INTRODUCTION

An essential job task for military personnel is a casualty drag. A backwards casualty drag is required when a soldier must drag a colleague from a hazardous environment. The US Army created a simulation that measures the capacity to perform this task, and involves dragging a 123-kg dummy (equivalent weight to a soldier wearing a combat load) backwards over a 15-m distance (2).

In the field, a casualty drag can be demanding, and execution of this task could affect subsequent tasks a soldier may need to perform (e.g., moving under direct fire). As a result, the ability to perform this task should be developed during basic training.

Military populations are now using technology more commonly associated with elite sport (3). Technology has been adopted in an attempt to ensure cadets experience the appropriate load to achieve the desired adaptations during training, and to reduce injury occurrence (4). One example of emerging technology that could have practical application in military training, especially basic training, is surface electromyography (sEMG) wearable technology.

sEMG wearable technology evaluates muscle activation and recruitment during physical activity, and uses this input to measure training load (TL) (7). The sEMG signal for each muscle was measured as a percentage of MVC to calculate TL (measured in arbitrary units; AU). The variables included: overall TL (sum of all muscles), and QUAD:HAM, GM:HAM, and QUAD:HAM+GM ratios. Independent samples t-tests calculated sex differences between CD velocity and the sEMG variables. Partial correlations controlling for sex calculated relationships between CD velocity and the sEMG variables.

The descriptive data for males and females are shown in Table 1. Males were significantly taller and heavier, and completed the CD faster than the females (all p < 0.01). Accordingly, females experienced a greater TL for the QUAD, HAM, GM, and total (all p < 0.01). There were no between-sex differences in the muscle ratios (p = 0.56-0.64).

A slower drag velocity correlated with a greater overall TL for both sexes. In addition to a greater QUAD TL (Table 2). There was a significant correlation between faster CD velocity and greater QUAD:HAM ratio.

RESULTS

The sensors provided a bipolar differential sEMG measurement with an inter-electrode distance of 2.1 cm and were comprised of a conductive polymer. No skin or electrode preparation was performed at the site for each electrode as it aligned with recommended product usage.

After a dynamic warm-up, participants completed maximum voluntary isometric contraction (MVIC) assessments via manual muscle testing for each leg which was used to normalize the sEMG data (1). Participants then performed two trials of a 123-kg casualty drag over 15-m (2). A 91-kg dummy with a 32-kg weighted vest was positioned on the ground, and participants grabbed the vest handles and dragged the dummy backwards over the required distance as quickly as possible. Time was recorded via stopwatch to calculate drag velocity (measured in meters per second; m/s), with the fastest trial analyzed.

The sEMG signal for muscle was measured as a percentage of MVC to calculate TL (measured in arbitrary units; AU). The variables included: overall TL (sum of all muscles), and QUAD:HAM, GM:HAM, and QUAD:HAM+GM ratios.

There was a significant correlation between faster CD velocity and greater QUAD-HAM ratio

CONCLUSIONS

The sEMG wearable technology could indicate the stress associated with soldiering tasks, in this instance a backwards casualty drag. Slower performance increased TL demands, which was notable for the females. This could impact other activities which could also result in high TL demands, such as moving to cover, where soldiers will need to sprint and move into different positions (e.g., kneeling or prone positions) (2). Greater QUAD contribution in the casualty drag, shown through the QUAD-HAM ratio, could contribute to faster performance.

This study provided a pilot analysis into how emerging sEMG wearable technology could be used to measure military tasks, and by extension potentially integrated into basic training. The current data detailed that less-efficient performance of the dragging task was related to higher TL demands. This has implications for soldier training, where TL increases have been associated with injury risk. sEMG wearable technology could be used to measure the stress of tasks where TL metrics may be difficult to measure (e.g., lifting and carrying loads, combat simulations).

Nonetheless, there is still a need for greater research into the validity and reliability of the sEMG wearable technology. This needs to be conducted prior to any further use in military populations.

OPERATIONAL RELEVANCE

This study provided a pilot investigation into how sEMG wearable technology could be integrated into basic training by measuring TL of a specific task. Initial measures indicated greater TL demands with slower CD task performance.

sEMG wearable technology could measure soldier TL during basic training, with objectives of enhancing performance and decreasing injury risk via workload monitoring and manipulation. However, more research is required to validate the sEMG wearable technology to ensure accuracy of data.

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