulated troop insertions while the participant operated in a Sikorsky S-70A-9 Black Hawk helicopter (Sikorsky Aircraft Company, Connecticut, USA). The participant utilized a pair of helmet mounted NVG (2.5 kg) during the whole exercise and triggered the data logger on and off during flights. Each flight consisted of low level, high speed (≈ 200km/h) component which generally lasted 10mins and this was immediately followed by a flared stall and troop insertion of about 30sec. At the end of the exercise, the participant performed a simulation of the typical head and body postures adopted in-flight, while the aircraft was stationary on the ground. This was performed to allow a comparison of the effects of relative air flow (herewith termed “headwind”) on muscle activity. Raw EMG were full wave rectified and low-pass filtered at 5Hz using a fourth-order, dual pass Butterworth digital filter. In-flight data was normalized to MVIC with mean and peak values for each flight calculated.

RESULTS AND DISCUSSION
Neck muscle activation levels experienced in-flight were more than double those elicited on ground (Figure 1). This large increase in activation may be attributed to the stabilizing muscle forces need during flight where high headwinds were present. High levels of activation (≥ 70% MVIC) were recorded in LCES, RCES and RUTR. These levels of activation were similar in magnitude to those experienced by fixed wing combat pilots, allowing the possible replication of specifically designed neck strengthening programs to this population of workers [3].

CONCLUSIONS
The findings from this preliminary study may provide a better insight into the magnitude of the occupational loads associated with hazards of this unique group of aviators. Such data may provide a sound basis for possibilities of injury intervention programs to better equip personnel to cope with these hazards.

Figure 1: Normalized activation levels of neck muscles on the ground and during flight.
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REFERENCES
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