

Core Muscle Strengthening Improves Balance Performance in Community- Dwelling Older Adults

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Balance and the Elderly

- Balance requires integration of multiple systems
 - Ability to maintain balance declines as we age¹
- Interventions to improve balance focus on²
 - "Balance exercises", physical activity
 - Lower extremity strengthening
- BUT, is that sufficient?
 - Leg strengthening has inconsistent effects on balance
 - Few studies have shown an association between changes in leg strength and changes in balance³
- *Identifying and addressing other modifiable impairments may lead to more effective interventions*



Core Muscle Function and Balance

- Core muscles stabilize trunk during functional movements^{4, 5}
- Diminished core muscle function
 - is associated with poor balance and mobility in older adults⁵
 - even after controlling for limb muscle size⁷ or strength⁸
- After 16 weeks of whole-body strength training
 - Improvements in core muscle endurance, but not limb strength or power, were associated with meaningful improvements in balance⁹
- *Can a simple core strengthening exercise program improve balance?*



Purpose

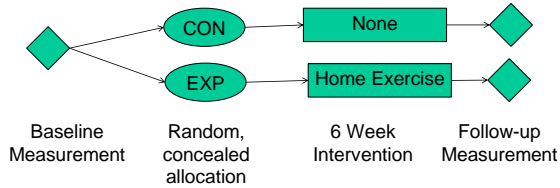
- To determine the effect of a 6-week core-strengthening home exercise program on balance in community-dwelling older adults
- We hypothesized that
 - the improvements in 1) *core muscle function* and 2) *balance* would be greater in the exercise group than a control group
 - 3) the change in core muscle function would be associated with the change in balance



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4

Study Design: Pilot RCT



- Participants
 - Generally healthy, 65-85 years old
 - Community ambulators
 - Able to walk around block without cane or walker by self report



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Intervention

- Core strengthening home exercise program
 - 8 exercises targeting strength, endurance, and control of key core muscles
 - 3 times per week for 6 weeks
 - Intensity progressed every 2 weeks by increasing reps or duration of hold
 - Exercise instruction
 - One-on-one training for each exercise
 - Instructions with text and figures
 - Follow-up instruction session at 3 week point
 - Compliance monitored by exercise log



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Core Strengthening Exercises



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Outcome Measures: Curl-up and Functional Reach

Curl-Up Test¹⁰

Functional Reach (FR)¹¹



- Pace = 25 per minute
- # of reps in 1 minute recorded

- 4 practice trials
- 3 test trials

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Outcome Measures: Star Excursion Balance Test

- SEBT¹²: Stand on 1 foot, reach with the other
- 4 practice trials, 3 test trials



Anterior

Posterolateral

Posteromedial

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9

Statistical Analysis

- Hypotheses 1 and 2: Between group comparison
 - The change from baseline compared across groups
 - Two-tailed independent samples t-test or, when not normally distributed, Mann-Whitney U test
 - Magnitude of difference in the change evaluated using
 - 95% CI on difference in the change scores
 - Between-group Cohen's d effect size (ES)
 - > 0.8 = large effect 0.5 = moderate effect

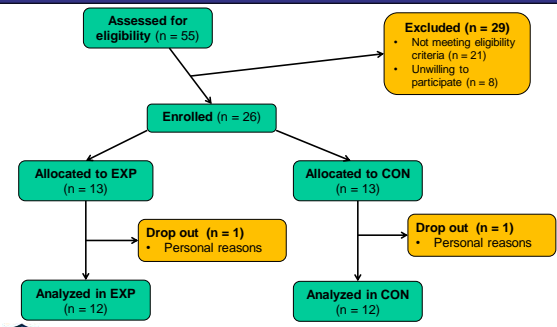
- Hypothesis 3
 - Spearman's rho correlation between change in curl-up and change in balance performance



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Results: Subject Flow



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Results: Baseline Data

	CON	EXP	Difference [95% CI]
Age (yrs.)	75.6 (3.6)	76.5 (6.9)	0.9 [-3.8, 5.6]
BMI (kg/m ²)	26.8 (5.1)	28.4 (5.8)	1.6 [-3.0, 6.3]
Gender	8 F, 4 M	8 F, 4 M	
Curl-up	17.6 (5.4)	16.5 (2.3)	-1.1 [-4.7, 2.5]
FR (cm)*	29.0 (6.2)	28.4 (5.2)	-0.7 [-5.5, 4.1]
SEBT Ant R (cm)	60.5 (11.2)	55.3 (13.6)	-5.1 [-15.7, 5.4]
SEBT PM R (cm)	42.3 (12.6)	43.1 (15.0)	0.7 [-11.0, 12.5]
SEBT PL R (cm)	64.6 (9.7)	65.6 (13.5)	1.0 [-8.9, 11.0]

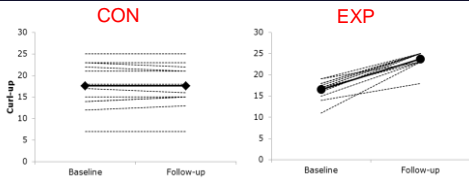
- 3 participants in each group at moderate risk of falls (FR < 26.9 cm)



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Greater Improvement in Curl-up Performance



Δ CON	Δ EXP	p	Diff [95% CI]	ES
0.0 (2)	7.5 (2)	<0.001	7.0 [6.0, 8.0]	4.45

No adverse events

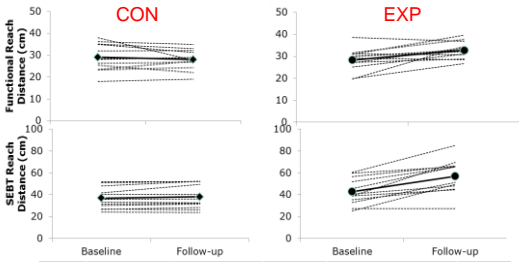
Self-reported compliance = 99.5%



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13

Greater Improvement in Balance Performance



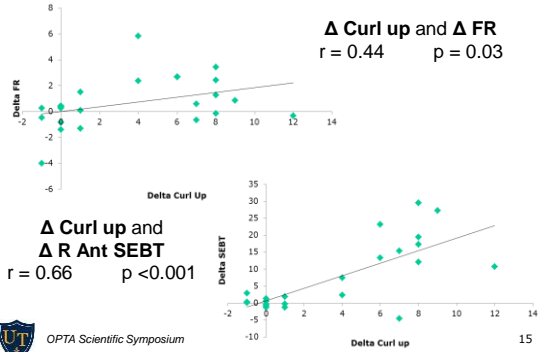
	Δ CON	Δ EXP	p	Diff [95% CI]	ES
FR	-1.02 (3.6)	4.6 (6.7)	0.006	5.3 [1.5, 8.2]	1.30
SEBT	0.15 (1.8)	11.7 (16.7)	<0.001	10.8 [6.2, 20.1]	2.00



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Change in Curl-up Related to Change in Balance



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Discussion

- Unsupervised, short-duration core strengthening home exercise program led to improved dynamic balance in community-dwelling older adults
- Changes in core muscle performance associated with changes in balance

- Limitations
 - Small sample
 - No longer-term follow up
 - Assessor not blinded to group assignment
 - Standardized protocols and scripts used to minimize bias



Conclusions and Implications

- Implications for clinicians
 - Diminished core muscle function
 - is a modifiable impairment that may contribute to poor balance
 - should be targeted in balance re-training programs

- Future studies should
 - Determine the required "dose" of core exercise
 - Determine if adding core strengthening exercises to comprehensive balance training programs enhances their ability to improve balance and reduce falls



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19

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20