The Effects of Balance and Proprioceptive Training on Falling in Older Adults

Havva Ezgi ALBAYRAK[*], Hande Besna GÖÇEN[**], Suzan AYDIN[***], Mustafa Oğuz KETHÜDAOĞLU[****], Aygül KÖSEOĞLU KURT[*****], Mehmet Kaan ALTUNOK[******], Bülent Abut ÖZSEZİKLİ[*******]

Abstract

Physiological changes and physical inactivity are observed in older individuals due to the gradual slowing down of body systems. These changes in the systems lead to a reduction in bodily functions. Falls and fall-related injuries are considered significant problems in adults aged 65 and above, with an even higher prevalence in those aged 75 and above. Proprioceptive systems are among the impaired systems. Dysfunctions of these systems include balance and proprioceptive systems, and dysfunctions in these systems increase with advancing age. Balance and coordination problems have been identified as important risk factors for falls among older adults. Additionally, proprioception decreases with age. Studies have shown that diminished proprioception is a significant contributing factor to falls in the elderly. The disruption of the body's balance and coordination system, along with the weakening of the proprioceptive system, leads to an increased risk of falls, which is a significant cause of mortality and morbidity in the elderly population. This review aims to investigate the impact of balance and proprioception training on fall prevention in elderly populations.

Keywords: Elderly, balance, proprioception, falls, physical inactivity.

Yaşlı Bireylerde Denge ve Proprioseptif Eğitimin Düşme Üzerine Etkileri

Öz

İleri yaşlı bireylerde vücut sistemlerinin zamanla yavaşlamasıyla fizyolojik değişiklikler ve fiziksel inaktiviteler görülür. Sistemlerde meydana gelen her türlü değişim vücut fonksiyonlarında olumlu veya olumsuz etkileşim yaratır. 65 yaş üstü yaşlı yetişkinlerde düşmeler ve düşmeye bağlı yaralanmalar önemli bir sorun olarak kabul edilmektedir. 75 yaş üstü yaşlı yetişkinler de ise bu sorunlar daha da yaygın

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[*] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; Lecturer; Avrasya University, Vocational School of Health Services, Occupational Therapy Department, Trabzon, Türkiye. E-mail: ezgii.karas@gmail.com ORCID https://orcid.org/0000-0002-4595-2043
[**] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; Lecturer; İstanbul Gelişim University, Vocational School of Health Services, Physiotherapy Department, Istanbul, Türkiye. E-mail: handegocen@outlook.com ORCID https://orcid.org/0000-0002-4208-0366
[***] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; Lecturer; İstanbul Gelişim University, Vocational School of Health Services, Physiotherapy Department, Istanbul, Türkiye. E-mail: suzanaltnkeser@gmail.com ORCID https://orcid.org/0000-0002-8470-9425
[****] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; Lecturer; Cumhuriyet University, Health Sciences Faculty, Physiotherapy and Rehabilitation Department, Sivas, Türkiye. E-mail: mustafaoguzkethudaoglu@gmail.com ORCID https://orcid.org/0000-0001-9723-9680
[*****] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; MSc. Pt.; Uropelvic Solutions, Istanbul, Türkiye. E-mail: aygulkoseoglu@gmail.com ORCID https://orcid.org/0000-0001-7180-3693
[******] MSc. Pt. PhD (c); Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye ; Lecturer; Selçuk University, Health Sciences Faculty, Physiotherapy and Rehabilitation Department, Konya, Türkiye. E-mail: mehmetkaan.altunok@selcuk.edu.tr ORCID https://orcid.org/0000-0002-3851-0685
[*******] Asst. Prof., Bahçeşehir University, Graduate Education Institute, Physiotherapy and Rehabilitation Department, Istanbul, Türkiye. E-mail: bulent@ozsezikli.com ORCID https://orcid.org/0000-0003-0805-8146

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görülmektedir. Bozulan sistemlerin başında postüral kontrol mekanizmaları gelir. Bu mekanizmaların içerisinde denge ve propriyoseptif sistem yer alır ve bu sistemlerdeki disfonksiyonlar ilerleyen yaş ile artmaktadır. Denge ve koordinasyon problemleri yaşlı yetişkinler arasında düşmeler için önemli bir risk faktörü olarak belirtilmiştir. Aynı zamanda propriyosepsiyon da yaşla birlikte azalmaktadır. Çalışmalar azalan propriyosepsiyonun yaşlılarda düşmelere neden olan önemli bir faktör olduğunu göstermiştir. Vücudun denge koordinasyon sisteminin bozulması ve propriyoseptif sistemin zayıflaması, yaşlı popülasyonda önemli bir mortalite ve morbidite nedeni olan düşme riskinin artmasına neden olur. Bu derlemede ileri yaşlı bireylerde denge ve propriyosepsiyon eğitiminin düşme üzerine olan etkilerinin ortaya konması amaçlanmıştır.

Anahtar Sözcükler: İleri yaşlı bireyler, denge, propriyosepsiyon, düşme, inaktivite.

Introduction

With the increasing life expectancy, it is important to identify transitions into later years and recognize the heterogeneity among older adults[1]. Falls and fall-related injuries are a significant public health concern, being a leading cause of death and morbidity among adults aged 65 and above[2], and the primary cause of accidental death among individuals aged 75 and above[3].

Balance is essential for maintaining one's posture and responding to voluntary movements. To preserve balance, an individual's center of mass must remain within a changing base of support[4]. Balance and coordination problems have been recognized as important risk factors for falls among older adults[5]. They are achieved through complex interactions among multiple sensory, motor, and integrative systems[6]. Aging can lead to impairments in any of these systems, resulting in balance disturbances[7]. Disruption of the body's balance and coordination system contributes to an increased risk of falls, which is a significant cause of mortality and morbidity in the elderly population[8]. This review article will discuss the effects of balance and proprioceptive training on falls in older individuals.

With aging, there is an increasing need for classification due to structural and functional changes[9,10]. The basis of classification is to analyze the changes that occur among different age groups. Therefore, a classification based on chronological age has been established for older adults. According to this classification, the age range of 65-74 is referred to as "Young-Old," the age range of 75-84 is referred to as "Middle-Old," and the age of 85 and above is referred to as "Old-Old"[11].

According to the World Population Prospects 2022 report, there were 771 million elderly individuals worldwide in 2022, which corresponds to three times the size in 1980 (258 million). It is estimated that the elderly population could reach 994 million by 2030 and 1.6 billion by 2050[11]. In Turkey, the population of individuals aged 65 and above, defined as the elderly population, increased by 24% between 2016 and 2021[12]. After 2021, it is known that 64,7% of the elderly in Turkey are in the age range of 65-74, 27,3% are in the age range of 75-84 and %8 are 85 years and older[12]. In 2024, the elderly population in Turkey is equal to 10.6% of the total population. The elderly population increased by 20.7% between 2019 and 2024. The elderly population rate is expected to be 13.5% in 2030, 17.9% in 2040, and 27% in 2060[13]. Due to increasing life expectancy and declining fertility rates, the age composition of the global population exhibits unprecedented and constantly changing patterns. As life expectancy extends due to medical and

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technological progress, the proportion and number of older adults within the total population increase rapidly, along with the emergence of various health conditions[14,15].

Old age is a period characterized by the maximum level of loss, such as the loss of relatives and friends, and increased social isolation. Individuals experience a impared in their ability to continue their work, perform daily activities, and maintain independent mobility. The frequency of these conditions increases with aging and gives rise to significant health problems that contribute to mortality and morbidity in older individuals[16].

Falling is one of the common problems associated with aging. As individuals age, it has been noted that one-third of them experience at least one fall per year, with the incidence increasing up to 60% among residents of nursing homes[17].

Falls

Falls, individuals over the age of 65, constitute a significant public health issue due to their medical, psychological, and economic consequences[18]. More than 30% of all older adults experience at least one fall per year, making it the second leading cause of injury-related deaths worldwide[19].

The World Health Organization (WHO) defines falls as unintentionally coming to the ground or lower levels, except when the individual intends to reach the ground or lower surfaces using different objects such as furniture or appliances for support and to rest. Fall risk is described as the transition of a person from one level to a lower surface, which can occur due to major events such as strokes or collision with objects. Falls, occurring in various ways, lead to a decrease in the independence of older individuals, placement in elderly care centers and nursing homes, and the emergence of unexpected problems[20].

Falls can be classified into three main categories: predictable falls, unpredictable falls, and falls resulting from accidents. Falls caused by accidents, such as slipping or tripping, account for 14% of all falls. Predictable falls, which are more likely to occur in individuals at risk, constitute 78% of all falls. Unpredictable falls, occur due to sudden physiological changes, fainting, dizziness, and account for 8% of all falls[21,22]. As individuals age, approximately one-third of them experience at least one fall per year, with the rate increasing up to 60% among residents of nursing homes[19].

Approximately %28-35 of individuals aged 65 and above experience falls every year, while this rate increases to %32-42 among those aged 70 and above. With an increase in financial costs, falls and fall-related injuries have become a significant global health problem in terms of their personal and societal impact and the interventions required to address these impacts for elderly individuals, their families, and society as a whole[23].

The aging process leads to biological, psychological, and physiological changes in individuals, resulting in dependence on daily life activities and a significant decrease in their quality of life[24]. This transitional phase affects individuals' ability to maintain their livelihood, reduces their ability to perform tasks, and consequently leads to a significant increase in accidents[21].

Fall-related injuries and deaths in old age have become a serious problem, especially in developed societies with an increasing elderly population. While the consequences of

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falls can be simple, such as bruises, superficial cuts, and sprains, they can also lead to serious problems such as fractures and cracks. In Turkey, 75% of falls among individuals aged 65 and above occur during routine home activities, and 44% are primarily due to global hazards. Falls are caused by the ground in 44% of cases, by step elevations such as stairs in 16% of cases, and by wet surfaces such as bathrooms in 4% of cases. Fear of falling significantly affects individuals who have experienced falls, are at risk of falling, or perceive the danger of falling. Studies report that many individuals experience fear of falling, although its prevalence is not fully known and is estimated to range from 25% to 85%[25].

Fear of Falling

Fear of falling refers to the experience of exaggerated fears and concerns about a decrease in self-confidence and the inability to perform daily activities[19,24]. When compared to falls, fear of falling should be carefully considered and recognized as a significant health issue due to the impairments it causes in maintaining daily life[26]. Around 50% of individuals who have experienced a fall report that fear of falling becomes a serious problem, leading 25% of them to actively avoid engaging in physical activities[27].

In older adults, fear of falling alters their quality of life and results in losses in daily life activities and independence, accompanied by distressing emotions such as fear and anxiety[28]. Additionally, as health problems increase, individuals perceive themselves as less capable, leading to a gradual decline in their movements and physical activities. Accidents become inevitable, restricting mobility and significantly impacting the quality of life of older individuals, particularly as age advances and movements slow down. This contributes to the increase of postural disorders and balance problems[29].

Balance

Postural control is the state of maintaining gravitational support on the supporting surface during rest and activity. In older adults, impairments in controlling postural stability lead to disturbances in both dynamic and static balance. The maintenance of balance is achieved through the coordinated functioning of three systems. The somatosensory system involves receiving information about the status of body parts such as muscles and joint capsules. It supports the coordination of eye, head, and neck movements, as well as posture and coordinated movement patterns. Hip and ankle strength are important because older adults at risk of falling are more likely to use ankle strategies to maintain postural stability[30]. The visual system provides information about head position and movements. Pyokko et al. suggested that visual input is more crucial than proprioceptive input in older adults. They found that when visual input was removed, there was a 52% reduction in postural stability in individuals over 80 years compared to a 22% reduction in young participants over the age of 60[31]. The vestibular system provides information about the position and velocity of the head in space[10]. The prevalence of vestibular dysfunction increases with aging and can range from 29% to 45% in individuals aged 75 and above. In the context of aging, with the progressive loss of central and peripheral nerve cells, all components of postural control undergo changes[32,33], which in turn affect balance and result in a decrease in the quality of life for the elderly population[34].

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Impairment in balance ability in older adults increases the risk of falls[19], leading to increased healthcare costs and changes in morbidity. Falls in older adults are also associated with decreased confidence and fear, often leading to reduced physical activity[35,36]. This, in turn, can negatively impact postural stability and result in a continuous decline in quality of life[37]. Consequently, researchers have a strong interest in understanding the components that contribute to postural instability and falls in older individuals.

Postural control represents a complex interaction between sensory and motor systems and aims to perceive peripheral stimuli, respond to the body's orientations within the environment, and maintain the center of mass within the base of support. Sensory information about the body's position within the environment primarily relies on proprioceptive, cutaneous, visual, and vestibular systems. Researchers have noted that individuals primarily rely on proprioceptive inputs to maintain their normal posture and safely perform most of their daily basic and instrumental activities[38].

Proprioception

Proprioception is defined as the perception of the body's position and movement in space[39]. It plays a significant role in maintaining balance during activities such as standing upright, different phases of walking, and purposeful limb movements. Sensory information utilized for postural control primarily stems from the inner ear, vision, and proprioception. Proprioception encompasses the signals received from mechanoreceptors located in muscles, tendons, and joint capsules[40].

There is information suggesting that proprioceptive signals from the leg muscles provide primary information in the postural control mechanism. This is because they are sensitive in detecting body sway during undisturbed balance. Falls and fall-related injuries increase with advancing age. In the context of falls, studies suggest that older adults rely more on proprioception rather than visual or vestibular cues to maintain postural control compared to young and middle-aged adults[41].

Proprioception represents an intervention area that can reduce the risk of falls in older adults. Exercises that improve proprioception attempt to develop the ability to perceive body movement and the position of joints, both at rest and in motion. Proprioceptive sensory input influences balance and the individual's perception of posture and is also associated with the coordination and responsiveness of the nervous system[42]. In this regard, its development differs from exercise interventions with multiple components[43]. When done correctly, proprioceptive exercises can be beneficial in improving outcomes related to frailty, function, and incidence of falls in older community-dwelling individuals. Pérez-Ros et al., who focused on proprioception to reduce falls in older adults, reported that home exercises given decreased the incidence of falls, the time allocated to physical activity increased, and the fear of falling decreased[43]. Espejo-Antúnez et al., in a randomized controlled study evaluating the effect of proprioceptive exercises on balance and physical function, reported that the exercise program showed significant improvements in areas such as functional mobility, balance, walking, and fall risk compared to the control group[44].

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Conclusion and Recommendations

With aging, changes occur in all systems of the body. These changes result in balance impairments and proprioceptive deficiencies. The balance impairments and proprioceptive deficiencies that arise with aging contribute to falls. Falls significantly impact the quality of life in older adults and pose health problems. Since the risk of falling in the elderly is quite high, it is necessary to take precautions for this. In this way, problems that may occur will be reduced. Balance and proprioceptive training in older adults has been found to reduce the risk of falls and positively impact their quality of life and physical performance. For older adults with a history of falls, more comprehensive approaches are necessary. Identifying the underlying cause of falls can help in reducing the risk of recurrent falls, and through these measures, it is believed that the morbidity and mortality associated with falls can be reduced.

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