Medial-Lateral Center of Mass Displacement and Knee Adduction
Biomechanics for Old and Young Adults Descending Stairs with Varying Surfaces

Jack D. Bianchi  
*Boise State University*

Nicholas L. Hunt  
*Boise State University*

Amy E. Holcomb

Clare K. Fitzpatrick  
*Boise State University*

Tyler N. Brown  
*Boise State University*
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Abstract
Introduction: Older adults (over 65 years) exhibit compensatory gait strategies, including larger, more variable medial-lateral center of mass (COM) displacement, during activities of daily living, such as stair descent. Larger COM displacement, however, reportedly increases knee biomechanics related to injury and disease. Yet, it is unknown whether older adults exhibit greater COM displacement when navigating stairs with a challenging surface, such as slick and uneven, or exhibit larger hazardous knee adduction biomechanics.

Purpose: To investigate whether age and surface increase medial-lateral center of mass displacement, and the knee adduction angle and moment related to joint injury and disease.

Methods: Twenty-nine (15 young – between 18 and 25 years; and 14 older – over 65 years) participated had COM displacement and knee biomechanics quantified during a stair descent on a normal, slick, and uneven surface. Then, maximum medial-lateral COM displacement, and magnitude and velocity of knee adduction angle and moment were submitted to RM ANOVA to test main effect and interaction between surface and age.

Results: Surface (p = 0.005), but not age (p = 0.099) impacted medial-lateral COM displacement. Participants decreased COM displacement on the uneven compared to normal surface (p = 0.024). Surface impacted the average velocity of the knee adduction moment (p = 0.017), but no other knee adduction measure (p > 0.05). Average velocity was larger on the normal compared to uneven surface (p = 0.035).
MEDIAL-LATERAL CENTER OF MASS DISPLACEMENT AND KNEE ADDUCTION BIOMECHANICS 
FOR OLD AND YOUNG ADULTS DESCENDING STAIRS WITH VARYING SURFACES

Jack D. Bianchi, Nicholas L. Hunt, Amy E. Holcomb, Clare K. Fitzpatrick and Tyler N. Brown

INTRODUCTION
Older adults (over 65 years) exhibit larger, more variable medial-lateral center of mass (COM) displacement during activities of daily living, such as stair descent.

The larger COM displacement, however, reportedly increases knee adduction biomechanics related to injury and disease.

It is unknown whether older adults exhibit greater COM displacement or large knee adduction biomechanics when navigating stairs with slick and uneven surfaces.

PURPOSE: To investigate whether age and surface increase medial-lateral center of mass displacement, and the knee adduction angle and moment related to joint injury and disease.

METHOD
Participants: 29 adults (15 young: 18 to 25 years; 14 older: over 65 years, with one accidental fall in last year) adults participated.

Task: Each participant performed 3 trials of the stair descent task on the normal, slick, and uneven surfaces (Fig. 1).

Biomechanical Analysis: 3D marker trajectories and GRF data were recorded with motion capture and processed in Visual3D to obtain COM and lower limb biomechanics.

RESULTS
Surface (p = 0.005), but not age (p = 0.099) impacted medial-lateral COM displacement (Fig. 3).

Participants decreased medial-lateral COM displacement on the uneven compared to normal surface (p = 0.024), but, no difference in medial-lateral COM displacement was observed between other surfaces (p > 0.05).

Surface impacted the average knee adduction moment velocity (p = 0.017), but not knee adduction angle (p > 0.05). Average knee adduction moment velocity was larger on the normal compared to uneven surface (p = 0.035).

KEY FINDINGS:
1) Challenging surface, particularly uneven, decreased medial-lateral COM displacement.
2) Uneven surface decreased average knee adduction moment velocity.
3) Age did not impact any COM or knee biomechanics measure.

CONCLUSION
Interestingly, participants adopted biomechanics, including decreased COM displacement and slower knee biomechanics on challenging surfaces, particularly uneven surface, that may reduce accidental fall risk or likelihood of suffering knee injury.

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