STEPPING AEROBICS: HOW DO THE STEPPING DIRECTION AND HEIGHT AFFECT JOINT KINETICS?

Man-Ying Wang [1], and Hsin-Chang Wu [2]

[1] University of Southern California, Los Angeles, CA, USA
[2] National Cheng Kung University, Tainan, Taiwan
E-mail: mwang@usc.edu

INTRODUCTION

Stepping aerobics are getting popular because of its similarity to daily living activities, accessibility to general population, safety to practice, and adjustable intensity with various forms (i.e., varying stepping speed, height, and direction) (Wang et al, 2003). Unfortunately, musculoskeletal loadings associated with this popular exercise program are rarely quantified. Thus, prescribing stepping aerobics as a potential intervention program for improving physical function has become difficult. The purpose of this study is using biomechanical methods to systemically quantify the influence of stepping regimen including 2 different directions (forward and lateral stepping) and 3 different step heights (6, 8, and 10 inches) on joint kinetics in healthy adults.

METHODS

Fifteen male and fifteen female healthy adults, aged from 19 to 29 years, participated in this study. Eighteen reflective markers were attached to anatomical landmarks of bilateral lower-extremities and pelvis. Subjects were then required to perform stepping aerobics on 3 different step heights (6, 8, and 10 inches) while recorded by a six-camera motion analysis system (120 Hz, Vicon 460, Oxford Metrics, Oxford, UK) and a force platform (Kistler, Model #9284, Winterthur, Switzerland).. They were also asked to perform the stepping aerobics in 2 movement directions, forward (FS) and lateral stepping (LS). The speed of the stepping aerobics was controlled at 120 steps/min by a metronome. The stepping activities were performed in a random manner and 3 successful trials of each activity were collected. The primary outcomes were the average peak joint moments and powers generated during the landing phase of each stepping activity at the ankle, knee, and hip. Data in sagittal and coronal planes were analyzed. Repeated-measure ANOVAs and Bonferroni post-hoc analyses were used to examine the differences in joint kinetics produced among the movement directions and different heights.

RESULTS

There were no statistically significant interactions between the movement direction and stair height in each variable accessed (joint moments and powers). Statistically significant main effects were identified between the directions of movements for the joint moments and powers at the hip, knee, and ankle joint ($p < .05$) (Fig. 1); except for the hip flexor moment ($p = .47$) and ankle dorsiflexor moment ($p = .06$). Joint powers and coronal-plane joint moments produced during LS were significantly greater than those generated during FS at the hip, knee, and ankle ($p < .001$). However, moments in the sagittal plane did not show a consistent trend between FS and LS among the 3 joints. There were also statistically significant main effect differences among

the 3 stair heights. Joint moments and powers were the greatest while performing the stepping aerobics on the 10-inch step and the lowest while performing the activities on the 6-inch step ($p < .05$).

CONCLUSIONS

A dose-response relation between the lower-extremity joint kinetics and step height was identified in this study. Stepping aerobics performed on the 10-inch step produced greater lower-extremity musculoskeletal loadings than those performed on the 6-inch step. The kinetic responses were also direction- and joint-specific.

REFERENCES

Wang, M-Y. et al. (2003). *Clin. Biomech.,* **18**, 214-221.

ACKNOWLEDGEMENTS

This study is supported by National Science Council, Taiwan NSC 92-2320-B-006-075

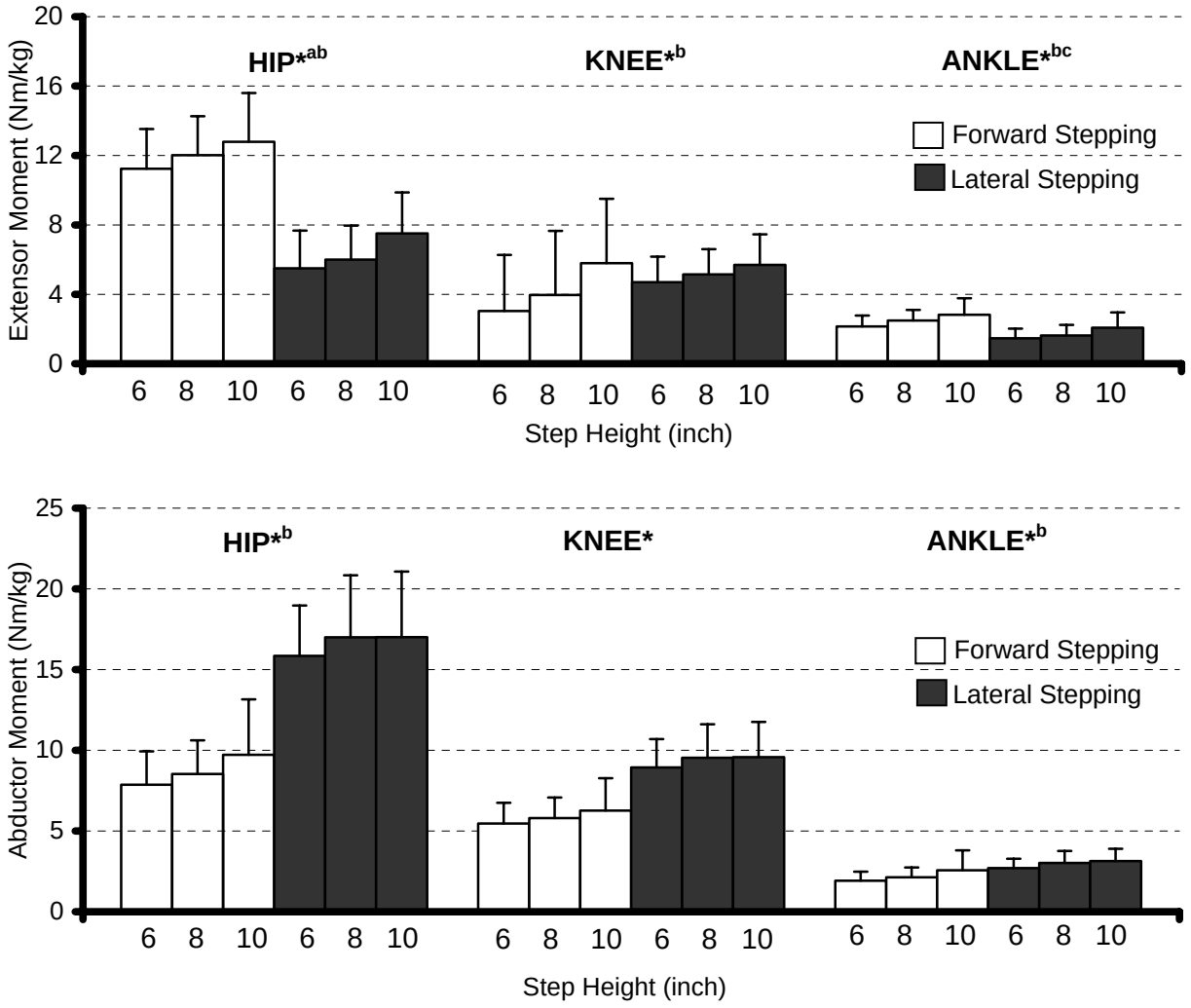

Figure 1: *Significant differences between FS and LS. [a]Significant differences between 6- and 8-inch step heights. [b]Significant differences between 6- and 10-inch step heights. [c]Significant differences between 8- and 10-inch step heights.