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CUMULATIVE EFFECTS OF FIVE DAYS HIKING ON POSTURAL STABILITY

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SUMMARY
Hiking is an exhausting exercise which produce muscle fatigue and foot injuries that may deteriorate sensory information and influence postural stability. Moreover, aspects of neuromuscular control may be quantified through measures of postural stability. Therefore, the aim of this study was to investigate the effects of a five days hiking on postural stability. During five days the participants crossed three hundred kilometers, stopping in periodic intervals during the day and resting at late afternoon. Twenty-six typical adults participated in this study. One AMTI force platform was used in collecting data at 100Hz. After a detrend operation to remove de mean, the center of pressure (COP) over the surface of the force platform was computed and COP time series were analyzed according to sway density curves. The results suggest a deterioration of postural stability with a decrease for MP and a more frequent torque burst production with an increase for MT. A 5 days hiking produced a cumulative effect on postural stability parameters of the walkers that may be a result of postural muscle fatigue along with foot problems and its related proprioceptive deficits.

INTRODUCTION
Fatigue reduces the ability of a muscle to generate force depending on peripheral and central mechanism. Acute fatigue of postural muscles induced by labor activities and prolonged exercises soliciting energy metabolism, like running or walking, influences postural stability and elicits changes in motor responses [1,2,3]. Hiking is an exhausting exercise which also produces foot injuries that may deteriorate somatosensory information and influence postural stability. Moreover, aspects of neuromuscular control may be quantified through measures of postural control [4,5]. However, there is no study reporting chronic effects of a cumulative fatigue on postural stability.

Therefore, the aim of this study was investigate the effects of a five days hiking on postural stability. A traditional hiking, called ecological hiking, takes place between Goiania city, state of Goias in central Brazil, and Araguaia River, which beautiful beaches are revealed under the typical dry and sunny winter of this region when its waters recede. During five days the participants crossed three hundred kilometers (Figure 1), stopping in periodic intervals during the day and resting at late afternoon.

Figure 1: Ecological walking participants followed by a fireman on a motorcycle. In the foreground, the beautiful Yellow Ipe, a tree that flowers during the dry season.

METHODS
Twenty-six typical adults participated in this study (twenty-four male and two female). All participants signed an informed consent form.

One AMTI force platform was used in collecting data. The force platform recorded ground reaction forces (GRF) and moments (M) at 100Hz and the data were filtered by a zero-lag second order low-pass Butterworth filter at 12.5 Hz.

The participants stood barefoot in quiet stance over the force platform. Subjects were told to stay still with their arms comfortably positioned along their bodies and to position their feet in a comfortable position. The volunteers performed three trials lasting 70 s, looking straight ahead to a target placed at a distance of 1.2 m. All data collection occurred at late afternoon in each of the five hiking days. The first 10s of each acquisition was discarded to avoid transients.

After a detrend operation to remove de mean, the GRF and M were used to compute the center of pressure (COP) over the surface of the force platform. The COP time series were analyzed according to sway density curve (SDC) [6,7]. SDC

parameterization provides three descriptors: the mean amplitude of the peaks (MP), the mean distance between successive peaks (MD) and the mean time interval between successive peaks (MT). Briefly, MP describes the degree of postural stability, MD relates to the amount of change in torque required for stabilization and MT is how often torque bursts are produced [6,7].

The values estimated from the three trials performed by each subject were averaged to improve reliability. Data processing were implemented in Matlab 7.14 (The Mathworks, USA).

Since the data distribution was not Gaussian for all descriptors in all days, the Wilcoxon rank test was applied to assess time effects during the five days. The significance level was $p<0.05$. The statistical tests were performed in SPSS 19 (SPSS, USA).

RESULTS AND DISCUSSION

Significant differences were observed between 1^{st} and 4^{th} days ($p=0.004$), 2^{nd} and 3^{rd} days ($p=0.049$) and 3^{rd} and 4^{th} days ($p=0.01$) for MP descriptor, between 2^{nd} and 4^{th} days ($p=0.023$) for MD descriptor and between 1^{st} and 4^{th} days ($p=0.045$), 2^{nd} and 3^{rd} days ($p=0.048$) and 2^{nd} and 4^{th} days ($p=0.01$) for MT descriptors.

A significant decrease for MP descriptor and increase for MT descriptor were observed in the days cited above. Additionally a significant decrease for MD was only found between the 2^{nd} and 4^{th} days, indicating a decrease in the amount of change in torque between these days. Thus, these results suggest a deterioration of postural stability with a decrease for MP and a more frequent torque burst production with an increase for MT.

There were no differences in any descriptor between 4^{th} and 5^{th} (last) day, suggesting that the cumulative effect of walking saturates after 4^{th} day.

CONCLUSIONS

A 5 days hiking produced a cumulative effect on postural stability parameters of the walkers, which may be resulting from muscle fatigue and foot injuries, both leading to somatosensory deficits.

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