Falls and Postural Stability in Older Individuals: Implications for Activities of Daily Living

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Abstract

The risk of falling is associated with aging-related motor and sensory declines. In fact, a higher incidence of falls has been observed in individuals of over 60 years who are known to have balance problems. The current knowledge regarding the mechanisms involved in the recovery of postural orientation and body equilibrium shows that the main changes occur as individuals become older and in those who are sedentary or are affected by some diseases. Extensive research and preventive efforts regarding the causes and consequences of falling have been conducted to better understand this issue. Fortunately, older individuals who practice regular physical activity present a healthy lifestyle and a lower risk and incidence of falling which may be associated with functioning of the postural control system. Recently, public health policies have been adopted by many countries in order to improve the quality of life of older individuals and reduce the high number of fallers among the elderly.

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17.1 Introduction

The aging process is characterized by individual constraints such as organic, physiological, and psychosocial, which lead to adaptation of even simple daily tasks. Brazil has one of the largest aging populations in the world, increasing from 14 million in 2000 (8.6 % of the population) to 20 million in 2010, and currently comprises 13 % of the population [1]. Health professionals who work with this population are concerned about the high incidence and risk of falls in older individuals and seek strategies to prevent the causes of this phenomenon [2].

A fall can be defined as the "unintentional displacement of the body to below the starting position, with correction of the disability in a timely manner, caused by multifactorial circumstances that compromise stability" [3]. The risk of falls has been associated with intrinsic and/or extrinsic characteristics of older adults. The intrinsic factors are related to physiological alterations during aging, such as decreased visual acuity; the abusive use of drugs/medication; chronic diseases such as hypertension, diabetes, arthritis, osteoarthritis, and osteoporosis, causing deficits in muscle strength, balance, and/or gait; and the psychological status, such as fear of falling, which affects, for instance, performance of the gait [4]. The extrinsic factors are environmental and social circumstances in which the older people are included, such as inadequate lighting, slippery surfaces, carpets without anti-slip coatings or with folds, obstacles when walking, no handrail support, high or narrow steps, and public pathways with holes or irregularities, among others [5].

Worldwide, about 424,000 individuals die each year as a result of falls, and a further 37.3 million fallers require medical attention [6]. Falling is the primary cause of accidental death in people over 65 years and is considered the most serious and frequent home accident, being responsible for 24 % of deaths in the older people. About 30 % of the older people fall each year, and this rate increases up to 40 % among individuals over 80 years and among older women up to 75 years. According to the Brazilian Health Ministry [7], the Public Health System has significant annual expenses related to fracture treatments in older individuals, principally related to hip fractures, which are the leading cause of morbidity and mortality in this population.

Fear or concern about recurrent falls is also associated with reduced mobility, loss of balance confidence, and activity restriction in older people. The evaluation is complex since it may involve physical, behavioral, and functional constraints [8]. For these reasons, it is important to identify possible causes and risk factors and propose several interventions in order to prevent falls in the older individuals.

Studies have shown that peripheral structure impairments, such as muscle weakness, loss of bone mineral density, sensorial constraints, nerve transmission delays, and a slower reaction time are associated with older fallers [9, 10]. For instance, older individuals with impaired nerve transmission and sensory constraints take more time to initiate the postural response after an environmental disturbance. These delays may lead to a higher center of mass excursion which requires greater production of torque at the ankle and/or hip joints. As older individuals appear to present age-related muscle weakness, balance may not occur.

In addition to these peripheral constraints, recent studies have indicated that balance disorders in older individuals may also occur due to altered central mechanisms. In particular, the older people demonstrate a loss of central neurons and synaptic connections, which reduces processing speed and the ability to perform multiple activities simultaneously, predominantly those involving postural control [11, 12]. Some differences in brain structure (loss of global brain mass, a decline in volume of gray and white matter), biochemistry (differences in brain neurochemistry), and function (changes in brain recruitment patterns) have been observed [13] when comparing older adults with younger ones. Recent evidence has demonstrated that brain activation alters as age increases [14], mainly in areas such as the cerebellum, precuneus, occipital cortex, and basal ganglia, which seem to be associated with ankle muscle activation. These brain areas are increasingly activated in older but not in younger adults during ankle dorsiflexion movements. Since these cortico-cerebellar areas contribute to higher-order cognitive processes [15] and postural and balance control [16], these neural changes have been interpreted as compensatory responses to age-related deficits in sensorimotor control of the distal lower limbs [14].

Therefore, functional constraints in both the central and peripheral nervous systems seem to lead to inappropriate age-related postural responses to a constantly changing sensory environment, which could be associated with an increased risk of falling among this population. For instance, many fall events occur during the performance of activities of daily living (ADLs) which associate two or more tasks simultaneously. A dual task is defined as the simultaneous performance of a primary task, usually postural, in association with another task, denominated secondary, which could be a cognitive task (speaking, counting down, or speaking different names), a simple motor task (holding a glass of water or carrying a tray), a complex motor task (changing pocket coins), or cognitive/motor task (using a telephone while walking) [14, 15]. In general, the performance of dual tasks in an adequate manner involves dividing attention and making more effort to process postural control and sensory information [11, 12]. Older individuals, when performing a dual task, present changes in the maintenance of postural control due to competition between the secondary task and effectiveness of motor responses and sensory input, increasing the body sway to maintain balance [12]. One reason for these results might be the fact that both postural control and cognitive/motor tasks occur at the cortical level, so to perform these activities simultaneously implies competition for cortical processing, causing a reduction in the automatism of the older people to perform simultaneous activities [11].

Currently, many physical exercises/activities have been recommended to maintain appropriate levels of multiple operating systems, and these benefits are also extended to postural control. However, the underlying mechanisms involved in these sensorimotor changes are still poorly understood. The aim of this chapter is to demonstrate the changes in postural control over the years and the mechanisms involved in the recovery of body stability. First, the aspects involved in the functioning of the postural control system will be discussed, after which, a multifactorial approach to reduce falls and the related injuries will be addressed.

17.2 Aging and Postural Control

Historically, postural control was considered a summation of parallel and hierarchical reflex pathways [9, 17, 18]. Currently, it is understood as the complex interaction between multiple neural systems underlying two functional goals: postural orientation, the relative positioning of the body segments with respect to each other and to the environment, and postural equilibrium, the state in which all forces acting on the body are balanced [17].

Considering that postural control involves not only balance but also the ability to assume and maintain a desired orientation, every movement involves postural control [17]. Therefore, the accurate functioning of the postural control system allows us to properly interact with the environment. However, a decline in postural control performance is well documented in the older population [19, 20]. Furthermore, these age-related changes in the postural control system have been related to falling individuals [21, 22]. Piirtola and Era [22] suggested that parameters of mean speed and the root mean square of center of pressure (CP) could be used as predictors of the number of falls among the older people during upright stance. It has been found that older individuals with a history of falls present a larger sway area of CP than older individuals with no history of falls [21]. Therefore, understanding the mechanisms underlying these alterations in the postural control system is critical to fall prevention.

The postural control system involves different control mechanisms and behavioral strategies. Regarding the control mechanisms, the compensatory (feedback) and anticipatory (feedforward) postural adjustments can be mentioned. Compensatory postural adjustments operate on the principle of negative feedback [23]; thus afferent feedback is used to control the position of the body when the initial setting is disturbed [24]. On the other hand, anticipatory postural control is based on predictive control [23], since disturbances are anticipated using higher-order processing rather than simple negative feedback [24]. Thus, this mechanism involves muscle activation prior to the disturbance. In general, feedback postural control is available when subjects are faced with unpredictable externally generated disturbances, and feedforward postural control operates when subjects deal with disturbances generated by their own movements (self-motion) [25].

In the older people, the feedforward postural control mechanism is not used effectively [26, 27], and, for this reason, it seems that older individuals rely more on feedback control [26]. For Dault and coworkers [26], the inability of the older individuals to use feedforward control could be related to motor and sensory modifications associated with aging. This is a problem for the postural control system because both feedback and feedforward control mechanisms must operate in combination to achieve optimal motor control functioning [28]. If muscle activation begins prior to the disturbance, it is possible to minimize the perturbation to vertical posture, and, consequently, less feedback postural control is required. On the other hand, if these anticipatory adjustments are not effective, the disturbance will be greater, and compensatory postural adjustments may not be enough to recover balance.

Behavioral strategies are required to recover balance after disturbances, and these have been widely described [9, 17, 29]. The ankle strategy is the most commonly used and is the most useful for slow and/or small perturbations [17]. In this strategy, the ankle muscles alone act to recover the balance [30]. Thus, after a perturbation, the vertical alignment is altered and the ankle muscles activated in order to produce a torque at the ankle joint. When the ankle muscles are not enough to restore balance, the hip strategy is used [30]. The hip strategy is useful for rapid or large-amplitude disturbances [17] and consists of flexing the hip, moving the center of mass posteriorly, or extending the hip to move the center of mass anteriorly [30]. In addition, there is the stepping strategy, which is usually used when the ankle and hip strategies are inadequate to maintain the center of mass within the limits of stability [9]. The stepping strategy is useful for very large and/or fast perturbations [9, 17] but may also be observed in small perturbations in subjects who have not previously experienced the body position or received instruction on keeping the feet in place [17]. Age-related alterations have also been documented in these behavioral strategies [9, 19, 20]. Some studies have shown that older individuals switch strategies from ankle to hip to recover postural stability even after a small (feedback control) but unpredictable perturbation [10, 31, 32]. Taking into account that postural control functioning is not such efficient in older adults, disturbances of balance are generally more difficult to recover by ankle strategy, and so older people adopt a more conservative hip strategy.

Integration of sensory inputs is crucial to provide accurate information for postural control system functioning. For instance, sensory inputs are used to adjust self-initiated disturbances of stability (feedforward) and also to detect externally triggered disturbances (feedback) [23, 33]. As the body oscillates, a wide variety of receptors are activated and provide different types of inputs to the central nervous system (CNS) to generate proper muscular contractions which are dependent on the goals of the desired task in a specific environmental condition [33].

Generally, information from three sensory systems is available to the postural control system: visual, vestibular, and somatosensory [34, 35]. The visual system provides information about the position and movement of an object in space and the position and movement of the limbs in the environment and the whole body through the eyes. The aging process reduces acuity, contrast sensitivity, depth perception, and rapid adaptation to changing depth [20, 33], which could make the older people more susceptible to falling. The somatosensory system provides information on the position of the body in space relative to the supporting surface and the position information and relative speed between body segments. The sensors of this system include muscle proprioceptors (Golgi tendon organ and muscle spindles) and joint and skin mechanoreceptors. The reduction in density and sensitivity of dermal mechanoreceptors, the stiffness of tissue, and degeneration of peripheral nerves may be related to decreased skin sensitivity over the years [20, 33]. The vestibular system provides information about the orientation and movement of the head, and the speed of information processing may reduce with age, also resulting in an increased risk of falls.

Falls in older individuals have been associated with multiple underlying causes, such as the sensory reweighting process [9]. Under normal conditions, the sensory systems provide redundant information to the CNS regarding maintenance of body position [35]. However, in constantly changing environments, some sensory cues may become more reliable than others in order to achieve the movement task. When this happens, visual, vestibular, and somatosensory inputs must be dynamically reweighted in order to optimize the control of postural stability [17]. Upweights and downweights of different sensory modalities appear to be linked in a nonlinear process [36, 37]. Some evidence suggests that the older individuals are not able to reweight sensory information appropriately [12, 20, 38]; however, it is still unclear whether such differences are due to central [38, 39] or peripheral mechanisms [40].

Recently, Toledo and Barela [40] found evidence that sensory reweighting in older adults might involve peripheral deterioration. In this study, older adults were submitted to several assessments in order to evaluate central and peripheral mechanisms. Peripheral mechanisms were evaluated by sensory (visual acuity, visual contrast sensitivity, tactile foot sensitivity, and detection of passive ankle motion) and motor (isometric ankle torque, muscular activity latency after stance perturbation) assessments, and central mechanisms were evaluated by postural control assessment (body sway during upright stance and induced by movement of a visual scene). The results revealed that less accurate sensitivity to passive ankle joint motion is related to larger body sway in sensory conflicting situations (induced by movement of a visual scene). Thus, there is evidence that if peripheral sensation is sufficiently intact, there is no difference in the sensory reweighting process between young and older adults (fallers and non-fallers) [41] suggesting that age-related changes in the reweighting process seem more likely to be due to peripheral mechanisms.

Despite these varied aspects, older adults engaged in physical exercise programs have demonstrated more effective performances of the postural control system in many daily activities. Besides the functional fitness improvements from regular physical exercise practice (strength, flexibility, coordination, balance, and resistance cardiovascular), active older individuals are constantly encouraged to interact with changing environments during exercise practicing which requires integration between useful sensory information and appropriate muscle contractions which could benefit the postural control functioning. Based on these results, many professionals have considered the multifactorial aspects to develop exercise programs and prevent falls.

17.3 Physical Activity and Postural Control of Older Adults

The participation of older individuals in specific or multimodal exercise programs is an important element in the prevention and rehabilitation of multiple aspects associated with falls, such as muscle weakness, deterioration in postural control, and committed instability during locomotion [e.g., 42, 43]. Although prevention of falls has been the goal of several exercise programs, with different contributions to the health style of the older people [e.g., 44–46], understanding of the aspects which might actually change one or more factors associated with the risk of falling is still being investigated. Meta-analyses and reviews about this issue have pointed out, in many cases, incomplete methodologies, without strict definition of the groups or training methods (frequency, intensity, duration) applied in physical activity programs for the older adults which compromise the knowledge of consistent results on the effects of exercise in reducing falls in this population [45, 47, 48].

Despite this lack of information, overall results have shown that the practice of different types of physical exercise has beneficial effects on the health and quality of life of older individuals, mainly due to maintenance of their functional and neural capacity, independent mobility, and ability to carry out ADLs, which has been associated with a lower risk and fear of falling [13, 43, 49, 50]. Table 17.1 summarizes the main findings regarding the effects of exercise/physical activity training on the postural and functional parameters which are associated with the risk of falling in older individuals.

Strength/resistance, balance, and aerobic training are the most popular activities practiced by older adults and the most commonly prescribed among health professionals to prevent the risk of falling [47, 51]. The American Geriatrics Society and British Geriatrics Society Clinical Practice Guidelines for the prevention of falls in older persons recommend additional training for gait and coordination that should be performed 1–3 times a week, with different exercise intensities, and a duration of at least 12 months to achieve the necessary preventive benefits to reduce falls. Pau and collaborators [52] investigated the effects of exercise intensity (light or vigorous) on sitting and standing, static balance, and gait tasks in older adults. The results indicated that vigorous intensity physical activity may reduce body sway in static and dynamic situations and improve gait parameters in the older adults during the performance of ADLs. Light physical activities appear to be also beneficial but only in tasks involving static balance. These findings might be used to plan and to implement more specific and effective fall prevention programs for older people.

Particularly, the decline in postural control and increase in the incidence and risk of falling due to the aging process [21, 22] have led older adults to practice exercises in order to improve or maintain adequate levels of functioning of this

Table 17.1 Summarized exercise/physical activity training effects on postural and functional parameters

Author	Main objectives	Mean age	Intervention/evaluation	Main assessments	Main results
Perrin et al. [42]	Examine the influence of continuous PSA practice on postural control in the elderly	AA: 73.9 years IA: 71.9 years AI:67.9 years II: 73.7 years	Period during which the subjects were engaged in PSA	Posturographic tests (static, dynamic with a single and fast upward tilt, and dynamic with slow sinusoidal oscillations) and electromyography responses	The postural control performance decreased in the order AA > IA > AI > II
Hess et al. [56]	Evaluate the effect of 10-week, high-intensity strength training program	EG: 80.9 years CG: 82.5 years	EG: 10 weeks (3 days/ week) I: high-intensity strength training program (quadriceps, hamstrings, tibialis anterior, gastrocnemius muscles)	Pre- and post-training evaluation Berg Balance Scale, TUG, Balance Confidence Scale	EG: improvements on Berg Balance Scale ($p = 0.030$), TUG ($p = 0.045$), Balance Confidence Scale ($p = 0.038$)
Colcombe et al. [50]	Examine whether aerobic fitness training of older adults can increase brain volume in regions associated with age-related declines	EG: 65.5 years CG:66.9 years YA: 18–30 years	EG: 6 months (3 days/week) I: aerobic exercises (cardiorespiratory fitness prescribed from HR) CG: 6 months (3 days/ week) I: aerobic exercises (whole-body stretching and toning)	EG and CG: VO2 and MRI images YA: MRI images	EG: increases in brain volume (gray and white matter regions)
Bruin et al. [46]	Evaluate the additional effect of functional exercises on balance and lower extremity function in strength training of older adults	EG: 86.3 years CG: 86.5 years	EG: 12 weeks (2 days/ week) I:strength and functional exercises (45 min + 30 min) CG: 12 weeks (2 days/ week) I: strength exercises (45 min)	Tinetti Scale, physical performance tests (timed walking measure, chair stand test, tandem stand), balance test, maximal isometric knee extensor muscle force	EG: improvement on Tinetti test ($p = 0.026$), chair stand test ($p = 0.012$), balance test ($p = 0.009$)

Martinez-Amat et al. [54]	Evaluate the effect of a 12-week-specific proprioceptive training program on postural stability, gait, balance, and fall prevention	EG: 79.35 years CG: 77.0 years	EG: 12 weeks (2 days/week) CG: maintain activity levels and medication during the 12-week intervention period	Pre- and post-training evaluation, Tinetti Scale (postural stability, gait, balance, and risk of falling), Berg Balance Test	EG: improvements on ML body sway with EO ($p < 0.05$) and AP body sway with EC ($p < 0.01$) Romberg quotient about surface ($p < 0.05$) and speed ($p < 0.01$) Gait (Tinetti test): improved 14.66 % Balance (Berg test scores): 11.47 %
Lee et al. [44]	Evaluate effects of a multifactorial fall prevention program on fall incidence and physical function in community-dwelling older adults	EG: 75.4 years CG: 76.0 years	EG: 3-month multifactorial intervention program (8-week, 1 day/week + daily home exercise) I: health education, home hazards evaluation/modification, exercise training (strengthening, balance, cardiorespiratory endurance, and flexibility) CG: 3-month multifactorial intervention program I: health education brochures, referrals, and recommendations without direct exercise intervention	Pre- and post-training evaluation Fall incidence (1 fall during the 12-month follow-up), PPA risk index (vision, muscular strength, reaction time, postural sway, and proprioception), TUG test, GDS, FES, IPAQ	Cumulative 1-year fall incidence EG: 25.2 % CG: 27.6 % EG: PPA improvements on fall risk index, reaction time, postural sway with EO, TUG test, and GDS, especially for marked fall risk older individuals

(continued)

Table 17.1 (continued)

Author	Main objectives	Mean age	Intervention/evaluation	Main assessments	Main results
Pau et al. [52]	Assess the effects of vigorous and light physical activity on static balance, gait, and sit-to-stand (STS) tasks in a cohort of healthy older adults	VPA: 69.8 years LPA: 70.3 years	VPA: 12 weeks (3 days/ week) I: 45 min with %HRR in the range 60–84 % (aerobic and anaerobic exercises) LPA: 12 weeks (3 days/ week) I: %HRR below 40 % (static and dynamic exercises for posture and balance, joint and spine mobility)	Pre- and post-training evaluation Bipedal stances (EO and EC). Unipedal stance (left and right), Gait: spatiotemporal parameters, Sit-to-stand test	VPA: improvements on gait parameters ($p < 0.001$) and STS time ($p < 0.001$), reduced body sway with EC ($p < 0.01$) LPA: decreased swing phase duration ($p = 0.042$) and reduced body sway with EC ($p < 0.05$)
Gianoudis et al. [51]	Evaluate the effectiveness and feasibility of a multimodal exercise program in older adults	EG: 67.7 years CG: 67.2 years	EG: 12 months (3 days/ week) – Osteo-cise exercise program I: HV-PRT, weight-bearing impact and challenging balance/mobility activities CG: to continue usual care and to take charge of own musculoskeletal health	Femoral neck and lumbar spine BMD, muscle strength, functional muscle power (Timed Stair Climb test), dynamic balance (Four Square Step and Sit-to-Stand tests), TUG, falls rate	EG: gains in femoral neck and lumbar spine BMD ($p < 0.05$), muscle strength ($p < 0.05$), functional muscle power ($p < 0.05$), and dynamic balance ($p < 0.01$)

PSA practice of physical and sporting activities, *AA* active-active group, *IA* inactive-active group, *AI* active-inactive group, *II* inactive-inactive group, *EG* experimental group, *CG* control group, *BBS* berg balance scale, *TUG* timed Up and Go, *I* intervention, *HR* peak heart rate, VO_2 maximal oxygen uptake, *MRI* magnetic resonance imaging, *min* minutes, *ML* medial lateral, *AP* anterior posterior, *EO* eyes open, *EC* eyes closed, *PPA* Physiological Profile Assessment, *IPAQ* International Physical Activity Questionnaire, *GDS* Geriatric Depression Scale, *FES* Fall Efficacy Scale-International, *VPA* vigorous physical activity, *LPA* light physical activity, *HRR* Heart Rate Reserve, *PRT* progressive resistance training, *HV* high velocity, *BMD* bone mineral density system [51, 53]. These exercises are based on generating situations involving balance and postural orientation, increased mobility through the environment, shifts of movement direction, postural disturbances through sudden events, and sensory system manipulation [45, 52]. These situations lead the postural control system to produce effective and adaptable motor responses due to the disturbances suffered in these contexts. Prioli and collaborators [38] showed that sedentary older individuals presented larger body sway in response to changing visual stimulus compared to active older and young adults. In addition, active older adults are able to respond more quickly and accurately to situations of sensory conflict than their sedentary peers. These results suggest that exercise practice might improve the perceptual-motor skills of the older adults decreasing the risk of falls associated with the deterioration of the postural control system.

Many studies have compared the effectiveness of different types of exercise on the postural control performance of healthy older people. Stretching and multisensory training [54]; strength and flexibility exercises [47]; functional exercises [46]; tai chi, Pilates, and Yoga [53]; and, recently, cognitive training and training with virtual reality [49, 55] are some of these exercises. For instance, Hess et al. [56] showed that high-intensity strength training improved the postural stability levels and balance confidence of 80-year-old individuals after 10 weeks of training. Overall, all these studies show that the practice of more than one type of exercise appears to be effective for decreasing postural instability, improving functional tasks and ADL performance and, thus, preventing the risk of falls.

Therefore, involvement in physical exercise programs may be crucial to the maintenance and improvement of postural control performance over the years. The period in which this practice occurred in the life of the older individual is also worth noting, since older individuals who have always practiced physical and sporting activities present better postural control performance, followed by older individuals who have recently begun this practice and those who practiced physical/sport activity only at earlier ages [42]. Older individuals who have never practiced regular physical/sports activity present the worst performance of this system, demonstrating greater postural instability compared to the other groups [42].

Recent studies have shown that the benefits of this practice extend beyond the neuromuscular and sensory alterations observed in the peripheral nervous system [13]. Colcombe and collaborators [50] observed an increase in the brain volume of healthy subjects, aged 60–79 years, after only 6 months of regular aerobic training. There is evidence that exercise may increase the performance of prefrontal brain regions, enabling better control of movement and compensation in the functioning of brain areas directly affected by the aging process, which causes balance disorders, lower coordination, and slower movements, mainly during gait [13, 49, 50].

Unfortunately, there is no consensus in the literature about which exercise is better for the maintenance and/or improvement of the postural control system and, consequently, fall prevention. This is most likely because there are no specific exercises to prevent falls; however, it seems that regular physical exercise, regardless of the type, enables the older people to act on the environment and receive sensory information in order to produce adequate muscular activation. Active older adults might be able to better calibrate their postural responses to environmental contexts.

Currently, many countries offer public policies to reduce the risk of falls in the older individuals due to the high costs of public health hospitalizations [57], reduced functional capacity postfracture, and increased dependence after falls. The main program for the prevention of falls recommended by the World Health Organization [58] comprises educational health, exercise practice, dual-task training, and identification of the risks of falling (individual, environmental, and social). There are many successful programs to prevent falls around the world, such as the Thematic Networks, the Prevention of Falls Network for Dissemination (ProFouND) in Europe, the National Institute for Health and Care Excellence (NICE) in the United Kingdom, the Canadian Falls Prevention Curriculum © supported by the Population Health Fund of the Public Health Agency of Canada, and the National Health Policy for the Elderly in Brazil. The programs propose taking part in a minimum of 50 h of these activities (equivalent to 2 h per week for 6 months, twice a week) for 12 weeks or more [59, 60]. Many programs have helped to reduce the incidence of falls and public costs from hospitalizations and morbidities in the elderly, ensuring the maintenance of functional capacity and quality of life for seniors.

17.4 Final Considerations

Postural control is essential for the majority of daily motor activities. Degradation of this system over the years may be related to the increased risk of falls in the older population. Neural activation and sensorimotor coupling seem to be altered in the older people which lead to poor postural responses to the environment. Exercise practice results in benefits for postural control in neurologically healthy older individuals, improving balance and reducing the risk of falls. Although the mechanisms underlying the improvements in the postural control system are not entirely known, many countries have developed fall prevention programs in order to reduce the incidence of falls and public costs from hospitalizations and morbidities in the older population.

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