



Effects of Exercise on Physical Performances among Frail Older Adults: A Review Study

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Abstract

Frailty is a crucial concept in determining physiological reverses among older adults. Physical frailty can predict the vulnerability for community-dwelling older adults as the functional performance declines. Recently, nurses and health care professionals have implemented the strategies to enhance physical capacity among frail older adults. Even the clinical guidelines of physical activity and exercise recommendations are widely published, older adults still engage in a low level of physical exercise. It is notable that exercise intervention is effective way to prevent frailty. This review indicates that a combination of aerobic, resistance exercise, and multicomponent exercise can improve physical performance such as increase muscle strength, balance, muscle mass, gait speed and prevent falls. Frailty is a reversible condition. Therefore, encouraging older adults to perform physical exercise is needed to maintain physical functioning as well as promote quality of life. Nurses play a significant role in frailty recovering both in hospitals and in aged care facilities.

Introduction

One of the geriatric conditions among older adults is frailty (Hoogendijk et al., 2018; Sieber, 2017). Frailty affects between a quarter and a half of people older than 70 years (Hoogendijk et al., 2018). Frailty is typically developed by the aging-related decline in strength, mobility, lean muscle mass, and activity level as well as malnutrition (Forman & Alexander, 2016; Mareschal et al., 2019). Frailty is claimed as an independent predictor for visiting urgent care in the emergency room, increased risk of falls, activities of daily living (ADL) disability, hospitalization, and mortality (Santos-Eggimann & Sirven, 2016).

Frailty is a biological syndrome of increased

physiological vulnerability and resistance to stressors caused by multiple impairments in organ function and the diminishment of physiological deteriorations (Forman & Alexander, 2016). It affects three physiological systems including the immune, endocrine, and neuromuscular changes (Pillatt et al., 2019). Immunological changes include the elevation of pathobiology in the inflammatory biomarkers' interleukin-6 and C-reactive protein (Afilalo et al., 2014). These biomarkers predict twice the mortality rate compared with non-frail older adults (Afilalo et al., 2014). Endocrine changes may decrease some hormones such as testosterone and estrogen. On the other hand, the level of cortisol is induced in the circulation (Pillatt et al., 2019). Neuromuscular changes involved in the loss of muscle mass and muscular strength. These are the

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clinical manifestations of sarcopenia (Pillatt et al., 2019). Thus, frailty affects multisystem dysregulations. Typically, older adults are determined as a vulnerability group and frailty is also related to morbidity and mortality consequently, loss of dynamic homeostasis and functional decline is accelerated by frailty. Frailty is related to maladaptive response of stressor and hormone in body that presented in frail older adults with chronic diseases (WHO, 2016).

The validated tool to assess frailty in older adults is Fried Frailty Index as clinical phenotype which is widely used to categorize the frailty into 5 key domains including a decline in walking speed, weakness as measured by low grip strength, low physical activity, exhaustion by self-report or poor endurance, and unintentional weight loss at least 10 pounds, have been reported in the past year. The clinical phenotypes presented at least 3 of 5 domains indicating frail (Fried et al., 2004). Physical frailty is a major problem of older adults and frailty is related to muscle wasting, cachexia, and catabolic circulation failure (Chen et al., 2014; Dent et al., 2016). Physical frailty can affect in activity of daily life. For example, older adults had a difficulty in walking and a difficulty in maintaining balance (McPhee et al., 2016). Indeed, the functional decline is accelerated, and the body mechanism starts to fail (Forman & Alexander, 2016). Therefore, we synthesized the empirical literature across studies on exercise intervention among frail older adults, the content of the intervention, the nurse's role, and the outcomes of the intervention. The purpose of this review was to summarize the effects of exercise intervention on physical performances among frail older adults in order to clarify the state of the science and determine whether interventions are clinical enough to use as a guide in promoting physical functioning.

Search Strategy

This is a review aimed at determining the effects of exercise intervention for frail older adults. We performed a literature search up to January 2020 from databases including CINALH, PubMed, Ovid-Medline and Scopus. Search terms were (frail* AND (exercise OR physical exercise) AND physical performance*). We retrieved published articles in the English language indicating the effects of exercise intervention on physical performance. The findings across studies were synthesized through a narrative review.

Exercise intervention for frail older adults

Frailty is reversible (Seiber, 2017). Physical frailty can be treated with nutritional and pharmacological interventions (Dent et al., 2016; Mareschal et al., 2019). Several groups of researchers had dramatically explored the effect of interventions for frail older adults (Bray et al., 2016; McPhee et al., 2016; Vina et al., 2016). This includes a home-based physical exercise program, group fitness programs, adequate nutrition consultation, supervised homebased exercise, supervised computerized balance training provided individually (Bray et al., 2016). Besides, tailored management of frailty condition have been focused for inpatients, outpatients, and older adults in the community with a combination by hormone replacement, problem-solving therapy, group sessions, group as well as individual educational sessions by geriatricians for persons being at risk of frailty, a single home visit by a health professional, multiple home visits by a nurse, multiple home visits by a nurse and alert button and cognitive training (Apostolo et al., 2018).

However, one of the most prominent treatment strategies for enhancing physical capacity among frail older adults is exercise (Vina et al., 2016). Frail older adults need to perform physical activity to reserve functional capacity (Apostolo et al., 2018). Researchers have intervened those kinds of physical activity and exercise to promote functional ability. Nevertheless, there is no evidence to assure whether the type of exercise that is beneficial and practical for frail older adults (Bray et al., 2016; Liu & Fielding, 2011). Exercise intervention aimed at reversing the frailty phenotype as well as enhancing positive functional impacts on frail older adults (Apostolo et al., 2018; Bray et al., 2016). Aerobic exercise training can improve maximal oxygen intake (VO_2 peak) and increase muscle mass, while resistance exercise training focuses on increasing muscle strength and motor performance (Aguirre & Villareal, 2015; Liu & Fielding, 2011). The existing evidence supported the advantage of exercise to promote gait ability and address multiple domains of strength, endurance, and balance (Bray et al., 2016; Liu & Fielding, 2011; Pillatt et al., 2019). It is recommended that exercise intervention can be used to delay the onset of frailty and prevent functional decline (Chen et al., 2018; McPhee et al., 2016).

Exercise training intervention is often used to promote physical performances among frail older adults (Vina et al., 2016). Exercise training has been recognized

to have delayed physical dependence such as, sitting and standing, balancing, agility, and ambulation in older adults (Gine-Garriga et al., 2014; Liu & Fielding, 2011; Rodriguez-Larrad et al., 2017). The benefits of exercise among physically inactive patients have been recognized to enhance physical movement in frail older adults (Aguirre & Villareal, 2015; Gine-Garriga et al., 2014; Pillatt et al., 2019). Aerobic exercises are widely used to recover a frailty (Aguirre & Villareal, 2015). The most empirical evidences of aerobic exercise evidence supported altering the frailty phenotype, including improvement in the maximal oxygen uptake (VO_2 peak) and increased muscle mass (Bray et al., 2016). VO_2 peak refers to the maximum rate of oxygen consumption measured during vigorous exercise and to be closely related to submaximal endurance exercise capacity and exercise tolerance (Bray et al., 2016). Resistance exercise emphasizes on how well muscle strength decreases with aging. Muscle strength generally decreases about 12% to 15% per ten years, in both male and female adults respectively (Shafiee et al., 2017).

The strength of the research-based evidence supporting the exercise intervention

The evidences suggested that regular physical activity or exercise training to frail older adults are recommended in clinical settings and communities. The guidelines from the Centers for Disease Control and Prevention (CDC) stated that older adults over 65 years should participate in 300 minutes of moderate-intensity aerobic exercise per week such as brisk walking, and muscle-strengthening activities on 2 or more days a week or participate in 150 minutes of rigorous-intensity activity a week such as jogging, a heavy garden, and dancing. That is beneficial for all major muscles (legs, hips, back, abdomen, chest, shoulders, and arms) (CDC, 2020). Likewise, strong scientific evidence showed that physical activity helped to maintain physical performance in older adults.

Aerobic exercise is widely used as a physical training. Bilateral leg extension and bilateral knee extension muscles were approached for leg extensor muscles. For balance and gait retraining exercise, the semitandem foot standing, line walking, stepping practice, walking with obstacles, exercises on foam pads sequence, and changing the base of support and weight transfer from one side to another side of the legs (Cadore et al., 2013). The duration for exercise training was 40

minutes including, (1) 5 minutes for warm up (2) 10 minutes for balance and gait retraining, 20 minutes for resistance training, and 5 minutes for stretching (Cadore et al., 2013). Measuring outcomes included gait ability, TUG (Time-Up and Go) test, gait velocity test (GVT), verbal GVT and counting GVT, FICSIT-4 tests, Barthel Index (BI), and a manual dynamometer for muscle strength (Cadore et al., 2013; Pedroli et al., 2019). However, the exact amount of exercise training needed is unclear because of the various characteristics and the adverse outcomes of frailty.

Multicomponent Exercise Program (MEP) is a structured program focused on combination among resistance, balance, and flexibility exercises (de Labra et al., 2015). The characteristics of MEP include perform exercise continuously with a combination a single daily activity, enhance endurance and balance training, and increase volume, intensity, and tolerance (WHO, 2016).

MEP usually includes gait, coordination, and physical function training (CDC, 2020). MEP typically can perform at homes or in communities which serve as community-based activities such as dancing, yoga, tai chi, and/or sport (CDC, 2020). Older adults may consider MEP as they incorporate multiple types of physical activity in their daily living (Giné-Garriga et al., 2014). Regarding exercise intervention for frail older adults, many studies focus on improving the overall health status of frail older adults regarding MEP. For example, Cadore et al. (2013) studied a MEP for enhancing the overall health status of frail older adult individuals. MEP is a combined program of endurance, strength, coordination, balance, and flexibility exercise (Giné-Garriga et al., 2014). MEP was performed on a 12-week (twice weekly) of randomized control trial (RCT) using MEP among 24 community-dwelling older adults with a mean age of 91.9 years. MEP composed of upper and lower body resistance to increase muscle power loads combined with balance and gait retraining exercise (Cadore et al., 2013). Frail older adults performed resistance exercise by approaching their major upper and lower limb muscles. For upper limbs, the seated bench press was performed (Rodriguez-Larrad et al., 2017). The finding showed that MEP decreased time spent on performing TUG.

MEP could enhance the strength and muscle power among older adults (de Labra et al., 2015; Pillatt et al., 2019). Engaging in MEP reduces the risk of frailty both communities (de Labra et al., 2015) and institutional cares (Rodriguez-Larrad et al., 2017). MEP is also feasible in institutional care setting.

Rodriguez-Larrad et al. (2017) studied the effects of MEP on physical functioning among frail older adults in nursing home. In this study, the MEP program consisted of twice a week within 48 hours totally for 6-month period intervention regarding strength, balance, and walking training within 45 minutes. Firstly, the intervention provides 5-minute brief warmup focusing on range of motion exercises and mobility of joints and extremities. Next, a 25-min of strength training aims to enhance individuals' upper and lower body functional capacity. Balance training is a third step to promote gait and balance. The activities include 10-minute totally for standing on tips and heels, one legged stand, semi-tandem/tandem exercise, circuit training, stepping, and ball reaching. Lastly, a 5-minute of cooling down is focused on stretching, breathing, and relaxing exercise.

The goal of the first 3 months was to increase muscle strength while the 3-month later aimed to improve functional capacity. The finding found that the MEP could improve functional performances, sedentary behavior, cognition and emotional status as well as biological marker such as interleukin-6 that relates to frailty and physical performance.

To sum up, older adults with frailty need MEP because frail older adults need aerobic exercise to preserve physiological function and humoral balance while resistance exercise also can improve activity daily living. MEP is considered to be the most effective strategy for improving gait, balance and strength, preventing fall incidence, and promoting the functional capacity among frail older adults.

Physical performance outcomes from exercising

Based on the review of the studies, exercise training intervention provided positive outcomes on physical performances as following.

1. Gait and Balance

TUG measures gait and balance regarding the time needed to complete a series of functional tasks including standing up from a chair, walking 3 meters, turning around, returning to the chair, and sitting down on a chair (Cadore et al., 2013). The finding showed that MEP decreased time to spend for performing TUG ($p < .05$) (Cadore et al., 2013)

2. Walking

Gait speed refers to a test that requires frail older adults to walk a certain distance. Gait speed is one of the predictors for survival in older adults

(Giné-Garriga et al., 2014). A systematic review and meta-analysis of Giné-Garriga et al. (2014) showed that exercise increased gait speed and frail older adults who received exercise training walked faster than the control group. Liu and Fielding (2011) suggested that aerobic exercise such as walking is accessible for frail older adults to engage and maintain their daily activity and physical performance.

3. Fall

Fall is one of the most important health outcomes. Fall is measured by using a questionnaire for asking older adults on the history of falls and incidence in previous 12 months. A review study showed that exercise could reduce the risk of falls by 57% among elder women with frailty after undergoing a resistance training program for 25 weeks compared with from baseline (Liu-Ambrose et al., 2004). The empirical finding is supported by another study. Cadore et al. (2013) found that the MEP decreased fall incidence at post-training compared with pre-training ($p < .01$). Muscle strength. Muscle strength is usually measured by using a manual dynamometer. Cadore et al. (2013) found that hip flexion and knee extension strength were increased after exercise intervention among exercise intervention group ($p < .01$ and $p < .05$ respectively)

In summary, the strengths of MEP comprised of resistance training, aerobic exercise, and balance training. Upon the review of exercise training, the positive outcomes of physical performance were affected by gait speed, TUG, fall, and muscle strength. As frailty is reversible, frail older adults would perform a better ADL such as walking with longer distances, spending less time to do TUG, preventing falls, and gaining muscle strength.

Gaps in the knowledge base related to the intervention

Upon the previous intervention studies, it is known that both aerobic, resistance exercise intervention and multicomponent exercise can improve physical performance, both increased muscle strength and muscle mass. Frail older adults in community have faced with physical performance assessment regarding the multicomponent exercise. Moreover, the rate of exercise progression and intensity remain unknown for frail older adults. In addition, the researchers have not emphasized specific diseases that older adults might have different experiences on frailty, such as different diseases. The researchers did not closely monitor the frail older adults and the progress of the exercise. A further

study was suggested to observe the levels of frailty during program intervention (Bray et al., 2016). The gap of study needs to be addressed to improve physical performance in frail older adults by tailored multicomponent exercise intervention and concern monitoring on the ability to perform physical exercise individually regarding functional abilities measure. The further step should examine the effects of multicomponent exercises in frail older adults with chronic diseases to enhance physical performance.

The challenges that limit the use of the intervention

Frailty is commonly found in older people with advanced age. The effect on the phenotype of frailty needs to be concerned. Although the studies on multicomponent exercises are beneficial for frail older adults, the effects of exercise on the various characteristics of frailty and the adverse outcomes of frailty are limited in using the intervention. This involves differences in a specific time, frequency, intensity, measuring, and setting of the intervention, and the level of health status in frail older adults. The adverse outcomes might occur if the older adults have musculoskeletal complaints or the level of frailty, particularly in exercise training in female older adults. Therefore, the effectiveness of intervention should emphasize these issues for randomizing the subjects. In addition, the measures for a screening of frailty in older adults need to be concerned about investigating the tolerance of frailty, the duration cannot take too long in a longitudinally study. The nutritional status might be related to the level of frailty as a study has shown that the protein-calories and vitamin D supplementation are related to increasing muscle mass.

Nursing intervention for frail older adults

Frail older adults are at risk for adverse effects on their health. They also considered as the most significant consumers of health resources across both acute and long-term care (Kojima et al., 2019). Nurses play a significant role in caring for frail older adults in terms of assessment, identifying, and managing older adults, who are susceptible to or experiencing frailty (Maxwell & Wang, 2017). Early stages of frailty are commonly found in older adults who live in the community, while they have the high risk of frailty (Chen et al., 2018). Identifying frailty among older adults in the early stage can prevent them from functional dependence and

improve or maintain functional independence (Maxwell & Wang, 2017). Taking care of frail older adults is complicated because they have an increased burden of symptoms that cause frailty, thus increasing external help (Kojima et al., 2019). The aims of nursing care of frail older adults are maintaining a state of homeostasis. Therefore, multiple interventions are necessary for this group. The interventions for frail older adults include 1) exercise including resistance, strength, physical exercise, and lingual exercise, 2) adequate nutritional maintenance, 3) apt environmental modifications, and 4) information on health (Maxwell & Wang, 2017).

Conclusion

Frail older adults are at risk for adverse effects on their health. The literature found that physical exercise was a challenge to perform. Exercise intervention for frail older adults in promoting their physical performances is crucial. Nevertheless, frail older adults need to adhere with physical exercise continuously at least 6 months in order to promote health-enhancing physical exercise. However, we should emphasize the nutritional maintenance and health literacy through frail older adults. Nursing interventions for frail older adults include physical exercise, adequate nutritional maintenance, appropriate environmental modifications, and information on health; which should be provided continually until stable.

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