Effects of 16-weeks of intrinsic foot muscle strengthening interventions on fall-risk in older adults.

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Falls are the leading cause of injury and injury-related death for older adults (age $\geq$ 65) in the US. Although falls are multifactorial, 20 years of past research has identified several foot problems that may cause falls. Plantar toe flexion weakness, including the intrinsic foot muscles (IFMs), and toe deformities are independent predictors of falls. Various exercise programs are known to reduce fall-risk; however, isolated IFM strengthening is neglected. IFMs provide local foot stability and sensory input necessary for balance and walking. The IFMs can be recruited with specific strengthening exercises or by use of minimally cushioned footwear. These interventions have shown improvements in IFM strength with long-term use in younger adults, and immediate improvements in stability in middle-aged and older adults. The effects of long-term IFM strengthening interventions on fall-risk in older adults is unknown.

Purpose/Hypothesis: To compare the effects of IFM strengthening exercises (IFMSE), minimal footwear use (MFW), and a control activity (C) on balance, functional mobility, and fall-risk in older adults. We hypothesized that both IFMSE and MFW use would improve balance and reduce fall-risk compared to a control. Number of subjects: n=86 (18 male 68 female; mean age 75.9 $\pm$ 7.5)

Materials and Methods: Community-dwelling older adult volunteers with identified fall-risk were randomized into either IFMSE (n=30), prescribed use of MFW (n=26), or a sham control (seated active upper and lower extremity range of motion and a brochure on home fall-prevention tips) (n=30). They performed their activity 5 days/week x 16 weeks. The Mini BesTest (MB) and Timed Up and Go (TUG) were measured at baseline, 8 and 16-weeks post intervention. A 3-group x 3-time repeated measures ANOVA was performed for within and between group differences for the MB and TUG. Results: There was a significant group x time interaction and a significant main effect for time ($p < 0.0000$) for the MB. The IFMSE and MFW groups both significantly improved MB scores while there was no change for the C group. The TUG had no significant change for any group. Mean MB scores: IFMSE (baseline: 20.0 $\pm$ 3.5, 8wk: 21.2 $\pm$ 3.4, 16wk: 22.4 $\pm$ 3.5); MFW (baseline: 19.8 $\pm$ 4.4, 8wk: 20.2 $\pm$ 4.1, 16wk: 22.0 $\pm$ 4.1); C (baseline: 19.6 $\pm$ 4.1, 8wk: 19.5 $\pm$ 4.2, 16wk: 19.5 $\pm$ 4.2). Mean TUG scores (seconds): IFMSE (baseline: 11.3 $\pm$ 2.5, 8wk: 11.6 $\pm$ 3.1, 16wk: 11.9 $\pm$ 4.0); MFW (baseline: 13.3 $\pm$ 6.9, 8wk: 12.1 $\pm$ 5.3, 16wk: 12.4 $\pm$ 7.6); C (baseline: 15.8 $\pm$ 22.3, 8wk: 15.1 $\pm$ 17.3, 16wk: 13.4 $\pm$ 11.1)

Conclusions: Both IFMSE and MFW use over 16 weeks improved balance and functional mobility in older adults to a similar degree. The MB score changes from baseline to 16-weeks for both IFMSE and MFW exceeded a previously reported minimal clinically important difference (MCID) of 2 points in a cohort of older adults. This could be interpreted as a sign of reduced fall-risk.

Clinical relevance: Training the IFMs with specific exercises or prescribed minimal footwear use can make meaningful improvements in balance and functional mobility in older adults and may reduce fall-risk. These interventions may be safely added to comprehensive fall-prevention programs.