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Effect of Load Carriage and Fatigue on Postural Sway Measures

Shane Murphy
Univesity of Montana, Missoula

UGP 2020 Final Report

Shane Murphy, Assistant Professor, School of Integrative Physiology & Athletic Training

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The purpose of this project was to identify how functional loads and exertion may alter common balance assessment metrics. Whole-body fatigue and load manipulations have previously been shown to alter postural control metrics, linked to an increased risk of falling, in laboratory-based settings; however, the application of functional loads and general exertion following strenuous load carriage has not yet been explored. Participants (n=43, female=14) completed static balance assessments and an exertional hike with a backpack weighing approximately 30% of the participants body weight or 23 and 18 kg for men and women, respectively. The out-and-back hike was approximately 3219 m in total, where the first half averaged a 17% uphill grade, with participants maintaining an RPE of 15 (Hard). Participants completed two 30-second standing conditions, load added and load removed, immediately before and after the strenuous load carriage. Center of Pressure (COP) was captured at 100 Hz and passed through a 2nd order low pass Butterworth filter ($f_{cutoff} = 4$ Hz). Time (Total Sway, Mean COP Velocity, Mean COP Distance, mediolateral and anteroposterior Root Mean Square Distance, mediolateral and anteroposterior Excursion Length, and 95% Confidence Ellipse) and frequency (Mean COP Frequency) domain balance metrics were calculated from the COP time series. A two-way repeated measure MANOVA (exertion x load) ($\alpha=0.05$) was used to identify differences between pre- and post-exertion and load added and removed, on all balance metrics. Significant main effects of exertion ($F_{9,34} = 4.88$, Wilk's $\Lambda = 0.47$, $p < 0.001$) and load ($F_{9,34} = 10.15$, Wilk's $\Lambda = 0.27$, $p < 0.001$) were revealed, with no significant interaction effect. Univariate and subsequent pairwise comparisons revealed significant differences ($p \leq 0.005$) for all balance metrics except Mean COP Frequency for both exertion ($p = 0.16$) and load ($p = 0.74$). For example, Total Sway, a measure of the total COP path length, increased from 29.3 ± 1.1 cm to 38.5 ± 2.0 cm and 29.7 ± 1.1 cm to 38.0 ± 1.7 cm for exertion and load factors, respectively. Time domain postural control metrics increased with the completion of a bout of strenuous load carriage, with no changes to frequency domain measures. Functional loads and exertion may increase the risk of falling following strenuous load carriage.

These findings have been submitted to the American College of Sports Medicine Annual Conference to be held virtually in the summer of 2021. A manuscript is currently being developed with intended submission to the Journal of Athletic Training in the summer of 2021. All expenditures justified within the initial grant application have been used and were integral in the success of the research project. The UGP will be noted in both disseminations noted above.