THE ASSOCIATION OF POWER METRICS ON DYNAMIC POSTURAL STABILITY WHILE WEARING FIRE-SPECIFIC EQUIPMENT AND GEAR

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INTRODUCTION

Firefighter specific equipment and gear (EQG) and fatigue can negatively impact a firefighter's ability to maintain stability; thus, increasing the risk of injury from slips, trips, or jumps. Power-to-mass ratio (PMR) and peak anaerobic power (PAPw) may play a role in mitigating the effects of EQG and fatigue to stability.

PURPOSE

The purpose of the study was to determine the relationship of PMR and PAPw to dynamic postural stability.

METHODS

30 male career firefighters were recruited. Firefighters first performed 3 trial of a counter movement vertical jump (CMJ) with maximal effort (Figure 1). PAPw was calculated using the Sayers equation: PAPw = (60.7 x jump height (cm)) + (45.3 x body mass (kg)) – 2055. PMR was expressed as PAPw/body mass (kg). Following the CMJ, they completed 3 trials of a single-leg landing and stabilization (SLLS) task under three conditions: without (w/o) EQG, with (w/) EQG, and w/EQG post fatigue. EQG conditions included a SCBA, turnout coat, pants, boots, hood, gloves, and helmet (approximate mass, 23.9 kg). For the SLLS the participant dropped onto their dominant leg from a 30 cm box placed 10% of their height away from a 40 cm x 60 cm force plate (Figure 2). Upon landing, participants had to remain motionless for ten seconds.

The first, 3 seconds of the vertical ground reaction forces (VGRF) after initial ground contact (IGC) were used to calculate the DPSI. IGC was defined as the instant the VGRF exceeded 5% body weight. A higher DPSI value represents worse dynamic postural stability. Between the w/EQG and w/EQG post fatigue conditions the firefighters performed maximal test of aerobic capacity using the Wellness Fitness Initiative (WFI) Stepmill Test. Multiple bivariate correlations were conducted to determine the relationship of power metrics to DPSI. The power metrics found to be significantly correlated with DPSI for each condition were entered into a linear regression model. Based on the bivariate correlations only PAPw was included in two separate linear regressions to predict w/EQG and w/EQG post fatigue DPSI. Alpha level was set a priori at .05.

Results

Power-to-mass ratio (i.e., PMR, r=.105, p=.582) and PAPw (r=-.272, p=.146) were not significantly associated to DPSI w/o EQG. PMR was not significantly associated to DPSI w/EQG (r=.136, p=.427) or w/EQG post fatigue (r=.150, p=.438). PAPw was significantly associated to DPSI w/EQG (r=-.449, p=.013) and w/EQG post fatigue (r=-.469, p=.010). PAPw statistically significantly predicted DPSI w/EQG ($F(1, 28) = 7.056$, $p < .001$, R^2=.201) and w/EQG post fatigue ($F(1, 27) = 9.349$, $p = .010$, $R^2 = .220$).

Figure 1. counter movement vertical jump

Figure 2. Single Leg Landing and Stabilization Task

CONCLUSION

The findings suggest PMR is not an indicator of dynamic postural stability. PAPw is a significant predictor of dynamic postural stability while donning EQG both pre and post fatigue. Higher PAPw was indicative of lower DPSI values (indicating better stability)

Practical Application

Practitioners should incorporate PAPw training into injury prevention programs as means of helping reduce the incidence of injuries resulting from slips, trips, falls, and jumps.

Acknowledgements

Supported by Oklahoma Center for the Advancement of Science and Technology - Grant No. HR18-054. The results of the present study do not constitute endorsement by the Oklahoma Center for the Advancement of Science and Technology.