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External loading during daily living improves high intensity tasks under load

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ABSTRACT

Tactical athletes (TA) perform high intensity tasks while carrying considerable external loads. This study examined the effects of wearing an external load during daily living (ELDL) on high intensity TA tasks. Nine trained men (21 ± 2 years; 180 ± 1 cm; 91.1 ± 4.4 kg) completed 3 weeks of ELDL which consisted of wearing a weighted vest equal to ~11%, 13%, and 16% body mass 4 days/week; 8 h/day during weeks 1, 2, and 3 of ELDL phase. Weight vests were not worn during training. A 3 week control phase (CON) commenced after ELDL. Four TA performance tasks were practiced during two familiarization sessions before experimental trials. The tasks included a 5 flight, 53 step stair climb, 44 m zig-zag sprint with 2 points of change in direction and kneeling on one knee, 2 × 25 m casualty drag (84 kg), and 8 × 25 yard shuttle run. All tasks were completed while wearing a 12 kg vest. Percentage change in performance from pre-to post-intervention were compared between ELDL and CON using dependent t-tests, and Cohen's D effect size was calculated for absolute change in performance for each task. All tasks displayed trends of robust improvement from baseline to post ELDL, followed by modest drops in performance during CON (p-value range = 0.03 to < 0.001; ES range 1.1–2.6). The addition of ELDL provides a transient enhancement of occupational anaerobic task performances for TA that exceeds resistance and conditioning training alone.

1. Introduction

Tactical athletes (TA) such as law enforcement officers, structural firefighters, and Soldiers all perform high intensity tasks in the field under external loads (Sothmann et al., 2004; Larsen et al., 2011; Dempsey et al., 2013). However, few investigations have examined longer term training interventions with weight vests on high intensity, TA specific tasks. Two primary methods of external load intervention protocols have been used in past investigations.

The first approach involves wearing weight vests during training only (Swain et al., 2010; Khlifa et al., 2010; Clark et al., 2010; Swain et al., 2011). The only two studies we are aware of that have investigated the effects of external load training on performing high intensity tasks under load have used weight vest intervention during training only (Swain et al., 2010, 2011). Both studies incorporated mixed gender, between subjects design with the treatment groups wearing weight vests designed to simulate ballistic vests during training and a control group that completed the same training program without the vests. The latter study (Swain et al., 2011) lasted 9 weeks (versus 6 weeks) and incorporated an external load up to three times greater (20 kg for women and 30 kg for men) than that used in the first study (Swain et al., 2010). Neither investigation found significant improvements in anaerobic running and jumping tasks conducted while wearing a weight vest (box agility drills, 200-m and 300-yd shuttles runs) or without a weight vest (vertical jump, broad jump) for the treatment versus control groups.

The second method requires subjects to wear weight vests during most waking hours and during training when possible and is commonly referred to as hypergravity training in past literature (Bosco et al., 1984, 1986; Bosco, 1985; Rusko and Bosco, 1987;

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Rantalainen et al., 2012; Sands et al., 1996; Barr et al., 2015; Scudamore et al., 2016). For clarity, the term external loading during daily living (ELDL) will be used when describing this type of training in the current manuscript. In contrast, ELDL in addition to wearing weight vests during training overwhelmingly results in positive gains in unweighted and weighted jumping and power production performance in collegiate and international level track and field athletes (Sands et al., 1996; Bosco et al., 1984, 1986; Bosco, 1985), improved unloaded sprint performance (Scudamore et al., 2016) or decreased ground contact time during sprinting (Barr et al., 2015).

Authors of a recently published review article (O'Neal et al., 2014) hypothesized that ELDL is likely the only weight vest training intervention approach that might elicit improvement of high intensity tasks under load. However, the efficacy of ELDL on improving TA style anaerobic tasks performed under external load has yet to be empirically tested. The purpose of this study was to examine change in performance of well-trained male athletes in stair climbing, sprinting from multiple points of cover, dragging a litter with an 84-kg load, and shuttle running while wearing a 12 kg weighted vests before and after 3 week phases of ELDL and a control phase (CON) with no ELDL.

2. Methodology

2.1. Participants

Highly fit, men between ages 18–25 y were recruited from local fitness facilities. All participants regularly (4 + sessions per week for the previous 12 months) participated in workouts that included traditional and Olympic style lifting, jumping, plyometric, recreational sports, and sprinting activities. Participants were classified as low health risk based on PAR-Q (Canadian Society for Exercise Physiology, 1994) responses and written informed consent was obtained before participation. All procedures were approved by the local Human Subjects Committee. Eleven participants began experimental procedures, but only 9 (age = 21 ± 2 years) were able to complete all procedures. One individual experienced an injury halfway through testing protocol outside of study activities. The other participant was unable to complete the second half of the study due to occupational obligations. Height (180 ± 1 cm) and weight (91.1 ± 4.4 kg) were assessed during the initial visit to the laboratory with a stadiometer and digital scale (BWB-800, Tanita, Tokyo, Japan). Body fat percent (11.2 ± 3.9%) percent was estimated using equations based off 3 site skinfold (chest, abdomen and thigh) thickness measured with Lange calipers (Beta Technology Incorporated, Cambridge, MD) (Pollock et al., 1980).

2.2. Design

This study used a within subjects design with no blinding and included three phases (see Fig. 1 for chronology). The first phase (weeks 0–2) was used to familiarize subjects with procedures and reduce learning effects from influencing performance task results. During an initial practice session athletes were introduced to and practiced all performance tasks until they were comfortable completing the tasks (described below). No set rest periods were given between practice attempts in this session. A familiarization session was conducted approximately one week later. All performance tasks were performed again, but with identical recovery periods as would take place during experimental trials allowing at least two or more practice attempts for each performance task.

The second phase began 7–10 days after the initial familiarization session (weeks 2, 3, & 4). Subjects returned for their baseline trial and returned 3 and 6 weeks later to complete the same performance testing protocol. During the first 3 treatment weeks subjects were exposed to ELDL. Subjects wore weight vests (ZFO Sports, San Jose, CA) during daily activities, and were required to wear their vests at least 4 days each week and a minimum of 8 h a day on the days the vest was worn. Weeks 5, 6, & 7 served as the CON treatment phase. Subjects continued their normal training routine without ELDL and were asked to keep training type and volume as consistent as possible between the ELDL and CON intervention weeks. The post-ELDL performance tasks assessment (beginning of week 5) served as the baseline measure for the CON. Performance tasks were assessed a final time at the end of the CON phase (beginning of week 8).

Subjects kept track of training activities (e.g. exercise bouts focused on strength training, endurance training, recreational sports, etc.) and hours spent wearing the vests in a journal (Table 1). Daily phone calls or text messages were used to prompt subjects and increase the accuracy of documentation. Vest loads were based on percentage of body mass (week 1 = 11.2 ± 0.6%; week 2 = 13.2 ± 0.7%; week 3 = 16.1 ± 0.4%).

2.3. Performance tasks

The first set of performance tasks were performed without weight vests and results are described elsewhere (Scudamore et al., 2016). Briefly these tasks consisted of three, 1 repetition max attempts for power clean, three single jump vertical jump tests, two sets of 4 continuous vertical jumps tests, three 45-yard sprints, a 150 yd. (6 × 25 yd.) shuttle run, and a 300 yd. (12 × 25 yd.) shuttle run. After these tasks were completed, subjects were given a 10-min rest period to recover before the next round of TA specific performance tasks. The tasks reported in the current study and described below were conducted while wearing a 12 kg weight vest.

The first task was a timed stair climb (SC) and required subjects to sprint up 5 flights of stairs that included 4 turns and 53 total steps. To increase ecological validity of the tasks, subjects were allowed to skip steps if desired, but were instructed to keep the same stair stepping pattern after the practice and first familiarization sessions. Furthermore, each subject was given a set of tennis balls to hold while sprinting so the stair rail could not be used for assistance, since many TA scenarios would require individuals to be

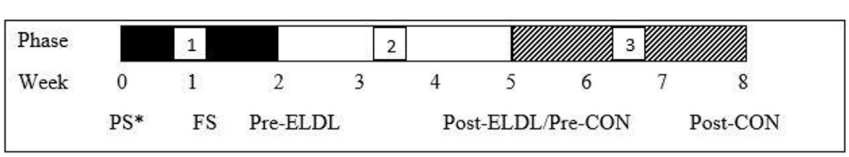

Fig. 1. Experimental design. PS* = practice session; all performance tasks were completed in order with as many attempts as participant desired but without standardized rest periods between attempts. FS = familiarization session; all performance tasks were completed in standardized order and with standardized recovery periods. All performance tasks were completed at the beginning and end of phases 2 and 3. Results from the last 3 sessions were used in data analyses. ELDL = external load during daily living treatment. CON = control treatment.