The Effect of Physical Activity on the Prevention and Number of Falls in Elderly People [scientific article]

SportLogia, dec. 2022, 18 (1), 45-59.
E-ISSN: 1986-6119
doi: 10.5550/sgia.221801.en.bz

Received: 25.10.2022.
Approved: 02.12.2022.
Udc:796.012-053.9

UTICAJ FIZIČKE AKTIVNOSTI NA PREVENCIJU I BROJ PADOVA KOD STARIJIH OSOBA

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ABSTRACT

Regular physical activity can bring significant health benefits to people of all ages, and the need for physical activity does not decrease with age, but it has been proven that it can prolong a healthier and more independent life, prevent disability and significantly contribute to improving the lives of the elderly. In addition to the fact that each type of physical activity to a certain extent improves motor skills (strength, coordination, balance, agility, ...), mental health (self-esteem, quality of life) and reduces the risk of cardiovascular and all other causes of death, regular participation in exercise promotes mobility and functional independence in adults. A fall is an event in which a participant without their own intention comes to a lying position on the ground or at a lower level. Regardless of the health status of the individual, falls are associated with insufficient movement, reduced opportunities to perform daily activities (dressing, bathing, housework, ...) and the risk of being admitted to institutions where the care of dependent persons is taken. Arthritis, depression, cognitive impairment, vision, problems with balance and unbalanced gait, decreased muscle mass, as well as excessive use of medication increase the risk of falling. The total volume and type of physical activity needed by the elderly is not very well defined. However, it can be concluded that the combination of physical activity (strength training, endurance training, exercises for the development of balance and mobility, ...) and adequate nutrition (sufficient intake of essential amino acids/protein sources) is of crucial importance for preserving physical condition, motor skills and the health status of persons of the third age, and thus also in the prevention of falls. The aim of this study is to describe and find the best training programs for the prevention of falls in the elderly.

Keywords: *exercise program, third age, falls*

1. INTRODUCTION

Life expectancy has increased significantly in the last few decades, and according to the latest Eurostat data, the population over 65 years currently accounts for 19.7% of the total world population, and by 2050 it is expected to reach up to 30% (Tornero-Quiñones, Sáez- Padilla, Díaz, Robles & Robles, 2020). In the process of aging, there is a deterioration of the health condition and physical fitness, which is reflected in the deterioration of the organism's functioning in the form of a decrease in physical, psychological and social functioning (Machado, Bazán, & Izaguirre, 2014; Velasco et al., 2015). Considering that aging is not only influenced by biological, but also psychological, social and environmental factors, whether this process will be effective also depends on each person to adapt to the changes that are taking place (Franco, 2018). Regular physical activity (PA) can bring significant health benefits to people of all ages, and the need for PA does not decrease with age, but it has been proven that PA can prolong a healthier and more independent life, prevent disability and significantly contribute to improving the lives of the elderly (Division of Aging and Seniors, 2011). According to the guidelines for PA, the elderly population should apply a minimum of 150 accumulated minutes per week of moderate to high intensity defined PA, in addition to weight-bearing exercises to develop strength, and flexibility exercises should be performed two or more times to improve them (Australian Government, The Department of Health, 2008; Office of Disease Prevention and Health Promotion, 2008; Department of Health, Physical Activity, Health Improvement and Protection, 2011; Canadian Society for Exercise Physiology, 2012). According to Byrne, Hills, Hunter, Weinsier & Schutz (2005), MET represents a physiological concept that is considered to be a simple procedure for expressing energy consumption during some PA, and as an increase in resting metabolic rate (RMR). However, the definition of MET varies from author to author. In this regard, Morris et al. (1993) explained that MET represents the amount of oxygen that the body consumes from inhaled air, adding that in basal conditions it is an average of 3.5 ml of oxygen/kg per minute. This definition is based on Jette, Sidney & Blumchen (1990) who defined MET as the metabolic rate at rest, i.e. the amount of oxygen consumed at rest, sitting quietly on a chair. Moderate to high FA intensity is most often reflected in any type of activity where the metabolic equivalent (MET) is ≥3.

Studies that dealt with this topic, i.e. assessing the level of PA in adults, concluded that a very small percentage (<5%) of the elderly population meets this criterion (The Health and Social Care Information Centre, 2009; Sun, Norman & While , 2013; Van Holle et al., 2014), so in the United Kingdom that percentage is only 2.4% (Davis et al., 2011), while in Canada no one met this criterion (Colley et. al, 2011). On the other hand, the highest percentage of the active population (87.04%) was reported by Hurtig-Wennlof, Hagstromer & Olsson (2010). In addition to the low level of participation in PA, the fact is that a sedentary lifestyle prevails among the elderly population, as they spend more than 85% of their daily time in this way (Fitzgerald et al., 2015; Jefferis et al., 2015). In addition to PA improving motor skills (strength, coordination, balance, agility, ...), mental health (self-esteem, quality of life) and reduces the risk of cardiovascular and all other causes of death, regular participation in PA improves mobility and functional independence in adults (McPhee et al., 2016; Zelenovic et al., 2021).Other studies have proven that PA can reduce the risk of various types of tumors, such as lung and prostate cancer, and generally have a positive effect on healthier aging by having certain benefits for the metabolism of old people (Cunningham, O'Sullivan, Caserotti & Tully, 2020). Also, PA has a preventive effect on the occurrence of sarcopenia, weakness and the risk of cognitive decline (Heyn, Abreu & Ottenbacher, 2004; Peterson et al., 2009; Sofi et al., 2011) and reduces the risk of obesity, heart disease and type 2 diabetes (Reiner, Niermann, Jekauc & Woll, 2013).

2. EPIDEMIOLOGY OF FALLS IN THE ELDERLY

Given that this literary work investigates the occurrence of falls in old people and their connection with PA, it is necessary to answer some questions that are studied in epidemiology. Epidemiology represents the basic quantitative science of public health and aims to examine the spread, determinants, treatments and possible control of certain unwanted phenomena, i.e. diseases (Rothman & Greenland, 1998). Falls are the second leading cause of injury-related mortality and morbidity in the elderly worldwide (Park, 2018), as approximately 35-40% of people over 65 experience this accident once a year (Hausdorff, Rios & Edelberg, 2001; Lundebjerg et al. al., 2001; Todd & Skelton, 2004). A fall is defined as an event in which the participant without his own intention comes to a lying position on the ground or at a lower level (Hauer, Becker, Lindemann & Beyer, 2006). Such events in old age can cause numerous consequences, such as exhaustion and isolation from society, and at the same time require high economic losses both for the individual and for the entire population (Stenhagen, Nordell & Elmstahl, 2013). At this age, an accidental fall is the first cause of unexpected death (Robitaille & O'Loughlin, 1990), and if the fall does not result in death, it becomes the main reason for disability, as well as for loss of independence and the need for institutionalization (Hausdorff, Rios & Edelberg , 2001). In their work, Pavlović et al. (2015) found that out of 300 elderly subjects who were placed in a health center or nursing home in Bosnia and Herzegovina, 17.1% of them experienced at least one fall in the previous 12 months.

3. ETIOLOGY OF FALLS AMONG ELDERLY PEOPLE

The etiology of falls depends on many factors, so the risks of falls themselves are numerous. Fifteen percent of falls occur under the influence of some external factor and mostly occur in younger and more active people, and require special medical treatment. Approximately the same number of falls occurs due to the occurrence of some neurological disorders such as epilepsy (Dionyssiotis, 2012). The other 70% of falls that occur are the result of the interaction of multiple factors (Rubenstein, Powers & MacLean, 2001; Campbell & Robertson, 2006). Regardless of the individual's general state of health, falls are associated with insufficient movement, reduced opportunities to perform daily activities (dressing, bathing, housework, ...) and the risk of being admitted to institutions that care for non-independent persons (Dionyssiotis, 2012; based on Tinetti & Williams, 1998). A small number of falls were caused by one factor; the largest number of falls is the result of a combination of the so-called chronic (physical and health status) and acute (environmental influence) risks (Rubenstein & Josephson, 2002; Campbell & Robertson, 2006). Maintaining good posture, i.e. correct body posture during daily physical activities, is based on the individual's ability to synchronize several systems in a certain cycle: sensory, cognitive and musculoskeletal system. During natural aging, there is a decrease in the normal functioning of these processes and systems (Rubek, 2006; Rubenstein, 2006). In the process of aging, in older people, their weakness, or fragility, increases, and thus the chances of unwanted events such as functional impairment, lack of independence and falls increase (Casas & Izquierdo, 2012; Laredo-Aguilera, Carmona-Torres & Mota-Cátedra, 2017). Frailty is defined as a biological state in which there is a poor reaction of vital physiological systems to maintain homeostasis after a stressful event (Mañas, del Pozo-Cruz, García-García, Guadalupe-Grau & Ara, 2017). Several studies (Cesari et al., 2002; Avdic, Pecar & Mujic-Skikic, 2004; Morris et al., 2004; Reyes-Ortiz, Al Snih, Loera, Ray & Markides, 2004; Sieri & Beretta, 2004) have attempted to examine what these factors are and how much of an impact they have on the decline in a certain population. The combination of factors that influence falls has led to the possibility of predicting the possibility of falls in the elderly. Among the many risks, there are also some protective factors such as physical activity. And all of the above when combined with reduced cognitive abilities, greatly contributes to

the increased risk of falls in elderly people (Zecevic et al., 2006; Kendrick et al., 2014). According to research, arthritis, depression, cognitive impairment, vision, problems with balance and unbalanced gait, decreased muscle mass, as well as excessive use of medication can increase the risk of falling (Rubenstein & Josephson, 2002; Campbell & Robertson, 2006).

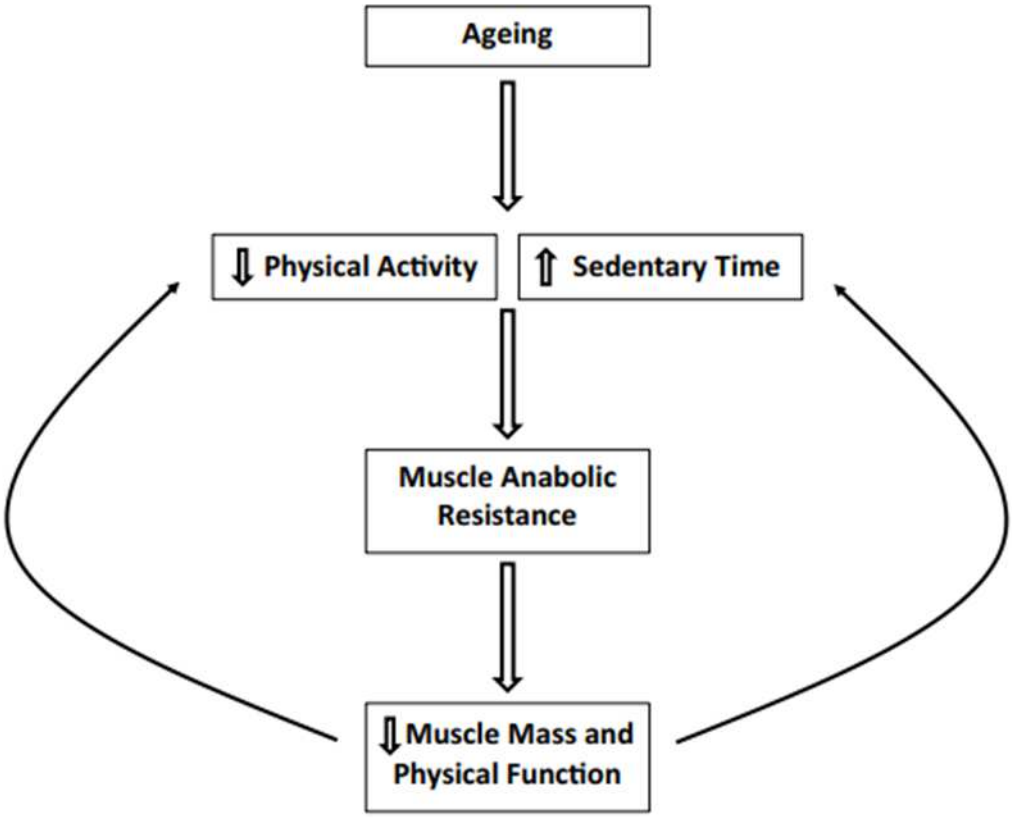

Diagram 1. *Interaction between physical activity, sedentary lifestyle and muscle anabolic resistance (adapted from Shad, Wallis, van Loon & Thompson, 2016)*

3.1 Unbalanced gait and balance disorder

A good balance represents a quick synergistic interaction between different physiologists and cognitive elements that enable a quick and precise response to a perturbation, or a disorder. This interaction represents a complex relationship between systems that enable rapid and precise changes to prevent decline (Richardson, 2017). Timely detection of impaired gait and impaired balance, as well as appropriate intervention in the right measure can contribute to preventing dysfunction and loss of independence (Salzman, 2010).

3.2 Cognitive impairments

Neuro-cognitive functions (perception, memory, thinking, learning, ...) have a great influence on the risk of falling (Kearney, Harwood, Gladman, Lincoln & Masud, 2013). Impairment of cognitive abilities, regardless of diagnosis, in elderly people also increases the chance of falling (Lord, Sherrington, Menz & Close, 2007). The increasing number of different forms of dementia, as well as the degree of cognitive impairment in the elderly, has increased the trend of falls in this population (Booth, Harwood, Hood, Masud & Logan, 2016).

3.3 Musculoskeletal condition and pain

There is a strong connection between a painful musculoskeletal system and the individual's reduced interest in engaging in FA leading to weakness, a decline in overall body functioning, a reduced sense of well-being and the appearance of independence. Muscle weakness, in addition to difficulties with walking, balance and use of walking aids, is a significant factor for the risk of falling. Any disorder of the entire musculoskeletal system, especially the lower extremities (lack of strength, orthopedic problems, etc.) is directly related to an increase in risk (Dionyssiotis, 2012).

3.4 Vision

Visual impairment as a reason for falls in adults is an underrepresented area of research, however, it is generally recognized as an important risk factor. Visual impairment and blindness increase with age and are often overlooked as a fall risk because these two phenomena occur in a slow process, sometimes so much so that it is not even noticed (Zhang, Shuai & Li, 2015).

3.5 Use of medication

Another possible cause of disturbed and unbalanced gait leading to falls is the use of several (four or more) medications (Dionyssiotis, 2012; according to Leipzig, Cummin & Tineti, 1999). Providers should recognize that polypharmacy is the source of many iatrogenic diseases. You should be especially careful when using medications with an effect on the central nervous system because they can affect reaction speed, memory, balance and brain blood flow (Michalcova, Vasut, Airaksinen & Katarina, 2020).

3.6 Physical inactivity

Sedentary lifestyle, the so-called today's modern disease is one of the main causes of falls in the elderly. Although there are a number of causes that alone or in combination can cause falls, it has been established that lack of walking and balance problems are the most common reasons for falls in the elderly (Lee & Paffenbarger, 2000; Kannus, Sievänen, Palvanen, Järvinen & Parkkari, 2005; Zelenovic et al., 2022). As a consequence of such habits, the physical condition of the elderly deteriorates and there is a decrease in muscle strength and coordination of the lower extremities combined with unsteady gait and balance (Daley & Spinks, 2000; Owino, Yang & Goldspink, 2001).

4. FALL RISK ASSESSMENT PROCEDURES

No procedure, which aims to assess the risk of falls in elderly people in care homes or society in general, has been used and certified throughout Europe (Dionyssiotis, 2008). However, there are some procedures that were used in some works.

- STRATIFY (St Thomas Risk Assessment Tool in Falling Elderly Inpatients) is a procedure for identifying patients with an increased risk of falling. However, this procedure is intended only for hospitalized persons (Oliver et al., 2008).
- One of the measuring instruments is PROFET (Prevention of Falls in the Elderly Trial), which serves to help monitored individuals in the intensive care unit in recognizing whether there is a risk of adverse events with permanent consequences (Close et al., 1999).
- In the literature review (Nandy et al., 2004), a group of questions was designed to identify people living in the community who are at high risk of falling. The authors used the FRAT (Falls Risk Assessment Tool) procedure, which can be carried out by non-medical personnel, because it is recommended to use this procedure to examine people who are not placed in hospitals or nursing homes. If four out of five questions are answered, the accuracy of this test protocol is 97%.
- In her study, Lips (1997) used a procedure by which she examined the risks of falls in 1285 people over 65 years of age with reported vision problems, previous falls and the use of a group of drugs for the treatment of anxiety, depression and the like. However, this procedure proves to be insufficiently precise and reliable.
- Assessment of the normal physiological state (Physiological Profile Assessment) is a procedure developed in their work by Lord, Menz & Tiedemann (2003), and aims to examine which system affects

stable and upright body posture (gait, balance, vision, proprioception, strength, ...). The disadvantages of this procedure are reflected in the fact that its implementation requires special training.

- According to the guidelines of the American and British Geriatrics Associations, the "Get up and Go Test" proved to be a simple test for people with reduced strength and balance after a fall. However, the disadvantage is that this test only examines basic movements of daily life such as standing up, walking, turning and sitting, and does not examine barriers to participation that may be encountered in the elderly (Todd & Skelton, 2004).

5. RECOMMENDATIONS OF PHYSICAL ACTIVITY FOR REDUCED FALL RISKS

There are different interventions for the prevention of falls, and they are divided into those that include the entire population without exception, and specific groups in which the risk of falling is increased, namely: women, frail elderly people or people who have experienced at least one fall in the past (Billis et al., 2011). Such interventions may be designed to reduce a single internal or external risk factor or may be focused to reduce a combination of risk factors (Moreland et al., 2003). However, PA represents a key role in the prevention of falls by limiting the reduction of muscle mass and strength, and stimulating postural control and accelerating recovery after injury (Bianco et al., 2014; Faraldo-García et al., 2016; Patti et al., 2017). It has been proven that a higher level of PA (MET≥3) reduces the risk of falling between 30 and 50% (Melzer, Benjuya & Kaplanski, 2004; Bellafiore et al., 2011; Gillespie et al. 2012). In almost every published study, which aimed to examine the risks of falls in the elderly, the conclusion was that PA, and even daily activities, represent an effective method for maintaining balance and preventing falls (Gillespie et al., 2003; Rao, 2005; Fernandez-Arguelles, Rodriguez-Mansilla, Antunez, Garrido-Ardilla & Muñoz, 2014). However, there is still uncertainty as to which type of PA can provide the best results for the purpose of reducing the risk of falls (Gine-Garriga, Roque-Figuls, Coll-Planas, Sitjà-Rabert & Salvà, 2014; Gobbo, Bergamin, Sieverdes, Ermolao & Zaccaria, 2014). As stated in the introductory chapter, according to the guidelines for PA in older people (Australian Government, The Department of Health, 2008; Office of Disease Prevention and Health Promotion, 2008; Department of Health, Physical Activity, Health Improvement and Protection, 2011; Canadian Society for Exercise Physiology, 2012) recommended that PA for strengthening muscle groups be performed two or more times for a total of 150 minutes per week at a moderate intensity (Piercy et al., 2007). Some review studies have addressed the recommendations of different specific exercise programs (strength, flexibility and balance training) that could influence fall risk regulation (Nelson et al., 2007; Borges et al., 2012). Exercise consisting of several components (strength and endurance training) is an effective intervention for health and improving the general physical condition of older people, and leads to the prevention of undesirable events such as falls and damage to the functionality of certain systems (Izquierdo, Cadore & Casas, 2014). On the other hand, exercises aimed at improving strength and balance are very effective in improving independence and preventing falls in the elderly (Mañas et al., 2018). In essence, specially controlled and programmed exercise adapted to the elderly can lead to functional independence and maintenance of strength and flexibility, which in fact are key factors that contribute to reducing the risk of falls in the elderly (Gómez, Borba-Pinheiro, Gois & Da Luz, 2015). Also, it has been proven that programs based on moderate to high intensity aerobic exercise and endurance can be used for the same purpose (de Vries et al., 2012; de Labra et al., 2015). Aerobic training has a positive effect on cardiovascular functions, prevents muscle atrophy and improves the quality of health and life (Navas-Enamorado et al., 2017). However, this type of PA activity should be carried out under controlled conditions with the presence of an expert, and with the consent of a doctor. Since balance is the ability to stand upright and move, it should be noted that training such as Tai Chi can play an important role in preventing falls (Melzer, Benjuya & Kaplanski, 2004).

6. CONCLUSION

Falls in the elderly are one of the most common phenomena that occur due to numerous internal and external factors, and they alone or in combination can lead to fatal consequences. The benefits of PA for improving musculoskeletal function and metabolic health are well known, while the total volume and type of PA activity required for the elderly is not well defined. However, it can be concluded that the combination of PA (strength training, endurance training, exercises for the development of balance and mobility, ...) and adequate nutrition (sufficient intake of essential amino acids/protein sources) is of crucial importance for preserving the physical condition, motor skills and health status of third-age people, and therefore in the prevention of falls. Based on the facts presented, the strategy for choosing an exercise program to improve the neuromuscular and cardiovascular status of the elderly should include the following:

- weight training is performed two or three times a week, through three sets of 8 to 12 repetitions with an intensity that progressively increases from 20 to 30% of 1RM;
- to improve functional abilities, endurance training should be based on performing tasks such as walking with progressive growth from 5 to 30 minutes;
- training for the development of balance should include exercises such as standing on one or both legs, walking on a line, walking heel-toe, transferring weight from the left to the right leg, as well as a modified Tai Chi program;
- multi-component exercise programs should include a gradual increase in the volume, intensity and difficulty of exercise performance, along with the simultaneous performance of resistance, endurance and balance;
- such programs should be retested to further examine their impact.

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APSTRAKT

Redovna fizička aktivnost može da donese značajne zdravstvene benefite kod ljudi svih godina, te se potreba za fizičkom aktivnošću ne smanjuje sa brojem godina već je dokazano da ona može produžiti zdraviji i samostalniji život, spriječiti invaliditet i značajno doprinijeti poboljšanju života kod starijih osoba. Pored toga što svaka vrsta fizičke aktivnosti u određenoj mjeri pobošljava motoričke sposobnosti (snagu, koordinaciju, ravnotežu, agilnost, ...), mentalno zdravlje (samopoštovanje, kvalitet života) i umanjuje rizik od kardiovaskularnih i svih drugih uzroka smrti, redovno učestvovanje u vježbanju pospješuje mobilnost i funkcionalnu nezavisnost kod odraslih osoba. Pad je događaj u kojem učesnik bez sopstvene namjere dolazi u ležeći položaj na zemlji ili na nižem nivou. Bez obzira na zdravstveno stanje pojedinca, padovi su povezani sa nedovoljnim kretanjem, smanjenim mogućnostima za izvođenje svakodnevnih aktivnosti (oblačenje, kupanje, kućni poslovi, ...) i rizikom za prijem u ustanove u kojima se vodi briga o nesamostalnim osobama. Artritis, depresija, kognitivna oštećenja, vid, problemi s ravnotežom i neuravnoteženim hodom, smanjenje mišićne mase, kao i prekomjerna upotreba medikamenata povećavaju rizik od pada. Ukupan obim i vrsta fizičke aktinosti potrebna za starije osobe nije baš najbolje definisana. Međutim, može se zaključiti da spoj fizičke aktivnosti (treninzi snage, izdržljivosti, vježbe za razvoj ravnoteže i mobilnosti, ...) i adekvatne ishrane (dovoljan unos esencijalnih amino kiselina/izvora proteina) je od krucijalnog značaja za očuvanje fizičkog stanja, motoričkih sposobnosti i zdravstvenog statusa osoba treće dobi, a samim tim i u prevenciji padova. Cilj ovog rada se ogleda u opisu i pronalaženju najboljih trenažnih programa za prevenciju padova kod starih osoba.

Ključne riječi: *program vježbanja, treća dob, padovi*

Primljeno: 25.10.2022.
Odobreno: 02.12.2022.

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Božić, D., & Zelenović, M. (2022). The effect of physical activity on the prevention and number of falls in elderly people. *Sportlogia, 18* (1), 45-59. https://doi.org/10.5550/sgia.221801.en.bz