**STAIR DESCENT TRANSITIONS IN THE ELDERLY: COORELATIONS BETWEEN LOWER LIMB JOINT IMPULSES, CADENCE, BALANCE LEVEL AND AGE**

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## INTRODUCTION

Stair negotiation has been associated with a higher fall and injury risk, especially for older adults [1]. Although several risk factors have been reported for falling, gait/balance disorders or weakness seem to be particularly important [2].

During stair negotiation, older adults appear to have a lower sagittal plane range of motion and to produce lower joint moments in the knee and ankle, as well as higher sagittal plane range of motion and joint moment at the hip, than younger adults [1]. These differences have been associated with the decrease in strength and changes in coordination, which occur with ageing [1]. However, in most of these studies, older adults aren't characterized/distinguished in terms of physical function or balance. The purpose of this study was to verify the correlations between lower limb joint impulses, produced during stair descent transitions, age, balance and cadence, in a sample of community dwelling older adults.

## METHODS

This study followed a cross-sectional design. The sample included 33 healthy, community-dwelling older adults, with 60 or more years and able to climb and descend a flight of stairs without using the handrail. Subjects' balance level was defined by summing the scores obtained on items 4 – step up and over, 5 – tandem walk, 6 – stand on one leg and 7 – stand on foam eyes closed, from Fullerton Advanced Balance (FAB) Scale [3].

Kinematic and kinetic data were collected using 8 infrared cameras (Qualisys Oqus 300) working at a frequency of 200Hz and synchronized with 2 Kistler force plates (9281B, 9283U014), one in front of the stairs and the other embedded below the first step. The passive markers were placed following the CAST marker set [4]. Participants walked at their comfortable pace. Three trials from each subject were processed in Visual 3D software (Professional Version v5.02.27, C-Motion, Inc). A 10 Hz 4th order Butterworth filter was applied to both kinematic and kinetic data. An 8 segments model (feet, shanks, thighs, pelvis and trunk) was built and optimized using global optimization [5]. Rotational impulses were obtained from lower limb joint moments, which were computed using standard inverse dynamics.

After checking for normality assumptions, Spearman correlation coefficient was determined using the software IBM SPSS Statistics (version 23). The significance level was set at $p \leq 0.05$.

## RESULTS AND DISCUSSION

The tested older adults had, on average, 71.6 ± 4.5 years (63-81) a balance score of 14.7 ± 1.4 points (11 – 16) and 9 (57.6%) were female. Cadence was shown to be negatively correlated to the ankle and knee joint impulses produced on the trailing limb, which controls the lowering of the center of mass (Table 1), and positively correlated with the leading leg knee and hip joint impulses, which accept the weight on the ground. Further, moderate negative correlations were also found between joint impulse produced in the hips on both legs and balance level. No correlations were found between joint moments and age.

## CONCLUSIONS

This study shows that, within a subsample of older adults living in the community, lower limb joint rotational impulses, produced during stair descent, seem to be more related with cadence and balance level than with age. Thus, subgroup analysis rather than the typical young vs older adults' comparisons, may be important in order to have a better comprehension about functional decline in the elderly.

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**Table 1:** Correlations between lower limb joint impulses, Age, Balance and Cadence: trailing leg: right; leading leg: left

| | Age | Balance | Cadence |
|---|---|---|---|
| **Right Plantar flexor rotational impulse (Nms/kg)** | 0.18 | -0.11 | **-0.88†** |
| **Left Plantar flexor rotational impulse (Nms/kg)** | -0.25 | 0.27 | **0.37*** |
| **Right Knee extensor rotational impulse (Nms/kg)** | 0.10 | <0.01 | **-0.67†** |
| **Left Knee extensor rotational impulse (Nms/kg)** | 0.21 | -0.16 | 0.12 |
| **Right Hip extensor rotational impulse (Nms/kg)** | 0.26 | **-0.47†** | -0.04 |
| **Left Hip extensor rotational impulse (Nms/kg)** | 0.15 | **-0.35*** | **0.48*** |

*p<0.05; †p<0.01