

Introduction

Depending on lifestyle, fall risk (FR) tends to increase with age, especially after 80 years old^{9,11}. However, performing *standing* balance exercises (i.e., not seated activities) not only reduces FR but also mortality risk, hospitalizations and health care costs while enhancing quality of life, but only if done consistently¹⁰⁻¹². Exercises in balance studies do not typically explore the *limits* of participants' standing balance capabilities, which would require an observed "wobble" body motion during exercise and a need for a "spotting" mechanism for safety.

S³ Balance® ("S³") is a program designed by physical therapists and physicians to reduce FR by taking advantage of "self-spotting" when exploring standing balance limits via a "wobble". Given the greater challenge to participants, we proposed that S³ exercises would yield a compelling reduction in participants' FR within 90 days. Further, we also believed that participants would enjoy the classes so they would continue beyond the trial (necessary to sustain benefits).

To measure FR before and after the trial, we used a Functional Reach Test (FRT) as our functional outcome measure (FOM) to determine treatment effectiveness¹. The FRT is an accepted FOM that measures a person's FR and has been shown to be reliable, valid and economical^{2-5,7}. Specifically, the FRT measures the maximal distance a person can reach forward beyond arm's length without moving the feet in standing⁴.

Procedure

Before measuring, the test was explained and demonstrated to each participant. For each test, the tester (for pre- *and* post-tests) stood to the front right or left (based on participant preference) of the participant (who would stand unassisted) and hold an extended measuring tape at the participant's shoulder level. The participant raised one arm to ~90° shoulder flexion (aligning with the measuring tape), where the tester would call out the number corresponding to the resident's third knuckle relative to the measuring tape and the recorder (usually a staff member, Ann or Colin) would record the value. The participant was then asked to lean as far forward as possible and try to "touch" the tester's hand, which was placed an untouchable distance away as a visual target. Once forward movement stopped, the tester would call out the position of the third knuckle relative to the tape measure for recording. This was repeated three times, with the first measurement being discarded. The final two values were averaged and represented the FRT value for the participant.

Results

Since November 2017, 13 trials have been completed (AL = assisted living, MC = memory care).

<u>Facility</u>	<u>Participants</u>	<u>FRT Range</u>	<u>Mean Change</u>
Arcadia Assisted Living (AL)	6	67 – 310%	185%
Avamere Arbor Court (MC)	4	38 – 184%	91%
Avamere Hillsboro (AL)	8	113 – 650%	271%
Brookdale McMinnville (AL)	5	136 – 350%	238%
Brookdale Wilsonville (AL)	5	230 – 773%	339%
Gresham Manor (AL)	4	41 – 277%	117%
Grove and Gardens (AL, MC)	5	64 – 669%	223%
Hearthstone (AL)	2	41 – 210%	126%
Holiday (Independent Living)	6	26 – 237%	94%
McLoughlin Place (AL)	3	175 – 212%	187%
Miramont Pointe (AL)	3	15 – 116%	55%
Prestige at Orchard Heights (AL)	3	13 – 21%	17%
Redwood Heights (AL)	4	8 – 60%	33%
Silver Creek (AL, MC)	4	12 – 75%	37%
Village Keizer Ridge (AL)	11	139 – 400%	246%
Village Keizer Ridge (MC)	5	100 – 367%	269%
Washington Gardens (MC)	5	317 – 494%	389%
West Hills Village (AL)	4	127 – 1,140%	414%
Windsong Memory Care (MC)	10	122 – 1,750%	459%
OVERALL	97	8 – 1,750%	199%

On average, participants were about 2 times less likely to fall at post-testing. Further, 68% of participants improved from a 2 to 8 times greater likelihood of falling to an odds ratio of 1, which is referred to as “low fall risk”. Facilities with the greatest improvement had at least 1 dedicated staff member or resident who held S³ classes on a regular basis (i.e., at least 3 days per week). The wide range in improvement was largely due to factors such as staff enthusiasm, participant functional status, attendance and resident willingness to push themselves with the exercises.

As a reference, below is a summary of commonly used programs to reduce FR.

<u>Program</u>	<u>Mean FR Reduction</u>	<u>Time Frame</u>
<i>Stay Safe, Stay Active</i> (Barnett 2003)	40%	9 months
<i>Otago</i> (Campbell 2005)	35%	2 months
<i>Life</i> (Clemson 2012)	31%	12 months
<i>Erlangen Intervention</i> (Freiberger, 2007)	23%	4 months
<i>SEFIP</i> (Kemmler 2010)	46%	18 months
<i>Adapter Physical Activity</i> (Kovacs 2013)	60%	6 months

<i>Tai Chi</i> (Li 2005)	55%	6 months
<i>Australian Group Exercise</i> (Lord 2003)	22%	12 months
<i>Veterans Affairs Group</i> (Rubenstein 2000)	66%	3 months
<i>FaME</i> (Skelton 2005)	54%	9 months

Discussion

Results suggest that S³ can improve balance and reduce FR in Independent, AL and MC facilities, especially when a dedicated staff member facilities consistent performance. Outgoing questionnaires show that most participants and staff members enjoyed the classes, as they created participant autonomy but with less staff strain.

Factors to consider when interpreting these results include (but are not limited to):

- *Hawthorne effect*: participants may have performed better on the FRT because they knew they were being observed.
- *Testing experience*: participants may have performed better on the final FRT because they had prior experience performing the test.
- *Statistical analysis*: results represent raw data only (i.e., no statistical models were used).
- *Convenience sample*: participants were chosen by the facilities based on need and likelihood of participating on a regular basis.
- *No formal control group*: measurements were not taken on residents who didn't participate from the outset.

However, given the dramatic FRT improvements, these trials strongly suggest that a significant portion of FR reduction can be attributed to an actual reduction in FR.

We hope these results will encourage facilities to implement S³ to not only reduce FR, but also help residents enjoy many other health benefits that regular standing exercise offers.

References

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