Background and Purpose

- Transferring from sit-to-stand is essential in everyday living, yet it is a common activity leading to falls in older adults.
- Muscle strength decreases rapidly after age 55, and is often accompanied with difficulties in rising from a seated position.
- Older adults may compensate for the loss of muscle strength by changing their transfer strategy.
- The purpose of this research is to: 1) investigate loading of the upper and lower limbs during transferring, and 2) determine how use of the upper limb affects transfer kinematics in young and older adults.

Methods

- We instructed 5 young adults (1.5 ± /4.3, 23.4 ± 2.3 yrs) and 7 older adults (4.3 ± /3.6, 84 ± 5.4 yrs) to transfer from an instrumented chair, built to measure forces and moments on the armrests and ground (fig. 1).
- Trials were conducted in randomized order involving no instruction, and while rising with and without use of the arms as fast as possible or at normal speed (fig. 2). In each condition, three trials were acquired.

Participants wore APDM inertial sensors at the wrists, upper arms, sternum, lower back, thighs, and ankles (fig. 3), which comprise of a triaxial accelerometer, gyroscope and magnetometer.

Preliminary Results

- Figures 4 and 5 above show the typical vertical reaction force traces of a young (left) and older adult (right) when transferring at normal speed.
- The vertical force on the armrests (brown traces) starts to increase halfway through the initiation phase (onset to seat off), indicating loading of the armrests. The vertical force shows a slight drop just after onset in the older adult, which may suggest the use of the upper limbs to assist trunk flexion. The percentage of loading on the armrests at seat off is comparable between young and old adults (see also fig. 6) but the peak vertical force on the armrest seems delayed in the older adult.
- The vertical force between the feet and ground (green traces) follow a similar pattern until the moment of seat off; both showing an initial decrease followed by a rapid rise in force. The peak vertical force is lower for the older adult, and the rising phase (seat off to end of rising) is longer and shows a more notable high frequency component.
- The duration of the transfer (onset to end of rising) is higher in older adults and seems unaffected by the use of the arms (see also fig. 7 and fig. 8).

Discussion

- Armrests load at seat off seems comparable between the two groups (35% of body weight). However, peak armrest load seems delayed in older adults, which may relate to a delayed trunk extension or an increased reliance on the upper limbs for maintaining balance.
- Use of the arms did not affect total transfer duration.
- Only 2 out of 7 older adults were able to get up without use of the arms, which illustrates the importance of the upper limbs for transferring.

References


Next Steps

- Increase sample size by measuring an additional 5 young and 3 older adults.
- Estimate trunk kinematics, such as trunk flexion angle and mediolateral sway, from the APDM inertial sensors data.
- Analyze the relative contribution to rising of the upper and lower limb from an impulse-momentum perspective.