

Improving Strength and Balance for Long-Term Care Residents At Risk for Falling: Suggestions for Practice

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ABSTRACT

- **Objective:** To synthesize the available literature on exercise and falls reduction interventions in long-term care (LTC) and provide practical information for clinicians and other decision makers.
- **Methods:** Review of positive trials included in systematic reviews.
- **Results:** Falls are a major concern for residents, families, clinicians, and decision-makers in LTC. Exercise is recommended as part of a multifactorial falls prevention program for residents in LTC. Strength and balance exercises should be incorporated into the multifactorial falls prevention program. They should be challenging and progressed as the residents' abilities improve. Evidence suggests that exercises should be completed 2 to 3 times per week for a period longer than 6 months. Exercise programs in LTC should be resident-centered and should consider residents' potential physical and cognitive impairments. Exercises in standing should be prioritized where appropriate.
- **Conclusion:** Appropriately challenging and progressive strength and balance exercises should be included in a multifactorial falls prevention program for residents in LTC.

Key words: long-term care; nursing homes; falls reduction; exercise.

Falls are common in long-term care (LTC) homes: the estimated falls rate is 1.5 falls per bed per year, which is 3 times greater than that for older adults living in the community [1]. Falls can have significant consequences for residents in LTC, including functional disability, fractures, pain, reduced quality of life, and death [1–6]. Indeed, 25% of residents who are hospitalized after a fall die within 1

year [3]. Consequently, falls prevention programs are important to help in reducing falls and averting the associated negative consequences.

Exercise may address the circumstances and physical deconditioning that often contribute to falls in LTC residents. Weight shifting [7], walking, and transferring [8–10], are common activities that precede falls, suggesting that balance, gait, and functional mobility training may be possible targets for prevention. Additionally, it is estimated that LTC residents spend three quarters of their waking time in sedentary activities [11,12] and have a high prevalence of sarcopenia [13–16]. Challenging balance training and resistance exercise are well-known intervention for reducing falls [17] and improving muscle strength for community-dwelling older adults [18]. However, evidence around balance and strength training for preventing falls in LTC is mixed [17,19,20], and careful planning and modification of exercises is necessary to meet the needs of LTC residents.

Residents in LTC are often medically complex, with multiple comorbidities [21] that can affect their ability to meaningfully participate in exercise. In Canada, 56.3% of residents have a diagnosis of Alzheimer's or other dementias, 25.0% have diabetes, 14.4% have chronic obstructive pulmonary disease, and 21.2% have experienced a stroke [21]. Residents also often have significant functional impairments. For example, 97% of residents require assistance with basic activities of daily living [21]. Therefore, the lack of effect of exercise as

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a single falls prevention strategy observed in previous studies may be because the often complex, multimorbid LTC population likely requires a multifactorial approach to fall prevention [17]. Additionally, organizational aspects of LTC homes (eg, specific funds dedicated to employing exercise professionals and to support exercise programming) can affect residents' engagement in exercise [22,23]. Subsequently, prescribing exercises in the LTC context must consider both resident characteristics and organizational features of the LTC home (eg, professionals available to support exercise programming).

A comprehensive exercise prescription describes the elements of an appropriate exercise program to facilitate implementation of that program. The exercise prescription should include a description of the type (eg, balance, strength) and intensity of exercises (eg, subjective or objective measurement of how hard the resident is working) included in the program [24]. The prescription should also include a description of the dose of exercise: frequency of exercise participation (eg, 2 days per week), duration of individual exercise sessions (eg, 30-minute sessions), and duration of exercise program (eg, 12-week program) [24]. Lastly, the prescription should describe the setting of the exercise program (eg, group or individual basis) and the professional delivering the program (eg, physiotherapist, fitness instructor) [24].

Therefore, the objectives of this article are to (1) synthesize studies demonstrating a positive effect of exercise on reducing falls for residents in LTC; (2) provide an overview of the principles of balance and strength training to guide clinicians in designing appropriate exercise prescription; and (3) make suggestions for clinical practice regarding an appropriate strength and balance exercise protocol by considering the influence of the LTC context.

Methods

To provide clinicians and other policy-makers with a description of which balance and strength exercises may be effective for preventing falls, we synthesized trials that demonstrated a positive effect on reducing falls or falls risk for residents in LTC. Studies were identified through a database search for systematic reviews in PubMed, Ovid, and Google Scholar using the keywords *falls*, *long-term care*, *nursing homes*, *exercise*, *strength*, *balance*, and *systematic reviews*. Our purpose

was to provide practical information on what works to prevent falls through balance and strength training for residents in LTC rather than to evaluate the available evidence. Therefore, only positive trials from systematic reviews were discussed, as we wanted to present exercises that seem to have a positive effect on decreasing falls. Positive trials were defined as those included in identified systematic reviews with a risk or rate ratio and confidence intervals below 1.0.

We first provide an overview of the conclusions of the systematic reviews found in our search. Next, for each positive trial we describe the following elements of the exercise component of the intervention: frequency, time of sessions, length of program, intensity, type of exercise including a description of the specific exercises performed, whether the intervention was delivered in a group or on an individual basis, the professional delivering the intervention, and any other features of the intervention aside from the exercise component. We used the ProFaNE taxonomy definitions [25] to identify and describe each element of the exercise interventions. Frequency is the number of times per week that residents engage in sessions, time of sessions is the amount allocated to each exercise session, duration of program is how long the resident participates in the exercise program, and intensity is the subjective or objective report of how hard the resident is working [25]. The types of exercises described were those targeting balance defined as "...the efficient transfer of bodyweight from one part of the body to another or challenges specific aspects of the balance systems (eg, vestibular system)" [25], and strength defined as "...contracting the muscles against a resistance to 'overload' and bring about a training effect in the muscular system" [25]. Strength could be either an external resistance (eg, dumbbell) or using body weight against gravity (eg, squat) [25].

Results

We found 3 systematic reviews that include exercise programs to reduce falls in LTC homes [17,19,20]. Overall, evidence suggests that exercise should be included as part of a multifactorial falls prevention program for residents in LTC. There is limited evidence that exercise as a single intervention prevents falls, and some trials, albeit underpowered, even demonstrate an increased risk of falling in the exercise group compared to control [19]. With regards to specific

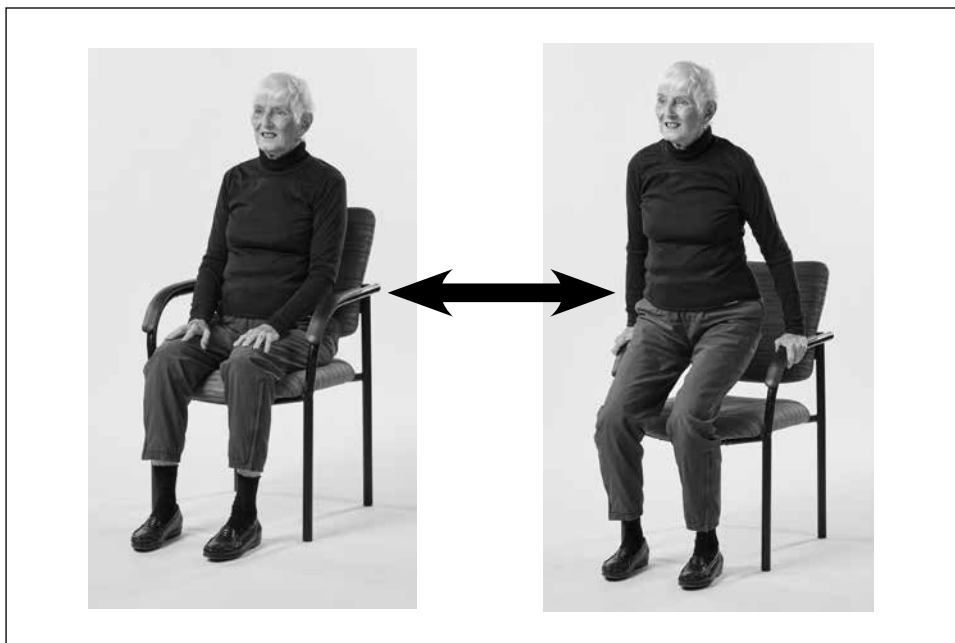


Figure. Example of functional strength exercise: sit to stand.

exercise programs, the Cochrane review found that gait, balance, and functional training decrease the rate of falls but not the risk of falling [26–28], and the 2013 review by Silva et al [20] concluded that combined exercise programs (ie, multiple types of exercise) that include balance tasks, are completed frequently (2–3 times per week), and over a long term (greater than 6 months) were most effective at preventing falls [20].

A more recent systematic review and meta-analysis [17] also concluded that there was no evidence that exercise as a single intervention can prevent falls for residents in LTC. **Table 1** provides a description of the exercise component of the seven positive trials [29–35] that were included in the 3 systematic reviews we identified in our search.

Type of Exercise

Balance Exercises

There were 4 positive trials that included balance exercises in their intervention [31,33–35]. Trials that had a positive effect on reducing falls and included balance training employed mostly dynamic balance exercises in standing (Table 1). However, only 2 of the 7 trials provided a detailed description of their balance exercises (Table 1) [26,34]. Jensen et al [30] and Dyer et al [31]

did not include a description of the balance training performed but stated that balance was part of the multicomponent exercise program. Becker et al [36] stated that participants performed standing balance exercises, while Schnelle et al [39] and Huang et al [32] did not include balance training in their trial.

Strength Exercises

Of the 7 positive trials included in this review, 6 included strength exercises [29–32,34,35]. The strength activities used in trials where exercise had a positive effect on decreasing falls included functional activities [29,31] and progressive resistance training [31,36] (Table 1). Functional activities are those that replicate what a resident might be required to do in their everyday life, such as performing sit-to-stands out of a chair (**Figure**) or practicing bed mobility (eg, rolling from side to side, transitioning from lying to sitting and vice versa) [25]. The exercise program in Schnelle et al's [29] trial had residents performing sit-to-stands every 2 hours, and arm curls or arm raises once a day. Participants in Jensen et al [30] at Dyer et al's [31] trials performed progressive resistance training but did not describe which particular exercises participants performed. Similarly, Becker et al [36] described progressive resistance training with

Table 1. Features of Exercise Interventions that Had a Positive Effect on Falls

Author	Description of the Exercise Component								Professional Delivering	Other Features of the Intervention
	Frequency	Time of Sessions	Duration of Program	Intensity	Type	Description	Group or Individual	Professional Delivering		
Schnelle [29]	Every 2 hrs, 5x/wk	Not reported	32 wk	Strength: Target goals set individually	Functional incidental training	Strength: Walk or wheel, repeat up to 8 sit-to-stands, upper body resistance training x 1 session daily (arm curls or raises)	Individual	Research staff	Prompted toileting, offered fluids	
Huang [32]	2x/wk	30 min	8 wk	Strength: 2-3 sets, 10 reps, Borg rating 12-13 (some-what difficult)	Upper and lower limb endurance	Strength: Grip ball, ankle dorsiflexion and plantar flexion, upper limb elevation, knee elevation, rising from chair	Group	Geriatric nurses	Cognitive behavioral therapy	
Jensen [30]	2-3x/wk	Not reported	9 wk	Strength: Moderate to high intensity, progressive Balance: Resident-specific	Strength, balance, gait, and safe transfer	Strength: Not described Balance: Not described	Not reported	Not reported	Staff education, environmental modification, supply/repair of aids, change in medication, hip protectors, post-fall problem-solving conferences, staff guidance	
Becker [35]	2x/wk	75 min	12 mo	Strength: 2 sets, 10 reps 10 rep maximum	Strength and standing balance exercises	Strength: Progressive resistance training with ankle weights and dumbbells Balance: Balance in standing	Group	Not reported	Staff training and feedback, information and education of residents, environmental adaptations, hip protectors	
Sihvonen [33]	3x/wk	20-30 min	4 wk	Balance: Individualized	Balance exercises	Balance: Dynamic balance exercises on balance platform: weight shifting, leaning, and stepping tasks, different stance positions (with decreasing base of support), larger distances, more directions, higher movement speeds), different support surfaces (thick versus thin foam), head movements and verbal tasks	Individual	Not reported	None	

Table 1. (continued)

Description of the Exercise Component									
Author	Frequency	Time of Sessions	Duration of Program	Intensity	Type	Description	Group or Individual	Professional Delivering	Other Features of the Intervention
Lord [34]	2x/week	60 min	52 wk	Strength: 30 reps Balance: not reported	Aerobic, strength, and balance exercises	Aerobic exercise: slow- to moderate-paced walking Strength: ankle dorsiflexors, knee extensors, hip abductors, and hip side flexors. Balance: pacing, dancing patterns, directional changes and speeds, and complicated routines of whole body movement, walking patterns – large strides, heel-toe walking, narrow- and wide-based walking, and sidestepping, tandem foot standing, heel-toe walking, line walking, standing on one leg, altering the base of support, weight transfers, rocking back and forth on toes and heels, rotating on the spot, lateral movement challenges, and reaching and stretching movements forward, laterally and upward.	Group class, with individualization	Not reported	None
Dyer [31]	3x/wk	40 min	12–14 wk	Strength: not described Balance: not described	Balance, gait, flexibility, strength, and endurance	Strength: Not described Balance: Dancing	Group class, individual class for those with physical frailty and/or marked cognitive impairment	Exercise assistants supported by physiotherapist	Staff education, medical reviews, environmental modifications, optician and podiatry assessments

dumbbells and ankle weights but did not describe any specific exercises. Participants in the trial by Lord et al [34] performed strengthening exercises of ankle dorsiflexors, knee extensors, hip abductors, and hip side flexors. One trial stated their exercise program focused on muscle endurance rather than strength (eg, higher repetitions with lower resistance), and participants did grip ball exercises, ankle dorsiflexion and plantar flexion, upper limb elevation, knee elevation, and sit-to-stands [32].

Frequency, Time of Sessions, Duration of Program

In our description of positive trials, exercise was performed on 2 to 3 days per week for 20 to 75 minutes per session, for periods ranging from 4 to 52 weeks (Table 1).

Intensity

For the trials including balance exercises, one trial described the intensity as resident-specific [37] and another as individualized [33]. Two studies did not describe the intensity of their balance exercises [31,34]. The intensity of strength exercises included in the positive trials was individualized for one of the trial [29]. Two trials had participants complete 2 to 3 sets of 10 repetitions [32,35], with one indicating an intensity of 12–13 or “somewhat difficult” on the Borg Rating of Perceived Exertion Scale [32] and the other using a 10-rep max [35]. Two studies described their strength exercises as progressive [31,37], and one at a moderate to high intensity [30]. Lord et al prescribed 30 repetitions of each strength exercise [34].

Delivery of Intervention

Exercise was delivered in a group setting for 4 of the trials [31,32,34,36], individually for 2 of the trials [26,29], and the setting was not described for one of the trials (Table 1) [30]. Finally, only 3 of the 7 articles reported the professional delivering the intervention: one was research staff [29], one was geriatric nurses [32], and one was exercise assistants supported by a physiotherapist [31].

Discussion

There is limited evidence to support the use of strength and balance exercise as a single intervention to prevent

falls in LTC. However, exercise should be included as part of a multifactorial falls prevention program. Trials that had a positive effect on decreasing falls training used dynamic balance exercises in standing, functional training, and progressive resistance training on 2 to 3 days per week, for 20 to 75 minutes per session, over 4 to 52 weeks. The intensity of balance exercises was individualized, and strength exercises were described as somewhat difficult or performed at a moderate to high intensity. Exercise was performed in a group or individually, and was delivered by research staff, geriatric nurses, exercise assistants supervised by physiotherapists, or more frequently, it was not reported who delivered the intervention.

Balance Training

Our work suggests that standing, dynamic balance exercises may be best to decrease falls. Example balance exercises include reducing the base of support (eg, standing with feet together instead of apart, or tandem with one foot in front), moving the center of gravity and control body position while standing (eg, reaching, weight shifting, stepping up or down), and standing without using arms for support or reducing reliance on the upper limbs for support (eg, use one hand on a handrail instead of two, or two fingers instead of the whole hand) [17]. It is well established that balance training programs, especially those including challenging exercises, can prevent falls in community-dwelling older adults [17]. However, the relationship is not as clear in LTC.

Strength Training

Reduced muscle strength has been identified as an important risk factor for falls [38]. There are also many psychological and metabolic benefits to strength training [39]. To induce change in muscular strength, resistance exercises need to be challenging and progressive. Our work suggests that strength training that is effective at decreasing falls is functional and progressive, and is completed at a moderate to high intensity. A resident should be able to do a strength exercise for one to two sets of 6 to 8 repetitions before being fatigued [40]. Once the resident can complete two sets of 13 to 15 repetitions easily the exercise should be progressed. Residents who are particularly deconditioned may need to begin with lower intensity strength exercises (eg, only do one set, with a lower resistance and progress

to a higher resistance) [40]. Residents should perform resistance exercises for all major muscle groups [40]. Progression could include increasing the number of sets (eg, increase from one to two sets), the resistance (eg, holding dumbbells while squatting), or the intensity of the exercise (eg, squat lower or faster) [41].

Implementing Exercise Programs in LTC

Implementation of exercise programs into LTC homes should consider the dose of exercise (eg, time and frequency of sessions, duration of program), if they are delivered in a group or individual setting, and who is delivering them. First, trials included in this paper suggest that strength and balance exercises to prevent falls were delivered 2 to 3 times per week, for 20 to 75 minutes per session, over 4 to 52 weeks. Second, previous work has established that exercise programs delivered on 2 to 3 days per week over a period of more than 6 months are most effective at reducing falls in LTC [20]. Finally, a recent task force report from an international group of clinician researchers in LTC recommends twice weekly exercise sessions lasting 35 to 45 minutes each [40]. Therefore, strength and balance exercises to prevent falls in LTC should be delivered at least twice per week, for at least 20 minutes, for greater than 6 weeks' duration.

Whether exercise should be performed in a group or individual setting remains unclear. Two of the 6 positive trials in this paper were completed individually, while 3 were in a group. The aforementioned task force also recommended that every resident who does not have contraindications to exercise must have an individualized exercise program as part of their health care plan [40]. However, whether the exercise program is provided on an individual basis or in a group setting was not delineated. Indeed, there are currently no recommendations concerning prioritizing group or individual exercise programs. Therefore, exercise programs being implemented into LTC homes should consider the residents' preferences, the social benefits of group exercise, and the feasibility of individualizing exercises for the complex needs of residents in LTC in large group settings.

Finally, which professionals should deliver the exercise program is also uncertain. Only 3 of the positive trials in this paper described the professional delivering the intervention, with one being research staff, one geriatric nurses, and one exercise assistants supported

by a physiotherapist. We suggest that professionals delivering an exercise program should be trained in exercise planning, delivery, and progression, be familiar with the principles of balance and strength training, and have training in working with older adults in LTC.

Modifications for Physical Impairments

Residents in LTC often have complex health needs, with multiple comorbidities (eg, stroke, Parkinson's disease, multiple sclerosis) [21]. Modifications of strength and balance exercises may be required to accommodate for physical impairments (eg, hemiplegia, drop foot, freezing gait). For example, if a resident has hemiplegia and cannot fully activate the muscles of one arm, one can do resistance exercises with a dumbbell on the functioning side and active assisted range of motion (ie, the exercise provider assists the resident to achieve full range of motion against gravity) on the hemiparetic side. A resident with Parkinson's disease who has freezing gait may need visual or rhythmical verbal cues to be able to accomplish standing balance tasks such as altered walking patterns (eg, wide or narrow stepping) [42].

Modifications for Cognitive Impairments

More than 80% of residents in LTC have some degree of cognitive impairment [21]. Cognitive impairment may be the result of stroke, depression, traumatic injuries, medications, and degenerative diseases such as Parkinson's and Alzheimer's disease [43]. A common misconception is that residents with cognitive impairment cannot benefit from exercise because they cannot learn new skills and have difficulty following directions. On the contrary, evidence suggests that exercise can improve functional mobility for residents with cognitive impairment [44,45].

Residents with cognitive impairment may require a different approach to facilitate participation in the desired exercises because of difficulty following multi-step directions, responsive behaviors, or increased distractibility [46]. Clear communication is key in improving the quality of interaction for residents with cognitive impairment. The Alzheimer Society of Ontario suggests 10 strategies for communicating with people with dementia [47], and we have provided suggestions of how to apply these communication strategies to the exercise context in LTC (Table 2). Other

Table 2. Strategies for Communication with Residents with Cognitive Impairments

Strategy	Example in Exercise Context
Approach the resident from the front	When greeting the resident, stand in front of them.
Identify yourself	Before starting the exercises, introduce yourself and say why you are there: "Hello, I'm Caitlin and I'm here to do some exercises with you."
Maintain eye contact	When describing the exercise and giving feedback, keep looking at the resident.
Address the resident by name	Use the resident's name when describing the exercise: "Bob, I want you to stand up."
Present one idea at a time	Break the exercise description up into digestible chunks of information. For example, facilitating a forward lunge: "Bob, pick up the weights." – Bob picks up the weight "Take a big step forward with one leg." – Bob takes a step forward "Bob, bend your knees." – Bob bends his knees "Now straighten your knees." – Bob straightens his knees
Repeat or rephrase the resident's responses to clarify what they are trying to tell you	"That exercise made my legs feel wobbly." "Did that exercise give your legs a workout?"
Ask "yes" or "no" questions and allow time for a response	"Jim, are you feeling ok?" instead of "Jim, how do you feel?"
Use gestures to back up your words	Demonstrate the exercise as well as describe it.
Listen actively, acknowledge their emotional state	Acknowledge the reasons for why a resident may not want to exercise and provide an alternative: Caitlin: "Mary, I'm Caitlin. I'm here to do exercises with you today." Mary: "I don't want to exercise, I am too tired right now." Caitlin: "I understand you are tired right now. May I come back later?"
Let the resident know if you are going to touch them to prevent startling	Let the resident know you are going to give them hands on feedback: "Irene, I'm going to move your arm to the side."

suggestions for engaging residents with cognitive impairment in strength and balance training include making the exercises functional (eg, ask them to pick something up of the floor to perform a squat, or reach a point on the wall to do calf raises) and playful (eg, toss a ball back and forth or sing a song about rowing to promote weight shifting) [48].

Standing versus Seated Exercises

Residents may not be able to participate in standing exercises for several reasons: perhaps the resident cannot stand or has severe balance impairments and a high falls risk; the resident may have poor insight into which exercises are safe to perform in standing versus sitting; or there may be limited supervision of a large group exercise class where the risk of falls is a concern. If balance impairments are a concern, where the risk of injury or falling while completing exercises in standing outweighs the benefit of doing the exercises, then

seated exercises are appropriate. However, when residents are able, we recommend encouraging some or all exercises in standing, to facilitate carry over of strength gains into functional tasks such as being able to rise from a chair and walking. A recent study, comparing standing versus seated exercises for community dwelling older adults, saw greater functional gains for those who completed the standing exercises [49]. Therefore, strength and balance exercises should be performed in standing, where appropriate.

Resident-Centered Exercise for Falls Prevention

Putting the resident at the center of falls prevention is important. Previous work has found that older adults have expressed a strong preference for care that transcends traditional biomedical care and that values efficiency, consistency, and hierarchical decision making [50]. On the contrary, resident-centered care emphasizes well-being and quality of life as defined by the

resident, values giving residents greater control over the nature of services they receive, and respects their rights to be involved in every day decision making [51,52]. Indeed, residents may choose to engage in risky behaviors that increase their risk of falls but also increases their quality of life. Previous work has found disconnects between residents' perceived frailty and the potential ability of protective devices to prevent adverse events, such as falls and fractures [53]. Additionally, one study identified that older residents feared being labelled, so instead hid impairments and chose to refuse assistance and assistive devices [54]. For example, a resident with impaired balance and gait may choose to walk independently when they have been deemed as requiring a gait aid (eg, rollator walker). However, they may value walking without a gait aid and accept the increased risk of falling. Therefore, it is essential to find the delicate balance between respecting a resident's right to make their own decisions and preventing adverse events, such as falls [52]. An example of this would be respecting a resident's right to refuse to attend exercise programming even though the team may think they can benefit from strength and balance training.

There is limited evidence around falls prevention and resident-centered care. A recent systematic review [55] revealed that resident-centered care may increase falls rates [56,57]. However, the authors of the review attributed the increase in falls to differences in frailty between the control and intervention group [56], and to environmental factors (eg, slippery flooring material, lack of handrails) [57]. Additionally, these trials did not include an exercise program as part of the resident-centered care program. On the other hand, resident-centered care has been associated with reduction of boredom, helplessness, and depression [58,59]. Most studies included in the review were quasi-experimental, which significantly limits the evidence quality [55]. At this point in time, the evidence suggests that resident-centered care is important for mood and quality of life but may have a negative or no effect on reducing falls.

Multifactorial Falls Prevention Programs

While there are mixed results about the effect of exercise as a single intervention for reducing falls for residents in LTC, the literature clearly supports exercise as part of a multifactorial falls prevention program [17,20,60–62]. A 2015 umbrella review [62] of meta-analyses of randomized controlled trials of falls prevention interven-

tions in LTC concluded that multifactorial interventions were the most effective at preventing falls in LTC. Additionally, recently developed recommendations for fracture prevention in LTC [61] suggest that balance, strength, and functional training should be included for residents who are not at high risk of fracture, while for those at high risk, exercise should be provided as part of a multifactorial falls prevention intervention. Clinicians must therefore incorporate elements aside from exercise into their falls prevention strategies. Interventions that have shown positive effects on reducing falls when delivered as part of multifactorial interventions include: staff and resident education [31,35,37], environmental modifications [31,35], supply/repair/provision of assistive devices [30], falls problem-solving conferences [30], urinary incontinence management [29], medication review [30], optician review [31], and cognitive behavioral therapy [32].

Conclusion and Suggestions for Clinical Practice

We suggest incorporating strength and balance exercises as part of a multifactorial falls prevention program for residents in LTC. Balance exercises should be challenging and dynamic (eg, weight shifting). Strength exercises should be of a moderate to high intensity (eg, can complete one to sets of 6 to 8 repetitions) and need to be progressed as the residents' abilities improve. Residents should participate in strength and balance training on 2 to 3 days per week, for 30- to 45-minute sessions, for at least 6 months. Exercises in standing should be prioritized where appropriate. Exercise could be delivered in a group or individual format, but should consider the residents' preferences, the social benefits of group exercise, and the feasibility of individualizing exercises for the complex needs of residents in LTC in large group settings. Professionals delivering an exercise program should be trained in exercise planning, delivery, and progression, be familiar with the principles of balance and strength training, and have training in working with older adults in LTC. Exercise programs in LTC should be resident-centered and consider residents' potential physical and cognitive impairments.

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Funding/support: Dr. Giangregorio was supported by grants from the Canadian Frailty Network and Canadian Institutes of Health Research.

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