

T.C.
YEDİTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

**COMPARISON OF MUSIC BASED MULTITASK
EXERCISE PROGRAM AMONG ELDERLY LIVING IN
NURSING HOME**

MASTER THESIS

MERVE NUR KARAÇOCUK IŞIK, PT.

ISTANBUL-2020

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SUPERVISOR

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İSTANBUL-2020

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APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated and numbered

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DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

Merve Nur KARAÇOCUK IŞIK



DEDICATION

I would like to dedicate my husband Mehmet Musa IŞIK and also I thank to my loving parents Hülya KARAÇOCUK and Ömer KARAÇOCUK and my brother Osman Safa KARAÇOCUK for their support.

Merve Nur KARAÇOCUK IŞIK



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LIST OF SYMBOLS/ABBREVIATIONS

AAE	Actual Angular Error
AC	Anterior (Or Superior) Canal
ACSM	The American College of Sports Medicine
BBT	Berg Balance Test
BOS	Base of Support
CAD	Coronary Artery Disease
CD	Creative Dance
COPD	Chronic Obstructive Pulmonary Disease
COM	Center of Mass
CV	Cardiovascular Disease
FTSST	Five Times Sit to Stand Test
GDS	Geriatric Depression Scale
JPS	Joint Position Sense
KI-ADL	Katz Index of Independence in Activities of Daily Living
MMSE	Mini-Mental State Examination
PC	Posterior Canal
PEM	Pursuit Eye Movement
PPF	Past, present, and future activities
SD	Standard Deviation
SEM	Saccadic Eye Movement
SPSS	Statistical Package for Social Sciences
ST	Stretching Exercises
TPD	Two-Point Discrimination
TUG	Timed Up and Go Test
VO2max	Maximal Aerobic Capacity
VP	Vibration Perception
VS	Vibration Sense
WHO	The World Health Organization
WHOQOL-OLD	World Health Organization Quality of Life Older

ABSTRACT

IŞIK,K,M(2020). Comparison of Music Based Multitask Exercise Program Among Elderly Living in Nursing Home, Yeditepe University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Master Thesis. Istanbul. The aim of the study is to compare the results of calisthenic exercises with rhythm and music in balance education using different sensory inputs in geriatric individuals living in nursing homes. The study included 16 geriatric individuals (9f,7m) aged 65 years and over living in ümraniye ırmak, ataşehir adora and dragos adora nursing home between June 2018 and August 2018. Individuals were divided into two groups. The group 1 (g1) (n=8; 74.00±8.55 years) received exercise training using different sensory inputs, while the group 2 (g2) (n=8; 77.62±5.15 years) received calisthenic exercise training using with rhythm and music. Exercise programs were performed once a week for eight weeks. Subjects in g1 received individual exercise training, while subjects in g2 received group training. To evaluate mobility, balance and walking parameters of the individuals, the timed up and go test (tug) was performed. Five times sit to stand test (ftsst) was used to evaluate functional capacity and lower extremity muscle strength, berg balance test (bbt) was used to evaluate balance and fall risks. Proprioception assessment was done with an angle reproduction test in the direction of dorsiflexion and plantarflexion and deviations were recorded. two-point discrimination with esthesiometer and vibration perception (vp) with a tuning fork (128 Hz) was evaluated. According to the results of study, group 1 showed statistically significant improvement for pre and post-intervention results in 5tstt, bbt, tug, jps, tpd (2.metatarsal head and heel pad), whoqol-old (sensory, autonomy, past, perfect, future), gds tests (table 4.6&4.7&4.8&4.9 p<0.05). When comparing to pre and post-intervention results, there is a significant difference in bbt and gds results in group 2 (p<0.05). There were significant differences in g1 in terms of 5tstt, bbt, tug, jps and mmse scores, when the difference between pre and post-intervention results in intergroup variables is considered. (table 4.11&4.12)(p<0.05). Consistent with our hypothesis, we found that exercise training using different sensory inputs is more effective on balance and proprioception.

Keywords: multi-task exercise program, balance, music-based exercise program, elderly, nursing home, calisthenic exercise



ÖZET

IŞIK,K,M(2020).Farklı Duyusal Uyaranların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon ABD. Yüksek Lisans Tezi. İstanbul Bu çalışmanın amacı; huzurevinde yaşayan geriatrik bireylerde farklı sensöri girdilerin kullanıldığı denge eğitimi ve ritm ve müzikle ile yapılan kalistenik egzersizlerin sonuçlarının karşılaştırılmasıdır. Çalışmaya Haziran 2018-Ağustos 2018 tarihleri arasında Ümraniye Irmak, Ataşehir Adora ve Dragos Adora Huzurevi'nde yaşayan, 65 yaş ve üzerinde olan 16 geriatrik birey(9K,7E) dahil edildi. Bireyler randomize kontrollü olarak iki gruba ayrıldı. Birinci Gruba (G1) (n=8; 74.00±8.55 yıl) farklı sensöri girdilerin kullanıldığı egzersiz eğitimi uygulanırken, ikinci gruba (G2) (n=8; 77.62±5.15 yıl) ritm ve müzik ile yapılan kalistenik egzersiz eğitimi uygulandı. Egzersiz programları haftada 1 kez, 8 hafta boyunca uygulandı. G1 deki olgular bireysel egzersiz eğitime dahil edilirken, G2 deki katılımcılar grup eğitimine dahil edildiler. Olguların; mobilite, denge ve yürüme parametrelerini değerlendirmek amacıyla zamanlı kalk ve yürü testi yapıldı. Fonksiyonel kapasiteyi ve alt ekstremité kas kuvvetini değerlendirmek için beş kez otur kalk testi, denge ve düşme risklerini değerlendirmek Berg denge ölçeği kullanıldı. Çalışmada, propriosepsiyon (dorsifleksiyon ve plantar fleksiyon yönünde) ölçüldü. İki nokta diskriminasyonu değerlendirmesi estezyometre ile, vibrasyon algısı diyapozon (128 Hz) ile değerlendirildi. Çalışmanın sonucunda grup içi tedavi öncesi ve sonrası farka bakıldığında Grup 1; 5TSTT, BBT, TUG, JPS, TPD (2.metatarsal head and heel pad), WHOQOL-OLD (sensory, autonomy, past, perfect, future), GDS testlerinde anlamlı fark gösterirken, Grup 2; BBT ve GDS testlerinde istatistiksel olarak anlamlı fark göstermiştir ($p<0.05$).BBT, KI-ADL ve VS skorlarında tedaviden sonra değerler karşılaştırıldığında istatistiksel olarak anlamlı farklılıklar vardır.İki grup karşılaştırıldığında; Grup 1'in 5TSTT, BBT, TUG, JPS ve MMSE skorlarında, ritm ve müzik ile yapılan kalistenik egzersiz eğitimi grubuna üstün olduğu bulunmuştur ($p<0.05$). Hipotez ile uyumlu olarak, farklı sensöri girdilerin kullanıldığı egzersiz eğitiminin denge ve propriosepsiyon üzerinde etkili olduğunu tespit ettik.

Anahtar Kelimeler:çoklu-görev egzersiz programı, denge, müzik temelli egzersiz programı, huzurevi, kalistenik egzersiz



1. INTRODUCTION AND PURPOSE

The World Health Organization (WHO) defines people aged 65 and over as elderly and aged 85 and over as very old. Gerontologists classified old age as a young age between 65-74 years, middle age between 75-84 years and advanced age over 85 years (old age) [1].

Ageing is a natural phenomenon that affects all people during their lives. It is correlated with a decline in the human body's physical and cognitive functions, as seen, also includes the likeliness of age-related diseases [2]. The aging process also influences gait, balance, and posture. Typical flexion posture is acquired at an advanced age. Body height shortens dorsal kyphosis increases, cervical and lumbar lordosis decreases. Shoulders drop and scapula protracted. Decreased adipose tissue in the face and extremities tends to accumulate in the abdominal region and hips. The center of gravity of the body is displaced, the line of gravity shifts, making the extension of the lower limb joints impossible [3].

Biological changes such as reduction of muscle mass and strength, loss of mobility, and motor coordination and impairment of balance characterize this phenomenon [4]. Balance problems in the elderly are most often caused by a multifactorial situation in the balance system, which may include age-related or disease-related decreases [5]. Impaired balance is also an essential independent predictor of the non-faller to faller status transition. About 30% of people over the age of 65 experience at least one fall each year. The two most common causes to fall to older people are known as difficulties or weakness with the environment and gait/balance [6]. The percentage of falling older adults increases with age [7]. Factors affecting the fall include accidental slipping or tripping, problems with near vision and hearing, postural drop in systolic blood pressure, cognitive impairment, and again depressive symptoms [3]. Many impairments in musculoskeletal, physiological, neurological, kinaesthetic, auditory, vestibular, proprioception and cognitive systems lead to the balance problem, which may result in a higher incidence of falls in older people [8]. After a fall, in addition to physical problems, psychosocial problems are also observed. Loss of self-confidence and fear resulting from the restriction of daily life activities, participation in life, and socialization can be listed as an essential result of the decline in functional level.

Therefore, the most important way to avoid the possible side effects of the fall is to prevent the fall. Prevention of external factors causing the fall is often preferred. The importance of balance in preventing falls is known and it has been shown in many studies that increasing balance in older individuals can be a preventative approach. In addition to external factors, attention should also be paid to internal factors that greatly affect the physical performance of older individuals [8, 9].

Physiological ageing has a significant impact on all phases of sensorimotor processing. An age-related change was also noted to be related to reduced somatosensory activity. It can significantly cause postural instability and falls [7]. There is a general opinion that the changes in postural control in the elderly relate to sensory channel degradation, i.e., vestibular, visual, and proprioceptive signs[10]. The relationship between postural and voluntary movement, based on conscious control, has an essential role in the fulfillment of motor function. The decrease in sensory input in the elderly leads to significant difficulties in feedback type motor control. In older individuals, there have been reported significant impairments in the senses of vibration and joint position, as well as in visual and vestibular sensory systems [3]. For example, deficits in lower limb joint proprioception have been reported to be significantly associated with postural stability. With aging, reduced proprioceptive perception tends to change postural movement patterns. The control strategy passes from the ankles to the hips and then rises in frequency and velocity in postural sway [9].

Elderly living in nursing homes or long-term care facilities have been reported to experience sensory deprivation or excessive sensory stimulation. In the nursing home, older people are less likely to need to use their senses, and sensory deprivation may occur. Therefore, older adults have been shown to have lower sensory tolerances and can be easily overstimulated. It is assumed that balance is necessary for the type and frequency of sensory stimulation they experience. Sensory deficiency and excessive sensory arousal in older individuals; can cause unhappiness, frustration, anger and anxiety [7].

Multisensory stimulation activities are defined as approaches and strategies that stimulate primary senses in a focused way to encourage more adaptive attitudes or adaptive environments and generate enjoyable sensory experiences. The sensory input is the signals that affect a human through sensory pathways involving arousal, olfactory,

auditory, and touch. Crucially, the integration of multi-sensory information obtained from various sensory modalities requires multiple brain areas to communicate over time [8, 9].

Multi-sensory exercise practice increases cognitive skills, motivation in daily living tasks and may reduce the rate of falling among the elderly [11].

Abolhasani also found that tactile sensory stimulations could be useful in reducing stress and discomfort, resulting in relaxation of both physical and mental [12]. An essential factor that should be noted are the features of the multi-sensory exercise program, that is, changes in position; unstable areas with different head movements and activities are commonly used in connection with visual suppression. Such factors include auditory, vestibular, somatosensory, and musculoskeletal functions, raising the responsiveness of the proprioceptive receptor, providing a better, conditions for maintenance of balance and mobility [13].

Jaques-Dalcroze's method, a music movement method founded in Switzerland at the beginning of the 20th century by Emile Jaques-Dalcroze (1865–1950), consists of various multitasking activities, often conducted at the rhythm of spontaneous piano music [14]. The type that adapted for the elderly includes various multitask movements practiced at the rhythm of spontaneous piano music, demanding gait and balance, but also memory concentration and coordination. In a study conducted in Geneva; studies have shown that eurythmics exercise in Jaques-Dalcroze improves walking performance under single and dual-tasks conditions and stability, and also minimizes both the falling level and the risk of falling in the elderly at risk in a nursing home [15].

In this study, two exercises program are included. The Group 1 (G1) received exercise training using different sensory inputs, while Group 2 (G2) received calisthenic exercise training using rhythm and music. This study aims to compare balance, proprioception assessment and vibration sense among geriatric individuals living in a nursing home.

Two hypotheses identified in the study:

H0: The geriatric individuals participating in the balance exercise training using different sensory inputs are not more beneficial effects on balance and proprioception assesment than participating in calisthenic exercise training using rhythm and music.

H1: The geriatric individuals participating in the balance exercise training using different sensory inputs, are more beneficial effects on balance and proprioception assesment than participating calisthenic exercise training with rhythm and music.



2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Aging

Aging is an important process. The demographic change in society is closely related to welfare. When we look at countries whose population is old or very old, we see that they have a high level of well-being. The aging process divides into three subsections: primary, secondary, and tertiary aging [16].

Alteration in biological, psychological, sociocultural and life-cycle processes is related to primary aging, which is normal during adulthood. For instance, menopause, decline reflexes with age, thinning of hair are related to the primary aging process. Secondary aging is developmental changes that are related to disease, lifestyle, other environmentally induced changes that are not expected. Alzheimer's disease and associated forms of dementia, cancer are examples of secondary aging. Tertiary aging describes mortality-related aging refers to deteriorated intellectual abilities that manifest shortly (months, maybe years) before death [17].

A deterioration leads to aging in a lot of domains of cognitive functions. Studies have also displayed that as a decline is not typical to all elderly individuals, and that some older adults can enjoy optimal aging without experiencing an essential cognitive deterioration. For instance, in successful aging, where individuals function efficiently and favorably as they age, there is a likely minor cognitive decline over the life span, and cognitive function can be protected 10th decade [18].

2.1.1. Aging and World

As a result of lower fertility and adult mortality, the population is aging in most countries of the world. In 2016, 8.7% of the world's population was elderly. The first three countries where the elderly population is the highest were Monaco with 31.3%, Japan with 27.3%, and Germany with 21.8%. Turkey has taken place in this ranking 66 out of 167 countries.

The rate of increase in the elderly population (2.1%) is higher than the general population growth rate (1.2%). While the world population has increased four times in the last 100 years (1950-2050), the fact that the elderly population will increase by ten times is an important point to underline. It is stated that the country with the highest

number of elderly population will be Singapore with 316% between 2008 and 2040 [19].

According to geography, races and beliefs are relative to the elderly changes. According to the European system, the older person needs help and from the moment he/she applies, to be followed, directed to the required places and to receive service for his / her problem directly [20].

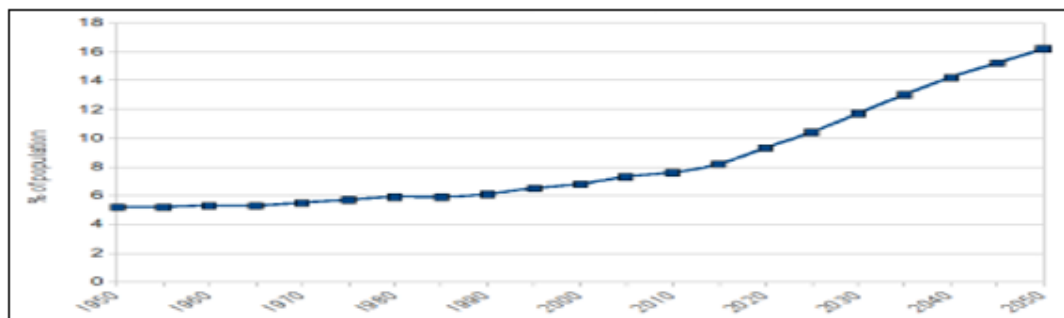


Figure 2.1. Population change in individuals over 65 years of age between 1950-2050 years [21]

2.1.2. Aging and Turkey

In Turkey, in particular, with the rapid decline in birth and death rates in the demographic transition process starting from the 1950s where a young population structure is seen that the transition towards an older population. It is observed that the fertility rate, which is five children per woman in the process of aging of the population, has decreased rapidly since the 1950s. The old population rate is projected to rise to 10.2 percent in 2023 and to 16.3 percent in 2040, 22.6 percent in 2060 and 25.6 percent in 2080 [22].

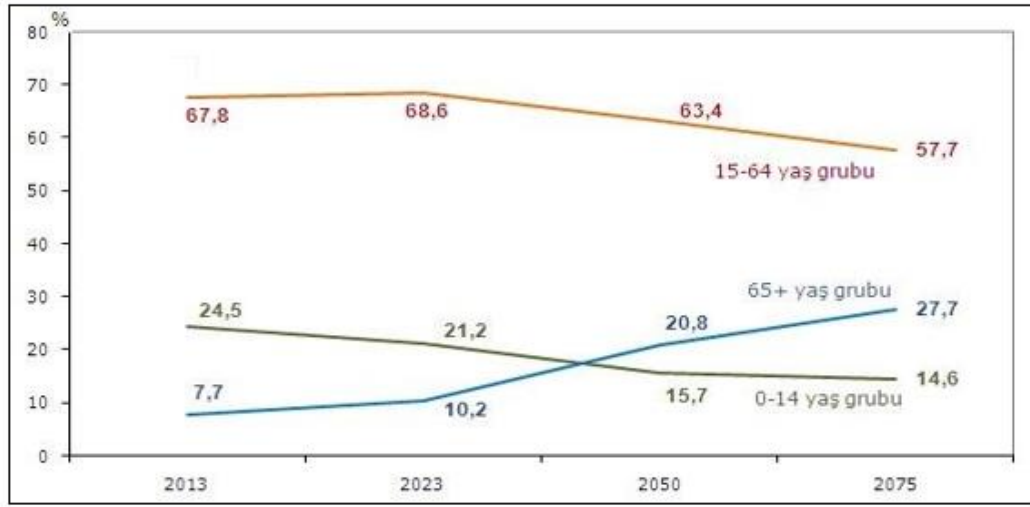


Figure 2.2. The change of the age structure of the population in Turkey, 2013-2075

It is known that the most critical role in the care of the elderly is the spouse, but the adult children have assumed this task by the age of the spouses becoming weaker in time. Adult children who undertake this task are the most important support and social communication resource for the elderly [23].

2.1.3. Problems Frequently Seen in Elderly

Actual biological aging is at different rates in different individuals, because genetic features, lifestyle, diseases and ways of dealing with the physiological changes are very different. In the normal aging process, time-dependent changes do not result in loss of function under normal conditions. Still, there may be a reduction in the reserve of organ systems and homeostatic control. To understand pathological changes in the elderly, it is necessary to learn the ordinary course of aging [17].

As a result of the chronological age between the birth and death of the individual, the total of changes occurring in the body throughout his life is called aging. In this process of change, in the body of an individual, physiological level, by the progress of time, irreversible, structural and functional changes occur. Along with the progress of age, changes in heart, circulatory, excretory, respiratory and immune system functions can be seen. [24].

Understanding age-related changes in both the synapse and the neurotransmitters are also crucial for understanding changes in behavior. With age, changes in neurotransmitter systems can occur without cell damage. Monoaminergic and dopaminergic transmission is observed to decrease significantly, resulting in depression and extrapyramidal side effects in the elderly. [25].

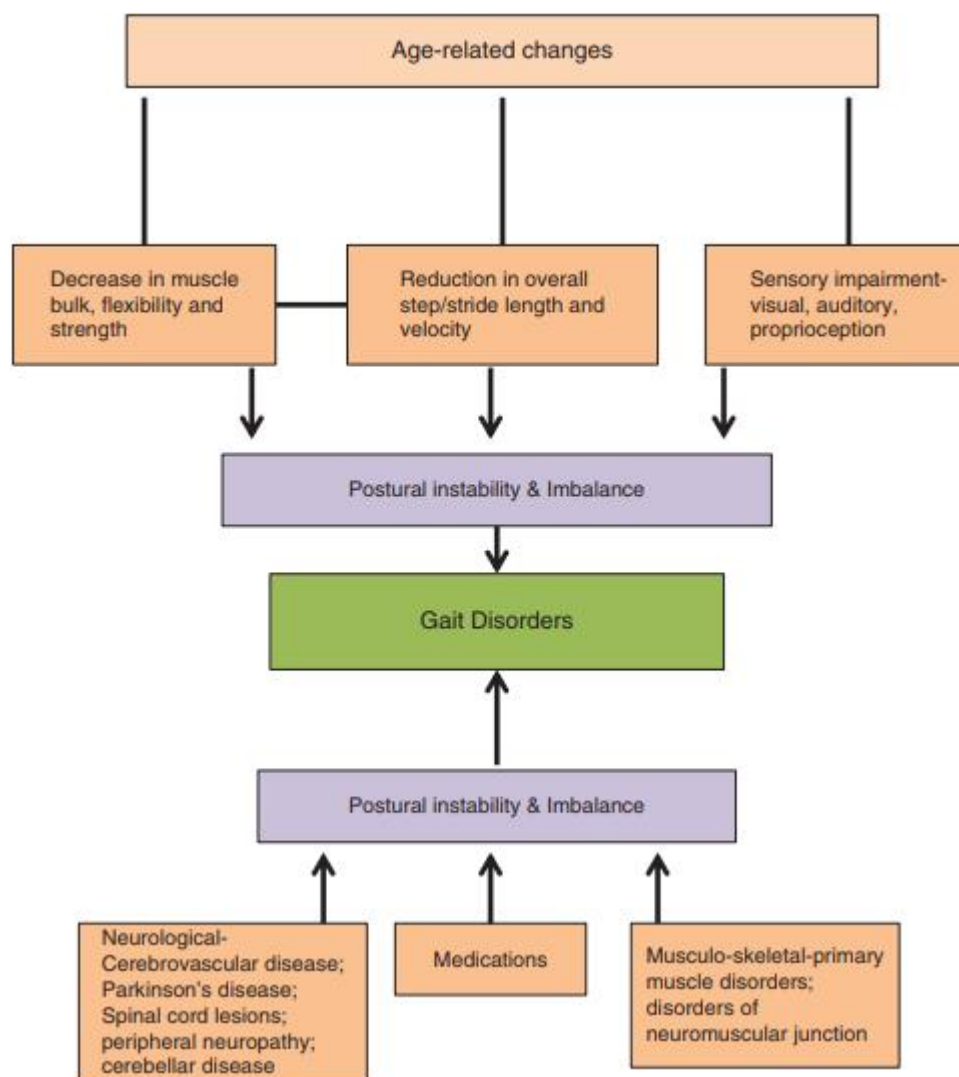


Figure 2.3. Age-related changes [26]

2.1.3.1. Cardiovascular Problems

The prevalence of cardiovascular disease (CVD) is increasing gradually. For example, coronary artery disease (CAD), hypertension, and diabetes may lead to ischemic, hypertensive, or diabetic cardiomyopathy [27].

With age, there may be changes in the heart, such as atrophy, marked or moderate hypertrophy. Atrophy often accompanies various worsening diseases, not part of healthy aging. A moderate increase in left ventricular thickness with age may be seen in normotensive elderly individuals. Left atrial size increases with age. Cardiac shadow expands slightly on a chest x-ray [28]. Reduced maximum heart rate causes low aerobic capacity. Moreover, the accumulation of fat deposits and tissue changes may be observed due to the hardening of the heart muscle [27]. The fat collects around the sinoatrial node and sometimes allows partial or complete separation of the node from the atrial tissue. A marked reduction in the number of pacemaker cells happens after 60 years of age. A changeable degree of calcification occurs on the left side of the heart skeleton. This may affect the proximal left and right branches leading to a critical risk for the atrioventricular node, atrioventricular bifurcation and atrioventricular conduction block [29].

2.1.3.2. Neurological Problems

The elderly are often affected by many neurological symptoms that have an impact on their health, function capability and overall quality of life [30]. With age, cognitive functions such as verbal intelligence, principle attention, memory, language communication capabilities, vocabulary, data processing speed, problem-solving, and recall of information are slowing down. Event time, speech fluency, mental rotation, reason-result relationship, deduction capabilities complex sorting-movement abilities are also decreasing over time [31].

Morphological brain changes and decreases in the age in daily activities are related to each other. Depending on age, neural integration and neural function deterioration occur in the neurovascular unit due to cerebrovascular changes. These changes affect brain structure and function, also affect molecular activities in the same region [32].

Meninges gradually thickens with age. The characteristic thinning of the myelin sheaths in the dorsal column begins in the fourth decade and progresses slowly. Similar changes in the lateral columns can be seen for the sixth decade. Degenerative changes in posterior root fibres also occur during this period. Ischemic changes in the anterior horn cells in the fifth decade and changes in the pigments with atrophy can be seen [33].

Neurological disorders in the elderly are thought to increase the risk of falling due to muscle weakness but the evidence for this is often obliquely derived from research on the causes of falls in the elderly. These studies reveal that patients who accepted to hospitals due to falls often suffer from neurological disorders [34].

2.1.3.3. Muskuloskeletal Problems

According to the World Health Organization (WHO), one of the most critical conditions in the elderly population is musculoskeletal disorders. The ageing process is a necessary and inevitable part of life. Although bones are seen as rigid, permanent structures, the skeletal system is dynamic and continuously renewed. As a result of remodeling, the person's age, physical stress, circulating hormone levels, calcium absorption and excretion rates will vary depending on genetic and environmental factors. Ageing bones become hardened by partial collagen cross-linking, absorb less energy, and resist forces that are reduced. For example, in the human femur, the porosity of bone doubles between 40 and 80 years; the osteoporotic bone absorbs energy much less than healthy aging bone, usually less calcium is stored and bone mass is reduced [35].

In older age, osteoblasts decrease in their lifetime, normal remodeling areas are inadequate, low-loop bone loss occurs. Age-related bone loss begins, loss in both men and women increases gradually. For this reason; in the elderly, soft tissue is not thick enough to support the bone effectively, so the weight of the weakened bones becomes more. As the intervertebral discs lose fluid in the spine, the body becomes shorter and weaker. The legs become less pronounced, which leads to a slight shortening of the neck. Long bones of arms and legs are more fragile due to mineral loss, but their length does not change and therefore, the body is shorter, arms and legs appear longer [36].

There are inevitably various changes in the musculoskeletal system, such as kyphosis, muscle loss, and aging. The posture is more hump, the knees, the hips may be more flexed. As the pelvis expands, the shoulders narrow. Movements are slow and limited; less arm swing is done. Posture and walking changes, balance loss, instability increase the risk of damage, which leads to falls and fractures [37]. Depending on the sedentary lifestyle that comes with age, the individual may lose 40 percent of the muscle mass. Individuals suffer weight loss as well as structural changes due to the decrease in fibril diameter with age [38].

2.1.3.4. Vestibular Problems

In the normal ageing process anatomical, physiological and functional losses are expected to occur [39]. The most common vestibular complaints in the elderly are dizziness and imbalance problems. These problems increase the risk of older people falling. Dizziness in the elderly is multifactorial, but peripheral vestibular dysfunction is one of the most common causes [40]. Specifically, it is well known that with aging there is a decrease of type I and II sensory hair cells and deterioration of otoconia (with otoconial body fractures) in the utricular and saccular maculae. So that, age-related vestibular function decreases. However, the mechanism of age-related cell loss in vestibular endogenous is unclear, but it is thought that the cumulative effect of genetic predisposition and oxidative stress may play a crucial role. Moreover, the function of the semicircular canal and otolith organs decrease with age. This degeneration is an age-related physiological period of demineralization [40, 41].

It is thought that the changes in calcium metabolism in the otolithic membrane cause microvascular ischemia, leading to decreased vestibular input in the elderly population. Thus, it can be observed that balance problem in the individual increase and as a result, mortality and morbidity increase [42].

2.1.3.5. Physiological Problems

In the ageing process, body functions decrease and terminate at a specific rate until cell life reaches an unsustainable point. Physiological changes occur in the structures of the individual, along with the aging process. Difficulties in detection and forgetfulness begin [43]. There may be variations in the digestive system, such as

decreased mucus and absorption, less contraction of the esophagus muscles, decreased gastric elasticity, increased gastroesophageal reflux, decreased intestinal motility, reduced blood flow and reduced efficacy of some enzymes [44]. There may be gastrointestinal changes that may affect food intake in older people. Interruptions in the discharge of the esophagus may be due to changes in the peristaltic wave activity of the esophagus. However, common nutritional inadequacies are also connected with bacterial contamination in the small intestine [45]. Moreover, renal function declines with age. There is a decrease in kidney mass, blood flow, glomerular rate and the elasticity, muscle tone, and capacity of the bladder [46]. Lung function decreases due to decreased elasticity of the lung, increased stiffness of chest wall and weakening of respiratory muscles. As a result of these changes, significant progressive reductions in forced vital capacity, diffusion capacity, gas exchange, ventilation, and respiratory susceptibility are developing [47].

Also, age-related changes affecting hormone secretion can be attributed to alterations in other systems. A decrease in glucose tolerance may be observed due to decreased insulin response to tissues and / or reduced insulin secretion. The basal metabolic rate slows down due to the shrinkage of the thyroid gland [44].

2.1.3.6. Social Problems

Musculoskeletal, neurological, vestibular and physiological changes and regressions also affect the social life of the older person and lead to a reduction in personal experience. Weak mobility, visual and hearing problems, digestive and gastrointestinal problems, memory loss, and chronic illnesses affect the quality of life of the individual and their morale and social life directly. The presence of depression in the elderly causes more exacerbation of diseases and increased deaths related to these diseases. Again in this age group, depression leads to disability and the need for care and social support, thus reducing the quality of life and negatively affecting the self-esteem of individuals [48].

2.2. Sensory System for Elderly

The sensory organs are directly linked to the cerebellum, brain stem, and brain cortex. The clues about the state of the body are taken by visual information and the effects of gravity. The cerebrum compares the information it receives from the sensory

organs with others, processes and then sends reflex responses to all muscles in the body, thereby maintain the posture and eye position [49].

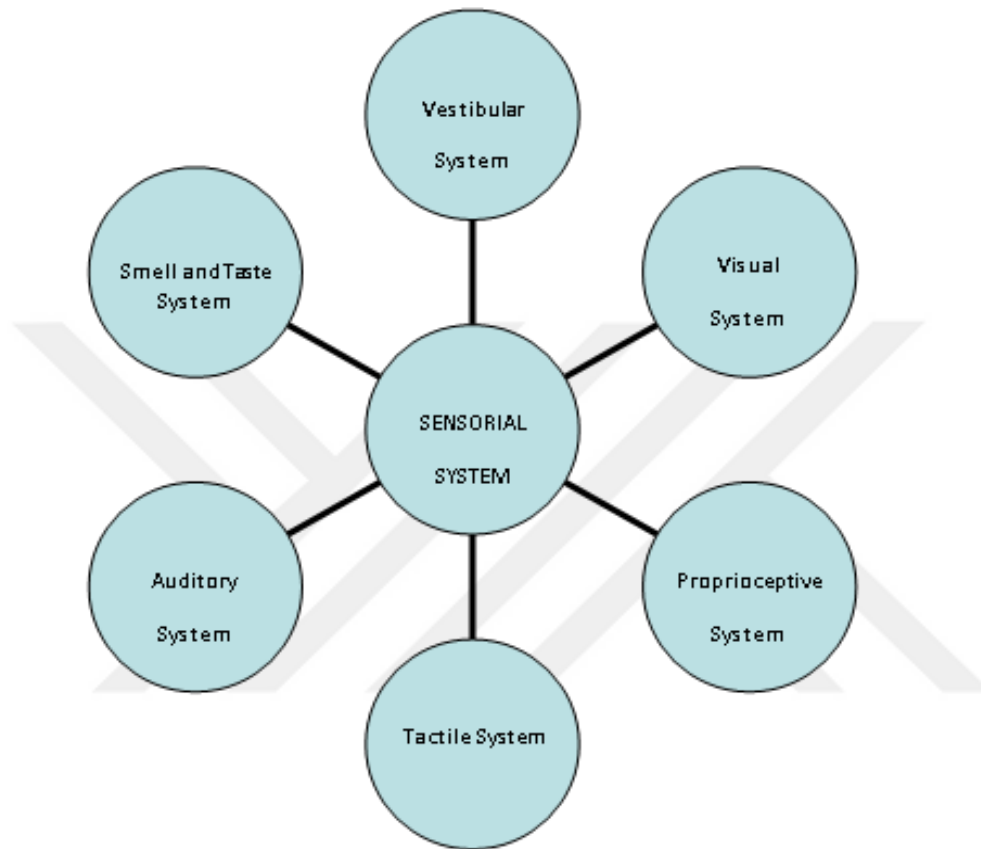


Figure 2.4. Sensations of Body [49]

2.2.1. Vestibular System

The vestibular nucleus is located in vestibular organ and is the system of the paths between these two structures. The vestibular organ located in inner ear consists of the utricle, and the semicircular canals. This system provides information about the central nervous system and allows for adjusting the position of the head, which is very important for postural control [50]. The sacculus, utricle and semicircular canals in the vestibular organ help the formation of equilibrium [51]. Two primary receptors, utricle, and sacculus, also known as otolithic organs, is responsible for the static balance. The upper surface of the receptor cells contains an organic matrix containing CaCO_3 crystals, that is, macular organ and they detect movement. Both of them

produce a sign about the linear movements of the head (forward-backward, right-left, up-down). They respond to slow head movements throughout the postural oscillations, thus helping to maintain the static balance by positioning the head according to the posture taken by the body. Since they are activated with gravitational movement, they provide tonic postural control [52, 53].

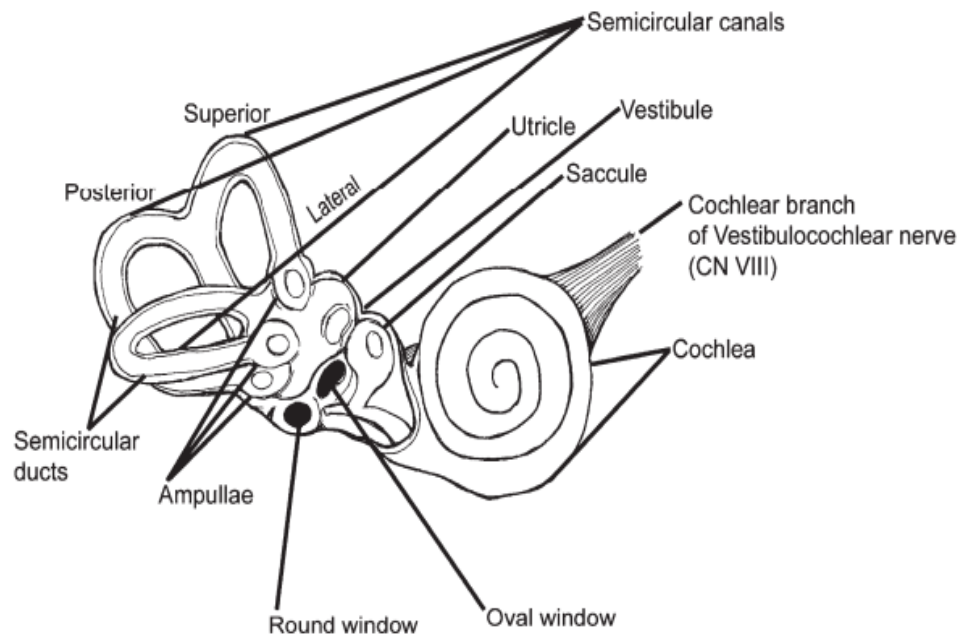


Figure 2.5. Bony & Membranous Labyrinth [53]

The semicircular canals are bilateral; they are three pieces (horizontal, posterior, superior) and they make a 90-degree angle with each other. Thanks to this upright arrangement, they perceive the head movements in a 3D plane and are responsible for the rotational movements due to the endolymph fluid in them. The semicircular canals in one ear work in coordination with the other ear and are effective in the formation of dynamic balance [52, 54].

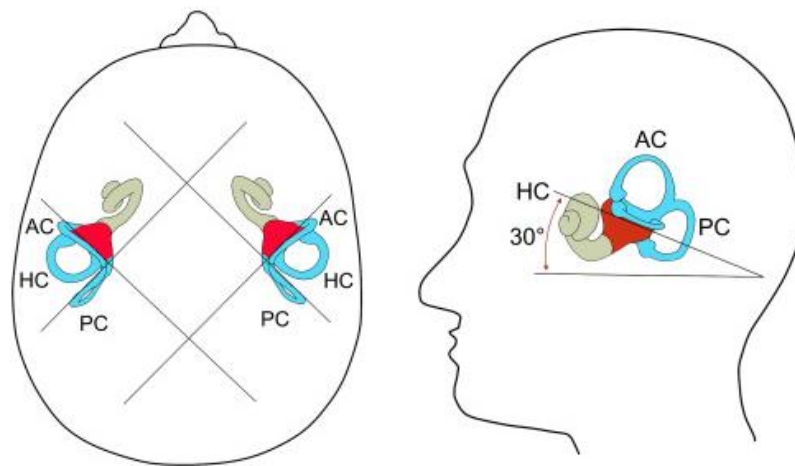


Figure 2.6. Schematic drawing of the orientation of the two labyrinths in the skull. HC, horizontal (or lateral) canal; PC, posterior canal; AC, anterior (or superior) canal [55].

Vestibulo-ocular and vestibulospinal reflexes are the reflexes of the vestibular system. Vestibuloocular reflex coordinates the movement of the eye to stabilize the image during the rotation of the head. Moreover, vestibuloocular reflex provides head/neck eye control. Vestibulo-spinal reflex connects with vestibular end organs and the neck and anti-gravity muscles stabilize the head and maintain the upright posture of the body [56].

The vestibular system provides special leg motor control for each phase during movement. The task of the motor cortex is to create important visual responses, to adapt easily to the different characteristics of the environment and to make the necessary adjustments. With vestibular stimulation, the person forms an internal representation of the body in the space during movement. This integration is essential for the other extremity to know the body position and the appropriate movement to provide an advanced level of complex movement and balance. In this way, according to the body position, the width of the support base is decided, and the desired position is obtained. Mobility and balance arising from the integration of senses, not only from the regression of the peripheral nervous system in old age; age-related brain structure and function is affected by the decrease [57].

2.2.2. Proprioceptive System

Proprioception can be defined as the position's sense of mechanoreceptive. It can also be defined as the ability of the body to be conscious and unconscious of its

position in space and gives a contribution to position sense and posture [58]. It plays a vital role in maintaining joint stability [59]. Proprioception includes two-part of position sense: static and dynamic parts. Static part of proprioception gives information about one body part orientation to another, and dynamic sense provides neuromuscular feedback about the rate and direction of movement. Therefore, proprioception is a complex process which contains stability and orientation during activities [60].

Proprioception gives sensory information about the stretching and contraction of muscles and compression of joints because of its receptors' locations [61]. The proprioceptive feedback comes from muscle spindle, mechanoreceptors of the skin, joint receptors and tendon organs [62].

Afferent information that is proprioception; contribute to the sense of awareness, general postural balance and segmental posture. In adults, it is the most important sensory system in the formation of postural responses [52]. Postural control depends on sensory inputs somatosensory information from muscle spindle and joint mechanoreceptors. However, most of these systems are declining with age. For instance, due to the reduction of plantar mechanoreceptors in older adults, it is likely that foot position awareness has significantly reduced compared to younger adults. This decrease further disrupts awareness of foot because of wearing shoes, resulting in reduced tactile feedback. Similarly, proprioceptive sensation in the toes and heel of the elderly may decreased [63].

The proprioceptive strategies used in older adults may change over time. Decreased proprioceptive signals cause the biomechanics of the abnormal joint. This results in joint degeneration. More significantly, lower extremity joint degenerations have been shown to be led to fall accidents [64].

2.2.3. Visual System

The visual system informs the brain about the position of the head, the orientation of the eye and the direction and speed of the head movements according to the environment [65]. The receptors of the visual system are located in the retina, located on the back wall of the eye. These receptors are photoreceptors and are called rods and cones. The rods are responsible for the scotopic vision and are more sensitive to light than cones; the cones are responsible for the photopic vision and realize the colour vision [66]. The stimuli to receptors go to the visual cortex in the brain via the

optic nerves and are processed and thus, balance is achieved by determining the position of the body in space and direction of the movement [52]. It provides a reference for the vertical direction by using the surrounding objects and is important in determining the direction of movement of the head. For example, when moving, objects appear to be moving in the opposite direction. In such a situation, the direction of movement of the head can be understood through the visual system. These features show that the visual system is more likely to support two other systems [59].

Owing to macular degeneration, cataract, glaucoma, and retinopathy, increased visual impairment occurs with age. Also, visual function (visual acuity, perception of contour and depth, sensitivity to contrast, peripheral vision) is reduced due in part to structural changes in the eye [67].

2.2.4. Tactile System

The largest sensory system of the body is the tactile system and it is very important for humans to organize behavioural, physical and mental conditions. All sensory neuron cells are found in the dorsal ganglion and have fibres from the joints, muscles, bones, ligaments and visceral [68]. Touch, pressure, pain, and heat receptors are found in the epidermis and dermis of the skin.

Two subdivisions, which are dorsal column medial lemniscal pathway (DCML) and anterolateral system (AL), are used to carry somatosensory from the body to the CNS. These subdivisions provide the ability to interpret the tactile world and to give response to touch. The DCML gives a response to mechanical stimuli and transmits primarily tactile stimuli. It is associated with tactile discrimination or perception. Besides, because of its task about carrying proprioceptive information, it transfers information about the position of the body and limbs in space. On the other hand, AL carries information about the pain, temperature, light touch and tickles. Also, there is also one more pathway called the trigeminothalamic pathway, which carries all somatosensory information from head and face [69].

When we touch an object in our daily life, we get information such as shape, size. This physical contact stimulates slowly and rapidly adapting sensory mechanoreceptors within the skin and allows activation in different areas of the cerebral cortex. With the cutaneous sensory body and receptors in the skin, sensory information

is carried and tactile sensation is formed [70]. This results in perception and awareness about the object [71].

Peripheral nervous system, anterior horn cell, neuromuscular junction, degeneration of the dorsal root ganglion are examples of some changes that occur with aging. Besides, the dermis becomes thinner and loses its elasticity and its vascularity decreases. Besides, there may be reductions in the sense of vibration, position, and kinesthesia [72].

2.2.5. Auditorial System

Auditory stimuli are sound waves and perceive that sounds generated by mechanical vibrations in the external environment [73, 74]. Sound waves stimulate the auditory receptors and the brain stem is sent to the hearing center. Then, these auditory impulses begin to be processed in the nuclei with impulses from other systems such as the vestibular system, muscles and skin. Auditory inputs, like visual inputs, go to other parts of the brainstem and cerebellum to integrate with other senses and generate motor responses. Last, this information goes to the cerebral hemispheres [61].

Along with ageing, there is a decrease in the number of neurons in the brain's hearing centers and cochlear nuclei, in the size of the cells, and changes in the neurochemical structure of the cells. This is related to the reduction of the ability of the central auditory system to process the sound [73]. According to the study, older people who live in nursing homes experience more moderate to very severe hearing loss [74].

2.2.6. Sensorial Problems in Elderly

The adjacent body segments must keep our body upright with the signs from each other and the environment [75]. Although the mechanism of sensory loss in the elderly has not yet fully explained, neuronal apoptosis can cause mild-moderate inflammation depending on the disorganization of the immune system [76]. Age-related sensory dysfunction, reduced sensory-motor performance, inefficient sensory stimuli, changes in the anatomy of sensory systems and decreased muscle strength lead to decreased balance performance in older adults [75, 77].

Changes with aging in vestibular, visual, and somatosensory systems may prevent the transfer of information toward the posture control center [78]. Because of these changes in postural instability, the daily life of the elderly becomes more difficult,

increasing the risk of falls and fear of falls [79]. Additionally, due to lack of sensory stimulus and inadequate sensory evaluation and decreased movement in the elderly, load transfer in the lower extremity is affected. Plantar sensitivity can occur because ankle movements are also affected [78, 80].

2.3. Balance

Balance means the protection of the body's position in equilibrium. When the body's center of mass (COM) is maintained in the limits of the base of support (BOS) within any position, the balance is provided [59]. The static balance control means to keep up the stable antigravity position in any steady position like standing or sitting. Standing balance is vital to perform daily activities like reading, taking a shower [59]. On the opposite hand, dynamic equilibrium control provides the stabilization of the body when the support surface is moving like from a sitting position to walking or in exceedingly moving platforms. Besides, there are postural reactions connected by balance changes [81]. This provides sudden balance reactions to unexpected external perturbations [59]. The centers contributing to the balance function are the cerebellum, basal ganglia and cortex. The regions responsible for the balance and coordination of the cerebellum; the flocculonodular lobe (vestibulocerebellum) is responsible for eye movements and the balance of the body due to its connections with the vestibular nucleus. Spinocerebellum sends an extension to the medial pathways through the nucleus, responsible for the body and proximal muscle tone [82].

Three movement strategies have been defined by Horak and Nasher to ensure balance. These are ankle, hip and step strategies. The first one is the ankle strategy. During small perturbations, it restores COM to a fixed position with movements in the ankle, providing stability control [59, 83]. Gastrocnemius, hamstring and paraspinal muscles are important in the loss of balance in the forward direction. The anterior tibialis, quadriceps and abdominals are important in the balance loss backwardly [83]. In the hip strategy, a person uses rapid hip flexion or extension to move COM within the BOS during the rapid or large external perturbations. The abdominalis and the quadriceps are used in forwarding sway, while the paraspinalis and the hamstring are used in backward sway [59, 84]. A third primary strategy is stepping strategy. During

the large forces, the COM displays beyond the limit of stability, and a step is used to regain balance control by enlarging the BOS[59].

The highest integration of balance and coordination data is the cerebral cortex. The visual system, vestibular system, proprioception and spinal tension reflexes provide the necessary information and the integration of this information in the central nervous system provides postural control [51]. Physical and mental deteriorations occur with age and it is difficult to maintain both static and dynamic balance for the elderly. To maintain the static balance, the body center of gravity should pass through the level of the second sacral vertebra and stay on the support surface [85].

2.3.1. Mechanism Affecting Balance in Elderly

2.3.1.1. The effects of the sensorial system on balance

The balance control is a coordinated sensorimotor interaction chain that continuously synchronizes information from the senses, especially proprioceptive, vestibular, auditory and visual modalities. The vestibular system, visual system, and proprioceptive system ensure the continuity of balance with different tasks. For example, the somatosensory and visual systems maintain balance while the eyes and feet are still standing open. In contrast, the vestibular system allows us to find balance by finding the appropriate position with the movements of the head on the unstable platform and the speed of the movement. The somatosensory system helps to balance by providing postural control [77, 86]. Studies show that any appropriate and timely increase in sensory information may lead to an improvement in the balance of the elderly. Stimulation of the soles of the feet is a kind of intervention that can develop the proprioception and somatosensory system. Several studies have shown the relationship between plantar stimulation and balance control [87]. The study of Fil (2013) about the effect of sensory therapy on a patient with Parkinson's Disease showed that this therapy method is effective on balance measures and postural stability of patients with Parkinson's Disease[88].

Natural ageing and age-related diseases can cause different sensory systems to be affected for balance control, including visual, vestibular, proprioceptive, and tactile systems. Especially distorted depth and various eye defects can be observed from the age of 50. The balance center is affected by the number of vestibular nuclei and the receptors whose structure is impaired by ageing. Golder et al. showed that significantly

worse functional mobility than non-disabled peers of older subjects with vestibular dysfunction. In old age, chronic diseases can affect the nervous system and lead to negative effects in both proprioceptive and somatosensorial area[89].

2.3.1.2. The effects of musculoskeletal system on balance

The musculoskeletal system provides the postural compliance, the integrity of the joints, the range of motion, muscle flexibility, sensory integrity and muscle performance required for balance.

2.3.1.2.1. Postural Control

Postural control is the most important factor in providing orientation and balance in the body [90]. A person takes sensorial inputs from prenatal life until end of life. These sensorial inputs are taken and integrated to create body awareness and body's actions. Some sensorial input gives us information about space, timing, and depth, and others may provide information about our body[91]. These three sensory inputs, somatosensory, vestibular and visual, are responsible for posture and posture control. The vestibular system provides reflexive responses for postural control, and the visual system is responsible for motion detection and processing, as well as fixation, while the proprioceptive system provides information about the position of the muscles and joints[92, 93].

It is accepted that supraspinal changes caused by aging are affected by balance control. However, the deterioration of postural control in the elderly is associated with increased corticospinal stimulation and decreased intracortical inhibition. The slowing of messages to the postural muscles can lead to more or less movement to control the position [94].

Postural changes may affect balance. The components of postural compliance, such as the tone of the muscles, the foot position and the pressure distribution to the ground, muscle elongation - shortening mechanisms, should be appropriate for the balance. With aging and immobile lifestyle, posture is adversely affected and changes in balance centers change the balance responses that will occur in the body [95].

2.3.1.2.2. Flexibility, Range of Motion and Movement

All anatomical structures and tissues, such as muscles, ligaments, connective tissue, bones, etc., must be involved in motor activity and provide the necessary answers. [96]. Over time, the flexion posture in the elderly affects the body's center of gravity. Mobility decreases and this decrease in movement negatively affects the balance and increases the risk of falling in a vicious cycle, leading to muscle weakness and muscle atrophy, which is especially evident in the lower extremities [97].

2.3.1.2.3. Muscle Performance and Endurance

Some of the muscles work as synergistic and others as antagonists. There is a balance of muscles according to performance, shape and function differences to achieve this harmony between the muscles. Only the strong or durable muscle is not sufficient for balance or movement. The synergist and antagonist muscles should be strong and endurance with adequate suitability. This is called muscle balance. For example, for a suitable knee flexion-extension movement, the force ratio of the hamstring and quadriceps muscles should be 2/3, so that the body can perform the movement in the most balanced and effective manner. In this way, all muscles perform their functions according to their optimum performance values. The optimization of muscle performance for good body balance should be added to the treatment program. Sarcopenia and cardiovascular changes occur in older ages affect balance [98].

2.4. Different Rehabilitation Programs for the Elderly

Regular exercise is very important for healthy active aging. Even in very advanced age, regular physical activity can increase physical capacity. Physical capacity in older ages, even minimal reductions can negatively affect daily activities such as getting out of the chair. An added disease attack can make an older person completely dependent and immobilized [99].

2.4.1. Aerobic Exercise

Aerobic exercise can be effective in preventing atrophy in the elderly brain for a period of 1 year by exposing neurogenesis in the hippocampus. Hippocampal volume changes are related to plasticity. However, it reveals cardiovascular adaptations that increase the highest oxygen consumption without changing strength significantly [100, 101]. Aerobic exercises such as walking, running, bicycle riding, dancing should be

preferred. Aerobic exercises are recommended with three or five times a week on non-consecutive days and 40%-60% of maximal aerobic capacity(VO_{2max}) is appropriate for moderate-intensity exercise. The American College of Sports Medicine(ACSM) guidelines advise the 150 min moderate-intensity exercise or 75 min vigorous-intensity exercise at least three days a week. The exercise program should be prepared individually, considering the personal characteristics and medical features [102].

2.4.2. Flexibility or Stretching Exercises

Flexibility or stretching exercises enhance the joint motion range after three to four weeks of periodic stretching two to three times a week. Still, with daily flexibility exercises, even greater gains are accomplished. Older people with decreased joint flexibility may have difficulty practising routine tasks such as wearing and getting things from a shelf. After a light-to-moderate aerobic or strength practice, flexibility exercise is most efficient [103].

2.4.3. Resistive Exercises

Strengthening or resistive exercises affect body composition positively, decrease the risk of disease and especially abdominal fat tissue. The other benefit is the improvement of bone health with increased bone mineral density. Exercises may perform with resistance bands, free weights, weight machines or self-weight of body. The exercise program should be initiated lower level and progressed gradually to avoid injury. At least two days a week, older adults should do resistive activities that involve all major muscle groups. It is recommended to perform the exercises 8-12 times per activity, or until it recommended to perform would be difficult to do another repetition without help. Many studies have indicated that combined aerobic and resistive training is more beneficial than resistive or aerobic exercise alone [102].

2.4.4. Calisthenic Exercises

Calisthenic exercises are aerobic exercises aiming to improve muscle and cardiovascular endurance. The intensity of the exercises builds on the numbers of sets, repetitions, and the length of the interval. They are rhythmic, smooth, amusing exercises that are easy to achieve alone or in a group and can be modified according to subjects' fitness levels. Exercise programs must improve physical activity in health care and cause to alter the lifestyle of subjects. To set up physiological adaptations, the exercises must be applied regularly at least three days a week for 12 weeks. After three months,

exercise is termed as long-term exercise. Also, these exercises have psychosocial benefits such as an increase in hand skill, responsibility sense, teamwork and competitive excitement [104, 105].

2.4.5. Music and Rhythm Therapy

Music can affect the physiological and psychological feedbacks of a person. Some kinds of music can alleviate pain, decrease anxiety.

The quality of life and relationships of physically sedentary people living in a nursing home may be affected. Appropriate exercises program with rhythmic music that stimulates increase mood improves depression. Satoh et al. noted that physical exercise with music enhanced the cognitive function of older people [106].

2.4.5.1. Jaques-Dalcroze Eurhythmics

Jaques-Dalcroze's approach is known as 'rhythmic gymnastics', developed in the early 20th century by the creator Emile Jaques Dalcroze (1865-1960) in Geneva. This approach, consisting of a variety of multitasking exercises, has been used worldwide in the field of music, dance, theatre and therapy. Practitioners create choreography by emphasizing music rhythm and body movements through various tasks based on the rhythm of piano music.

Recently, classes for older adults have been developed. With its integrated motor and cognitive content, it is an application that requires more dual-task applications than other forms of exercise that require multi-component attention. Regular practice of Jaques-Dalcroze Eurhythmics can consist of multi-tasking exercises, primarily challenge gait and balance. In addition, with the rhythm of piano music, a high level of attention, coordination and memory improvements were observed [107, 108].

Music-based multitask exercise program (i.e., Jaques-Dalcroze eurhythmics) would enhance gait and balance and reduce fall risk in community-dwelling older adults at high risk of falling [109].

Trombetti et al. showed that music-based multitasking exercise training (at one session per week for six months) improved gait performance and balance in older people [110].

2.4.6. Proprioceptive and Balance Exercises

Proprioception sense involves information collected by mechanoreceptors located in articulations, tendons, muscles, and skin, allowing some notion of the human body's positioning regarding its orientation in space or with motion [111].

For all elderly adults, balancing and proprioceptive training should be a periodic of the practice to avoid falling, particularly in adults at a greater danger of falling. Balance training should be at least two hours a week. Group-based or home-based exercises should be carried out continuously for permanent non-fall prevention consequences. To minimize the risk of falling during practice, balancing training should be carefully monitored at first and start with less challenging postures [103].

Static balancing activities can also be used as tentative training activities that involve balance and control during dynamic activities. Static balance training can be initiated once the individual can carry weight on the extremity. The overall progression of static equilibrium activities includes a progression from bilateral to unilateral activities, from activities with eyes open to eyes closed, and from activities carried out on a stable to an unstable surface. Activities can initially be carried out on a stable ground like the ground. These can be advanced to operations such as a foam mat, cushion, or equilibrium table on unpredictable ground. She/he should initially conduct these actions while focusing on her / his body position sense, muscle control, and joint motion to improve sensory information. Over time activities can be integrated into the balancing training tasks such as catching or throwing a ball. Training in different positions places different demands on the structures of the joint and the musculotendinous and provides different sensory feedback [112].

Many studies have confirmed that the traditional Chinese form of Tai Chi exercise is effective in maintaining equilibrium among the elderly through improved proprioception, especially ankle proprioception. Tai Chi provides proprioceptive and neuromuscular control with its continuous slow movement and conscious awareness of body movements such as body-mindfulness practice [113]. This exercise focuses on the gentle alignment of the eyes, head, body, and upper and lower extremities; for this purpose, in many older adults, Tai Chi is given unique significance in the regular practice [114].

Water exercises are also suggested about low and moderate-intensity activities and taking into account their advantages to the practice of these exercises [111].

Silsupadol et al. proposed that cognitive dual-task programs (equilibrium exercise + behavioural training) are more effective than single-task practice (equilibrium practice) to improve equilibrium function [114].

2.4.7. Sensorial Programs in Elderly

The multi-sensory signal within the central nervous system is synchronized at several rates. Adequate motor patterns are then chosen depending on previous experiences for postural alterations and motions. In association with ageing, decreased mechanical and proprioceptive sensation tends to alter the features of postural control [11].

One of the causes of balance deficiency in elderly individuals is the reduction in semicircular channels, sacs, utricle, proprioceptive system, sensory receptors in the retina. Even in the elderly without balance disorder, there is a slight decrease in the vestibulo-ocular reflex (VOR), smooth pursuit eye movement gain, saccadic rate and an increase in latencies. Sensory organization exercises of balance; vestibular (different head movements), somatosensory (hard, soft, smooth, irregular, moving contact surfaces) or visual (eyes open, eyes closed, moving visual warning) warnings by changing the accuracy and presence, increasingly difficult to static and dynamic are examples. Also, exercises such as walking backwards, stepping to the side, eyes open and then counting on soft ground, and walking in the dark on the cushion are examples of sensory exercises [115].

Exercises practiced with balls on uncomfortable surfaces with varied head positions and activities combined with sensory stimulus should be used to enhance postural control over the elderly population. As elderly require vestibular, somatosensory and musculoskeletal structures, increase the sensitivity of neurons and provide better environments for balancing [116]. Furthermore; in some studies, it has been shown that multiple stimulation methods have a positive effect on the cognitive status, depression and anxiety level of the elderly [117]. Vestibular training programs have been claimed to be effective even in the elderly affected by various neurological and vestibular disorders. [118].

3. MATERIALS AND METHODS

3.1. Subjects

The sample of the study consists of individuals (n = 16) living in Atasehir Adora Nursing Home, Dragos Adora Nursing Home, and Ümraniye Irmak Nursing Home from June 2018 to August 2018. Among the subjects who meet the inclusion criteria, individuals who accept to participate in the study divided into two groups.

The study group was divided into participants involved in Exercises Training using Different sensory inputs Group (Group 1) and Calisthenics Exercise using Rhythm and Music Group (Group 2).

3.1.1. Inclusion Criteria

- Participating in the study voluntarily
- Being >65 years old
- Living in a nursing home
- Having maintained a standing position without support for 2 minutes and above
- Having the independent walking capacity for 20 m and above
- Having Score from Mini-Mental Test ≥ 18
- Having sufficient hearing capability to follow music

3.1.2. Exclusion Criteria

- Unstable cardiovascular conditions (hypertension, unstable angina pectoris)
- Vertigo
- Serious neurological problems affecting walking / or balance

The study protocol was approved by the Yeditepe Üniversitesi Ethical Committee at the date of 20.06.2018. Participants involved in the study on a voluntary basis. The study protocol was explained to each subject and informed written consent was obtained from each subject. (Appendix 1).

3.1.3. Flow of Chart

We planned to have 20 individuals who satisfied interventions. As for the first step, we separated the participants according to involved the Sensory-Based Balance Training (Group 1) and Calisthenics Exercise using with Rhythm and Music Group (Group 2).

After the end of the first assessment, eight weeks exercise training program initiated with 16 participants. However, four individuals were excluded from the study due to various reasons, and they did not complete the exercise program. (Figure 1. Flowchart Diagram)

3.1.4. Study Protocol

The study carried out at Adora Nursing Home Elder Care Center, Dragos, Adora Nursing Home Elderly Care Center-Ataşehir, and Irmak Nursing Home Elder Care Center-Ümraniye. The treatment protocol was planned to be 40 minutes for the for the Group 1(G1) (n=8) and the Group 2 (G2) (n = 8) for eight weeks. Heart rate and blood pressure were measured before and after the study. All exercise program was started with warm-up exercises for 5 minutes. Call down period with 5 minutes was applied to two groups at the end of the exercise program. G1 participated in exercises using different sensory inputs training, which is described as “Reykjavik model.”G1 implemented with a sensory training program consists of proprioceptive training, especially for the lower limb vestibular and eye control training facilitation and combinations of proprioceptive and vestibular impulses to fall-prevention. A physiotherapist did the training protocol under supervision in the nursing home. They performed exercise while barefooted firm and soft surfaces, during quiet stance and movements once a week. Group 1 attended a one to one activity for 40 minutes. During exercise sessions, subjects were encouraged to pay attention to sustain their balance using verbal commands.

In the study, the subjects in G2 were participated in the calisthenics exercise programs using rhythm and Jaques-Dalcroze rhythm music exercise program that consists of ankle dorsiflexion, plantar flexion, knee flexion, extension exercises, bilateral upper extremity and hip flexion, extension, abduction, adduction exercises, sit and up. During the exercises, subjects tried clapping and followed music rhythm in the sitting position. Exercises for weight-bearing (forward-to-back, right, left) and trunk

movements (flexion-extension) showed to subjects. Each step is performed for 20 seconds, three sets are repeated, 40 seconds rest between each set. Relaxation time and exercises can be adjusted according to the individual. The elderly were allowed to sit when they got tired while exercising. For safety, during training sessions, exercises were performed on the wall edge to prevent the elderly from falling.



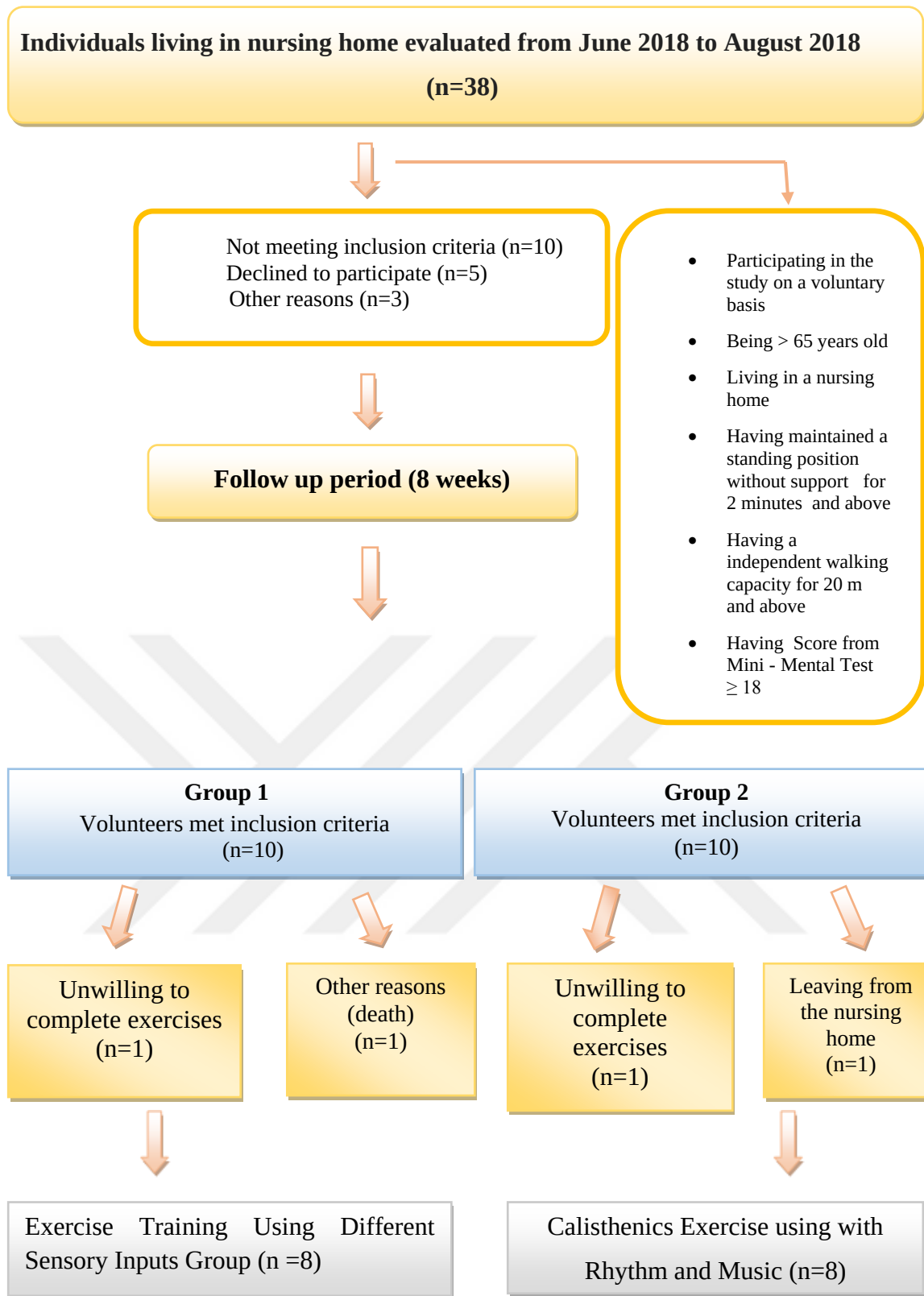


Figure 3.1. Flowchart Diagram

3.2 Evaluation

3.1.5. Structured Questionnaire for Patient's Demographic Characteristics

The structured questionnaire prepared by researchers applied face-to-face interviews. The questionnaire included age, gender, height, weight, body mass index, education level, marital status, to understand the socio-demographic conditions of volunteers. The second part of the questionnaire was about their exercise behaviours, smoking habits, taking medications, having chronic diseases, having children, history of previous falls, number of falls, length of nursing-home stay (APPENDIX 2)

3.1.6. World Health Organization Quality of Life Older Adult (WHOQOL-OLD)

WHOQOL-OLD contains 24 questions, and each question is answered with a 6 point Likert scale. These areas include sensory abilities, autonomy, past, present and future activities, social participation, death, and dying intimacy. The total score is between 4-20. Furthermore, intimacy “Sensory abilities” (question 1,2,10,20) evaluate sensory functioning and effects the loss or deterioration of sensory abilities (eye, nose, ear, taste, and feel). “Autonomy” (question 3,4,5,11) assess the independence of old age and expressed the ability to live on its own. “Past, present and future activities” (question 12,13,15,19) characterize the satisfaction of the achievements of life and the view of the future shows. The “social participation” (question 14,16-18) mentioned in especially in the community, describe how to participate in daily life activities. The “death and dying” (question 6-9) concerns and fears about death. “Intimacy”(21,22,23,24) evaluate personal and private relations skills [119].

3.1.7. Mini-Mental State Examination (MMSE)

MMSE assesses cognitive functions globally. The questions are asked to the patient and answer questions verbally. It consists of eleven items under five main headings: orientation, record memory, attention and calculation, recall and language. The total score is evaluated over 30 points. Dementia stages are 24-30 points normal, 20-23 mild stage, 10-19 middle stage, 0-9 advanced. The MMSE takes only 5-10 minutes to administer and is so practical to use repeatedly and regularly. Older with cognitive impairment, community-dwelling, hospitalized, and institutionalized adults may assess performance [120].

3.1.8. Timed Up and Go Test (TUG)

Timed Up and Go Test evaluates mobility, balance, and walking characteristics and, fall risk in community-dwelling. The person is positioned with feet touching the ground and arms free. The time is started when the person gets out of the chair and the time is stopped when they walk 3m (10ft) and sit back in the chair. It is repeated on average three times. It is rapid and simple to fulfill without special equipment or training. Performance values according to age ranges are as follows;

60-69 years; mean 8.1 s (7.1-9.0) (95% CI)

70-79 years; mean 9.2 (8.2-10.2)

80-99 years; mean 11.3 (10.0-12.7) [121, 122].

3.1.9. Katz Index of Independence in Activities of Daily Living (ADL)

The aim is to evaluate the independence of daily living activities in geriatric individuals. It consists of six questions, including information on bathing, dressing, toileting, transferring, continence, and feeding. The highest score (6) indicates that there is no dependency status, (4) there is moderate insufficiency, and (2) points and below is a dependence level. The scale aims to recognize new functional disabilities that may occur during follow-up and to plan care accordingly. The client takes baseline measurements and compares them to the routine [123].

3.1.10. Five Times Sit to Stand Test (FTSST)

It shows the functional ability and strength of the lower extremities, whether there is a loss of balance. The patient is asked to sit up five times without stopping as much as possible. When the person finishes the test and sits down, the stopwatch is stopped. If the patient starts using the arms or cannot complete the test, the stopwatch is stopped after 1 minute. Test-retest reliability of FTSST is excellent in older adults living in the community. For those who repeat this test five times, it can be accepted that the people who left the following are not better than average performance. (60-69 y/o 11.4 sec, 70-79 y/o 12.6 sec, 80-89 y/o 14.8 sec) [124, 125].

3.1.11. Berg Balance Test (BBT)

Berg Balance Test is used to evaluate the risk of balance and fall. Accompanied by the observer, it measures the balance-related tasks consisting of 14 questions that scores on a scale of 0 to 4. The total score is 56. The participant takes a score of 0, if

he/she is not able to do the task, and takes a score of 4 if the participant can finish the task based on the principle. The risk category is divided into high risk of falling from 0-20, middle fall risk between 21-40, low fall risk 41-56. The test takes approximately 15-20 minutes to finished and requires no advanced equipment [126].

3.1.12. Assessment of Joint Position Sense Assessment (Proprioceptive Assessment)

Apart from visual, auditory, and verbal information, the movement and position perception of the various parts of the body in the space is defined as proprioception. Its primary role is in sensory-motor control for balance, coordination movement acuity, and joint stability. Its clinical evaluation commonly bases on the assessment of the joint position sense (JPS) [127].

The instructor moved a person's limb to a target position. This was returned to the neutral position, before finally moving the limb again, while requiring the participant to reveal when they thought the target angle was reached. The actual angular error (AAE) was calculated deviations from the targeted angle are measured with the goniometer for the targeted angles at 10° dorsiflexion, 15° plantar flexion for the ankle [128].



Figure 3.2. Digital Goniometer

3.1.13. Two-Point Discrimination (TPD)

A two-point discrimination test evaluates the ability to perceive two points simultaneously applied to the skin. It is a measure of the smallest distance between two points of skin [129]. Aesthesiometer is a hand-held instrument used to evaluate two-point discrimination that is woven and distinguished by the skin for notices progressive

loss of sensation in the foot. The vinyl coverings caliper are moving the forks into contact with the anatomical part of the foot and then pressing until the person feels a sensation [130]. We assessed five areas from these; second metatarsal head, plantar webbing between fourth and fifth digits, styloid process, heel pad, a point between the first metatarsal head and navicular eminence [131].

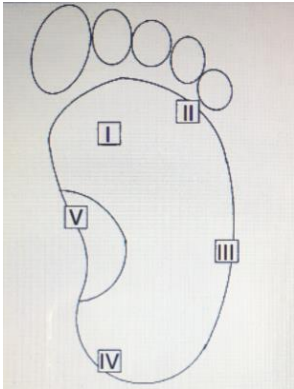


Figure 3.3. Sensory Areas on Foot



Figure 3.4. Aesthesiometer

3.1.14. Assessment of Vibration Sense (VS)

A tuning fork of 128 Hz is placed perpendicular to the bone with constant pressure. Simultaneously, the practitioner starts counting the seconds and how many seconds the person feels the vibration is recorded. The test is repeated three times in the area where the inspection area is made. Before testing, the inspector must apply the vibrating adjustment fork to a part of the person's body to ensure that the person can notice the vibration [132]. We assessed lower limb vibration detected at the base of the first metatarsal bone, medial malleolus, and tibial tuberosity [133].



Figure 3.5. Assessment of Tibial Tuberosity with Tuning Fork



Figure 3.6. Assessment of Medial Malleolus with Tuning Fork

3.1.15. Geriatric Depression Scale (GDS)

Geriatric Depression Scale (GDS) is one of the most useful used tests in the screening of depression in populations with medically ill or dementia [134]. This scale formed consisting of 15 questions; a total of 15 points are given. The questions are answered with yes / no format. There is a description of depression stages according to points; between 0-4 no depression, 5-8 mild depression, 9-11 mid-level depression, 12-15 severe depression [135].

3.2. Intervention

Exercise Education: Before both exercises program, the individuals were informed about evaluation methods, parameters, and tests by the practitioner. Individuals also were informed about the importance and effects of exercise training, the exercise conditions to be considered and exercise precautions.

The exercise program consists of 5 minutes warm-up period (treadmill or participants engaged in static stretching movements) and, finally, 5 minutes cool-down period (stretching and relaxation movement).

3.2.1. Sensory-based Balance Training Protocol

The proprioceptive training program, vestibular and eye control training protocol, combined proprioceptive and vestibular training protocol and falling reaction training was applied by physiotherapist under the supervision in nursing-home once a week. They performed exercise while barefooted firm and soft surfaces, during quiet stance and movements once a week. During exercise sessions, subjects were encouraged to pay

attention to sustain their balance using verbal commands. Individuals attended the session individually.

Table 3.3. Proprioceptive Exercise Protocol

		8 week
1	Sensing weight distribution on the sole of feet	The individuals performed exercises for 20 seconds, with 3 repetitions. Between all set 40 seconds, rest were given the individuals.
2	Weight shift from side to side	
3	Weight shift forwards and backwards	
4	Moving arms in different directions	
5	Stamping feet on the spot Standing on a balance cushion, foam or trampoline	
6	Standing on a balance cushion, foam or trampoline (Exercises 1–4)	
7	Stamping feet	
8	Walking on uneven surfaces and surfaces with different textures	



Figure 3.7. Standing on a balance cushion, foam with bilateral arm flexion exercise.



Figure 3.8. Standing on a balance cushion, foam with bilateral arm abduction exercise.



Figure 3.9. Standing on a balance cushion with weight shifting exercise.



Figure 3.10. Stamping feet exercise.

Table 3.4. Vestibular and Eye Control Protocol

		8 week
1	Head kept still, eyes moved in all directions or following a moving target	The individuals performed exercises for 20 seconds with 3 repetitions. Between all set 40 seconds, rest were given the individuals.
2	Eyes kept still during movements of the head in all directions	
3	Moving the head in all directions with eyes following head movements	
4	Moving the head in all directions with eyes closed	
5	A quick rotation of the head with a fixed gaze	
6	A quick rotation of the head, eyes following head movements	
7	A quick rotation of the head with eyes closed	
8	Sitting on a rotational chair; Chair rotated irregularly in both directions with eyes open and closed	
9	Walking exercise	



Figure 3.11. Head kept still, eyes moved in all directions or following a moving target.



Figure 3.12. Moving the head in all directions, eyes following head movements.



Figure 3.13. A quick rotation of the head with eyes closed.



Figure 3.14. Moving the head in all directions with eyes closed.



Figure 3.15. Moving the head in all directions with eyes closed.



Figure 3.16. Sitting on a rotational chair and rotated irregularly in both directions with eyes open and closed.

Table 3.5. Combined Proprioceptive and Vestibular Protocol

		8 week
1	Standing on a balance cushion or foam; Reaching for an object in different directions	The individuals performed exercises for 20 seconds with 3 repetitions. Between all set 40 seconds, rest were given the individuals.
2	Catching and throwing a ball	
3	Keeping a balloon in the air	
4	Walking exercise	
5	Moving head in all directions, fixing the gaze on surrounding objects	
6	A quick right and left turns	



Figure 3.17. Moving head in all directions, fixing gaze on surrounding objects.



Figure 3.18. Moving head in all directions, fixing gaze on surrounding objects.



Figure 3.19. Eye movement exercise.



Figure 3.20. Catching and throwing

Table 3.6. Fall Reaction Protocol

		8 week
1	Standing; Practicing quick-stepping actions in different directions to prevent a fall,	20 seconds x 3 repetitions 40 seconds rest
2	Subjects pushed in different directions with and without prior warning	

3.2.2. Callisthenics Exercise Protocol using with Rhythm and Music

The individuals exercised sitting and standing exercises using the Jaques-Dalcroze rhythm and music exercise program. Individuals in the same nursing home participate in training in groups. The protocol was applied by a physiotherapist under the supervision in nursing-home once a week.

Table 3.7. Calisthenics Exercise Protocol using with Rhythm and Music

		8 week
1	Sitting and standing; Ankle; Dorsiflexion, Plantar Flexion, Inversion ,Eversion	The individuals performed exercises for 20 seconds with 3 repetitions. Between all set 40 seconds rest were given the individuals.
2	Knee; Flexion, Extension	
3	Hip; Flexion; Extension; Abduction; Adduction	
4	Bilateral upper extremity exercise(flexion, abduction)	
5	Clapping and followed music rhythm	
6	Standing; Exercises for weight-bearing (forward-to-back, right to left)	
7	Exercise for trunk movements (flexion-extension)	
8	Stand on one leg (right-left)	
9	Walking in time to the music	
10	As the tempo changed, change direction on a signal	



Figure 3.21 and Figure 3.22 Knee flexion, extension exercises.



Figure 3.23. Hip Flexion exercise.



Figure 3.24. Exercises for weight-bearing.



Figure 3.25. Exercise for stand on one leg.



Figure 3.26. Walking exercise.

3.3. Statistical Analysis

Statistical Package Analyze for Social Sciences (SPSS) version 25.0 was used for data analyses. The statistical data were expressed as mean $\pm$ standard deviation ($\bar{x} \pm SD$) and percentages (%) for normally distributed variables. For quantitative variables, the number (n) and percentage (%) were calculated. Kolmogorov–Smirnov test was used to assess the distribution of data. Nonparametric tests were used when parametric conditions could not be achieved. Statistical analysis was performed before and after treatment for parametric and non-parametric data with respectively Paired Sample t-test and Wilcoxon signed-rank test. An independent-samples t-test and Mann-Whitney u-test were used to compare parametric and non-parametric variables. A Chi-square test was used to assess categorical variables. The level of significance was accepted as $p \leq 0.05$.

4. RESULTS

The study included elderly individuals (n=20, 9 Female/7 Male) who living in Ataşehir Adora Huzurevi, Dragos Adora Huzurevi, and Ümraniye Irmak Huzurevi, İstanbul Turkey. The individuals were separated into two groups. Two people were removed from the study due to leaving the nursing home, one person was reluctant to participate in the study, and one person was removed from the study due to death.

The age range of people in the study population was between 66-92. The mean value of age, height, weight, body mass index, a number of falls, length of nursing-home stay in the study groups were given in Table 4.1. There were no statistical differences in age, height, weight, body mass index, the number of falls, length of nursing-home stay in two groups. (Table 4.1)

Table 4.1 Baseline characteristics of participants

	Groups		t	P*
	Group-1 (n=8) Mean±SD N	Group-2 (n=8) Mean±SD N		
Age (years)	74.00±8.55	77.62±5.15	0.57	0.32
Height (cm)	158.37±8.99	163.12±10.23	0.09	0.34
Weight (kg)	64.87±9.80	65.75±9.99	0.05	0.86
BMI (kg\m²)	25.78±2.43	24.65±2.58	0.11	0.38
Number of falls	0.75±0.70	1.50±1.06	1.92	0.12
Length of nursing-home stay (year)	1.87±1.83	1.87±0.35	5.57	1.00

Group-1: Exercise Training using Different Sensory Inputs Group; Group-2: Calisthenics Exercise with Rhythm and Music Group.

Abbreviations: BMI, body mass index; *Independent Sample t-test, the level of significance set at p<0.05.

In the population of the study, there were 4 females, 4 males (n=8) in the G1, and 5 females, 3 males (n=8) in the G2 group. The gender distribution of the study population was 56% for females, versus 44% for males.

Table 4.2 is showing that the socio-demographic characteristics of gender, marital status, having children, history of previous falls of the study population. A Chi-square test was used to compare socio-demographic characteristics. There were no statistically significant differences according to gender, marital status, having children, history of previous falls between groups (Table 4.2, $p>0,05$).

Table 4.2. A comparison of Gender, Marital Status, Having Children and History of Previous Falls Between Groups

		Group 1	Group 2	X²	p
		% (n)	%(n)		
Gender	Female	50 (4)	62.5 (5)	0.25	0.61
	Male	50 (4)	37.5 (3)		
Marital Status	Single	25 (2)	25 (2)	3.11	0.37
	Married	0 (0)	25 (2)		
	Widow	75 (6)	50 (4)		
Having Children	Yes	75 (6)	62.5 (5)	2.91	0.59
	No	25 (2)	37.5 (3)		
History of previous falls	Yes	62.5 (5)	87.5 (7)	1.33	0.24
	No	37.5 (3)	12.5 (1)		

Data expressed as % (n).

Table 4.3 is showing that the distribution of chronic problems. Everyone has at least one chronic problem. Only participants with one disease have n=6 (%75) people in the G1, while n=3 (%37.5) participants in the G2. In the first group, the number of people with two chronic diseases was n=1 (%12.5), and in the second group, the number of people with two chronic diseases was n=3 (%37.5). While hypertension is the most common chronic problem, the least chronic heart failure, varicose vein disease, goiter, osteoarthritis and fungal disease in the G1. Besides; while hypertension and diabetes mellitus are the most common chronic problem, the least COPD and fungal disease in the G2.

Table 4.3. Distribution of chronic problem in participants

	Group 1 % (n)	Group 2 % (n)
Number Of Chronic Problems		
One	75 (6)	37,5 (3)
Two	12,5 (1)	37,5 (3)
Three and Above	12,5 (1)	25 (2)
Name Of Chronic Problem		
Hypertension	62,5 (5)	50 (4)
Diabetes Mellitus	25 (2)	50 (4)
COPD	25 (2)	-
Chronic Heart Failure	-	12,5 (1)
Orthopedic Diseases	12,5 (1)	12,5 (1)
Fungal Disease	12,5 (1)	-
Osteoarthritis	-	12,5 (1)
Asthma	-	25 (2)
Goiter	-	12,5 (1)
Varicose Vein Disease	-	12,5 (1)

Data expressed as % (n) COPD (Chronic Obstructive Pulmonary Disease)

Table 4.4 shows the prevalence of various leisure time activities in the study groups. This estimation method, of course, helped them to provide more than one answer to the questions. It was found that the most frequent leisure time activities are watching television/ listening radio, walking and talking with friends in G1, most frequent leisure time activities is watching television/ listening radio in G2. The number of those who were performing 3 or more activities was n=6 (%75) in the G1 and n=3 (%37.5) in the G2.

Table 4.4. Distribution of leisure time activities in the study group

	Group 1 % (n)	Group 2 % (n)
Number Of Leisure Time Activity		
One	-	37,5 (3)
Two	25 (2)	25 (2)
Three and Above	75 (6)	37,5 (3)
Name Of Leisure Time Activity		
Television/Radio	87,5 (7)	75 (6)
Walking	87,5 (7)	50 (4)
Religious activity	12,5 (1)	-
Reading	37,5 (3)	12,5 (1)
Talking with Friends	87,5 (7)	37,5 (3)
Handworking	25 (2)	-
Painting	-	12,5 (1)
Data expressed as % (n)		

While 69% of subjects have children, 31% do not have children. Considering the frequency of interviewing older people with their children, 18.8% never meet their children, 12.5% meet once a year, 37.4% meet once a month, 12.5% meet once a week, and 18.8% always talk with his children. The participation of the elderly in the nursing home activity; 81.2% of the participants attend the event while 18.8% of them prefer not to participate in the event.

An independent samples t-test was used to compare variables between Group 1 and Group 2 before the interventions (Table 4.5). The results showed that joint position sense (JPS) for plantar flexion and vibration sense (VS) for the first metatarsal head had statistically differences in both groups ($p < 0.05$). The mean value of JPS for plantar flexion and vibration sense (VS) for the first metatarsal head were higher in G1 than G2 during pre-evaluation (Table 4.5).

Table 4.5. Comparison of pre-intervention variables between groups

		Group 1 mean±SD	Group 2 mean±SD	p value t
5TSTT		26.32±9.44	22.90±12.69	p:0.55 t:0.61
BBT		41.00±7.74	36.12±6.62	p: 0.19 t: 1.35
TUG		5.23±1.78	21.02±7.45	p:0.89 t:-0.13
KI-ADL		5.25±1.38	4.12±1.12	p: 0.09 t: 1.78
JPS	Dorsiflexion	3.46±1.95	2.48±0.51	p:0.19 t:1.36
	Plantar flexion	4.63±1.89	2.97±0.84	p: 0.04* t: 2.25
Vibration Sense	Tuberositas Tibia	5.23±1.78	3.04±2.28	p: 0.05 t: 2.14
	Medial Malleol	4.18±1.57	2.67±1.65	p: 0.08 t: 1.87
	1st Metatarsal Head	4.49±1.05	2.52±2.08	p: 0.03* t: 2.39
TPD	2nd Metatarsal Head	2.81±0.77	2.46±1.44	p: 0.55 t: 0.60
	Plantar Webbing 4th-5th	2.72±1.23	2.66±1.85	p: 0.25 t:-1.91
	Styloid Process	2.03±1.56	2.57±2.73	p: 0.63 t: -0.48
	Heel Pad	2.60±1.45	2.86±1.08	p: 0.68 t: -0.40
	Point 1st head-navicular	2.00±1.49	3.10±1.55	p: 0.17 t: -1.44
WHOQOL-Old	Sensory	10.00±2.13	8.25±2.25	p: 0.13 t: 1.59
	Autonomy	12.62±3.46	13.87±2.47	p:0.13 t:-0.80
	PPF	13.62±2.19	13.62±2.32	p:1.00 t:0.00
	Social Participation	11.25±4.59	12.50±2.00	p:0.49 t:-0.70
	Death and Dying	9.12±5.51	7.50±3.38	p: 0.48 t: 0.71
	Intimacy	13.87±2.41	11.12±3.90	p: 0.11 t: 1.69
	Total	70.50±13.79	66.87±8.85	p: 0.54 t:0.62
MMSE		22.00±4.10	20.25±2.25	p: 0.30 t:1.05
GDS		6.62±3.73	4.37±2.26	p: 0.16 t: 1.45

*Independent sample t-test significance $p < 0.05$ Five Times Sit to Stand Test (FTSST), Berg Balance Test (BBT), Timed Up and Go (TUG), Katz Index of Independence in Activities of Daily Living (KI-ADL), Vibration Sense (VS), Two Point Discrimination (TPD), World Health Organization Quality of Life Older Adult (WHOQOL-OLD), Mini-Mental Scale (MMS) and Geriatric Depression Scale (GDS).

The paired sample t-test was used to determine the differences regarding pre and post-tests mean scores of 5TSTT, BBS, TUG, and KI-ADL. In G1, it was witnessed that a statistically significant decrease was observed in the mean of 5TSTT(s) and TUG(s) ($p < 0.05$) (Table 4.6). According to intragroup variables, there were statistical differences in BBS in both groups ($p < 0.05$). Only the difference between pre and post-intervention results of KI-ADL was not found statistically significant.

Table 4.6. Comparison of Five Times Sit to Stand Test (FTSST), Berg Balance Test (BBT), Timed Up and Go (TUG), Katz Index of Independence in Activities of Daily Living (KI-ADL) Scores of Intragroup Variables

		Group 1 mean $\pm$ SD	p value	Group 2 mean $\pm$ SD	p value
5TSTT(s)	Before	26.32 $\pm$ 9.44	p:0.001** t:5.88	22.90 $\pm$ 12.69	p:0.05 t: 2.25
	After	17.03 $\pm$ 7.52		19.02 $\pm$ 9.45	
BBT	Before	41.00 $\pm$ 7.74	p:0.005** t:-4.11	36.12 $\pm$ 6.62	p:0.005** t: -4.02
	After	49.00 $\pm$ 6.07		38.37 $\pm$ 6.52	
TUG	Before	20.49 $\pm$ 7.97	p:0.002** t: 4.62	21.02 $\pm$ 7.45	p:0.11 t: 1.82
	After	14.50 $\pm$ 5.13		19.24 $\pm$ 5.22	
KI-ADL	Before	5.25 $\pm$ 1.38	p:0.19 t: -1.42	4.12 $\pm$ 1.12	p:0.17 t:-1.52
	After	5.62 $\pm$ 0.74		4.37 $\pm$ 1.18	

Data expressed as mean $\pm$ standard deviation. Five Times Sit to Stand Test (FTSST), Berg Balance Test (BBT), Timed Up and Go (TUG), Katz Index of Independence in Activities of Daily Living (KI-ADL).

When comparing joint position sense, vibration sense and two-point discrimination for intragroup, there were statistically significant differences for the dorsiflexion and plantarflexion of JPS and TPD for the second metatarsal head and heel pad in G1. The results showed that the mean of proprioceptive deviations was decreased in G1 (Table 4.7, $p < 0.05$).

Table 4.7. Comparison of Joint Position Sense (JPS), Vibration Sense (VS), Two Point Discrimination (TPD) Scores of Intragroup Variables

			Group 1 mean±SD	p value	Group 2 mean±SD	p value
JPS	Dorsiflexion	Before	3.46±1.95	p:0.004** t:4.13	2.48±0.51	p:0.16
		After	2.22±1.66		2.35±0.57	t:1.57
	Plantar Flexion	Before	4.63±1.89	p:0.002** t: 4.95	2.97±0.84	p:0.73
		After	2.41±1.14		3.01±0.90	t: -0.35
Vibration sense	Tuberositas Tibia	Before	5.23±1.78	p:0.24 t:-1.28	3.04±2.28	p:0.46
		After	5.62±1.19		3.57±2.18	t:-0.77
	Medial Malleolus	Before	4.18±1.57	p:0.07 t:-2.06	2.67±1.65	p:0.45
		After	5.18±2.15		2.91±1.27	t: -0.79
	1st Metatarsal Head	Before	4.49±1.05	p:0.05 t:-2.30	2.52±2.08	p:0.79
		After	4.99±1.01		2.34±2.10	t: -0.27
TPD	2nd Metatarsal Head	Before	2.81±0.77	p:0.008** t: 3.68	2.46±1.44	p:0.95
		After	1.80±0.60		2.43±0.75	t: 0.05
	Plantar Web 4th-5th	Before	2.72±1.23	p:0.85 t: 0.18	2.66±1.85	p:0.10
		After	1.62±0.51		1.67±1.08	t:1.83
	Styloid Process	Before	2.03±1.56	p:0.24 t: 1.27	2.57±2.73	p:0.61
		After	1.33±0.68		1.95±0.93	t: 0.52
	Heel Pad	Before	2.60±1.45	p:0.03* t: 2.61	2.86±1.08	p:0.41
		After	1.67±0.95		2.27±1.10	t: 0.87
	Point 1st head-navicular	Before	2.00±1.49	p:0.59 t: 0.51	3.10±1.55	p:0.24
		After	1.66±0.87		2.12±1.02	t: 1.25

Joint Position Sense (JPS), Vibration Sense(VS), Two Point Discrimination (TPD).Data expressed as mean ±standard deviation.

As seen in Table 4.8, While G1 showed statistically significant differences in sensory, autonomy, and PPF subscores of WHOQOL-Old, (p<0.05), G2 had vice versa. The GDS values were showed that both groups had a statistically significant decreasements (p<0.05).

Table 4.8. Comparison of World Health Organization Quality of Life Older Adult (WHOQOL-OLD), Mini-Mental State Examination (MMSE) and Geriatric Depression Scale (GDS), Past-present-and future-activities (PPF) scores of Intragroup Variables

			Group 1 mean±SD	p value	Group 2 mean±SD	p value
WHOQOL-Old	Sensory	Before	10.00±2.13	p:0.02* t:2.82	8.25±2.25	p:0.10 t: 1.87
		After	8.87±2.16		7.75±1.58	
	Autonomy	Before	12.62±3.46	p: 0.01* t:-3.52	13.87±2.47	p:0.47 t:-0.75
		After	15.12±2.03		14.75±2.12	
	PPF	Before	13.62±2.19	p:0.02* t:-2.80	13.62±2.32	p:0.10 t: -1.84
		After	15.12±2.03		14.75±2.12	
	Social Participation	Before	11.25±4.59	p:0.19 t:-1.44	12.50±2.00	p:0.58 t: -0.57
		After	12.75±3.15		12.87±2.29	
	Death and Dying	Before	9.12±5.51	p:0.28 t: 1.15	7.50±3.38	p:0.65 t: -0.46
		After	8.12±4.18		8.25±3.69	
	Intimacy	Before	13.87±2.41	p:0.36 t: -0.96	11.12±3.90	p:0.43 t: -0.82
		After	14.87±3.48		12.87±4.05	
	Total	Before	70.50±13.79	p:0.18 t: -1.45	66.87±8.85	p:0.08 t: -2.02
		After	74.37±9.84		69.50±7.72	
MMSE		Before	22.00±4.10	p:0.06 t:-2.20	20.25±2.25	p:0.35 t: -1.00
		After	24.00±4.27		20.37±2.13	
GDS		Before	6.62±3.73	p:0.02* t:2.99	4.37±2.26	p:0.01* t: 3.18
		After	3.50±3.42		2.25±1.03	

Data expressed as mean ±standard deviation World Health Organization Quality of Life Older Adult (WHOQOL-OLD), Past-present-and future-activities (PPF) Mini-Mental State Examination (MMSE) and Geriatric Depression Scale (GDS)

The comparison of the post-intervention results of 5TSTT, BBT, TUG, KI-ADL JPS and VS intergroup variables was performed with an independent sample t-test (Table 4.9). There were statistically significant deviations on BBT, KI-ADL and VS ($p<0.05$).

Table 4.9. Comparison of Post-Intervention Results of Intergroup Variables

		Group 1 mean±SD	Group 2 mean±SD	p value t
5TSTT		17.03±7.52	19.02±9.45	t:-0.46 p:0.64
BBT		49.00±6.07	38.37±6.57	t:3.37 p:0.00*
TUG		14.50±5.13	19.24±5.22	t:-1.83 p:0.08
KI-ADL		5.62±0.74	4.37±1.18	t:2.52 p:0.02*
JPS	Plantar Flexion	2.41±1.14	3.01±0.90	t:-1.16 p:0.26
	Dorsiflexion	2.22±1.66	2.35±0.57	t:-0.20 p:0.84
Vibration Sense	Tuberositas Tibia	5.62±1.19	3.57±2.18	t:2.32 p:0.04*
	Medial Malleol	5.18±2.15	2.91±1.27	t:2.56 p:0.02*
	1st Metatarsal Head	4.99±1.01	2.34±2.10	t:3.20 p:0.00*

Data expressed as mean ± standard deviation. Five Times Sit to Stand Test (FTSST), Berg Balance Test (BBT), Timed Up and Go (TUG), Katz Index of Independence in Activities of Daily Living (KI-ADL), Joint Position Sense (JPS), Vibration Sense (VS).

The comparison of the post-intervention results of TPD, WHOQOL-OLD, MMSE and GDS intergroup variables was performed with an independent sample t-test (Table 4.10). There was no significant difference in TPD, WHOQOL-OLD, MMSE and GDS results for intergroup variables.

Table 4.10. Comparison of Post-Intervention Results of Intergroup Variables

		Group 1 mean±SD	Group 2 mean±SD	Significance
TPD	2nd Metatarsal Head	1.80±0.60	2.43±0.75	t:-1.86 p:0.08
	Plantar Webbing 4th-5th	1.62±0.51	1.67±1.08	t:-0.11 p:0.90
	Styloid Process	1.33±0.68	1.95±0.93	t:-1.49 p:0.15
	Heal Pad	1.67±0.95	2.27±1.10	t:-1.16 p:0.26
	Point 1st head-navicula	1.66±0.87	2.12±1.02	t:-0.97 p:0.34
WHOQOL-Old	Sensory	8.87±2.16	7.75±1.58	t:1.18 p:0.25
	Autonomy	14.62±3.11	14.25±1.98	t:0.28 p:0.77
	PPF	15.12±2.03	14.75±2.12	t:0.36 p:0.72
	Social Participation	12.75±3.15	12.87±2.29	t:-0.09 p:0.92
	Death and Dying	8.12±4.18	8.25±3.69	t:-0.06 p:0.95
	Intimacy	14.87±3.48	12.87±4.05	t:1.05 p:0.30
	Total	78.37±9.84	69.50±7.72	t:1.10 p:0.29
MMS		24.00±4.27	20.37±2.13	t:2.14 p:0.057
GDS		3.50±3.42	2.25±1.03	t:0.98 p:0.35

Data expressed as mean ±standard deviation Two Point Discrimination (TPD). World Health Organization Quality of Life Older Adult (WHOQOL-OLD), Past-present-and future-activities(PPF) Mini-Mental State Examination (MMSE) and Geriatric Depression Scale(GDS),

Independent samples t-test were applied to examine differences comparing the values during pre and post evaluations among two groups. There were statistically significant deviations on 5TSTT, BBT, TUG, JPS ($p<0.05$). As was seen in Table 4.11, it was observed that the differences between pre and post measurement of 5TSTT, BBT, TUG, JPS and MMSE had greater improvement among G1.

Table 4.11. Comparison of the Difference Between Pre and Post Intervention Results of the Five Times Sit to Stand Test (FTSST), Berg Balance Test (BBT), Timed Up and Go (TUG), Katz Index of Independence in Activities of Daily Living (KI-ADL), Joint Position Sense (JPS), Vibration Sense (VS) in Intergroup Variables

		Group 1 mean±SD	Group 2 mean±SD	p value
Δ5TSTT		-9.29±4.46	-3.88±4.87	p:0.03* t:-2.31
ΔBBT		8±5.5	2.25±1.58	p:0.01* t:2.84
ΔTUG		-5.98±3.65	-1.77±2.75	p:0.02* t:-2.59
ΔKI-ADL		0.37±0.74	0.25±0.46	p:0.89 t:-0.13
ΔJPS	ΔDorsiflexion	-1.23±0.84	-0.13±0.23	p:0.000** t:-4.88
	ΔPlantar Flexion	-2.21±1.26	0.04±0.33	p:0.003** t:-3.56
ΔVibration Sense	ΔTuberositas Tibia	0.38±0.85	0.53±1.96	p:0.84 t:-0.19
	ΔMedial Malleol	0.99±1.36	0.23±0.83	p:0.19 t:1.34
	Δ1st Metatarsal Head	0.49±0.61	-0.17±1.80	p:0.18 t:-1.31

Independent samples t-test were applied to examine differences comparing the values during pre and post evaluations among two groups. There was statistically significant deviations on MMSE (Table 4.12, $p < 0.05$). It was observed that the differences between pre and post measurement of MMSE had greater improvement among G1.

Table 4.12. Comparison of the Difference Between Pre and Post Intervention Results of the Two Point Discrimination (TPD), World Health Organization Quality of Life Older Adult (WHOQOL-OLD), Mini-Mental State Examination (MMSE) and Geriatric Depression in Intergroup Variables

		Group 1 mean$\pm$SD	Group 2 mean$\pm$SD	p value
ΔTPD	Δ2nd Metatarsal Head	-1.01 $\pm$.77	-0.02 $\pm$ 1.23	p:0.07 t:-1.91
	ΔPlantar Webbing 4th-5th	-0.1 $\pm$ 1.52	-0.98 $\pm$ 1.52	p:0.26 t:1.16
	ΔStyloid Process	-0.70 $\pm$ 1.55	-0.62 $\pm$ 3.39	p:0.95 t:-0.05
	ΔHeel Pad	-0.92 $\pm$ 1	-0.58 $\pm$ 1.90	p:0.66 t:-0.44
	ΔPoint 1st head-navicula	-0.33 $\pm$ 1.69	-0.97 $\pm$ 2.19	p:0.52 t:0.65
ΔWHOQOL-Old	ΔSensory	-1.12 $\pm$ 1.12	-0.50 $\pm$ 0.75	p:0.21 t:-1.30
	ΔAutonomy	2 $\pm$ 1.60	0.37 $\pm$ 1.40	p:0.49 t:2.15
	ΔPPF	1.50 $\pm$ 1.51	1.12 $\pm$ 1.72	p:0.65 t:0.46
	ΔSocial Participation	1.50 $\pm$ 2.92	0.37 $\pm$ 1.84	p:0.37 t:0.91
	ΔDeath and Dying	-1 $\pm$ 2.44	0.75 $\pm$ 4.52	p:0.43 t:-0.78
	ΔIntimacy	1 $\pm$ 2.92	1.75 $\pm$ 5.97	p:0.75 t:-0.31
	ΔTotal	3.87 $\pm$ 7.52	2.62 $\pm$ 3.66	p:0.67 t:0.42
ΔMMSE		2 $\pm$ 2.56	0.12 $\pm$ 0.35	p:0.01* t:-2.47
ΔGDS		-3.12 $\pm$ 2.94	-2.12 $\pm$ 1.88	p:0.43 t:-0.80

5. DISCUSSION

The most important results of our study revealed that the differences between pre and post measurement of 5TSTT, BBT, TUG, JPS, and MMSE had greater improvement in G1 compared with G2 ($p < 0.05$, Table 4.11&4.12). Consistent with a hypothesis, we found that the geriatric individuals were participating in the exercise training using different sensory inputs had more beneficial effects than participating calisthenic exercise training using with rhythm and music in terms of balance and proprioception assessment.

In the literature, there are several conducted studies on the effectiveness of sensorial activities in terms of balance. Moreira N.B et al. in their study, divided individuals (MEG; 84.83 ± 4.11 years, CG; 82.30 ± 3.23 years) into two groups; the multi-sensory exercise group ($n=24$; 3d/w; 50min; 16w) and the untreated control group ($n=21$) [13]. Their rehabilitation program consists of challenging participants' warm-up (5 min), strength (10 min), balance and coordination (10 min), multi-sensory input (basic, medium, high multisensory activities; 15 min) and flexibility and cool down exercises (10 min) in various tasks (with graded difficulty). They found that the multisensory exercise group showed statistically significant improvements in balance and mobility (berg balance test scores) (from 41.8 to 44.3) ($p < 0.05$). Furthermore, Islam M. et al. studied on 29 elderly individuals by dividing individuals into training group ($n=15$; 76 ± 4 years) and control group ($n=14$; 76 ± 7 years) and patients were evaluated by the one leg balance with eyes closed test for static balance, limits of stability (LOS) balance test for dynamic balance and 30-s chair stand test for muscular strength [136]. The TG exercise program consisted of balance exercise designed to challenge warm-up, visual (opened-closed eyes), vestibular (move head) somatosensory (stand on foam) and muscular (standing on one leg, bending body different direction) and cool-down period (2 d/w, 60 min, 12w) and CG was not performing any programmed exercise. The results show that the exercise program in older adults is beneficial in improving both static and dynamic balance and lower body strength. (TG, stand test scores from 24.8 ± 4.9 to 29.75 ± 8 ; CG from 22.9 ± 3.9 to 24.1 ± 5 ; $p < 0.01$). In our study, we divided into participants involved in exercise training group using different sensory inputs activities (G1; $n=8$, 74.00 ± 8.55) and calisthenics exercise using rhythm and music (G2; $n=8$,

77.62±5.15). Accordance with our results, the exercise programs should be included the sensorial exercises in the geriatric population due to the favourable effects on balance. We found statically significant improvements in BBT score in both groups (G1 from 41.00±7.74 to 49.00±6.07; G2 from 36.12±6.62 to 38.37±6.52; $p<0.05$, Table 4.6). But, BBT had greater improvement in G1 compared with G2 ($p<0.05$, Table 4.9 & 4.11). Moreover; G1 had higher the 5TSTT(s) scores from 26.32±9.44 to 17.03±7.52 ($p<0.05$, Table 4.6). However, there was no statically significant difference in G2 in terms of 5TSTT scores (from 22.90±12.69 to 19.02±9.45, Table 4.6) We concluded that sensory-based exercises or calisthenic exercises with music could be preferred for improving balance [136].

Choi et al. performed a study with forty older women with over 70 year old and divided into two groups which were resistive exercise with head rotation exercise (RE+HRE), and resistive exercise (RE) group [137]. In their study, RE+HRE group experienced knee extension, leg press, ankle dorsiflexion and plantarflexion, mini-squat using the elastic band and balance training consisted of quick kicks, leg curl, water skiing, as well as eyes followed the movement of the head. Head rotation is performed for last the 1 min at each exercise. While the RE group experienced exercise without head rotation for the same duration. (1d/w, 40 min, 6 w). They assessed the older woman with one-leg stance test, postural sway, timed up and go test, four square step test, mini-balance evaluation systems test, sit-to-stand test. (TUG scores RE+HRE from 8.49 ± 1.93 to 7.51 ± 1.53 ; RE from 9.64 ± 2.28 to 9.54 ± 1.56 ; STS scores RE+HRE from 20.20 ± 5.38 to 22.55 ± 6.11 ; RE from 19.40 ± 3.70 to 21.55 ± 4.3 , $p < .05$). The authors found significant improvement between the treatment and the control groups. This study suggested that RE+HRE is more effective than RE in improving dynamic postural balance and gait in elderly. They also, speculated that this improvement results from vestibular stimulation improved coordination between vision and the vestibular signals and helped stabilize dynamic postural balance during head rotation movement. Furthermore, Gerhardy T. et al. have argued that vestibular function during walking and rotation affects postural balance. Their goal of the study is to evaluate the relationship between balance control and the performance of sensory systems. 41 community-dwelling older adults between 58 and 89 years of age (mean: 72.6 ± 7.5 years) took part in the study. TUG and its subphases ‘sit-to-walk’, ‘walking,’ ‘turning,’ ‘turn-to-sit’ and ‘sit-down’ were evaluated and sensory systems’ performance was measured by

posturography during standing. From posturography, the auditory, somatosensory, and vestibular control ratios (CR) were measured and associated with TUG subphases. They indicated that high vestibular ($78.01 \pm 28.20\%$), and somatosensorial performance (12.62 ± 20.46) in the study was associated with total TUG time performance. The low vestibular performance was associated with particularly 'turning' and 'walking' scores [89]. In our study, vestibular, proprioceptive and eye follow-up exercises were given to G1 individuals, while calisthenic exercises were given to G2 individuals. When comparing the participants in terms of TUG scores in two groups, there was statistical meaningfulness in G1 ($p < 0.05$, Table 4.6). In accordance with this study, individuals in G1 may have completed the TUG test faster after receiving a vestibular stimulus. (TUG score from 20.49 ± 7.97 to 14.50 ± 5.13 , $p = 0.002$, Table 4.6). In another similar study, Lui et al. investigated the effects of ageing on visual-vestibular interaction for postural control during STS (sit to stand) in 15 young (22.5 ± 1.1 years) and 15 older (73.9 ± 5.3 years) participants. Vestibular information was manipulated using galvanic vestibular stimulation [138]. In response to the horizontal and vertical linear acceleration of the brain, the otolith organs in the vestibular system can be strongly stimulated during STS. As a consequence, vestibular information, in addition to vision, can provide significant sensory input to maintain equilibrium and vertical orientation during STS. On this basis, in our study, we demonstrated that there was an improvement in 5TSTT (s) in both groups, but a statistically significant difference was found in G1 comparing with G2 (26.32 ± 9.44 to 17.03 ± 7.52 , $p < 0.05$). The reason why it is more meaningful in G1 may be that the individuals in G1 have shown further improvement as they received a vestibular stimulus.

According to the study of Trombetti et al., subjects living in community-dwelling were allocated to an intervention group ($n=66$; 1d/w; 60 min.; 6 months) and a delayed intervention control group ($n=68$; 1d/w; 60 min.; 6 months) and individuals were evaluated by Timed up & go and Tinetti tests [109]. The primary outcomes were assessed at 6 months; during the second 6-month period, the delayed intervention control group participated in the intervention program, while the early intervention group returned to their habit. Exercises consisted of walking, a wide range of movements, challenged multidirectional weight shifting, walk-and-turn sequences, upper body movements when walking and standing; were performed by the rhythm of

Jaques-Dalcroze eurhythmics. They determined that balance and functional tests were improved compared with the control group. They also, emphasized that Jaques-Dalcroze eurhythmics tends to be able to alter patterns of physical activity in older people by providing good encouragement to initiate and sustain exercise behavior. In our study, we assessed the individuals with the BBS and TUG tests. A significant improvement was observed in BBT scores in G2 ($n=8$; 77.62 ± 5.15 years). But, there was no significant difference in G2 in terms of TUG scores (from 21.02 ± 7.45 to 19.24 ± 5.22 ; Table 4.6). In another study; Hee Joung Joung and Yongho Lee studied with eighty-two community-dwelling older adults, and they divided into participants a dance group ($n = 41$, age = 70.5 ± 7.89 years) and a stretching group ($n=41$, 71.77 ± 7.78 years) [110]. In their study, the dance group was received walking, running, bending, stretching, and shaking activities, while the stretching group received upper- and lower-body stretching exercises (2d/w; 90 min ;8wk). At the end of the study, they revealed that significantly increased scores for lower-limb strength (30-s chair stand), BBS and mobility (TUG time) CD group. According to the results of our study, we observed that BBS scores of the G2 were improved ($p<0.05$, Table 4.6). On the other hand, there were no significant statically differences in TUG time and 5TSTT scores in G2.

Youngsook Bae studied that the improvement of plantar sensation and balance after saccadic eye movement (SEM, 5 min) and pursuit eye movement (PEM, 5 min) exercises in community-dwelling older women. The participants (104 females; 75.11 ± 6.25 years) were divided into two groups. Postural balance was assessed as the area, length, and velocity of the center of pressure fluctuation before and after eye movements programs. In both groups, significant reductions in the area, length, and velocity of the COP were observed in the open and close eyes ($p<0.01$) and the PSA (plantar surface area) for both the left and right feet significantly increased after the interventions in both the SEM and PEM groups ($p < 0.01$). These results indicated that both SEM and PEM activate the extraocular muscles, and thus positively influence postural balance. They also, estimated that some ocular movements could modify postural control in the maintenance of upright standing position in humans. In our study, we applied the eye movements protocol (follow-up with eyes when the head is stationary, follow-up with eyes when the head is moving, saccadic and pursuit of the eyes) to individuals in G1 ($n=8$; 74.00 ± 8.55 years) [139].

In a study by Karim Korchi et al.; 16 individuals (87.9 ± 5.7 years) living in the nursing home were divided into 3 groups. A control group that did not perform any physical exercise, and two groups in which they participated in a multimodal exercise program performed barefoot or shoes. The walking exercises, sit-to-stand exercises and balance exercises (standing; position on a firm surface with eyes open and closed double-stance standing with side-by-side, semi-tandem, and full tandem feet positions), one-leg standing, neck hyperextension, rising on tip-toes, neck and trunk rotation) were performed (60 min;3d/w;3 months). Postural, gait and plantar cutaneous sensitivity parameters of the participants were evaluated. They found that the exercise program produced greater effects on balance and plantar skin sensitivity when barefoot exercises were performed, without any noticeable effect on the gait [140]. According to results of our study, the individuals in G1 performed exercises such as walking, weight shift forwards, backward and side to side, taking steps on a cushion with barefoot showed greater improvement in BBT and TPD scores (2.metatarsal head from 2.81 ± 0.77 to 1.80 ± 0.60 and heel pad from 2.60 ± 1.45 to 1.67 ± 0.95) in G1 ($p < 0.05$, Table 4.6& 4.7& 4.9).

Marmeleira et al. investigated the effect of a music-creative dance (CD) program (3d/w; 12 w) on proprioception in 37 elderly adults aged 55-80 years[141]. After 12 weeks, there was a significant improvement in knee joint sensation, knee kinesthesia (flexion) and arm position in the CD group. Considering how proprioception is related to balance and mobility in older adults, their studies have had important consequences. As a result of our study, individuals in G2 showed an improvement in terms of dorsiflexion of JPS (from 2.48 ± 0.51 to 2.35 ± 0.57), but it was not statistically significant. ($p:0.16$; Table 4.7)

Sensory thresholds in older adults are assumed to be much higher due to changes in receptor morphology, decreased receptor density, decreased skin elasticity, and decreased nerve conduction. In their review study, Wickremaratchi and Llewelyn stated that the perception threshold is high in various vibration intensities in elderly individuals and that the sensation of vibration is affected by age, especially after 65 years, compared to other senses[68].In our study, measurement of vibration sense with 128 Hz diapason gained from the tuberosity of the tibia, medial malleolus, and first metatarsal head was evaluated. There were statistically significant deviations on VS (base of the first metatarsal bone, medial malleolus, and tibial tuberosity) post-

intervention result of intergroup variables ($p < 0.05$, Table 4.9). Also, Perry's searched the effects of the level of plantar-surface sensitivity in older adults compared to young adults. Ninety-five older adults (65–73 years old) and seven young adults (23–26 years old) participated in this study and evaluated vibration thresholds at four frequencies (3, 25, 100 and 250 Hz) and four foot sole locations (heel, first metatarsal, fifth metatarsal and great toe) touch thresholds were evaluated with Semmes-Weinstein monofilament at the same areas. At the end of the assessment, elderly have significant higher plantar-surface insensitivity as compared to young adults. Furthermore, the authors stated that vibration tests at 100 Hz showed that, at the beginning of the seventh decade (72–73 years of age), participants started to double their detection threshold compared to their younger counterparts (65–71 years of age) [142]. Consistent with this study, TPD (second metatarsal head and heel pad) scores significantly changed after interventions in G1 (second metatarsal head from 2.81 ± 0.77 to 1.80 ± 0.60 ; heel pad from 2.60 ± 1.45 to 1.67 ± 0.95 , $p < 0.05$, table 4.7). The reason we did not find any significant difference in G2 (77.62 ± 5.15 years) maybe because the average age was higher than G1 (74.00 ± 8.55 years).

Aging creates a risk of deterioration of health and quality of life (QoL). Sandra Haider and colleagues revealed that balance was the variable most strongly associated with various QOL (quality of life) domains. This relationship may be because balance is the most essential requirement in daily life, and because of the fear of falling, problems in maintaining balance lead to limitation of activities. [143]. Our results were in accordance with that study. After the interventions, there were improvements in subparameters of WHOQOL-Old, the differences of pre and post measurement in sensory, autonomy, past-perfect-future were found statistical differences in G1. ($p < 0.05$, Tablo 4.8). According to our findings, improvement of balance parameters may have affected the quality of life.

Ana Torres and Joana Venancio used various exercises in multisensory stimulation programs (MSP) aimed at both promoting different cognitive functions such as thought, mindfulness, creativity, and integration of ideas, as well as stimulating different senses. Thirty-three older adults between the ages of 65 and 94 (82.18 ± 7.85), the intervention group ($n=16$), and the waiting group ($n=17$) (2 d/w, 45 min, 5 weeks). They found that there are statistically significant differences in the GI in terms of autonomy, perception of sensory function, present, and future activities, social

participation, death, intimacy [144]. When comparing our results of WHOQOL-Old, the differences between pre-measurement and post-measurement in sensory, autonomy, present, and future activities were found statistical differences in G1 ($p < 0.05$). While there was no difference in social participation, death, intimacy parameters. The reason for this difference may be due to the shorter duration of the application and the smaller number of people in our study.

Some studies compare the effects of multisensory exercise on cognitive function in the literature. In one of these studies; Alba Sancheza et al. conducted study with 18 participants with severe or very severe dementia who were randomly assigned to two groups MSSE (multisensory stimulation environment) group ($n=9, 88.09 \pm 6.80$) and individualized music sessions group ($n=9, 88.73 \pm 7.36$) [145]. In their study; MSSE group was received visual, auditory, tactile, and olfactory stimulation (water bed, aroma therapy, color fiber-optic cables, a video, tactile board) encouraging participants to engage with sensory stimuli of their choice, while the individualized music sessions group received music therapy according to their musical preferences. (2d/w, 30 min, 16w). Cornell scale for depression in dementia, rating anxiety in dementia and severe mini-mental state examination were assessed at the baseline, at week 8, at the week 16, and 8 weeks after the intervention for long-term monitoring. At the end of the study, no improvements were found in cognitive status (SMMST scores) during the intervention, and there were no differences between the MSSE group and individualized music groups. They argue that according to their results following to 16 weeks of stimulation programs could have positive effects on cognitive status in healthy or in mildly affected dementia elderly individuals. In another study, Macedo at al. investigated the beneficial effects of a multisensory and cognitive stimulation program of elderly subjects living either in long-term care institutions (institutionalized, I, $n=20, 75.1 \pm 6.8$ year) and in communities with their families (non-institutionalized, NI, $n=15, 74.1 \pm 3.9$ year) [146]. The groups received multisensory therapy (visual, olfactory, auditory, and ludic stimulation) and cognitive stimulation program (2 d/w; 48-session). Both elderly groups were evaluated with the mini-mental state examination and conducted evaluations (over one year) at five-time points (2 months, 4 months, 6 months, 8 months, and 12 months) after the completion of the intervention. At the end of that intervention program, they investigated how long those beneficial effects remained in the same groups of volunteers. After the intervention, there were

improvement in MMSE scores in both groups after 48 sessions (I group from 20.70 ± 0.8 to 24.3 ± 0.72 ; NI group from 23.4 ± 0.5 to 26.6 ± 0.59). They argued that elderly subjects living with their families in an enriched community environment showed delayed and smaller rates of cognitive decline than elderly subjects living in long-term care institutions. According to the results of our study, we observed that after exercise training using different sensory inputs; mean values of MMSE in G1 (from 22.00 ± 4.10 to 24.00 ± 4.27) increased more than G2 (from 20.25 ± 2.25 to 20.37 ± 2.13), however; it was not significantly meaningful ($p:0.35$, Table 4.8). In another study; Hars M. et al. carried out a study that includes 134 community-dwellers aged ≥ 65 years and investigated whether 6 months of music-based multitask training had beneficial effects on cognitive functioning and mood in older adults. They applied music-based education to the intervention group ($n = 66$, 1h/w; 6 months) while the control group ($n = 68$) were maintained their usual habits. Their multitask exercises program have consisted of basic exercises comprised walking following the piano music, responding directly or oppositely to changes in music's rhythmic patterns, quick reactions exercises. After the 6 months of therapy, they found statically significant improvement pre and post-intervention results in MMSE scores (from 25.9 ± 2.7 to 26.9 ± 2.1). They argued that music-based multitask training was associated with improved cognitive function in community-dwelling older adults, compared with non-exercising control. In contrast, our results demonstrated that, there were no significant differences in G2 in terms of MMSE scores (from 20.25 ± 2.25 to 20.37 ± 2.13) [147]. (Table 4.8). Therefore, we could speculate that there can be two reasons preventing the statistical significance of the improvements. First, we think that the sample size is not large enough. Second, we hypothesize that the number of sessions conducted were not adequate to enhance the cognitive status of older people.

Staal J. and Amanda carried out a study that includes 24 geriatric people. The MSBT (multi-sensory behavior therapy experimental) group ($n = 12$; 80.33 ± 1.59) received sensory reinforcement (visual, auditory, olfactory, and tactile) (1d/w; 30 min; 6wk) while a standard inpatient psychiatric care control group ($n = 12$; 72.00 ± 0.84) received recreational activity therapy (movement awareness, grooming, crafts, and reality orientation). After the 6 weeks of therapy, individuals were evaluated by Katz Index of Activities of Daily Living. They found that the MSBT treatment group have significantly improved levels of independence in ADLs on the KI-ADL than members

of the control group ($p = 0.04$) [148]. They suggested that utilizing MSBT may decrease apathy and agitation and additionally improve activities of daily living in hospitalized people with moderate to severe dementia more than standard care alone. As a result of the exercise training with using different sensory inputs conducted in our study, there was a statistically significant difference in post-intervention results of KI-ADL scores. (G1 5.62 ± 0.74 ; G2 4.37 ± 1.18 $p:0.02$; Table 4.9).

It is a common view that an old individuals (65 years of age) who is experiencing biological, emotional, and social changes and are at higher risk of depression and anxiety due to decreased self-esteem, decreased activity, and mobility, loss of friends and relatives, diminished financial and physical independence and chronic diseases.

Moghaddasifa et al. carried out a study that includes 28 older people and investigated the effect of multisensory stimulation (MSS) on the depression and anxiety status among nursing home-dwelling older people [12]. They applied sensory stimulations of touch, sound, and sight (3d/w; 25 min; 4wk) to the treatment group (67.3 ± 4.6 years) while the control group (68.1 ± 3.6) routine interventions and services in the center, such as watching TV, talking with each other. After the 4 weeks of therapy, individuals were evaluated by Beck Depression Inventories. They found significant improvement in pre and post-intervention results in TG. (Depression inventories scores TG from 14.8 ± 3.7 to 10.1 ± 5.3 ; CG from 14 ± 3.4 to 14.5 ± 5.5). They argued that MSS could improve the condition of depression and anxiety in the elderly in community-dwelling. As a result of the exercise training with using different sensory inputs conducted in our study, there was a statistically significant difference in G1 in terms of GDS scores. (from 6.62 ± 3.73 to 3.50 ± 3.42 , $p < 0.05$, Table 4.8). Moreover; Karatay and Akkuş preferred to use the Beck Anxiety Scale and Geriatric Depression test for observing the effects of a multi-stimulant home-based intervention program on anxiety and depression among older adults. They performed their study with 77 elderly individuals. They applied ROM stretching, relaxing, and breathing exercises (15min.) and participants performed handcraft-related activities varied each week with music (15min.), conversation (5min), newspaper/book reading (5min). (1d/w; 40 min; 7w). At the end of the study, the Beck Anxiety and the Geriatric Depression Scale scores showed a decrease ($p < 0.05$) after the intervention. According to their results, activities that would provide older persons to feel that they have accomplished something are

therefore very significant. Also, preferred artistic activities like painting or making simple objects because of the effect of colors on the cognition process. Consequently, findings demonstrate that the multi-stimulant approach to improve cognitive capacity and mood among individuals older than 60 years was successful according to Karataş and Akkuş [149]. According to our results, there was a statistically significant difference in G2 in terms of GDS scores (from 4.37 ± 2.26 to 2.25 ± 1.03 , $p:0.01$, Table 4.8). This improvement in G2 may be due to the positive effect of music and group training on depression and mood. We can conclude that calisthenic exercises training using rhythm and music could be preferred to reduced depressive symptoms.

There were several limitations of our study. The most important limitation is having a small sample size to generalize the effect of sensory-training and calisthenic exercises with rhythm and music training on balance in community dwelling elderly. The long-term effects could not be observed due to the difficulty of finding healthy individuals in the older age groups that meet the criteria for participation in the study and the low level of their desire to participate in the nursing home. Second, in our study, early effects were examined before and after treatment, but re-evaluation could not be made to look at long-term effects. It is thought that the duration of 8 sessions is not sufficient and the number of weekly sessions should be higher. Since learning in the elderly is slower, it could be provided to perceive better with many repetitions and long applications, and the variety of applications could be increased.

6. CONCLUSION AND SUGGESTIONS

The results of our planned study to compare the effects of calisthenic exercises with rhythm and music and exercise training using different sensory inputs in elderly individuals living in nursing homes.

It can be concluded that the exercise training using different sensory inputs is more effective than calisthenic exercise training using with rhythm and music activities in terms of balance and joint position sense. The exercise training using different sensory inputs activities can be used as a training method or routine activities to improve physical and mental health.

In the future, we suggest investigating that ;

- Follow-up studies should examine the long-term effects of intervention programs, and they can follow how long these changes take after interventions.
- Other studies should be conducted where the duration of therapy and frequency of sessions are higher.
- Exercises can be given for older individuals in a nursing home within safe limits.

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8. APPENDIX

APPENDIX 8.1: INFORMED WRITTEN CONSENT



Bu anket, Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı, Yüksek Lisans Tezi için hazırlanan "**Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması**" adlı araştırma kapsamında yapılmaktadır. Bu çalışmanın amacı farklı duyuşal uyarıların kullanıldığı denge eğitiminin sonuçlarının karşılaştırılmasıdır. Çalışmaya 20 birey katılmakla birlikte çalışmamız 8 hafta, haftada bir gün 40-45 dakika sürecektir. Araştırma kapsamında çalışmaya katılmayı kabul eden gönüllü bireylerin yaşı, cinsiyeti, eğitim düzeyi, mesleği, medeni durumu, sosyo-demografik koşulları, var olan kronik hastalıkları, geçirilen cerrahi durumları ve yaralanmaları, sigara-alkol kullanımı, huzurevinde kaldıkları süre, huzurevinde hangi aktiviteleri yaptıkları, boş zamanlarını nasıl değerlendirdikleri konusunda bilgilere ulaşarak, tedavi planına dahil edilecektir. Bu amaçla kullanılan değerlendirmelerin sonuçları yalnızca araştırma kapsamındaki çalışmalarda kullanılacaktır.

Bu araştırmaya katılıp katılmama kararını vermeden önce, araştırmanın neden ve nasıl yapılacağını bilmeniz gerekmektedir. Bu nedenle bu formun okunup anlaşılması büyük önem taşımaktadır. Eğer anlayamadığınız ve sizin için açık olmayan şeyler varsa, ya da daha fazla bilgi isterseniz bize sorunuz. **Cevaplarınız bizim için değer taşımaktadır.** Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. İstedığınız zaman çalışmayı sonlandırabilirsiniz.

Kişisel bilgileriniz herhangi bir amaçla, kurum yöneticileri veya üçüncü kişilerle kesinlikle paylaşılmayacaktır. Bu çalışma için gönüllü katılımcıdan, özel ya da devlete ait sağlık ödeneklerinden hiçbir şekilde ücret talep edilmeyecektir.

Katılımınız için teşekkür ederiz.

Danışman Öğretim Üyesi: Prof.Dr.Feryal SUBAŞI

Araştırmacı: Fzt. Merve Nur KARAÇOCUK IŞIK

Çalışma hakkında yazılı ve sözlü açıklama ,adı belirtilen araştırmacı tarafından yapıldı."**Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması"** incelemek amacıyla yapılan bu çalışmaya hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı kabul ediyorum.

Gönüllünün Adı / Soyadı / İmzası / Tarih

Açıklamaları Yapan Kişinin Adı / Soyadı / İmzası / Tarih

Fzt. Merve Nur Karaçocuk Işık

APPENDIX 8.2: STRUCTURED QUESTIONNAIRE

Yeditepe Üniversitesi
Sağlık Bilimleri Enstitüsü
Fizyoterapi ve Rehabilitasyon Anabilim Dalı
Bölüm 1. Demografik Özellikler

Tarih :.../.../.....

1) Hastanın Adı Soyadı:

Telefonu:

Huzurevi Adresi:

2) Yaş:

() 65-74 yaş arası () 75-84 yaş arası () 85 yaş ve üzeri

3) Cinsiyet: () Kız () Erkek

4) Boy uzunluğu (cm):

5) Vücut ağırlığı (kg) :

6) Dominant taraf: El () sağ () sol

Ayak () sağ () sol

7) Medeni Durumunuz: () Hiç evlenmemiş () Evli
() Boşanmış () Eşi ölmüş

8) Eğitim durumunuz

Okuryazar değil

İlköğretim

Lise

Üniversite ve üzeri

☐
☐
☐
☐

8) Mesleğiniz:

9) Maddi durumunuz:

1000TL'den az

☐

1000-2000TL

☐

2000-3000TL

☐

3000TL ve üzeri

☐

10) Sosyal güvenceniz:

Var

☐

Yok

☐

11) Gelir türü : () 65 yaş aylığı () Emekli maaşı () Diğer

12) Gözlük kullanıyor musunuz? () Evet () Hayır

13) Herhangi bir sürekli hastalığınız var mı? Varsa hangileri?

() Sürekli bir hastalığım yok

() Romatizma () Ortopedik hastalık () Nörolojik problemler

() Travma () Diğer.....

14) Kullandığınız ilaçlar nelerdir?.....

15) Kullandığınız ilaçların dozu nedir?/Günde/Haftada

16) Herhangi bir ameliyat geçirdiniz mi? () Evet () Hayır

17) Daha önce düşme durumu yaşadınız? () Evet () Hayır

- 18) Düşme sayısı kaç? () 1 kez () 2 kez () 3 ve daha fazla
- 19) a) Sigara kullanıyor musunuz?
() Hiç içmedim () Sigara içtim ama bıraktım () Halen içiyorum
b) Günde kaç adet sigara içiyorsunuz?.....adet/gün
Sigara: Paket/Yıl
- 20) Çocuğunuz : () var () yok Varsa kaç çocuğunuz var.....
- 21) Çocuklarıyla görüşme durumunuz nedir? () Hiç Bir Zaman () Yılda Bir () Ara Sıra () Ayda Bir () Haftada Bir () Her Zaman
- 22) İstanbul'da yaşayan yakınlarınız var mı? () Evet () Hayır
- 23) Yakınlarınızla görüşme sıklığınız nedir? () Hiç Bir Zaman () Yılda Bir () Ara Sıra () Ayda Bir () Haftada Bir () Her Zaman
- 24) Kaç yıldır huzurevinde kalıyorsunuz? () 1 yıldan az () 1 -3 yıl () 4-6 yıl () 7 yıl ve üzeri
- 25) Huzurevinde kalma nedeniniz nedir? () Mecburiyetten () Kendi isteğiyle () Çocukların tavsiyesi üzerine () Sağlık ve çocukların ilgisizliği yüzünden () Yanıt yok
- 26) Oda arkadaşınız var mı? () Evet () Hayır
- 27) Huzurevinde vakit geçirme aktiviteleri var mı? () Evet () Hayır
- 28) Huzurevinde vakit geçirme aktivitelerine katılıyor musunuz? () Evet () Hayır
- 29) Aktivitelere katılma istekliliği; () İsteksiz () Bazen istekli () Her zaman istekli
- 30) Boş zaman aktiviteleriniz nelerdir?
() El işi yapma () kitap\gazete okuma () yürüyüş () radyo dinleme\TV izleme
() ibadet yapma () kurum içinde sohbet etme\oturma\dolaşma () Belirli bir şey yok, yeme, içme, yatma, uyuma () diğer ...
- 31) Egzersiz yapıyor musunuz? () Evet () Hayır
- 32) Yaptığınız egzersiz her seferinde kaç dakika sürüyor?
() 15-20 dk az () 20-30 dk () 30 – 60 dk

Bölüm 2.Kardiyovasküler parametreler

	İlk	Son
Kalp Hızı		1.dk 3.dk 5. dk
Kan Basıncı (sistolik/diastolik)		1.dk 3.dk 5.dk

□

Bölüm 3. 5 kez Otur - Kalk testi

İlk (sn)	
Son (sn)	

Bölüm 4. Proprioepsiyon Değerlendirmesi

	Sağ		Sol	
	<u>ilk</u>	<u>son</u>	İlk	Son
<u>Dorsi fleksiyon açısı:</u>				
<u>Plantar fleksiyon açısı:</u>				

Bölüm 5. Duyu Değerlendirmesi

	İlk	Son
İki Nokta <u>Diskriminasyonu</u>		
Vibrasyon		

APPENDIX 8.3. MINI MENTAL TEST

YÖNELİM (Toplam puan 10)

- Hangi yıl içindeyiz ()
- Hangi mevsimdeyiz ()
- Hangi aydayız ()
- Bu gün ayın kaçı ()
- Hangi gündeysiniz ()
- Hangi ülkede yaşıyoruz ()
- Şu an hangi şehirde bulunmaktasınız. ()
- Şu an bulunduğunuz semt neresidir ()
- Şu an bulunduğunuz bina neresidir ()
- Şu an bu binada kaçınıcı kattasınız. ()

KAYIT HAFIZASI (Toplam puan 3)

Size birazdan söyleyeceğim üç ismi dikkatlice dinleyip ben bitirdikten sonra tekrarlayın (Masa, Bayrak, Elbise) (20 sn süre tanınır) Her doğru isim 1 puan ()

DİKKAT VE HESAP YAPMA (Toplam puan 5)

100'den geriye doğru 7 çıkartarak gidin. Dur deyinceye kadar devam edin.
Her doğru işlem 1 puan. (100, 93, 86, 79, 72, 65) ()

HATIRLAMA (Toplam puan 3)

Yukarıda tekrar ettiğiniz kelimeleri hatırlıyor musunuz? Hatırladıklarınızı söyleyin.
(Masa, Bayrak, Elbise). ()

LİSAN (Toplam puan 9)

- a) Bu gördüğünüz nesnelerin isimleri nedir? (saat, kalem) 2 puan (20 sn tut) ()
- b) Şimdi size söyleyeceğim cümleyi dikkatle dinleyin ve ben bitirdikten sonra tekrar edin.

"Eğer ve fakat istemiyorum" (10 sn tut) 1 puan ()

- c) Şimdi sizden bir şey yapmanızı isteyeceğim, beni dikkatle dinleyin ve söylediğimi yapın.

"Masada duran kâğıdı sağ/sol elinizle alın, iki elinizle ikiye katlayın ve yere bırakın lütfen"

Toplam puan 3, süre 30 sn, her bir doğru işlem 1 puan ()

- d) Şimdi size bir cümle vereceğim. Okuyun ve yazıda söylenen şeyi yapın. (1 puan)

"GÖZLERİNİZİ KAPATIN" (arka sayfada) ()

- e) Şimdi vereceğim kâğıda aklınıza gelen anlamlı bir cümleyi yazın. (1 puan) ()

- f) Size göstereceğim şeklin aynısını çizin. (arka sayfada) (1 puan) ()



APPENDIX 8.4. THE TIMED UP AND GO TEST

Zamanlı Kalk Ve Yürü Testi

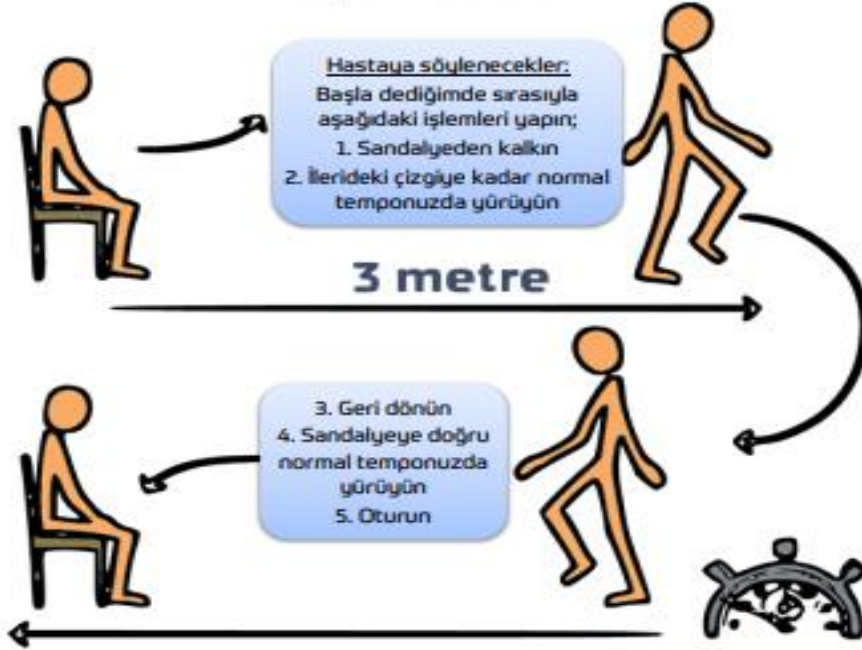
The Timed Up and Go (TUG) Test

Hastanın Adı Soyadı:

Tarih:/...../.....

Yaşlılarda düşme riskini ve mobilitayı değerlendiren testin uygulanışı için bir sandalye ve bir kronometre gereklidir.

Test hastanın her zaman kullandığı ayakkabı ile yapılır ve eğer ihtiyaç duyuyorsa yürümeye yardımcı araçlarını kullanabileceği söylenir. Sandalyenin önündeki 3 metrelik alan belirlenir. Hastadan sandalyeden kalkıp bu mesafeyi yürüyüp tekrar oturması istenir. Geçen zaman testin sonucunu verir.



Geçen Süre: saniye

Yaşlı bir birey bu testi 12 saniyeden daha uzun sürede tamamlıyorsa düşme riski vardır

Var olanları işaretleyin:

- | | |
|--|---|
| ☐ Yavaş ve değişken tempo | ☐ Denge kaybı |
| ☐ Kısa adım aralığı | ☐ Kol sallama kısa ya da yok |
| ☐ Duvara tutunuyor. | ☐ Ayaklarını sürüyor |
| ☐ Kalıp gibi dönüyor | ☐ Yürüme araçlarını düzgün kullanmıyor |

APPENDIX 8.5. KATZ INDEX OF INDEPENDENCE IN ACTIVITIES OF DAILY LIVING (ADL)

Katz Günlük Yaşam Aktiviteleri Ölçeği Katz Index of Independence in Activities of Daily Living (ADL)

Hastanın Adı Soyadı: Tarih:/...../.....

Etkinlikler	Puan	Bağımsız (1 Puan)	Bağımlı (0 Puan)
Banyo yapma		Kendi başına yıkanabiliyor veya vücudunun küçük bir parçasının yıkanması için yardım alıyor.	Kendi başına yıkanamıyor veya vücudunun büyük bir kısmının yıkanmasında başkasına ihtiyaç duyuyor
Giyinme		Dolaptan kendi başına kıyafetlerini çıkarıp giyinebilir (Ayakkabısını bağlarken yardım alabilir).	Giyinirken yardım alıyor veya tamamen başkası tarafından giydiriliyor.
Tuvalet yapma		Tuvalete gitme, tuvaletini yapma, temizlenme, üzerini tekrar giyme gibi aktiviteleri kendi başına yapabiliyor.	Tuvalete giderken yardım alıyor, tek başına temizlenme vb. etkinlikleri yapamıyor ya da lazımlık (sürgü) veya lazımlıklı iskemle kullanıyor.
Transfer		Yataktan kanepeye veya tersi etkinliği tek başına veya baston vb. cihaz ile yapabiliyor.	Yataktan sandalyeye geçerken kısmi veya tam olarak bir başkasının yardımına ihtiyaç duyuyor.
Kontinans		Defekasyon ve mesane üzerine tam kontrolü mevcut.	Kısmi veya tam mesane veya bağırsak inkontinansı mevcut
Beslenme		Yemeği tabaktan ağzına kendisi götürebiliyor (Yemeği başkası hazırlayabilir).	Bir başkası tarafından yediriliyor veya parenteral beslenmeye muhtaç

Katz, S., Down, T.D., Cash, H.R., & Grotz, R.C. (1970) Progress in the development of the index of ADL. The Gerontologist, 10(1), 20-30.

Toplam Puan: (6 puan: hasta bağımsız / 0 puan: hasta tam bağımlı)

APPENDIX 8.6. GERIATRIC DEPRESSION SCALE

Geriatrik Depresyon Ölçeği Geriatric Depression Scale (GDS)

Hastanın Adı Soyadı: _____ Tarih: ____/____/____

Geçen hafta kendinizi nasıl hissettiniz? Aşağıdaki sorulara en doğru cevapları veriniz.

		Evet	Hayır
1	Genel olarak hayatınızdan memnun musunuz?	☐ ₀	☐ ₁
2	Faaliyet ve ilgilerinizin çoğunu bıraktınız mı?	☐ ₁	☐ ₀
3	Hayatınızın anlamsız olduğunu düşünüyor musunuz?	☐ ₁	☐ ₀
4	Sıklıkla canınız sıkın mıdır?	☐ ₁	☐ ₀
5	Gelecekte ümitli misiniz?	☐ ₀	☐ ₁
6	Sizi rahatsız eden ve kafanızdan bir türlü atamadığınız düşünceler var mı?	☐ ₁	☐ ₀
7	Keyfiniz çoğu zaman yerinde midir?	☐ ₀	☐ ₁
8	Sanki size kötü bir şey olacakmış gibi bir korku yaşıyor musunuz?	☐ ₁	☐ ₀
9	Kendinizi çoğu zaman mutlu hisseder misiniz?	☐ ₀	☐ ₁
10	Sıklıkla çaresiz hisseder misiniz?	☐ ₁	☐ ₀
11	Sıklıkla huzursuz ve yerinde duramaz olur musunuz?	☐ ₁	☐ ₀
12	Dışarı çıkıp değişik şeyler yapmaktansa evde kalmayı mı tercih edersiniz?	☐ ₁	☐ ₀
13	Gelecekle ilgili olarak sık sık endişelenir misiniz?	☐ ₁	☐ ₀
14	Birçok kişiye göre daha fazla unutkanlığınız var mı?	☐ ₁	☐ ₀
15	Hayatta olmak sizin için güzel bir şey mi?	☐ ₀	☐ ₁
16	Çoğu zaman kederli ve üzgün müsünüz?	☐ ₁	☐ ₀
17	Kendinizi oldukça değersiz buluyor musunuz?	☐ ₁	☐ ₀
18	Geçmiş düşünmek canınızı oldukça sıkıyor mu?	☐ ₁	☐ ₀
19	Hayat size oldukça heyecan verici geliyor mu?	☐ ₀	☐ ₁
20	Yeni bir şeye kalkışmak size oldukça zor geliyor mu?	☐ ₁	☐ ₀
21	Gücünüz kuvvetiniz yerinde mi?	☐ ₀	☐ ₁
22	Durumunuz size ümitsiz geliyor mu?	☐ ₁	☐ ₀
23	Çoğu insanın sizden daha iyi durumda olduğunu düşünüyor musunuz?	☐ ₁	☐ ₀
24	Küçük şeyler canınızı sıkıyor mı?	☐ ₁	☐ ₀
25	Sıklıkla ağlamaklı olur musunuz?	☐ ₁	☐ ₀
26	Dikkatinizi toplamakta güçlük çeker misiniz?	☐ ₁	☐ ₀
27	Sabahları yataktan kalkmak çok zor geliyor mu?	☐ ₁	☐ ₀
28	Başkaları ile birlikte olmayı eskisi gibi istiyor musunuz?	☐ ₀	☐ ₁
29	Kolayca karar verebiliyor musunuz?	☐ ₀	☐ ₁
30	Eskisi kadar iyi düşünebiliyor musunuz?	☐ ₀	☐ ₁

0 - 10 puan "depresyon yok"

11 - 13 puan "muhtemel depresyon"

14 ve üzeri puan "kesin depresyon"

APPENDIX 8.7. BERG BALANCE TEST

Hastanın Adı Soyadı: _____ Tarih: ____/____/____

1	Oturma Pozisyonundayken Ayağa Kalkmak	
	Yönerge: Lütfen ayağa kalkın. Ellerinizi destek almamaya çalışın.	
	☐ 4	Ellerini kullanmadan ayağa kalkabilir ve kendi kendine denge sağlayabilir.
	☐ 3	Ellerini kullanarak ayağa kalkabilir.
	☐ 2	Birkaç denemeden sonra ellerini kullanarak ayağa kalkabilir.
	☐ 1	Ayağa kalkmak ve denge kurmak için çok az yardıma ihtiyacı vardır.
☐ 0	Ayağa kalkmak için orta düzeyde ya da çok yardıma ihtiyacı vardır.	
2	Desteksiz Ayakta Durmak	
	Yönerge: Lütfen hiçbir yere tutunmadan iki dakika ayakta durun.	
	☐ 4	2 dakika emniyetli bir şekilde ayakta durabilir.
	☐ 3	Gözetim altında 2 dakika ayakta durabilir.
	☐ 2	Desteksiz 30 saniye ayakta durabilir.
	☐ 1	Desteksiz 30 saniye ayakta durabilmek için birkaç denemeye ihtiyacı var.
☐ 0	Yardım almadan 30 saniye ayakta duramaz.	
3	Desteksiz Oturmak (Arkaya Yaslanmadan Oturmak) (2. Soru 4 puan işaretlenmişse soruyu atlayınız)	
	Yönerge: Lütfen kollarınızı kavuşturarak iki dakika oturun.	
	☐ 4	Emniyetli bir şekilde 2 dakika oturabilir.
	☐ 3	Gözetim altında 2 dakika oturabilir.
	☐ 2	30 saniye oturabilir.
	☐ 1	10 saniye oturabilir
☐ 0	Desteksiz 10 saniye oturamaz.	
4	Ayaktayken Oturma Pozisyonuna Geçmek	
	Yönerge: Lütfen oturun.	
	☐ 4	Ellerinden asgari düzeyde yardım alarak emniyetli bir şekilde oturabilir.
	☐ 3	Ellerinden yardım alarak kontrollü bir şekilde oturur.
	☐ 2	Bacaklarıyla sandalyeden destek alarak kontrollü bir şekilde oturur.
	☐ 1	Kendi başına oturabilir ama kontrollü değildir.
☐ 0	Oturmak için yardıma ihtiyacı vardır.	
5	Transfer	
	Yönerge: Sandalyeleri transfer yapılacak şekilde göre yerleştirin. Hastaya bir kolluklu bir de kolluksuz koltuğa doğru yer değiştirmesini söyleyin. İki sandalye (biri kolluklu diğeri kolluksuz) ya da bir yatak ve bir koltuk kullanabilirsiniz.	
	☐ 4	Ellerini çok az kullanarak emniyetli bir şekilde transfer olabiliyor.
	☐ 3	Emniyetli bir şekilde transfer olabiliyor, ellerini kesinlikle kullanıyor.
	☐ 2	Sözlü kılavuzlukla ve gözetimle veya gözetimsiz transfer olabiliyor.
	☐ 1	Yardım edecek bir kişiye gereksinimi var.
☐ 0	Güvende olabilmesi için yardım edecek veya gözetecek iki kişiye gereksinimi var.	

6	Gözler Kapalıyken Desteksiz Ayakta Durmak	
	Yönerge: Lütfen gözlerinizi kapayın ve ayakta 10 saniye hareketsiz durun.	
	☐ 4	10 saniye emniyetli bir şekilde ayakta durabilir.
	☐ 3	Gözetim altında 10 saniye ayakta durabilir.
	☐ 2	3 saniye ayakta durabilir.
	☐ 1	Gözlerini üç saniyeden fazla kapalı tutamaz ama ayakta sabit durabilir.
	☐ 0	Düşmemek için yardıma ihtiyacı vardır.
7	Ayaklar Bitişikken Desteksiz Ayakta Durmak	
	Yönerge: Ayaklarınızı birleştirin ve tutunmadan ayakta durun.	
	☐ 4	Kendi başına ayaklarını birleştirip 1 dakika emniyetli bir şekilde ayakta durabilir.
	☐ 3	Kendi başına ayaklarını birleştirip 1 dakika gözetim altında ayakta durabilir
	☐ 2	Kendi başına ayaklarını birleştirip 30 saniye ayakta durabilir.
	☐ 1	Yardım ile istenilen pozisyona gelebilir, ama ayaklar bitişik vaziyette ancak 15 saniye ayakta durabilir.
	☐ 0	Yardım ile istenilen pozisyona gelebilir, ama bu pozisyonu 15 saniye muhafaza edemez.
8	Ayaktayken Kollar Gergin Öne Doğru Uzanmak	
	Yönerge: Kollarınızı 90 derece kaldırın. Parmaklarınızı uzatın ve öne doğru uzanabildiğiniz kadar uzanın. [Gözetmen eller 90° iken hastanın parmak uçları hizasında bir cetvel tutar. Öne uzanırken hastanın parmakları cetvele değmemelidir. Hastanın en ileri uzanabildiği noktada parmak uçlarının kat ettiği mesafe kaydedilmelidir. Gövdenin dönmesini önlemek için, hastaya mümkünse iki kolunu da uzatmasını söyleyin].	
	☐ 4	Rahatça öne uzanabilir >25 cm.
	☐ 3	Rahatça öne uzanabilir >12,5 cm.
	☐ 2	Rahatça öne uzanabilir >5 cm.
	☐ 1	Öne uzanabilir ama gözleme ihtiyacı vardır.
	☐ 0	Öne uzanmaya çalışırken dengesini kaybeder/dışardan destek gerekir.
9	Ayaktayken Yerden Nesne Almak	
	Yönerge: Ayağınızın hemen önünde bulunan ayakkabıyı/terliği alın.	
	☐ 4	Terliği rahatça alabilir.
	☐ 3	Terliği alabilir ama gözetim eşliğinde.
	☐ 2	Terliği alamaz ama terliğe 2-5 cm kadar yaklaşabilir ve kendi kendine denge sağlayabilir.
	☐ 1	Terliği alamaz, almaya çalışırken de gözetime ihtiyacı vardır.
	☐ 0	Terliği almayı denemez/düşmemek ya da dengesini kaybetmemek için yardıma ihtiyacı vardır.
10	Ayaktayken Sağ Ya Da Sol Omuz Üzerinden Dönerek Geriye Bakmak	
	Yönerge: Sol omzunuzun üzerinden dönerek arkanıza bakın. Aynısını sağ tarafınızda tekrar edin. [Gözetmen deneğin daha iyi bir dönüş hareketi gerçekleştirmesini sağlamak için deneğin arkasında yer alan bir nesneyi bakış noktası olarak belirleyebilir.]	
	☐ 4	Terliği rahatça alabilir.
	☐ 3	Terliği alabilir ama gözetim eşliğinde.
	☐ 2	Terliği alamaz ama terliğe 2-5 cm kadar yaklaşabilir ve kendi kendine denge sağlayabilir.
	☐ 1	Terliği alamaz, almaya çalışırken de gözetime ihtiyacı vardır.
	☐ 0	Terliği almayı denemez/düşmemek ya da dengesini kaybetmemek için yardıma ihtiyacı vardır.

11	360° Dönmek
	Yönerge: Tam daire çizerek şekilde kendi etrafınızda dönün. Durun. Sonra ters yönde tam daire çizin.
	☐ 4 4 saniye ya da daha kısa sürede emniyetli bir şekilde 360 derece dönebilir.
	☐ 3 4 saniye ya da daha kısa sürede sadece bir tarafa doğru emniyetli bir şekilde 360 derece dönebilir.
	☐ 2 Emniyetli bir şekilde fakat yavaş bir şekilde 360 derece dönebilir.
12	☐ 1 Yakın gözetime ya da sözlü uyarıya ihtiyacı vardır.
	☐ 0 Dönerken yardıma ihtiyacı vardır.
	Desteksiz Ayakta Dururken Değişerek Bir Ayağı Yere Basamak Veya Tabureye Yerleştirmek
	Yönerge: İki ayağı da sırasıyla taburenin üstüne koyun. Her iki ayak da tabureye 4 kere değene kadar harekete devam edin.
	☐ 4 Kendi başına emniyetli bir şekilde ayakta durabilir ve 20 saniyede 8 adımı tamamlayabilir.
13	☐ 3 Kendi başına ayakta durabilir ve 8 adımı 20 saniyeden daha uzun bir sürede tamamlayabilir.
	☐ 2 Gözetim altında yardım almadan 4 adım tamamlayabilir.
	☐ 1 Az yardımla 2 adım tamamlayabilir.
	☐ 0 Düşmemek için yardıma ihtiyacı vardır/çaba gösteremez.
14	Bir Ayak Önde Olarak Desteksiz Ayakta Durmak
	Yönerge: Hastaya gösterin: Bir ayağınızı diğerinin tam önüne koyun. Bunu yapamıyorsanız, ayağınızı, topuk kısmı öteki ayağınızın başparmağı hizasına gelecek şekilde bir adım atın. (3 puan vermek için adımın mesafesi diğer ayağın uzunluğunu geçmeli ve duruşun genişliği deneğin normal yürüyüş adımıdaki genişliğe yakın olmalı.)
	☐ 4 Normal yürüyüş adımını bağımsız olarak atabiliyor ve 30 saniye tutabiliyor
	☐ 3 Ayağını diğerinin önüne bağımsız olarak koyabiliyor ve 30 saniye tutabiliyor.
	☐ 2 Bağımsız olarak küçük adım atabiliyor ve 30 saniye tutabiliyor.
15	☐ 1 Adım atmak için yardıma ihtiyacı var ama 15 saniye durabiliyor
	☐ 0 Adım atarken veya ayakta dururken yardıma ihtiyacı var.
16	Tek Ayak Üstünde Durmak
	Yönerge: Tek ayağın üzerinde durabildiğinizce fazla durun
	☐ 4 Tek ayağı üzerinde 10 saniyeden daha fazla durabiliyor.
	☐ 3 Tek ayağı üzerinde 5-10 saniye durabiliyor.
	☐ 2 Tek ayağı üzerinde 3-5 saniye durabiliyor.
	☐ 1 Tek ayağı üzerinde durabiliyor ancak bunu 3 devam ettiremiyor.
	☐ 0 Tek ayağı üzerinde duramıyor.

Puanlama

0-20: Yüksek Düşme Riski! Tekerlekli sandalye - Walker gerekli 21-40: Orta derecede düşme riski. Baston - Tripod gerekli 41-56: Düşük risk. Yardıma araç gerekmez.

Berg KJ, Wood-Dauphinee S, (1995) Scand J Rehabil Med. 1995 Mar;27(1):27-36.

Toplam Skor (0-56):

APPENDIX 8.8. ETHICAL COMMITTEE APPROVAL



T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15-1510
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

21/06/2018

İlgili Makama (Merve Nur Karaçocuk Işık)

Yeditepe Üniversitesi, Fizyoterapi Bölümü Prof. Dr. Feryal Subaşı'nın sorumlu olduğu "**Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması**" isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası (**1486** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **20.06.2018** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 869**).

Prof. Dr. Turgay ÇELİK
Yeditepe Üniversitesi
Klinik Araştırmalar Etik Kurulu Başkanı

APPENDIX 8.9 PERMISSION LETTER FROM THE INSTITUTION

EGZERSİZ ALANI KULLANIM İZİN YAZISI

Fzt.Merve Nur Karaçocuk Işık' ın "Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması" isimli yüksek lisans çalışmasına ait planlanmış egzersiz ve aktivitelerin - uygulama esnasında devam etmekte olan seans veya çalışmalara engel olmayacak şekilde - kurumumuz Atasehir Adana-3 'ne ait egzersiz/aktivite salonunda uygulanmasını kabul ediyorum.

Ad – Soyad
İmza

Sibel GÜNGÖR

EGZERSİZ ALANI KULLANIM İZİN YAZISI

Fzt.Merve Nur Karaçocuk Işık' ın "Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması" isimli yüksek lisans çalışmasına ait planlanmış egzersiz ve aktivitelerin - uygulama esnasında devam etmekte olan seans veya çalışmalara engel olmayacak şekilde - kurumumuz A. DORA HUZ. YAS. BİM. 'ne ait egzersiz/aktivite salonunda uygulanmasını kabul ediyorum.

Ad – Soyad
İmza

EGZERSİZ ALANI KULLANIM İZİN YAZISI

Fzt.Merve Nur Karaçocuk Işık' ın “Farklı Duyusal Uyarıların Kullanıldığı Denge Eğitiminin Sonuçlarının Huzurevinde Yaşayan Geriatrik Bireylerde Karşılaştırılması” isimli yüksek lisans çalışmasına ait planlanmış egzersiz ve aktivitelerin - uygulama esnasında devam etmekte olan seans veya çalışmalara engel olmayacak şekilde - kurumumuz **Özel İsmik Kültür Genel Hastanesi**.....’ne ait egzersiz/aktivite salonunda uygulanmasını kabul ediyorum.

Ad – Soyad

9. CV

Kişisel Bilgiler

Adı	Merve Nur	Soyadı	IŞIK
Doğum Yeri		Doğum Tarihi	
Uyruğu		TC Kimlik No	
E-mail		Tel	

Öğrenim Durumu

Derece	Alan	Mezun Olduğu Kurumun Adı	Mezuniyet Yılı
Doktora			
Yüksek Lisans	FTR	Yeditepe Üniversitesi	2020
Lisans	FTR	Yeditepe Üniversitesi	2015
Lise	Sayısal	Süleyman Demirel Anadolu Lisesi	2009

Bildiği Yabancı Dilleri	Yabancı Dil Sınav Notu (#)
İngilizce	

#Başarılmış birden fazla sınav varsa(KPDS, ÜDS, TOEFL; EELTS vs), tüm sonuçlar yazılmalıdır

Görevi	Kurum	Süre (Yıl - Yıl)
Fizyoterapist	Care Oyun Akademisi	2015 -

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Bilgisayar Bilgisi

Program	Kullanma becerisi

*Çok iyi, iyi, orta, zayıf olarak değerlendirin

Bilimsel Çalışmaları

SCI, SSCI, AHCI indekslerine giren dergilerde yayınlanan makaleler

Diğer dergilerde yayınlanan makaleler

Uluslararası bilimsel toplantılarda sunulan ve bildiri kitabında (*Proceedings*) basılan bildiriler

Hakemli konferans/sempozyumların bildiri kitaplarında yer alan yayınlar

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