International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Effects of Buffalo Home-Based Functional Exercise in Community-Dwelling Older Adults with Medium to High Fall Risks - A Proof of Concept

Machiko R. Tomita[1], Jeanne Langan[1], Kimberley Persons[1], Margaret Wilber[2], Bruce J. Naughton[2]

[1]Dept of Rehabilitation Science, University at Buffalo, 505 Kimball Tower, Buffalo, New York, 14214, U.S.A.
[2]Catholic Health Systems, LIFE project, 55 Melroy Ave. Lackawanna, New York, 14218, U.S.A.

Corresponding Author: Machiko R. Tomita

Received: 17/03/2016 *Revised: 18/04/2016* *Accepted: 25/04/2016*

ABSTRACT

Background: Exercise plays an important role in maintaining functional mobility as we age. Therefore, finding approaches that boost participation and effectiveness of home-based exercise is essential, particularly for older adults with lower function. A geriatric rehabilitation team developed XXXXXX Functional Exercise (BFE), which encourages exercise by relating and pairing it to daily activities.
Objective: This study was to determine the effectiveness of BFE on increasing exercise adherence and reducing falls and fall risks in community dwelling older-adults with medium to high fall risk.
Methods: This randomized controlled study with a 12-week home-based exercise intervention recruited 21 enrollees of the Program of All-inclusive Care for the Elderly at one site. Therapists prescribed BFE for 11 participants and conventional home-exercise for 10 participants. Fall risk outcome measures included ankle strength, objective and subjective balance, physical performance, function and health.
Results: Both groups improved in levels of the Short Physical Performance Battery, but only the BFE group improved in balance confidence (p=.028) and Instrumental Activities of Daily Living (p=.019). Beyond 6 weeks of BFE, no falls were reported in the BFE group. Exercise minutes per week for home-based exercise were similar. BFE participants reported that BFE was fun and easy to do, and expressed a willingness to continue the BFE.
Conclusion: Despite similar adherence with both exercise programs, BFE has advantages over conventional home exercise. Associating exercise with daily activities can offer a more effective approach to home exercise programs. Meaningfulness of exercise may be the reason. Further larger studies are encouraged.

Key words: physical function, home-based exercise, falls, fall risks, frail older adults.

INTRODUCTION

Among older adults (aged 65 or older), falls are the leading cause of both fatal and nonfatal injury. [1] When older adults fall, they develop a fear of falling, [2] which is likely to limit their physical activities, leading to reduced mobility and loss of physical fitness. This, in turn, will increase their actual risk of falling again. [3] For interventions to prevent falls, reducing fear of falling is a major goal in addition to improving muscle strength and balance especially in older adults who are at risk of falling. Exercise is considered the most effective intervention to prevent falls, [4] but for frail older adults, benefits of exercise are conflictive. Some reported improved physical performance [5] and decreased falls, [6] but others found no effects in function [7] or even increased falls. [8] It is because

exercise is not equally effective across all levels of frailty in older adults. For example, Otago exercise is a collection of lower extremity stretching, strengthening and balance exercises that the Centers for Disease Control and Prevention (CDC) encourages older adults to perform to prevent falls. [9] However, when it was offered for home-exercise in a group of community-dwelling older adults who were eligible for nursing home placement, it was effective only for higher functioning older adults but not for medium and low functioning older adults. During the 6 month study period, for people with higher function the number of falls decreased by 58% from 1.2 to 0.5 (p=.01). In contrast, the number of falls for people with low function increased by 77% from1.3 to 2.3, and for people with medium function, by 17% from 2.4 to 2.8. [10] Therefore, the conclusion by Rose [11] that older adults with higher risk of falling need more tailored and progressive exercise programs that target physical risk factors associated with falling seems appropriate**.**

In the study described above, adherence was not recorded, but low adherence was suspected, based on the past history. Traditional structured home-based exercise in older adults has low adherence, even after physical therapy treatment; 30% do not adhere at all and 70%, some. [12] Several reasons for low adherence have been identified. These include boredom, difficulty fitting the exercise into their daily routine and poor understanding of how to do the exercises. [12-15] Responses from participants given home-exercise programs were explicitly recorded in qualitative studies. One participant reported that home-exercise "was so dumb boring…" [14] When another participant was asked how exercise fit into her daily routine she responded, "That's what I'm telling you, it didn't." [15] These comments indicate that home-exercise needs to be interesting and fit well into their daily routine to achieve high adherence.

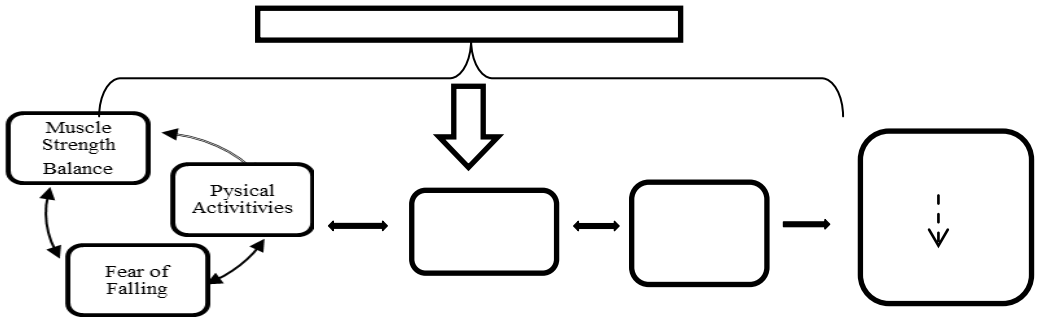

Figure I: The process of effects of exercise in older adults (P double E) model.

To address exercise for older adults with lower function and low adherence to home-exercise, a group of geriatric clinicians and researchers, developed BXXXX Functional Exercise (BFE) based on the Process of Effects of Exercise in Older Adults (P double E) model (Figure I) and the description of an Australian LiFE exercise program. [16] Similar to conventional home-exercise programs, BFE incorporates strengthening, stretching and balance exercises into a home-program. However, BFE differs from conventional programs by imbedding the exercises into older adults' daily functional activities. Further, BFE is different from the LiFE program by using environmental cues to remind participants to exercise throughout the day and involving older adults in the exercise goal setting. Incorporating environmental cues that are relevant to the participant and involving the participant in goal setting can increase the participant's investment in the exercise program. Associating exercises with daily functional activities may also underscore the relevance of exercising, and decrease anxiety from unfamiliarity with exercise. Creating a more

user friendly framework for exercise may lead to increased physical activity directly impacting Activities of Daily Living (ADL) and Instrumental ADL (IADL) performance. Gaining confidence in their strength, and becoming more physically active may also reduce fear of falling. The relationship between muscle strength, balance, physical activity and fear of falling is indicated in the left hand side of Figure I. By linking exercise to ADLs rather than the conventional approach of providing a simple list of exercises, BFE may result in greater benefits in all areas presented in the model. The purpose of this study was to determine the effectiveness of BFE compared to a conventional home-exercise program in an older adult population at risk for falls.

Focusing on this population, research questions of this study were: Do participants in the BFE intervention group increase muscle strength, physical performance level and/or functional level as well as reduce fall risks and falls, or improve health? Are changes similar to a conventional home-based exercise program?

What will be the frequency of exercise, satisfaction with the BFE program, and willingness to continue?

MATERIALS AND METHODS

Participants: Participants were recruited from one site of the Program of All-inclusive Services for Elderly (PACE). PACE is a nationwide Medicare and Medicaid program in the U.S. that helps people meet their healthcare needs in the community, preventing a nursing home or other care facility placement. The majority of the PACE program services are provided at the site's adult day health center by an interdisciplinary team of healthcare professionals. [17] All PACE enrollees are qualified for nursing home placement but are living in the community. Among them, falls have been a major problem. [18] For several years, on average, 79.3 % of enrollees fell and the average falls were 1.8 times every six months. [19] Recruitment was accomplished through a convenience sampling method. Potential participants were made aware of the study through flyers and through small meetings at one of the PACE health centers called the XXX Center in XXXX. Altogether 24 participants were identified and all of them scored less than or equal to 40/56 on the Berg Balance Scale, which indicates low to medium function. [20] Other inclusion criteria were participants whose age were 60 years or older, ambulatory with or without the use of a mobility device such as a cane and a walker, and healthy enough to participate in the program as determined by the Medical Director at the Center. Exclusion criteria were having progressive Parkinson's disease, scheduled surgery, or fast declining cognition. At the baseline assessment, two people were found ineligible due to near non-ambulatory status. After the baseline assessment, a random assignment was made using computer generated random digits. One person was hospitalized before the random allocation occurred. Analysis was made using data of 21 participants who completed the follow-up assessments. The study was approved by the IRB of the University XXXXXX and the XXXXXX Health System.

Design and Intervention: This study employed a randomized controlled design with a 12-week intervention period. The home-based BFE was led by physical or occupational therapists in the XXXX Center who met with participants in the treatment group every 2 weeks for 3 months. The therapist evaluated a participant and talked with him/her regarding daily activities in which the participant wanted to improve, and then determined the BFE prescription. Research assessments were completed by graduate level students in clinical rehabilitation programs trained on all assessments in the research design. They were blind to participants' intervention group.

The BFE program was tailored to the participant, but many had common activities. Here are several examples of combining exercise with common daily activities.

Prior to getting out of bed, bring your knees towards your chest to feel a stretch in your buttocks; try to hold this position for 30 seconds (Figure IIa).

When you take a can/bottle out of the cupboard to make lunch, take a second can/bottle out and perform 10 repetitions of arm lifts (lifting to a height that is not painful) (Figure IIb).

When you walk into the kitchen, take a moment to pause at the counter and stand on one foot for 10 seconds using the counter for balance if you need to (Figure IIc).

When watching television, exercise during the commercials. Stand up and sit down 10 times.

The exercises were adapted for each individual as the therapist saw fit, but the concept of relating the initiation of the exercise to an environmental cue was consistent.

a. Stretching hip extensors in bed. **b. Lifting a can to strengthen the shoulder complex in the kitchen.** **c. Standing on one foot for balance in the kitchen.**

Figure II: Examples of BFE

Throughout the intervention period, a therapist met every two weeks with participants and guided them, kept records of their progress and their adherence to the program. At each meeting, progress was discussed and exercises were updated as deemed appropriate by the therapist. If participants experienced pain or felt uncomfortable with the exercise, they were told to stop doing the exercise and consult their therapist. For the group who participated in conventional structured home-based exercise, therapists also met with them every two weeks. This exercise was also intended to increase balance and muscle strength, but they were instructed on the number of repetitions and how many times a week without any relationship with their daily activities or cues. All participants continued to attend the XXXX Center and participated at their discretion in the exercise programs offered by the facility. These were Tai-chi, yoga, and movement with music, all of which were completed in a seated position and lasted approximately 45 minutes. The form of exercise rotated, but every day, one of these three types of exercise and walking for exercise (approximately 15 minutes) was offered. Participants were not asked to change their level of participation in any programs offered at the Center. The format of the home-exercise program was the only change introduced to participants.

Measures: Measures for fall risk have established psychometric properties. The strength of ankle dorsiflexion was measured by manual muscle testing (MMT) using a 0-10 scale. [21] The 0-10 scale uses a whole number for each manual muscle grade and eliminates the use of plus or minus signs associated with the more commonly used manual muscle testing scale of 0-5. Ankle dorsiflexor strength is a predictor of functional mobility. [22] The Activities Specific Balance Confidence Scale (ABC) measures balance confidence, [23] which is the reversal of fear of falling. The ABC is a 16-item self-report measure with each item rated on a scale ranging from 0 -100 and a total score of less than 67 of 100 is a risk for falling in older adults. [24] The Short Physical Performance Battery (SPPB) is an objective assessment tool to evaluate lower extremity functioning balance, strength, endurance, and gait in older adults. This has

three sub-tests: repeated chair stand, standing balance, and time to walk 8 feet. The total is calculated by adding the three scores, ranging from 1 to 12. These score indicate levels of limitation: 0-3= severe, 4-6= moderate, 7-9 = mild, 10-12 = minimal. [25] Functional Independence Measure (FIM) measures degrees of disability composed of 13 ADL items assessing motor functions and 5 items, cognitive functions, measured based on a 7-point scale. [26] This study used only the motor domain. IADL in the Old Americans Resources and Services consists of 7 items, and the total score ranges from 0 to 14. [27] The number of falls was obtained from both participants and the XXXX Center. Health measures included hospital stays, emergency room visits, and the number of sick days. Falls and health information was recorded every 2 weeks during the study period by the therapists. The number of sick days was categorized as one of the following: less than one week, more than a week to less than one month or more than one month. [27]

Statistical Analysis

Paired sample t-tests were used to analyze variables, which were continuous scales, normally distributed and significantly correlated between the two time points. If these criteria were not met, Wilcoxon Singed Ranks Tests were used. If dependent variables are categorical, we used McNemar tests for 2 X 2 table correlated samples. For the number of falls and fallers, Fisher's Exact Tests were used to compare the two groups. Due to a small sample size, only within-subject analyses were conducted using one-tailed tests, for the two groups separately. The significance level was set at .05 and SPSS v.23 [28] was used for analyses.

RESULTS

Baseline characteristics including age, sex, living status, race/ethnicity, education and use of mobility device of the two groups were equivalent although the BFE group was older by 3 years (Table 1).

Table I: Baseline Demographic Characteristics

Variables	BFE Group (n=11) Mean & SD n & %	Control Group (n=10) Mean & SD n & %	Difference
Age	73.2 (10.1)	70.0 (7.3)	t=0.815 (p=.425)
Sex- Female	7 (63.6%)	9 (90.0%)	Fisher's Exact Test (p=.311)
Living Status- Alone	8 (72.7%)	5 (50.0%)	Fisher's Exact Test (p=.387)
Race/Ethnicity			χ^2=2.010 (p=.366)
Caucasian	10 (90.9%)	9 (90.0%)	
Black	0	1 (10.0%)	
Hispanic	1 (9.1%)	0	
Education			χ^2=4.582 (p=.333)
< 12 years	2 (18.2%)	5 (50.0%)	
High school	6 (54.5%)	2 (20.0%)	
2-year college	1 (9.1%)	1 (10.0%)	
BA/BS	1 (9.1%)	2 (20.0%)	
Graduate School	1 (11.1%)	2 (16.7%)	
Use of mobility assistive device: Yes	11 (100%)	9 (90%)	Fisher's Exact Test (p=.476)

Effects of BFE and conventional exercise

After 12 weeks of exercise, the BFE group improved ankle dorsiflexion strength, on average, one point of the 0-10 MMT scale, equivalent to 13.9%, but the control group did not change (-1% to 0%), neither change reached a level of statistical significance.

Mean scores of the ABC improved by 8.4% for the BFE group resulting in a statistically significant change (p=.028). The average for the group went from a low level of physical functioning (<50%) to a moderate level (50-80%). [29] The control group improved by 2.6%, but without statistical significance.

Both groups improved in physical limitations measured by the SPPB. For the BFE group, 6 people (54.5%) improved a level, and in the control group 4 people (40%) improved by a level. Both were statistically significant (p<.018 and p< .023, respectively). At baseline, all participants were at risk of falling (≤6 of 12 on the SPPB) but 12 weeks later, two people in each group (18.2% for the BFE group and 20.0% for the control group) were considered as not having a fall risk. [30]

The BFE group increased their IADL score with statistical significance while the control group remained similar. For the ADL score, both groups declined without significance (by 0.2 of 91 points for the BFE group and by1.3 for the control group).

For the first 6 weeks, the number of falls was similar, but for the second 6 weeks none of the BFE group fell. In contrast, 40% of the control group fell. As shown in Figure III, these changes were statistically significant only for the BFE group.

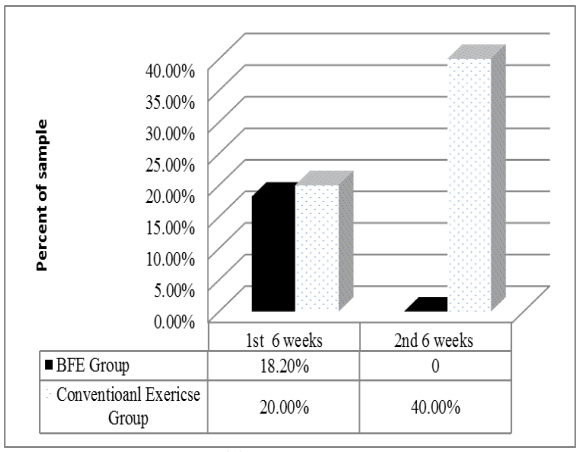

Figure III. Percent of fallers in BFE and control groups.

Table II: Within-Group Comparisons for Changes in Fall Risks, Function, Fall, and Health between Treatment and Control Groups

Variables	Baseline Mean (SD) or n (%)	12 weeks Mean (SD) or n (%)	Change Mean (SD) or n (%)	Difference
Ankle Dorsiflexion (R)				
BFE	7.18 (2.06)	8.18 (1.98)	1.0 (2.32)	t=1.427 (.092)
Control	7.55 (1.59)	7.45 (2.29)	-.1 (1.65)	t=-0.192 (.476)
Ankle Dorsiflexion (L)				
BFE	7.41 (2.23)	8.18 (1.98)	.77 (1.41)	t=1.061 (.160)
Control	7.60 (1.91)	7.60 (1.91)	0 (.93)	t=0 (.500)
Balance Confidence				
BFE	49.8 (22.7)	58.1 (22.0)	8.3 (12.1)	t=2.286 (.028)*
Control	52.0 (15.8)	54.6 (21.4)	2.6 (9.2)	t=0.882 (.206)
SPPB level				
BFE				
Very low	4 (36.4%)	1 (9.1%)	-3 (-27.3%)	Z=2.236
Low	7 (63.7%)	8 (72.7%)	1 (9.0%)	(.018)*
Moderate	0	2 (18.2%)	2 (18.2%)	
Control				
Very low	6 (60.0%)	4 (40.0%)	-2 (20.0%)	Z=2.000
Low	4 (40.0%)	4(40.0%)	0	(.023)*
Moderate	0	2 (20.0%)	2 (20.0%)	
ADL				
BFE	80.4 (5.7)	80.2 (5.1)	-0.2 (4.9)	t=-0.123 (.452)
Control	79.3 (4.5)	78.0 (5.9)	-1.3 (2.8)	t=-1.473 (.088)
IADL				
BFE	10.5 (1.4)	10.9 (1.5)	0.4 (0.5)	t=2.390(.019)*
Control	10.0 (2.3)	9.9 (2.2)	-0.1 (0.3)	t=-1.000 (.172)
# of Falls	1st 6 weeks	2nd 6 weeks		
BFE	0.23 (0.8)	0 0		1st 6 weeks Z=051 (.479)
Control	0.30 (0.7)	0.5 (0.8)		2nd 6 weeks Z=2.226 (.012)*
# of Fallers	1st 6 weeks	2nd 6 weeks		
BFE	2 (18.2%)	0		1st 6 weeks (.669)
Control	2 (20.0%)	4 (40.0%)		2nd 6 weeks (.035)*
Hospital stays (times) (Past 3 mos.)				
BFE	0.9 (0.3)	0	- 0.9 (0.30)	Z=-1.00 (.159)
Control	0.30 (0.68)	0	- 0.30 (.67)	Z=-1.342 (.090)
ER visits (Past 3 mos)				
BFE	0.27 (0.65)	0	-0.27 (0.65)	Z=-1.324 (.090)
Control	0.20 (0.42)	0.30 (0.48)	0.10 (0.32)	Z=1.000 (.159)
Sick days (Past 3 mos)				
BFE < 1 wk.	11 (100 %)	11 (100%)	0	Z=0 (.500)
1 wk - 1 mo.	0	0	0	
>1 mo.	0	0	0	
Control < 1 wk.	5 (50.0%)	10 (100%)	5 (50%)	Z=2.070 (.019)*
1 wk - 1 mo.	3 (30.0%)	0	-3 (30%)	
>1 mo.	2 (20.0%)	0	-2 (20%)	

*<.05

Regarding hospital stay, both groups decreased to no stay. For emergency room visits, the BFE group had none while the control group increased by one time. Finally for the number of sick days in the past 3 months, all participants of the BFE group stayed healthy (<1 week) and the control group improved to the same level as the BFE group. Table II summarizes the results.

Participation and satisfaction in exercises: On average, the BFE group exercised 12 minutes/week longer than the control group in their homes. In contrast, at the XXXX Center, the control group

exercised 21 minutes/week longer. Therefore, per week the BFE exercised 13 minutes shorter than the control. The difference between the two groups was not significant. Figure IV presents the minutes of exercise per week.

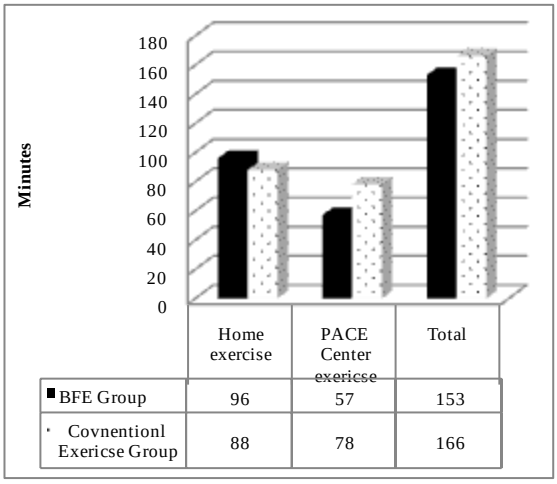

Figure IV: Minutes per week for two home-based exercise groups

Regarding evaluation of the programs, no one was dissatisfied with either of the home- exercise programs. In the BFE group, one participant (9.1%) reported "neither satisfied nor dissatisfied", five (45.5%) reported "satisfied", and five (45.5%) reported "very satisfied". For the control group, three participants (30.0%) selected "neither satisfied nor dissatisfied", five (50.0%) said "satisfied: and two (20.0%) said "very satisfied." The differences between the groups were not significant (Z=1.451, p=.074). Regarding willingness to continue the exercise, 100% of the BFE group said "Yes" and for the control group, two (20%) said "Maybe" and eight (80%) said "Yes". The difference was not significant (Z=1.522, p=.064).

Many positive comments about BFE were explicitly expressed, more so than the conventional exercise. No negative comments were reported by the BFE group. Opinions were: *liked it because I could do it whenever; liked it so I did more each time and was sure of myself; was looking forward to doing it; can do (daily activities) a lot more than when first started* (2 people); *can stand now; gained strength; improved balance; joints have been loosened up; little by little eased into it and blended well with what I liked to do; helped me physically (2 people); feel better after the (BFE)exercise;* and *know what to do better than before.* The control group expressed: They were easy to do (two people); can do things more than before; and like it because I feel better.

DISCUSSION

This study investigated the effectiveness of XXXX Functional Exercise (BFE) on fall risk factors, function, falls, and health in enrollees of a PACE program. Participants were considered frail because they were eligible for nursing home placement and had a high fall rate, on average, in the past. Acknowledging frailty has various levels, it is important to recognize the participants' specific status pertaining to fall risks at the time of initial assessment. Participants had (a) a medium to high risk of falling measured by the BBS (<40 of 56), (b) moderate to severe limitations (≤6 of 12) on the SPPB, which equates to a higher likelihood of falling compared to those who scored 7 points or above (odds ratio = 3.82), [30] and (c) less than 67% ABC, which also is indicative of future falls. [23]

For these older adults, BFE was effective in all steps of the P double E model, either statistically or clinically. The BFE group improved: (a) by increasing dorsiflexor strength of both ankles from an average of 7/10 (holds test position against slight to moderate pressure) to an average of 8/10 (holds test position against moderate resistance), [31] (b) by improving level of confidence in physical function from low (<50%) to moderate level (50-80%) on the ABC, [29] (c) by increasing one level on the SPPB, except for one participant and (d) by improving in IADL. Most importantly, the effectiveness of BFE becomes apparent after 6 weeks of continued BFE, finding no fallers, while 40% of the control group fell. Finally, the BFE group was healthy, evidenced by no hospital stays, no Emergency Department visits, and reporting less than one week of sickness (the smallest increment of sick days on the questionnaire

scale). In contrast, the control group improved only on their SPPB score and the number of sick days. Therefore, it is reasonable to conclude that a proof of concept was demonstrated for the effectiveness of BFE for fall prevention in older adults with medium to high fall risks.

While it was hypothesized BFE would be more effective than conventional exercise, the rational for this anticipated benefit was not convincingly supported by the results. The original expectation was the BFE group would exercise more frequently than the conventional exercise group, resulting in greater amount of time exercised for the BFE group. The actual result was the BFE group exercised only 12 minutes per week longer in their home than the control group. Furthermore, the control group exercised longer in the XXXX Center than the BFE group resulting in the control group overall logging 13 more minutes exercising than the BFE group. Then why did the BFE group tend to improve more than the control group? Tailored practice within the home setting can have greater benefit to older adults than exercising for a longer time in a less tailored community program.

Participants in the BFE group provided input on environmental cues that would trigger exercises throughout the day and how the exercises would integrate with the ADL they want to improve. This tailored client-centered approach could help overcome common barriers to successful home exercise programs: lack of knowledge of exercises, no interest and low self-efficacy. [12-15,32] In addition it emphasizes elements that encourage participation: inclusion in decision-making, seeing the exercises as relevant and able to improve their function. [32] By pairing exercises in BFE to daily activities and allowing participant input, the program was more likely to be relevant and meaningful to participants.

Meaningfulness is an important concept in the field of occupational therapy. As Trombly explains, [33] the participant is unique and the therapist cannot substitute his or her own values in selecting appropriate occupational (exercise, in this case) goals for their client. Meaningfulness can be tied with the emotional value that interesting, familiar, or beneficial experience offers the participant and can be motivating. [33] Similar to other studies, when participants are involved in developing the exercise program, they do better than if exercises are dictated to them. [34,35] Recently, a meta-synthesis of cancer survivors' experience of exercise-based cancer rehabilitation emphasized importance of meaningfulness of exercise-therapy. [36] The positive self-report of participants in BFE, "fun", "enjoyable" "like" "easy" and "can do what I wanted to do", suggests that participants perceived the program as a meaningful activity. Larger studies are needed to investigate inter-relationship between types of exercise, meaningfulness of exercise, and outcomes.

Another potential reason for greater benefits from BFE is associated with the structure of the program. Exercises in the BFE program are distributed throughout the day as opposed to mass exercise with longer time concentration. According to motor learning literature, distributed practice leads to better long-term retention of the skill. [37] Frequency of exercise more than amount of time may play a role in improving function in frail older adults.

Perceived benefit of a home exercise program can be tied with increased confidence in participants' abilities or self-efficacy, and improvement in performing daily activities. This could contribute to 100% of the BFE participants' being willing to continue BFE. Only a few past studies have reported willingness to continue exercise. Among them, the highest percentage of participants willing to continue home-based exercise in the literature is 68.9%, reported one year after a 2-year exercise trial for women aged 80 years or older. [38] In comparison with the rate, the BFE group's rate was very high. However, as an exercise program becomes longer, 2 years, adherence and willingness may diminish. The BFE study period was

only 12 weeks. A long-term effect of BFE on willingness to continue exercise needs to be investigated further.

This study has several limitations. Due to a small sample size, analysis of covariance (ANCOVA) using the scores with a baseline difference between the two groups as covariate were not performed. Therefore, without direct comparisons, we examined changes for two groups separately. This approach reduces the strength of evidence. Secondly, the control for frequencies or amount of exercise activities in the XXXX Center was not possible because attendance is the enrollees' choice. However, more effective type of exercises to prevent falls such as BFE may be introduced, possibly according to the level of fall risks. Thirdly, the difficulty to record frequencies for BFE should be noted. Since BFE is performed throughout the day, participants may not precisely remember the frequencies or duration of the exercise. Therapists asked this question every 2 weeks, but it is basically a self-report. Requesting an exercise log be kept does not work well. In past research in a similar population log books had minimal documentation from participants at the end of the study. Therefore, an automated activity tracking system such as Fitbit may be used for accurate records in the future.

CONCLUSION

BFE is an effective, unsupervised home-based exercise that is incorporated into daily activities and can overcome negative connotations related to home-based exercise. BFE has resulted in reduced falls and fall risks in 12 weeks, which may be attributed to several factors associated with positive outcomes in exercise programs. This includes participants providing input into the exercise program and understanding the exercise, having a meaningful exercise program, self-efficacy and distributing practice throughout the day. Further, larger long-term studies, with the use of a good tracking system for activities, are necessary.

ACKNOWLEDGEMENT

This study was funded by the Community foundation for the Greater Buffalo. Our deep gratitude is extended to occupational and physical therapists at the LIFE Program: Silvia Wisher, Debora Wild, Coleen Martino, and Diane Swatsworth for providing interventions in this study. In addition, we sincerely appreciate Joshua Helak, Margaret Reidel, Alyssa Sirica Ashley Moore and Jessica Seiter who were occupational therapy graduate students at the University at Buffalo for data collection.

REFERENCES

1. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web–based Injury Statistics Query and Reporting System (WISQARS) [Internet]. 2013. Available from http://www.cdc.gov /injury/wisqars/.
2. Bell A, Talbot-Stem JK, Hennessy A. Characteristics and outcomes of older patients presenting to the emergency department after a fall: A retrospective analysis. Med J Aust. 2000; 173(4):179-182.
3. Vellas BJ, Wayne SJ, Romero LJ, et al. Fear of falling and restriction of mobility in elderly fallers. Age Ageing. 1997; 26:189-193.
4. Lin MR, Wolf SL, Hwang HF, et al. A randomized, controlled trial of fall prevention programs and quality of life in older fallers. J Am Geriatr Soc. 2007; 55(4):499-506.
5. Binder EF, Schechtman KB, Ehsani AA, et al. Effects of exercise training on frailty in community-dwelling older adults: results of a randomized controlled trial. J Am Geriatr Soc. 2002; 50:2089-2091.
6. Wolf SL, O'Grady M, Easley KA, et al. The influence of intense Tai Chi training on physical performance and hemodynamic outcomes in transitionally frail, older adults. J Gerontol A Biol Sci Med Sci. 2006; 61:184-189.
7. Gill TM, Baker DI, Gottschalk M, et al. A program to prevent functional decline in physically frail, elderly persons who live at home. N Engl J Med. 2002; 347:1068–1074.
8. Faber MJ, Bosscher RJ, Chin A, Paw MJ, van Wieringen PC. Effects of

exercise programs on falls and mobility in frail and pre-frail older adults: A multicenter randomized controlled trial. Arch Phys Med Rehabil. 2006; 87:885-896.
9. Centers for Disease control and Prevention, CED Compendium of effective fall interventions: What works for community-dwelling older adults. 3rd ed. [Internet] 2015. Available from http://www.cdc.gov/homeandrecreationalsafety/falls/compendium.html.
10. Wilber M. Participant centered intensified home exercise program to prevent falls. National Pace Association Annual Conference; 2015 October 18-21; Philadelphia, PA, Alexandria, VA. 2015. U.S. National Pace Association. P.27.
11. Rose, DJ. Preventing falls among older adults: No "one size suits all" intervention strategy. J Rehabil Res Develop. 2008; 45(8):1153-1166.
12. Forkan R, Pumper B, Smyth N. et al. Exercise adherence following physical therapy intervention in older adults with impaired balance, Phys Ther. 2006; 86:401-410.
13. Allen K, Morey MC. Physical activity and adherence. In: H. Bosworth (Ed). Improving Patient Treatment Adherence; A Clinician's Guide. New York: Springer; 2010. p. 38.
14. Barker, RN Brauer SG. Upper limb recovery after stroke: The stroke survivors' perspective. Disabl Rehabil. 2005; 27(20):1213-1223. p.1220.
15. Brown EVD, Dudgeon BJ, Guttmann K, et al. Understanding upper extremity home programs and the use of gaming technology for persons after stroke. Disabil Health J 2015:507-513. p. 510.
16. Clemson L, Singh MA, Bundy A, et al. Integration of balance and strength training into daily life activity to reduce rate of falls in older people (the LiFE study): randomized parallel trial [Internet]. BMJ, 2012. 345:e547, 1-15. Available from http://www.bmj.com/content/345/bmj.e4547
17. The Centers for Medicare& Medicaid Services. PACE [Internet]. Available from http://www.medicare.gov/your-medicare-costs/help-paying-costs/pace/pace.html
18. National PACE Association. What is PACE? [Internet] 2015. Available from http://www.npaonline.org/website/article.asp?id=12&title=Who,_What_and_Where_Is_PACE?
19. Wilber M. 2013-2014 LIFE Performance Improvement project. New York State Department of Health. Oct 15, 2014.
20. Berg KO, Maki BE, Williams JI, et al. "Clinical and laboratory measures of postural balance in an elderly population." Arch Phys Med Rehabil. 1992; 73(11):1073-1080.
21. Kendall F, McCreary E. Muscle Testing and Function. 4th ed. Baltimore, MD: Williams & Wilkins; 1993.
22. Ng SS, Hui-Chan CW. Ankle dorsiflexor, not plantarflexor strength, predicts the functional mobility of people with spastic hemiplegia. J Rehabil Med. 2013; 45(6):541-5.
23. Lajoie Y, Gallagher SP. Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and ABC scale for comparing fallers and non-fallers. Arch Gerontol Geriatr. 2004; 38:11-26.
24. Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. J Gerontol Med Sci. 1995; 50(1): M28-34.
25. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol Med Sci. 1994; 49(2):M85-M94
26. Uniform Data System for Medical Rehabilitation, FIM [Internet]. 1999. Available from http://www.udsmr.org/WebModules/FIM/Fim_About.aspx
27. Fillenbaum GG. Multidimensional Functional Assessment of Older Adults: The Duke Older Americans Resources and Services Procedures. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.
28. IBM SPSS [Internet]. 2015, Armonk, New York.
29. Myers AM, Fletcher PC, Myers AN, et al. Discriminative and evaluative properties of the ABC Scale. J Gerontol A BioI Sci Med Sci. 1998; 53:M287-M294.

30. Veronese, N, Bolzetta F, Toffanello E, et al. 2013. Association between Short Physical Performance Battery and falls in older people: The Progetto Veneto Anziani Study [Internet]. Rejuvenation Res. 2014, Jun 1. 17(3):276-284. Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4062103/
31. Dutton M. Principles of manual muscle testing in orthopedic examination, evaluation, and intervention [Internet]. McGraw-Hill Global Education Holdings, LLC. 2016, Available from http://highered.mheducation.com/sites/0071474013/student_view0/chapter8/manuaul_muscle_testing.html
32. Bunn F, Dickinson A, Barnett-Page E, et al. A systematic review of older people's perceptions of facilitators and barriers to participation in falls-prevention interventions. Aging and Society. 2008; 28:449-472.
33. Trombly CA. Occupation: Purposefulness and meaningfulness as therapeutic mechanisms. AJOT. 1995; 29(10): 960-972.
34. Lee TD. Contextual interference: Generalization and limitations. In N. J. Hodges & A. M. Williams (Eds.), Skill acquisition in sport: Research, theory, and practice II (pp.79-93). 2012. London, England: Routledge.
35. Merbah S, Meulemans T. Learning a motor skill: Effects of blocked versus random practice: A review. Psychologica Belgica. 2011; 51:15-48.
36. Midtgaard J, Hammer NM, Andersen C, et al. cancer survivors' experience of exercise-based cancer rehabilitation-a meta-synthesis of qualitative research. Acta Oncologica. 2015; 54(5):609-617.
37. Martenuik RG. Retention characteristics of motor short-term memory cues. J Motor Behav. 1973; 5:249-259.
38. Campbell AJ, Roberson MC, Gardner MM, et al. Falls prevention over 2 years: A randomized controlled trial in women 80 years and older. Age Ageing. 1999; 28(6):513-518.

How to cite this article: Tomita MR, Langan J, Persons K et al. Effects of buffalo home-based functional exercise in community-dwelling older adults with medium to high fall risks - a proof of concept. Int J Health Sci Res. 2016; 6(5):146-156.

****