Challenging horizontal movement of the center of mass during sit-to-stand performance: Impact on stability control measured in healthy young and older adults

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Introduction

• Sit-to-stand ability is a prerequisite to many activities of daily living & is required for independent mobility

• Sit-to-stand difficulty in older adults increases the risk of falls (Yoshida et al., 1983) and institutionalization (Branch and Meyers, 1987)

• “Five times sit-to-stand test” predicts recurrent falls in healthy community-living older adults (Buatois et al., 2008)
Introduction

• Two significant challenges of sit-to-stand:
  
  • Vertically raising the COM from the sitting to standing position
  
  • Transition from a relatively large and stable BOS to a considerably smaller BOS
  
• Two requirements for successful sit-to-stand:
  
  • Muscle strength (Bohannon, 2009, 2007; Bernardi et al., 2004; Gross et al., 1998; Hughes et al., 1996): to vertically raise the COM from sitting to standing.
  
  • Balance and stability: to control the forward movement of COM once the standing position is assumed.
Purpose

• To explore the effect of changes in the required horizontal movement of COM during sit-to-stand on stability control in healthy young and older adults
Hypotheses

- Increased horizontal movement of COM during sit-to-stand will:
  - increase instability (longer stabilization time and greater COP excursion).
  - increase AP shear forces.
- Above effects are greater in healthy elderly than young adults.
Protocol

• Participants:
  • 11 healthy young (10 F, 1M), age = 23±4 years
  • 11 healthy elderly (7 F, 4M), age = 74±8 years

• Two task conditions:
  • feet far from the chair (Far condition / requires greater horizontal movement of COM )
  • feet close to the chair (Close condition / requires less horizontal movement of COM )

• Four trials in each condition
Far Condition

Close Condition
Measurements

- Kinetic data (1000 Hz)
- Kinematic data (60 Hz)
Results: Duration of Preparation and Movement Phase

The bar chart illustrates the duration (in ms) of the Preparation (Prep) and Movement (Mvm) phases for young and elderly participants. The bars are color-coded to represent close and far conditions. Asterisks indicate significant differences between conditions.
Results: AP Shear Forces
Results: Duration of AP and ML Stabilization Phase
Results: Total COP Path

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*Significant differences are indicated by asterisks (*) on the graph.
Summary

• Challenging horizontal movement of the COM increased instability for older vs. young adults:

  • Longer stabilization time in both AP and ML

  • Greater COP sway in both AP and ML during the first second of the stabilization phase
Summary

- Similar characteristics of the sit-to-stand between the young and older adults prior to the terminal phase (e.g. similar durations, peak forces)
Conclusion

• When evaluating individuals’ capacity for safe and successful sit-to-stand performance it is important to consider both muscle strength and stability control.

• Such information may be helpful to guide more effective rehabilitation strategies.
Thank You!