STEP HEIGHT EFFECTS ON LOWER LIMB BIOMECHANICS AND BODY CENTRE OF MASS MOTION DURING ELLIPTICAL EXERCISE

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INTRODUCTION: Elliptical exercise (EE) has been shown to be beneficial for the development and maintenance of cardiorespiratory fitness. Despite these benefits, the feet are constrained by pedals to follow an elliptical trajectory, with the possibility of producing disadvantageous joint loads, body instability and potential musculoskeletal overuse injuries (Lu et al., 2007). Proper selection of step height during EE may help reduce these disadvantageous joint loads and instability. The purpose of the study was to study the effects of step height on the lower limb biomechanics and associated body center of mass (COM) motion during EE.

METHODS: Ten healthy male adults (23.7 ± 1.2 yr; 173.5 ± 3.9 cm; 72.2 ± 10.8 kg) performed EE at three step heights (13, 15 and 17 cm) with a pedal rate close to walking cadence and without workload while 3D kinematic data of the whole body and left pedal reaction forces (PRF) were measured using a motion analysis system and a six-component force transducer, respectively. The peak excursion of the body COM, PRF, lower limb joint angles and moments between step height conditions were analyzed using repeated measures analysis of variance with a significance level of 0.05.

RESULTS: With increasing step height, the subjects managed to keep the COM motion within a limited range ($p>0.05$), whereas the posterior component of PRF was significantly reduced in early stance ($p=0.003$). During stance phase, peak hip extension was decreased ($p=0.04$). During swing phase, peak hip and knee flexion angles were increased ($p=0.002$; $p=0.001$), while peak hip abduction angle and peak knee extensor moments were diminished ($p=0.02$; $p<0.001$). Peak hip extensor moments were increased and peak hip abductor moment decreased in late swing ($p<0.001$) (Fig. 1).

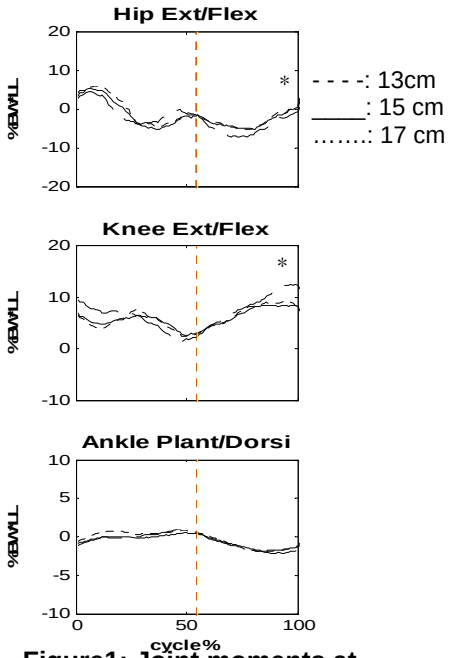

Figure1: Joint moments at three step heights. (∗: p<0.05)

DISCUSSION & CONCLUSION: During EE, greater peak flexion at the hip and knee, and peak hip abduction during swing phase were used to compensate for the change of pedal trajectory and to keep the body stable when step height increased. With the more flexed posture in response to increased step height, the reduced posterior shear force shifted the line of action of the PRF more anterior to the hip joint center and less posterior to the knee joint center, leading to increased hip extensor and decreased knee extensor moments in late swing. The current results showed that proper selection of step heights during EE may help reduce harmful joint loadings, especially for the knee joints, and thus reduce potential risk of injuries.

REFERENCES:

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