INTRODUCTION & PURPOSE

Investigations of human movement variability have been used as a means of exploring neuromotor functioning, where performance variability is thought to provide the system with flexibility and a mechanism for adaptation to movement repetition [1,2,4,6]. Operationally, variability has been considered to fall within optimal limits (Figure 1), while excessively high or low variability has been implicated in injury susceptibility [1,2,4,6]. Landing has been explored due to a high incidence of injury in athletic performance, as well as the ability to easily control task demands through increases in landing height [3,4].

The purpose of this investigation was to evaluate changes in lower extremity kinetic variability in the frontal plane, exploring gender comparisons during landing. Peak frontal plane joint moments were used to access variability across landing heights at the hip, knee, and ankle joints. Landing height was increased as a proportion of maximum vertical jump height (MVJH), which characterized lower extremity functioning across a range of task demands.

METHODS

Fourteen participants (7 male, 7 female; mean age 22.6±3.4 years; height 1.71±0.10m; mass 67.56±10.31kg) free from previous lower extremity injury were examined. Informed consent was obtained prior to participation as approved by the Research Ethics Board at the affiliated institution.

Kinematic and kinetic data were simultaneously acquired using a 12-camera system (Vicon MX T40-S; 200Hz), 35-point spatial model (Vicon Plug-in Gait Fullbody), and two synchronized force platforms (Kistler 9281B; 2000Hz). Data filtering and interpolation included a low pass, 4th order filter. Landing phase was defined from ground contact to the point vertical COM velocity was zero (Figure 2). Peak frontal plane moment variability for females (Figure 4).

RESULTS

Overall, female participants demonstrated greater lower extremity kinetic joint variability during landing compared to males, but showed significant decreases when landing in excess of 100% MVJH. Future research should explore a wider range of task demands, seeking to better understand the relationship between movement variability and movement control, with attention to gender comparisons. Lesser kinetic variability at the knee may also shed light into the high rates of injury at this joint, providing avenues for future research.

DISCUSSION

Differences in frontal plane lower extremity peak moment variability were identified among landing heights, lower extremity joints, and between genders. A significant main effect for lower extremity joint (F2,78)=7.771, p<.001, p2=.166 showed lesser variability at the knee joint (16.9±4.5%) relative to the hip and ankle joints (23.8±2.9%, p=.008). This suggests freezing at the knee joint during landing, which may have implications for injury susceptibility [1,2,4,6].

Female participants demonstrated greater overall lower extremity peak moment variability than males (23.8±2.9%, 19.7±1.8%), respectively in the frontal plane (F1,78)=6.126, p=.015, p2=.073. Significant interaction was observed between landing height and gender (F2,48,175.327)=7.158, p<.001, p2=.084, suggesting that males and females differed in peak lower extremity moment variability across landing heights. As a result, simple main effects analyses were carried out.

CONCLUSIONS

Overall, female participants demonstrated greater lower extremity kinetic joint variability during landing compared to males, but showed significant decreases when landing in excess of 100% MVJH. Future research should explore a wider range of task demands, seeking to better understand the relationship between movement variability and movement control, with attention to gender comparisons. Lesser kinetic variability at the knee may also shed light into the high rates of injury at this joint, providing avenues for future research.

REFERENCES