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YEDİTEPE UNIVERSITY
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COMPARISON OF THE EFFECTS OF TELEREHABILITATION-BASED MOTOR AND COGNITIVE DUAL TASK EXERCISE IN PATIENTS WITH PARKINSON'S DISEASE-A RANDOMIZED CONTROLLED STUDY

MASTER THESIS

ŞÜKRİYE ÇAKIR, PT.

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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 24.04.2023 and numbered .....

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Director of Institute of Health Sciences

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.

Şükriye Çakır

DEDICATION

I want to dedicate my thesis to my new life in United States of America.

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LIST OF SYMBOLS AND ABBREVIATIONS

PD Parkinson's Disease

BG Basal Ganglion

GPE Globus Pallidus Externa

GPI Globus Pallidus Interna

SN Subthalamic Nucleus

PNF Proprioceptive Neuromuscular Facilitation

DT Dual Task

ADL Activities of Daily Living

PT Pre-Treatment

AT After Treatment

HY Hoehn & Yahr Staging

BBS Berg Balance Scale

FES-I Fall Efficiency Scale-International

MoCA Montreal Cognitive Assessment Scale

PDQ-39 Parkinson's Disease Questionnaire

TUG Timed Up and Go Test

10 MWT 10 Meter Walk Test

5XSST Five times sit to stand test

ABSTRACT

Çakır, Ş. (2023). Comparison of the Effects of Motor and Cognitive Dual Task Exercises Based on Telerehabilitation in Parkinson's Patients, Yeditepe University, Institute of Health Sciences, Department of Sport Physiotherapy, Master Thesis. Istanbul.

This study investigated the effects of telerehabilitation and motor and cognitive dual-task exercises on cognitive function, balance, walking, fall risk and quality of life in individuals with Parkinson's Disease. Thirty individuals who met the inclusion criteria and were diagnosed with 'Idiopathic Parkinson's Disease' by a neurologist were recruited. Individuals were randomly divided into three groups as Dual Task (DT) cognition (n=10), Dual Task motor (n=10) and Control group (n=10). All individuals were given a physical exercise program. In addition, individuals in the Dual Task cognition group were given cognitive tasks and individuals in the Dual Task motor group were given motor tasks. The treatment was administered online under the supervision of a physiotherapist for 60 minutes three times a week for eight weeks. In the study, the 10-meter walking test was used to assess walking speed, the Berg Balance Scale (BBS) for balance, and the Montreal Cognitive Assessment Scale (MoCA) for cognitive function, the International Fall Effectiveness Scale (FES-I) for fear of falling, the Parkinson's Disease Questionnaire (PDQ-39) for quality of life, Timed Up and Go Test (TUG) was used for physical performance, and the Five Times Sit to Stand Test (5XSST) was used for extremitytrunk strength and muscle endurance. Individuals were evaluated by the same physiotherapist before and after treatment (8 weeks). When the Quality of Life, MoCA, TUG and 10m walkingtest were evaluated, the mean scores obtained in the posttest in the dual task cognition and dualtask motor task groups were statistically higher than the pretest scores ($p<0.05$). Similar increases were observed for these scales in these two groups. When BDS, 5XSST, and FES-I were evaluated, more significant results were obtained in the DT cognition group.

In our study, it was found that dual-task training programs with physical exercises were effective in increasing the quality of life, walking speed and improving cognitive function. When the superiority of cognitive-motor and motor-motor dual-task combined physical exercises were examined, the cognitive-motor dual-task exercise group was found to be significantly superior in improving balance and reducing the fear of falling.

Keywords: parkinson's disease, dual-task exercises, rehabilitation, balance, gait

ÖZET

Çakır, Ş. (2023). Parkinson Hastalarında Telerehabilitasyona Dayalı Motor ve Bilişsel İkili Görev Egzersizlerinin Etkilerinin Karşılaştırılması, Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Spor Fizyoterapisi Anabilim Dalı, Yüksek Lisans Tezi. İstanbul.

Bu çalışma Parkinson Hastalığına sahip olan bireylerde telerehabilitasyon yöntemi ile motor ve kognitif ikili görev egzersizlerinin kognitif fonksiyon, denge, yürüme, düşme riski ve yaşam kalitesi üzerine etkilerini araştırmıştır. Çalışmaya dahil edilme kriterlerini karşılayan ve nörolog tarafından 'İdiopatik Parkinson Hastalığı' tanılı 30 birey alınmıştır. Bireyler randomizasyon yöntemiyle Dual Task (DT) biliş (n=10), Dual Task motor (n=10) ve Kontrol grubu (n=10) olarak üç gruba ayrılmıştır. Tüm bireylere fiziksel egzersiz programı verilmiştir. Ayrıca Dual Task biliş grubundaki bireylere bilişsel görevler verilmiş ve Dual Task motor grubundaki bireylere ise motor görevler verilmiştir. Tedavi sekiz hafta boyunca haftada üç kez 60 dakika gözetim altında çevrim içi olarak fizyoterapist gözetiminde uygulanmıştır. Çalışmada yürüme hızını değerlendirmek için 10 metre yürüme testi, denge için Berg Denge Ölçeği (BDS) ve bilişsel fonksiyon için Montreal Bilişsel Değerlendirme Ölçeği (MoCA), düşme korkusu için Uluslararası Düşme Etkinliği Ölçeği (DEÖU), yaşam kalitesi için Parkinson Hastalığı Anketi (PHA-39), fiziksel performans için Zamanlı Kalk Yürü Testi (ZKYT), ekstremite gövdekuvveti ve kas dayanıklılığı için Beş Defa Oturup Kalkma Testi (5XSST) kullanılmıştır. Bireyler tedavi öncesi ve tedavi sonrasında (8 hafta) aynı fizyoterapist tarafından değerlendirilmiştir. Yaşam Kalitesi, MoCA, ZKYT ve 10m yürüme testi değerlendirildiğinde dual task biliş ve dual task motor görev gruplarında son testte elde edilen puan ortalamaları ön test puanlarından istatistiksel olarak daha yüksekti ($p<0.05$). Bu iki grupta bu ölçekler için benzer artış gözlenmiştir. BDS, 5XSST ve DEÖU değerlendirildiğinde DT biliş grubunda daha anlamlı sonuçlar elde edilmiştir.

Çalışmamızda fiziksel egzersizlerle ikili görev eğitim programlarının yaşam kalitesini ve yürüme hızını artırmada ve bilişsel fonksiyonun gelişmesinde etkili olduğu bulunmuştur. Biliş-motor ve motor-motor ikili görev fiziksel egzersiz eğitiminin üstünlüğü incelendiğinde, dengeyi geliştirme ve düşme korkusunu azaltmada biliş-motor ikili görev egzersiz grubu anlamlı derecede üstün bulunmuştur.

Anahtar sözcükler: parkinson hastalığı, ikili görev egzersizleri, rehabilitasyon, denge, yürüyüş

1. INTRODUCTION AND PURPOSE

Parkinson's disease is the most common type of parkinsonism. PD is a chronic progressive neurodegenerative disease characterized by motor and non-motor symptoms (1). The disease affects millions of people worldwide and is the second most common neurodegenerative condition after Alzheimer's disease. The estimated prevalence of PH in industrialized countries is 0.3% in the general population, 1.0% in people older than 60 years and 3.0% in people older than 80 years (1-2).

Terminologically, parkinsonism describes a syndrome characterized by rigidity, tremor, and bradykinesia, primarily caused by Parkinson's disease. Parkinsonism due to disruption of dopaminergic nigrostriatal pathways can have many causes. Parkinsonism picture Idiopathic PH, Parkinson plus syndromes and other groups accompanied by Parkinsonism (2).

The dopamine-producing cells in the substantia nigra, which is responsible for movement, balance, and walking in idiopathic PD, appear to degenerate in this disease. The clinical picture includes gait disturbance, slowing of arm swing movements, festination, freezing (motor block), postural instability. In Parkinson's disease, a bradykinetic, short-stepping, shuffling, forward-bent gait is characteristic, which usually causes difficulties in movement sequences such as walking, turning, and transfers. While hypokinesia may occur during movements such as walking, speaking and writing, it may also occur during complex actions while trying to perform or coordinating two simultaneous motor tasks. The main aim of rehabilitation in Parkinson's disease; transfer, correction of posture, upper extremity function and balance, prevention of falling and increasing physical capacity with walking (3,4).

Besides well-documented motor symptoms, most Parkinson's disease (PD) patients suffer from associated non-motor complications, including cognitive impairment, mood disorders, olfactory disturbance, sleep disturbance, fatigue, and anxiety (5). Non-motor symptoms, cognitive impairments are especially common in Parkinson's disease, and 83% of patients develop dementia after 20 years. The non-motor symptoms of PD can be just as detrimental to a patient's health and overall quality of life as the motor symptoms (6).

Decreased cognition can increase the risk of falls by reducing a person's ability to make decisions, solve problems, and perform tasks simultaneously. Also, slowed processing speed and reaction time, impaired gait and balance have been consistently associated with cognitive impairment and are known risk factors for falls. Motor tasks such as walking and balance are

complex processes that require the cooperation of both sensory-motor and cognitive systems. Slowed cognitive processing speed cannot compensate for the deterioration of sensory-motor systems that can occur with aging and may compromise the motor planning and responses necessary to maintain balance in challenging environments (7).

Exercises for breathing, posture, relaxation, stretching, strengthening, and balancing are all part of the traditional rehabilitation regimen. The rehabilitation approach also incorporates movement techniques that target motor learning, such as the hint technique, dual tasking, and virtual reality therapies. The relationship between the control of unconscious (automatic) and voluntary (cognitive) movement determines motor performance in healthy people. Parkinson's patients have a loss of automaticity in their motor actions as a result of the dopaminergic activity in the dorsal basal ganglia declining, and frontal cortex-based cognitive control becomes more prominent. Parkinson's sufferers consequently require greater cognitive abilities to do either physical or cognitive tasks (8). It is intended to use cognitive tactics, cue strategies, and exercise at the forefront to promote independence, safety, and quality of life. Parkinson's neurorehabilitation aims to boost motor function by targeted motor skill acquisition; these studies should incorporate repetition, intensity, and difficulty. The frontal cortex is used by people with Parkinson's disease to control the magnitude and speed of conscious movements. Cognitive engagement is crucial in Parkinson's disease exercise programs because prefrontal cognitive circuits are involved in the early stages of motor learning. Cue tactics, dual-tasking (dual-task training), and motivating techniques can help with cognitive engagement and verbal/proprioceptive feedback. While these coping mechanisms try to get around damaged basal ganglia, motor learning techniques encourage healing through practice (9,10).

In daily functional activities, the body needs the ability to perform two or more tasks at the same time (such as talking while walking). HR may include two different motor tasks simultaneously, or it may include a cognitive task in addition to the motor task. Automatic movements previously performed in neurological diseases gain importance (11). Split attention, which provides the ability to respond to more than one stimulus at the same time, was more affected than timed attention. Divided attention is required to perform two tasks carried out simultaneously, such as a cognitive and motor task (for example, walking and speaking). In Parkinson's Disease, functional mobility and dual-task (DT) ability are impaired due to the effect of divided attention and executive functions. Individuals frequently encounter activities that require HR performance in their daily lives. In situations that require manual dexterity such as writing messages while walking, carrying plates while talking, taking notes while talking on

the phone, taking money out of the wallet while doing calculations, cleaning by singing and cooking by chatting, motor function is carried out simultaneously with an additional motor or cognitive function with minimal interaction. required. Studies have shown that Parkinson's Patients; showed that they performed worse when performing cognitive and balance or walking tasks at the same time (12).

Traditional treatment has focused on balance and gait training, but individuals need to perform an additional motor/cognitive task along with the motor task in daily life. Traditional treatment approaches may be insufficient for the patient to return to his daily life. It has been reported that dual-task training significantly improves walking speed and stride length in Parkinson's patients who are given dual-task training (13). In the studies, two main strategies emerge in dual-task (DT) training: 1) Partial task strategy includes training each task separately. 2) The overall task strategy includes simultaneous training of both components of the DT. In studies, it is said that the variable prioritization (focusing on motor or cognitive task) technique can increase learning (14). In other studies, as a result of the comparison of integrated training (two tasks are applied at the same time) and sequential training (tasks are applied sequentially), a shortened reaction time and an increase in the number of correct answers were observed in cognitive assessment (15). In gait parameters, an increase in walking speed, stride length and cadence was observed. It has been reported that both trainings have positive effects on falling (16). It has been suggested that multi-directional movement strategies applied with classical exercise 8 programs may be effective on walking speed, endurance, step variability and reduction of falls (17). The tasks given in dual task studies are divided into two as motor and cognitive. As the engine is walking, tasks such as catching a ball, carrying a tray, carrying a glass of water without spilling, and buttoning are given as an additional task. Cognitive tasks differ. Tasks such as measuring reaction time, decision making-separation, mental monitoring, working memory and verbal fluency are given. These tasks increase the patient's attention and focus on the task, and also aim to improve executive functions (17,18).

Telerehabilitation (TR) is defined as the use of information and communication technologies to provide various health services to patients living at home, supported by many national health systems around the world. TR offers a different approach that can better meet patient demands and provides an opportunity to communicate remote rehabilitation practices in individuals with disabilities due to various injuries (19). In addition, the value of TR is increasing day by day and is based on concrete possibilities such as providing effective

rehabilitation care to individuals and preventing the displacement of the patient or therapist due to limited functional status or limited access to health services (20).

The implementation of remote rehabilitation interventions through telerehabilitation or communication technology is a promising method that can be widely used in the future to achieve good functional recovery in PD. Telerehabilitation studies with PD are generally aimed at motor speech and voice disorders, and it is stated that it is an effective method to eliminate or reduce the voice quality symptoms caused by the disease, and the online evaluation of speech and voice disorders in PD is valid and reliable (21). When the literature is examined in terms of the effectiveness of telerehabilitation-based exercise applications, it draws attention to the importance of online physiotherapist supervision in these applications. It was concluded that telerehabilitation is similar and preferable to face-to-face training in individuals with PD when applied in real time with a physiotherapist. When we look at the literature, as far as we know, there is no study in which motor and cognitive dual-task exercises are given together and followed up remotely in elderly individuals with PD.

Therefore, our aim was to compare the effects of telerehabilitation method and motor and cognitive dual-task exercises on cognitive, gait, fall risk and quality of life in individuals with Parkinson's Disease.

2. GENERAL INFORMATION

2.1 Parkinsonism

The word Parkinsonism evokes many diseases that are known with symptoms that occur due to different causes. The features that occur in Parkinsonism are resting tremor, bradykinesia, rigidity, loss of postural reflexes, impaired posture and freezing (motor blocks). Caused by disruption of dopaminergic nigrostriatal pathways. Parkinsonism can have many causes (22). These causes include strokes, tumors, metabolic problems and medications. Rapid progression and treatment in a patient with Parkinsonism clinic. It is important to investigate the main problem and make a definitive diagnosis because it does not respond to the problem. Parkinsonism picture can be classified as idiopathic PD, Parkinson plus syndromes and other groups accompanied by Parkinsonism

Parkinsonism classification **Table 2.1** is shown (22) (Bradley 2016)

Primary (Idiopathic) Parkinsonism . Parkinson's Disease . Juvenile Parkinsonism	**Multisystem Degeneration (Parkinson Plus Syndromes)** . Progressive Supranuclear Palsy . Multi system atrophy (Shy-Drager Syndrome) . Corticobal degeneration . Striatonigal degeneration . Progressive pallidal atrophy . Parkinsonism-dementia complex . Pallidopyramidal disease
Secondary (Acquired, Symptomatic) Parkinsonism . Medicines . Antipsychotics, antiemetics, some calcium . Channel blockers (diltiazem, flunarizine, cinnarizine) . Toxins (Manganese, carbon monoxide) . Underbelly parkinsonism	**Heredodegenerative diseases** . Wilson's disease . Neuroacanthocytosis . Hereditary ataxias . Familial basal ganglia calcification . Aceruloplasminemia

. Vascular parkinsonism . Normal pressure hydrocephalus . Others	. Neuroferritinopathy

2.1.1 A Brief History of Parkinson's Disease

The clinical features of Parkinson's Disease (PD) were defined as movement disorder, gait difficulty, forward-bent posture, and muscle weakness as a result of updated studies (23). Parkinson's Disease (PD) was first described by British physician James Parkinson in his book "An Essay of the Shaking Palsy" in 1817. By incorporating stiffness and sensory findings into the initial clinical symptoms, Charcot renamed it "Parkinson's Disease." Among the conditions that produce parkinsonism, PD is the most prevalent neurodegenerative disorder. Clinical findings are shown by PH, basal ganglia, and brain stem nuclei involvement results (24). Especially as a result of the loss of dopaminergic cells in the pars compacta region of the substantia nigra, it is a chronic, progressive disease that manifests both motor and non-motor signs.

2.1.2 Parkinson's Disease Epidemiology and Demographics

The prevalence of the disease is estimated to be 0.3% in the general population and 1-2% in the senior population over 65. It has an incidence of 18/100,000 and a prevalence of 360/100,000. 80% of parkinsonism cases are caused by Parkinson's disease (PD). After Alzheimer's Disease, PD is the second most prevalent neurodegenerative condition worldwide (25). PD is uncommon in those under the age of 40, but as people age, it becomes more common. While the rate is between 1.5 and 2% after the age of 65, it is between 3 and 5% once you reach the age of 85. This rate is 111/100 000 in Turkey. There is a 1.2–1.5 times higher risk in men than in women when taking into account the disparity in disease prevalence betweenthe sexes. The condition has been linked to tea, smoking, and caffeine use (26). Although thereare contradictory researches, it is claimed that using coffee, smoking, or drinking tea can all lower the incidence of PH. The link between exposure to iron, copper, manganese, and lead andan increased risk of disease has not been established.

2.1.3 Pathophysiology of Parkinson's Disease

Motor and non-motor symptoms are both present in Parkinson's Disease, a neurodegenerative condition that affects several systems. When the basal ganglia (BG) structures are impacted, it happens, allowing movement to start, stop, and have its amplitude and pace adjusted. The thalamus, brain stem, and basal ganglia are all affected by the dopaminergic system. The basal ganglia function as a coordinated network that regulates memory, mood, learning, and planning in addition to movement (27). BG is made up of five distinct anatomical components that are connected histologically and functionally and are located deep into the cerebellum. Putamen, caudate nucleus, substantia nigra, glubus pallidus interna-externa, and subthalamic nucleus constituents make up its subcomponents. The striatum includes the putamen and globus pallidus. It is generally agreed that the classical motor characteristics of PD are caused by neuronal death in the substantia nigra pars compacta (SNc) and the accompanying reduction of striatal dopamine content. Lewy bodies, which are eosinophilic inclusions with a dense core encircled by a pale-staining halo of radiating filaments, are required for the neuropathological diagnosis of PD in addition to the presence of clearly visible dopaminergic neuronal loss in the SNc.

Lewy bodies' role in pathogenesis is still unknown, but the discovery that misfolded a-synuclein is a significant component of radiating filaments and is also present in neuronal processes as Lewy neurites has changed perceptions of their formation and contribution to neuronal loss. This has resulted in a significant change in how pathologists view the onset and progression of the disease process, and PD is now recognized as a synucleinopathy (28,29). It is now apparent that Lewy body pathology and the deposition of a-synuclein are thought to originate in the olfactory bulb and lower brain stem, from which they are thought to spread gradually to involve the midbrain and, ultimately, cortical regions.

A staging of the caudorostral spread of Lewy body and a-synuclein pathology in PD was first proposed by Braak and colleagues in 2003, when they proposed that a-synuclein deposition begins in the dorsal motor nucleus of the vagus (stage 1), from where it is thought to proceed in an upward direction via the pons (stage 2) to the midbrain (stage 3) and from there to the basal prosencaphalon and mesocortex (stage 4), finally reaching the neocortex (stages 5 and 6) (30). Motor characteristics of PD are first visible at stage 3 after a significant loss of dopaminergic neurons in the SNc. Although it is acknowledged that not all PD cases exactly follow this formal pattern of PD pathology spreading, it is now generally understood that PD does involve spreading pathology (31). This brings up the crucial idea that PD disease might

spread from one neuron to another. Although the exact mechanism is unknown, altered a-synuclein released by a damaged neuron and absorbed by an adjacent, unaffected neuron or direct transfer between neurons may act as a "seed" in a prion-like mechanism to maintain the cycle of a-synuclein misfolding and the spread of a-synuclein pathology.

2.1.4 Parkinson's Disease Course

Parkinson's disease progresses at varying rates throughout its duration. Typically, it has a beginning that is subtle and steadily worsens with time. The right or left extremity may only be involved in one case of the first symptom, which may have an asymmetrical onset (32). Early signs of the condition include dullness in facial expression, a reduction in mimicry, a reduction in the arm swing when walking, and a slowing down of daily tasks (such as dressing, eating, and walking). Among the earliest signs are hoarseness, decreased volume, and micrography (shrinking in handwriting). Parkinson's disease that manifests early (before age 40) has a better prognosis, a slower pace of progression, and more intact cognitive abilities. It is said that those with late-onset Parkinson's disease are more likely to experience early-onset dementia and balance issues. Dyskinesia and motor fluctuation are more likely to appear in patients with early onset (33). Non-motor symptoms like constipation, sadness, and REM sleep behavior disturbance are prevalent in the early stages of the illness. Late in the course of the illness, motor symptoms such falling attacks, the freezing phenomenon, dyskinesia, and motor fluctuations appear. Five to ten years after the diagnosis, non-motor symptoms such dysphagia,insomnia, dementia, autonomic dysfunction, and incontinence start to appear. For clinical staging of the disease and assessment of progression, Hoehn and Yahr's According to the staging system he developed, there are 5 stages: (34)

Stage-1 Unilateral involvement, minimal or no functional loss

Stage-2 Bilateral or midline involvement, no balance disorder

Stage-3 Bilateral involvement, balance disorder and impaired postural reflexes, mild-moderate

There is a level of disability

Stage-4 There is severe disability, the patient can walk and stand without support.

can be sustained, but remains substantially inadequate.

Stage-5 Completely wheelchair or bed dependent without assistance

2.1.5 Clinical Features of Parkinson's Disease

The complex condition known as Parkinson's disease (PD) manifests both motor and non-motor symptoms (35). Bradykinesia, tremor, and stiffness are unilateral or asymmetrical symptoms of Parkinson's disease. Clinically, one significant characteristic that sets PD apart from other neurodegenerative disorders is its ongoing asymmetry. In addition to motor symptoms, non-motor symptoms also exhibit this asymmetric trait (Table 3.2). For instance, a more severely impacted participant would have more pain in their extremities, a higher level of exhaustion, and a lower pain threshold.

Table 2.2. Clinical signs and symptoms in Parkinson's disease

CLINICAL SYMPTOMS AND FINDINGS	
Motor Symptoms	**Non- motor Symptoms**
□ Bradykinesia □ Tremor □ Rigidity □ Postural instability □ Postural deformities □ Striatal Hand □ Striatal Foot □ Camptocormia □ Pisa Syndrome □ Scoliosis □ Antecollis □ Retrocollis □ Walking □ Freezing □ Other motor disorders	□ Cognitive/Neuropsychiatric Disorders □ Depression □ Anxiety □ Apathy □ Dementia □ Bradyphrenia □ Impulse control disorder □ Fatigue □ Autonomic Disorders □ Respiratory disorders □ Urinary dysfunction □ Orthostatic hypotension □ Excessive sweating □ Seborrhea □ Sexual dysfunction □ Sleep Disorders □ Sensory Symptoms □ Pain □ Paresthesia □ Olfactory dysfunction

Motor Symptoms

Bradykinesia: It is crucial for determining the diagnosis of PH. It is a movement condition characterized by pronounced slowness, diminished repetition frequency and amplitude, and exhaustion. Under the umbrella term of bradykinesia, the concepts akinesia and hypokinesia are combined. Akinesia is the inability to start moving. The sustained slowing of movement is known as hypokinesia. Early symptoms could include facial dullness (hypomimia), hypersialorrhea from fewer swallows, slurred speech (hypophony), and font shrinkage (micrography). The font size and sentence length are reduced in the final sentence when the patient is requested to write the same sentence three times (36). The existence of bradykinesia is suggested by decreased arm swing while walking, straining to get out of a low chair, and turning in bed. By making an observation, bradykinesia can be found. Sequential motions of the patient (fist open-close, supination-pronation movement, foot tapping, etc.) are observed during the physical examination, and slowing of movement and decrease in amplitude are assessed.

Tremor: The most prevalent and easily characterized PH sign is resting tremor (37). It frequently affects just one hand unilaterally and has a frequency of 4-6 Hz. The distalextremities show it off more. This symptom can appear at different times over the course of theillness and in different persons. About 50% of people experience it as their initial symptom, and about 75% of patients experience it at some point during the course of the disease. In 9% of patients, tremor goes away as the illness worsens. And in 11% of cases, there is no tremor atall. Resting tremor in Parkinson's patients can affect the lips, jaw, and legs. Contrary to essentialtremor, it hardly ever affects the voice or the neck (3,38). Movement of the extremity (used forwriting and holding objects) ceases with sleep and total relaxation, whereas the opposite extremity's movement rises with mental activity, tension, and walking (39,40).

Therefore, rest tremor creates timidity rather than a significant impairment in daily life tasks. Patients with Parkinson's disease can also experience postural tremor, which occurs frequently and is comparable to resting tremor. When the arms are extended forward, a postural tremor develops with a delay after the rest tremor has disappeared. This is why it is referred to as "reemergent tremor," or re-emerging tremor. Due to its frequency and receptivity to dopaminergic therapy, it is classified as a form of rest tremor. Postural tremor reduces one's ability to hold items against gravity, such as newspapers, and causes liquids to flow. It consequently presents more issues than rest tremor (3,41,42). Furthermore, action tremor is frequently observed in PD and is related to how severe rest tremor is.

Rigidity: When agonist and antagonist muscles contract simultaneously during passive movement, there is an increase in tone that results. Patients characterize it as rigidity and immobility. It starts unilaterally in the proximal upper extremity and can subsequently migrate distally to the neck and muscles on the opposite side. Arm swing is decreased and the joint's range of motion is constrained by rigidity. On the affected side, shoulder pain is typically how it first manifests. Patients experience difficulties turning in bed. The most frequently assessed motions during the assessment are wrist rotation and elbow flexion-extension. The "Froment maneuver" is a series of repeating movements done to the opposite extremity to emphasize the rigidity (43). The term "gear sign" refers to the detection of stiffness cut in tremor coexistence cases. The patient's hands and feet will eventually. In the distal phalanx joint, ulnar deviation and flexion deformity are frequent. Rigidity in the back muscles might lead to the development of an anterior flexion posture.

Postural Instability: After the emergence of other clinical characteristics, postural instability brought on by the loss of postural reflexes is typically observed in the latter stages of the disease. Age-related alterations in sensory function, orthostatic hypotension, and other parkinsonian findings including the capacity to combine visual, vestibular, and proprioceptive inputs have an impact on it. With the frostbite phenomenon, it is the most frequent reason for falls and increases the risk of hip fractures (44). The "pull test" is used, in which the patient's shoulders are abruptly dragged backward, to assess postural instability. The patient's inability to maintainbalance by taking more than two steps or the lack of any postural reaction are both aberrant responses. Patients with a history of falls are more likely to experience postural instability, which worsens when motor and cognitive tasks are carried out at the same time (45). It is the PH result that responds least favorably to dopaminergic therapy (46). While some axial symptoms of PD have been proven to improve with the use of therapies such dopaminergic medication, pallidotomy, and deep brain stimulation, postural instability as measured byplatform tilt and visual tilt has not been demonstrated to improve with these therapies.

Postural Deformities: Awkward axial postures arise as a result of neck and trunk rigidity (axial rigidity). Rigidity-related postural abnormalities are identified by the flexion of the neck, trunk, wrist, and knee. However, flexion posture is typically observed in the disease's latter stages (47). PD-related major postural abnormalities include:

a) Striatal hand: This deformity resembles the swan neck deformity observed in several arthritic conditions and is defined by ulnar deviation at the wrist, flexion of the metacarpophalangeal joints, and extension of the interphalangeal joints.

b) The striatal foot, which is the big toe extended, the other toes flexed, and it is in the standing equinovarus position (48).

c) Camptocormia: This very pronounced forward slanting position is defined by bending of the lumbar or thoracic spine.

d) Pisa syndrome: This condition causes a considerable lateral flexion of the trunk.

g) Scoliosis: This condition involves the lateral curvature of the spine, which is frequently accompanied by vertebral rotation.

f) Antekollis: Defined as the forward flexion of the head and neck, it can be seen as a component of the forward-leaning posture in Parkinson's disease (PD) if it is modest. However, some patients also experience disproportionate antecollis, which manifests as a more pronounced neck flexion than trunk or extremity flexion.

g) Retrocollis is a neck posture abnormality characterized by the head being extended.

Gait Disorders: Bradykinesia and postural instability lead to gait disruption in PD. The walk is characterized by its slowness, restricted support surface, shuffling, reduced arm swing, neck flexion, and posture that leans forward. Some gait characteristics may display asymmetry due to arm swing or foot dragging that may favor one side of the body more than the other. In the later stages, patients begin to walk quickly and quickly, as if striving to regain their center of gravity. This type of walk is known as a festination walk. Propulsion of the festinations moving forward and backward, it's known as retropulsion. The heel-toe kick transitions into a flat-foot kick, a toe-heel kick, and finally a step at PH. As a result, where there is carpet, it becomes harder to walk over or pass over obstructions (49).

Freezing: In the following period, individuals are noted with issues such difficulties starting to walk, stopping at turns and door thresholds, and freezing during walking, which is a type of akinesia. Lower extremities are more commonly affected by frostbite. Usually, it manifests as brief, abrupt, and transient motor blockages that don't last longer than 10 seconds. It happens when you first start to walk, when you turn, in small spaces, and when you cross the street (50).

One of the most frequent reasons for falls is this. Fall assaults that result in frostbite include those that happen naturally or during rotating. Risk factors for frostbite include bradykinesia, stiffness, the presence of postural instability, and a protracted illness. The disease is typically in its later stages when it happens. Jumping over things, walking with music or rhythm, shifting your weight to one leg, and walking on command can all help prevent frostbite.

Other motor disorders

- Prehistoric reflexes

It happens as a result of the frontal lobe's inhibitory systems being disturbed. For instance, 34.1% of the patients exhibited palmomental reflex, while 80.5% of the patients had glabellar reflex. Unwanted movements during voluntary movement have been seen in some patients' homologous muscles on the opposing side of the body. Mirror motions refer to this circumstance that was seen in the early asymmetrical era of PH (51).

- Neuro-ophthalmological discoveries

It is claimed that a number of neuroophthalmological anomalies in PD may be the root of visual and ocular problems. Reduced blinking, ocular discomfort, visual hallucinations, blapherospasm, impaired convergence, and eye opening are some of the symptoms. It encompasses conditions including supranuclear gaze palsy, oculogyric crises, and apraxia (52).

- Bulbar dysfunction

Bulbar abnormalities such dysarthria, hypophonia, dysphagia, and sialorrhea are typically observed in PD and contribute to insufficiency just as much as or more than the cardinal symptoms. These results are assumed to be related to stiffness and orofacial-laryngeal bradykinesia. The tip of the tongue phenomenon, repetitive, soft, and fluctuating panting, and difficulty finding words are all signs of speech difficulties. Laryngeal during swallowing or failure to begin swallowing (53). Esophageal movements that are prolonged or that are prolonged in general lead to dysphagia. Due to the reduction in swallowing, PH is related with an increase in saliva (54,55).

- Rectal disorders

The morbidity and mortality associated with PH are severely impacted by respiratory or obstructive respiratory failures. The central or peripheral obstructive breathing pattern may be brought on by cervical arthrosis, stiffness, or a restriction of passive normal joint motion in the neck. Chest wall stiffness is related to restrictive dysfunction. Levodopa medication can also result in respiratory dyskinesia (56).

- Dystonia

One of the early signs of PH in young people may be this. The condition may develop in females as a result of levodopa medication or prolonged duration.

Non-Motor Symptoms

Non-motor symptoms, which are frequently observed in PD, may appear before motor symptoms and may have a more negative impact on quality of life.

Cognitive/Neuropsychiatric

With 17% of patients reporting significant depression, 22% light depression, and 13% dysthymia (chronic depression), depression is a common ailment in Parkinson's disease (PD). Depression, which can strike at any stage of the illness, may come on before motor dysfunctions and PD. Period could be a sign (57).

- **Anxiety**

It can happen at any stage of the disease and has an incidence that ranges from 25 to 40%. It can also manifest in Parkinson's patients as panic disorder or one of the phobic disorders (58).

- **Apathy**

Difficult to distinguish from exhaustion or despair, but particularly The patient'sextreme apathy is a key identifying characteristic for the caregiver (59).

- **Dementia**

15 years after their diagnosis of PH, 84% of patients reportedly have cognitive decline, and 48% of them are given dementia diagnoses. Dementia is five times more likely to occur in Parkinson's patients than in healthy individuals (60).

- **Bradyphrenia**

Early on in the course of the illness, it is observed. It is described as the circumstance in which patients answer questions slowly yet can provide accurate responses when given ample time. This demonstrates that although the patients' minds and reasoning abilities are slowed down, their memory function is unaffected (61).

- **Impulse control disorder**

It is a behavioral disorder that is harmful and connected to dopamine replacement therapy. It is common to see behavioral abnormalities including obsessive gambling, compulsive shopping, overeating, excessive cravings (particularly for sweets), and

hypersexuality. Additionally, punding, which is characterized as aberrant, repetitive, and pointless behavior (constantly using, inspecting, arranging, and sorting objects), occurs. Dopamine dysregulation syndrome is the collective name for all of these symptoms (62).

- **Fatigue**

The sensation of fatigue, which can be characterized as a sense of tiredness or burnout, is becoming more and more apparent in PD patients. It is one of the signs that makes patients with Parkinson's unable to function and has the greatest negative effect on their quality of life (63).

Autonomic Disorders

- **Respiratory disorders**

It is one of the most common complaints and is observed in about 50% of patients. Ten years may pass between the time of the diagnosis and the onset of PH. Raises the risk by about 2.5 times. Constipation is on the rise, in part due to insufficient movement and water consumption. The colon may grow as a result of severe constipation, and obstructive ileus may develop, necessitating surgery (64).

- **Urinary dysfunction**

Parkinson's patients regularly experience it, and it has a big impact on their quality of life frequent urination, abrupt urination, detrusor hyperactivity, or hypoactivity. It results in issues including nighttime urination, urge incontinence, and urge urination (65).

- **Orthostatic hypotension**

It typically manifests in the later stages of the illness, and its prevalence is thought to range between 30 and 50%. The patient is conscious of pallor, vertigo, or loss of balance while standing or moving around. Antiparkinsonian medications are thought to make orthostatic hypotension worse. Orthostatic hypotension is linked to functional impairments and falls (66).

- **Excessive sweating**

It is a typical discovery that might affect any portion of the body or the entire body. Sweating more than usual is thought to be an overreaction to everyday stressorsm (67).

- **Seborrhea**

It is the condition of excessive secretion of sebum, an oily and waxy substance secreted from the sebaceous glands. Seborrheic dermatitis is brought on by an infection and inflammation that occur simultaneously. Particularly vulnerable areas are the scalp on either side of the nose, forehead, and face skin (68).

- **Sexual dysfunction**

Dopamine insufficiency is linked to sexual dysfunction in people with Parkinson's disease. Hypersexuality brought on by levodopa medication has recently come to light as a troubling symptom of impulse control disorder (69).

Sleeping Disorders

Most patients—60–98%—are affected. Although some clinicians believe that sleep abnormalities such excessive drowsiness and sleep attacks are a symptom of the disease, others believe that they are caused by pharmacological treatment. This theory is supported by the appearance of REM sleep behavior disorder, which affects one in three patients. A risk factor for the development of PD, REM sleep behavior disorder is characterized by violent nightmares that include shouting, swearing, hitting, kicking, and jumping (70). There are powerful therapies available, making it crucial to catch it early before it causes harm to the patient or the person sharing his bed. More than half of the patient experience sleep problems, particularly insomnia. Even though excessive daytime sleepiness might make you feel tired, it can also happen on its own.

Sensory Symptoms

- **Pain**

According to research (71), 76% of Parkinson's sufferers experience pain. Musculoskeletal, neuropathic or radicular, associated with dystonia, primary or central, and akathisic pain are the five forms of pain experienced by people with PH. The lower extremities are where pain is most frequently felt, and almost half of all patients report experiencing musculoskeletal pain. In certain circumstances, the first indicator is the 11% of patients who report shoulder ache. It's critical to differentiate between dystonic and non-dystonic discomfort. Because non-dystonic pain (numbness, tingling, burning, coldness, soreness, heat, and discomfort) is unexplained and cannot be addressed, but dystonic pain is connected with low

levels of levodopa therapy (72). 40% of patients experience young onset chronic pain, which is highly correlated with significant motor problems and depressive symptoms. The difference between the "on" and "off" periods affects the pain threshold.

- **Paresthesia**

Parkinson's patients do not have an objective sensory deficit, yet 38% of them experience paresthesias such numbness, coldness, tingling, and burning (73).

- **Olfactory dysfunction**

Olfactory impairment affects between 45 and 90% of people with PD is evolving. The sense of smell is diminished in more than 80% of Parkinson's patients or completely gone. Years before the beginning of motor symptoms, decreased smell, an indication of olfactory impairment, occurs. Compared to other parkinsonism disorders, PD has a more severe loss of smell sense. Olfactory impairment therefore aids in the clinical diagnosis of PH (74).

2.1.6 Parkinson's Disease Diagnostic Criteria

Although many criteria are used in the diagnosis of idiopathic PH, clinical diagnostic criteria of the United Kingdom Parkinson's Disease Society Brain Bank are mostly used. This evaluation includes supporting and exclusionary criteria. According to these criteria, bradykinesia is accompanied by at least one of rigidity, resting tremor or postural instability. At least 3 supporting criteria must be present and 16 exclusionary criteria must not be present (75). Diagnostic criteria are given in Table 2-3

Table 2-3: UK Parkinson's Disease Brain Bank Clinical Diagnostic Criteria

Inclusion Criteria	**Exclusionary Criteria**	**Supporting Criteria**
-Bradykinesia -Accompanied by at least one of the following: a) Rigidity b) 4-6 Hz resting tremor c) Postural instability (Primarily visual, vestibular, cerebellar or not related to proprioceptive dysfunction)	- History of recurrent stroke and consecutive Parkinson-like symptoms progress - History of recurrent head trauma - Definite encephalitis history - Ocological crises - History of neuroleptic use at the onset of symptoms - Affecting more than one relative - sustained remission - Unilateral persistence of symptoms after three years - Supranuclear gaze palsy - Cerebellar findings - Severe autonomic involvement in the early period - Severe dementia in the early period (with memory, language and praxis impairment) - Babinski sign - Cerebral tumor or communicating on computed tomography scan presence of hydrocephalus Failure to respond to high-dose L-Dopa (malabsorption must be excluded) - Exposure to MPTP	For a definitive diagnosis of PH, at least 3 of the following criteria must be present: -Unilateral onset - Progressive course Presence of resting tremor - Continuation of the symptoms asymmetrically on the side where the disease started Good response to levodopa (70-100%) - Response to levodopa lasting 5 years or more - Dyskinesias due to levodopa - Clinical course of 10 years or more

2.1.7 Treatment of Parkinson's Disease

The goals of treatment include reducing the motor and non-motor symptoms that develop as the disease progresses, achieving independence in everyday tasks, and improving quality of life. The type of PD symptom that causes the most discomfort (tremor, bradykinesia), the stage of the disease, the patient's age, the presence and intensity of symptoms, the factors impacting quality of life, and the treatment regimen should all be considered. The three categories of treatment for PH include pharmaceutical, surgical, and rehabilitative (76). The primary goal of pharmacological therapy is to restore the dopamine level to normal or to produce the dopamine effect. Levodopa is the best and gold standard medication for the treatment of Parkinson's disease.

The patient's quality of life is compromised by side symptoms such dyskinesia and motor irregularities, though. Levodopa loses its effectiveness with time, and when administered for a long time, there are times when the shorter effect duration prevents one dose's effect from catching up with another "wearing off" is the end-of-dose phenomena (77). Then there are oscillations in activity, such as the on-off phenomena, when things are sometimes good ("on") and sometimes bad ("off"). During the later era, dyskinesias are visible. In circumstances where motor abnormalities and dyskinesias cannot be controlled medically, surgical treatment may be recommended. Ablative techniques (thalatomy, pallidotomy), deep brain stimulation, and implants are used during surgical treatment (78).

2.2 Rehabilitation in Parkinson's Disease

Although PD is typically thought of as a disease of the motor system, it is actually a complicated illness that affects both the motor and non-motor systems. Although early-stage pharmaceutical treatment for PH is effective, there are issues with side effects. Medical treatment can't stop neurodegeneration, which dictates how the disease progresses; it is typically used as a symptomatic cure (79).

Other treatment approaches are required because physical function is insufficient for restricting and mobilizing in daily living activities despite the use of various medical and surgical treatments. In addition to medical and surgical therapies, the use of physiotherapy and rehabilitation techniques as non-pharmacological treatments is encouraged. Maintaining independence and enhancing quality of life are the goals of rehabilitation, which also takes into account the disease's stage and environmental factors. Methods of rehabilitation should be set up to treat hampered functions and stop more issues. As a result, it's crucial to start the disease

at an early stage strengthening, preserving, and expanding joint range of motion, correcting posture, transferring, and reinforcing, particularly to get rid of disorders like contracture and discomfort that prevent movement and mobilization (80). It is intended to offer assistance in enhancing fine motor abilities, protecting and enhancing respiratory capacity, improving gait, boosting balance and coordination, improving speech and swallowing, and improving quality of life (81,82).

Patient education, stress management, psychosocial support, nutrition regulation, and continuance of daily activities are all important. Retraining in communication and motor skills is crucial for improving quality of life. With the help of cognitive processes, it is hoped that patients will be able to control their functional motions and maintain postural stability. There are two approaches to patient education. The first is bypassing the injured basal ganglia through compensatory techniques, and the second is enhancing practice-based learning skills and performance (83).

2.2.1 Rehabilitation Approaches in Parkinson's Disease

Approaches that don't require the patient to actively participate, like chest physiotherapy, applications for rigidity, pain inhibition, and stretching for shortenings, should be chosen during the patient's "off" phase. Balance, posture, and extensor muscle strengthening, walking drills, balance, and coordination are all addressed in the "ten" period. Applications that need for patient engagement, like exercises, ought to be chosen (84).

Important tips for physical treatment and rehabilitation in people with Parkinson's disease (85);

- Implementation of hint strategies to improve gait.

- Implementation of cognitive movement strategies to improve transfers

- Special exercises to improve balance

- Strength and joint mobilization exercises to increase physical capacity

Table 2.4. Rehabilitation approaches in Parkinson's disease

Rehabilitation Approaches in Parkinson's Disease			
Conventional Rehabilitation Approaches	**General Strategies**	**Occupational Therapy**	**Speech Therapy**
- Relaxation - Joint Movement Span Exercises (ROM) - Stretching Exercises - Breathing Exercises - Mobility - PNF Techniques - Posture Exercises - Strengthening Exercises	- Hint (sign) Strategies - Cognitive Movement Strategies -Dual Task	- fine motor skill donating - At home or at work suitable ergonomics providing	- Sialorea aimed at reducing approaches - Dysarthria treatment - Swallowing therapy

2.2.1.1 Conventional Rehabilitation Approaches

Exercises for ROM, stretching and relaxation, Proprioceptive Neuromuscular Facilitation (PNF) methods, neutral temperature, massage, biofeedback, and reciprocal movements of the lower body against the upper body should all be utilized to decrease and prevent rigidity and promote flexibility (86). Daily living activities are substantially impacted by walking issues, stride lengthening brought on by bradykinesia, and the occurrence of the freezing phenomena in PD. The purpose of treatment is to enable the patient to take steady, lengthy strides across a distance. When walking, stimuli including an L-cane, parallel lines written on the ground, a laser pointer, rhythmic walking to music, and a number. You can use auditory and visual stimuli to teach people how to count, hold a drink, solve math problems, and perform dual-task exercises (87). For difficulties encountered during turning, exercises such as walking in 8 lines and walking in a circle can be performed. Elderly people can circle in 6 steps, whereas Parkinson's patients need about 20 steps to turn or freeze. Instead of focusing

on quick rotation, patients should focus on wide-angle rotation with full trunk movement. It is possible to rotate in a clockwise direction.

Balance and coordination can be improved with exercises like sitting and standing cane exercises, reciprocal exercises, contrary movements (sitting and clapping, opposite reaching, standing cross-arm and leg raising, etc.), and more. Parkinson's patients' morbidity and mortality are typically brought on by respiratory issues connected to immobility, like pulmonary embolism and aspiration pneumonia. Due to postural and respiratory strain, kyphotic posture, head forward, and shortening of trunk flexor muscles result (88). Exercises that enhance posture and lessen respiratory issues include diaphragmatic and segmental breathing exercises, lower and upper extremity exercises involving deep breathing, trunk, shoulder, and upper extremity mobilization, and wand exercises

2.2.1.2 General Strategies

- **Hint (cue) Strategies**

Giving Parkinson's patients verbal or visual cues while they perform active walking activities can be considered to improve gait. Clues are environmental cues or cues the patient himself creates, deliberately or unconsciously, to cause action (automatic and repetitive). The specific way the clues improve the movement is still unknown (89). They are believed to correct motor dysregulation, give an ideal flow that activates the cerebellar visual-motor pathways, or provide an external rhythm that makes up for the basal ganglia's deficient internal rhythm. The tips do not, however, benefit every sufferer similarly.

Four categories can be used to classify tips:

1. Auditory cues, such as counting or utilizing a walkman with rhythmic music

2. Visual clues, such as walking on lines on the ground or turning around and walking backwards by hopping over a cane

3. Tactile clues, such as touching a leg or hip

4. Cognitive signals, such as picturing the proper stride length

- **Cognitive Movement Strategies**

One could argue that using cognitive movement methods helps transfer in Parkinson's sufferers. Complex automated moves in these methods can be divided into a number of smaller moves carried out in a particular sequence. These sub-movements are made up of quite straightforward motions. By doing this, the movement's course transforms into a course in which the movements are carried out intentionally. In this way, the primary issue with decreased internal control is avoided, particularly the inability to inhibit recurrent basal ganglia motions. You should mentally be ready before doing the movements. The performance is within conscious control and can be guided by using suggestions to commence the movement, even though the newly learnt series of motions cannot be automated (90).

2.2.1.3 Occupational Therapy

Due to the unilateral tremor and bradykinesia that are typically present in Parkinson's patients, fine motor abilities are impaired in daily activities. To restore and develop fine motor abilities, occupational therapy may include exercises like grasping objects of various sizes, using hand ergonometry, and writing training. At home or at work, appropriate ergonomics should be offered and explained (91).

2.2.1.4 Speech Therapy

Slurred speech, trouble finding words, reduced speech fluency, sialorrhea, dysarthria, and dysphagia are just a few of the speech and swallowing issues that are common in PD. Treatment for dysphagia, which is brought on by insufficient or excessive salivation (sialorrhea), should involve weakening of the tongue and pharyngeal muscles, oral motor function exercises, and classic swallowing exercises. The applications that can be preferred in PD include spelling for dysarthria, activation of mimic muscles, PNF exercises, face and oral muscular workouts, expiratory muscle training, verbal training, and LSVT (Lee Silverman Voice Treatment) (92).

2.2.2 Aims of Rehabilitation According to the Stage of the Disease

According on the patient's level of physical activity and the disease's stage, physiotherapy targets should be chosen. The goal of the treatment plan is enabling the patient to carry out his everyday tasks safely and independently. The application areas of physical therapy include transfer (turning in bed, getting up from a chair, etc.), posture, gripping, reaching, falling

(including fear of falling), balance, and walking functions. Other therapy objectives include increasing physical stamina, avoiding falls, and avoiding pressure sores (93,94,95).

Progress in PH can be summarized in three phases:

Early phase (HY stage 1-2.5): The balance and walking functions of the patients are less affected, there is no functional limitation and they are less.

Intermediate Phase (HY stage 2-4): Patients with balance problems have increased risk of falling. Restriction develops in the activities of daily living of patients who need supervision or assistance.

Late Phase (HY stage 5): Patients are bed-bound or wheelchair-bound. At this stage, the person who cares for the patient plays an important role in the treatment (96).

2.3 Dual Task (Dual Task Training)

The simultaneous maintenance of cognitive or motor activities forms the foundation of the dual task methodology. This strategy is generally applied when walking or going about regular activities. It comprises the capacity to conduct secondary motor and cognitive activities in addition to providing postural equilibrium. To do DTs (dual tasks) optimally, several cortical areas must be activated (97). The ability to perform difficult activities is assumed to deteriorate as a result of cortical-neural degeneration brought on by neurological illnesses. In functional MRI (fMRI) imaging, it was found that the dual task gait activated the prefrontal and supplementary motor areas more than the single task did. In another imaging investigation, brain connections were examined when people walked, talked, and did both at the same time. The motor areas were found to be more activated during walking and less active just during walking, depending on the degree of difficulty. Cerebellum, supplementary motor region, prefrontal area, and parietal area were all affected by this activation. When people with PD multitask, the prefrontal cortex is particularly active (98). In a different study, it was discovered that the PD group with mild cognitive impairment had less connectivity in the left frontoparietal network of the prefrontal cortex than the healthy control group (99). Due to the reduction in automaticity, the prefrontal cortex, which has cognitive processes, performs a compensatory role. When task demands are too great, poor motor performance and a higher risk of falling may result. Therefore, the hypothesis that the formation of fronto-striatal linkages during challenging activities may enhance functions has evolved (100).

Shifting and shifting activities, separating concentration, and avoiding information access when necessary improve performance on difficult tasks, such as DT. Prefrontal cortex, anterior cingulate, and parietal are examples of executive control networks that are in charge of paying attention to task demands. It has been linked to the cortex and other areas of the forebrain. Neurons in the networks that control attention and executive function are lost in neurodegenerative disorders (101). The integration of sensory data and motor planning required to maintain equilibrium during dynamic events like posture and gait is the responsibility of executive functions. The decline in DT performance brought on by adjusting to difficult tasks in neurodegenerative disorders is caused by the loss of executive processes. Depending on the decline in ability to accomplish two tasks at once, a rise in the danger of falling, a decline in quality of life, and a rise in the risk of falling, a decline in quality of life, and a loss of functional abilities are all associated with deteriorating dual task performance. abilities that are functional are seen (102).

The capacity to handle multiple tasks at once falls under the umbrella of executive functions. Various ideas have been developed in response to difficulties in performance when handling two or more tasks. Changes in attentional capacity and information processing speed account for this. These theories include congestion theory and central capacity sharing. DT interaction occurs despite the primary capacity-sharing model's goal to split the attentional capacity across the two tasks since the shared capacity is constrained. Both tasks encounter interruptions. The congestion model predicts that if two activities are handled by the same neural connections, one of the tasks would pause and take longer to complete (102).

The capacity to maintain attention-demanding mobility activities is compromised in PD. Multiple tasks must frequently be completed simultaneously during daily activities in order to sustain both motor and cognitive processes. Demands exceed capacity because attentional capacity is finite, and the same tasks have an impact on dual-task performance. It is believed that one or both tasks will be disturbed if the attention capacity is exceeded while multitasking (11,103).

Cognitive impairment is one of the main causes of this. Patients' executive function impairment, attention issues, and automaticity all have a negative impact on their ability to do two tasks at once impact (104). The basal ganglia lose dopamine in Parkinson's disease (PD), which affects automaticity as well as attention and executive functioning. It alters frontostriatal connections, which has an impact on cognitive flexibility and task switching in particular.

Dual task training uses the combination of motor and cognitive tasks to enhance functional performance. It is being studied if using two tasks simultaneously has an impact on cognitive processes such walking characteristics, walking speed, balance, cognitive flexibility, and processing speed (105). It is believed that this application can enhance executive functions, in particular. To explain the variations in dual-task performance during dual-task training, two hypotheses have been put forth. The foundation of the task automation paradigm is the automation of movement through task-by-task learning. This model predicts that raising single-task automaticity will lower attentional resource consumption and boost dual-task performance. Increased automaticity should be achieved by frequent and intensive applications. On the other hand, the task integration paradigm encourages combining the two tasks (106). This paradigm contends that by integrating tasks, dual-task performance will increase. Due to the complexity of the activities, dual-task training uses more cognitive and motor resources and strengthens coordination and motor skills. In dual task studies, there are two types of tasks: motor and cognitive. Tasks like catching a ball, carrying a tray, carrying a drink of water without spilling, and buttoning are added while the engine is moving. different cognitive activities. There are 5 groups, including:

1) Task measuring reaction time: This task measures the delay between sensory stimulation and behavioral response. The purpose of it is to gauge processing speed.

2) Task involving judgment and discrimination: Investigates the reaction to a specific stimulus that calls for focused attention. You can employ the Stroop color-word test.

3) Mental monitoring task: While performing a mental activity, one's capacity to keep track of additional information is assessed. It is used to measure the speed and consistency of information processing.

(For instance, counting down numbers, days, months, or three from one hundred)

4) Working memory task: This involves remembering the data that is pertinent to the process.

5) Verbal fluency task: Assesses the ability to derive words under the provided conditions, while simultaneously assessing executive processes. (Districts in Istanbul, names of animals beginning with a specific letter, etc.) (107)

Exercise therapy is frequently used to enhance motor performance, but it's important to remember that patients' cognitive abilities are compromised (108). Dance, aerobic exercise, and weight training have all been shown to improve cognitive function in clinical research.

Enhancing everyday living tasks through the combination of cognitive function and motor performance is the main objective of dual task techniques (109). Different strategies have been emphasized recently to enhance DT capacity, particularly in neurodegenerative disorders (110). In the studies, the dual task applications were categorised into three classes. These include cue training, virtual reality treatments, and multimodal treatments. Through the practice of divided attention, multimodal therapies aim to enhance dual-task performance. Patients are given the opportunity to interact with locations and items that require attention in virtual reality applications. Verbal cues and cognitive cues can assist patients modify their actions when it comes to cue education (111).

Walking is a challenging task that calls for cerebral support, which in turn calls for motor and cognitive control to maintain bilateral synchronization and postural stability. More cerebral support is needed when an additional task is presented during walking or balance, hence it is anticipated that one or both of the primary or secondary tasks may be impacted (112). When a cognitive exercise is presented while walking in people with moderate-to-advanced PD, walking performance degrades and walking parameter variability is seen (113,114). According to reports, patients are more likely to fall when their DT performance declines (115).

Recent research has demonstrated that DT training improves both motor and cognitive function. Increases in walking speed, stride length, amplitude, and cadence are reportedly all impacted by it (12,13,116,117). According to some reports, DT training can help people who frequently fall or have a fear of falling (118).

Recently, researchers have looked into how well exercise programs affect both motor and cognitive abilities. Cognitive impairment and a loss of automaticity are seen as a result of the neurodegenerative process that occurs in PD. However, it is claimed that the patients' ability to learn motor skills is still intact (119).

In studies using animal models of PD, it has been discovered that activity-related interventions can affect dopaminergic and glutamatergic stimuli, rearranging arousal from the cortical pathway. Learning and exercise can also cause a dynamic interaction between regenerative and degenerative mechanisms. Gait training on a treadmill has shown to be neuroplastic for dopaminergic signaling. Exercise-induced neuroplasticity serves as the foundation for PD rehabilitation techniques (86,120). A person's quality of life can be significantly enhanced and their risk of falling can be decreased by increasing their capacity to multitask while walking. Both motor and cognitive deficits affected gait and DT performance

in patients with gait problems. Due to this, it is essential to concentrate on both motor and cognitive abilities during therapy in order to improve performance by including dual-task training into walking.

3. MATERIALS AND METHODS

3.1 Subjects

Forty-two patients who applied to the Neurology Department of Maltepe University Medical Faculty Hospital to participate in the study were evaluated and 30 patients with a diagnosis of 'Idiopathic Parkinson's Disease' who met the inclusion criteria were included in the study.

The study protocol was approved by the Marmara University Non-Interventional Ethics Committee on 27.01.2023 and its publication number is 74 (Annex 1). The study was also registered on ClinicalTrials.gov (NCT05894473).

The estimated sample size for this study was calculated as 95% power with a margin of error of 0.05, with a 95% confidence interval, if individuals are included in such a way that at least 5 weeks according to the interobserver Berg Balance Scale for the 8-week study. The total sample size was determined as 30 people.

3.1.1 Inclusion Criteria

The inclusion criteria of the study were;

- Being diagnosed with idiopathic Parkinson's Disease
- Getting at least 21 points from the Montreal Cognitive Assessment Scale test
- Stability of drug therapy taken in the last 1 month
- Being in the “ten” period of the patients
- Being able to walk independently on flat ground (3 and above according to Functional Ambulation Classification)
- Exercising 1-3 hours a week

3.1.2 Exclusion Criteria:

- The exclusion criteria of the study were;
- Serious hearing or vision problems
- Having other neurological, cardiovascular or orthopedic disorders that may prevent walking
- Any other neurological disorder (eg dementia, cerebrovascular disease)
- Having an education level of less than 5 years
- Patients with a pacemaker

- Having vascular lower extremity pathologies
- •Not having internet access with a smart phone or computer

3.1.3 Flow of Research

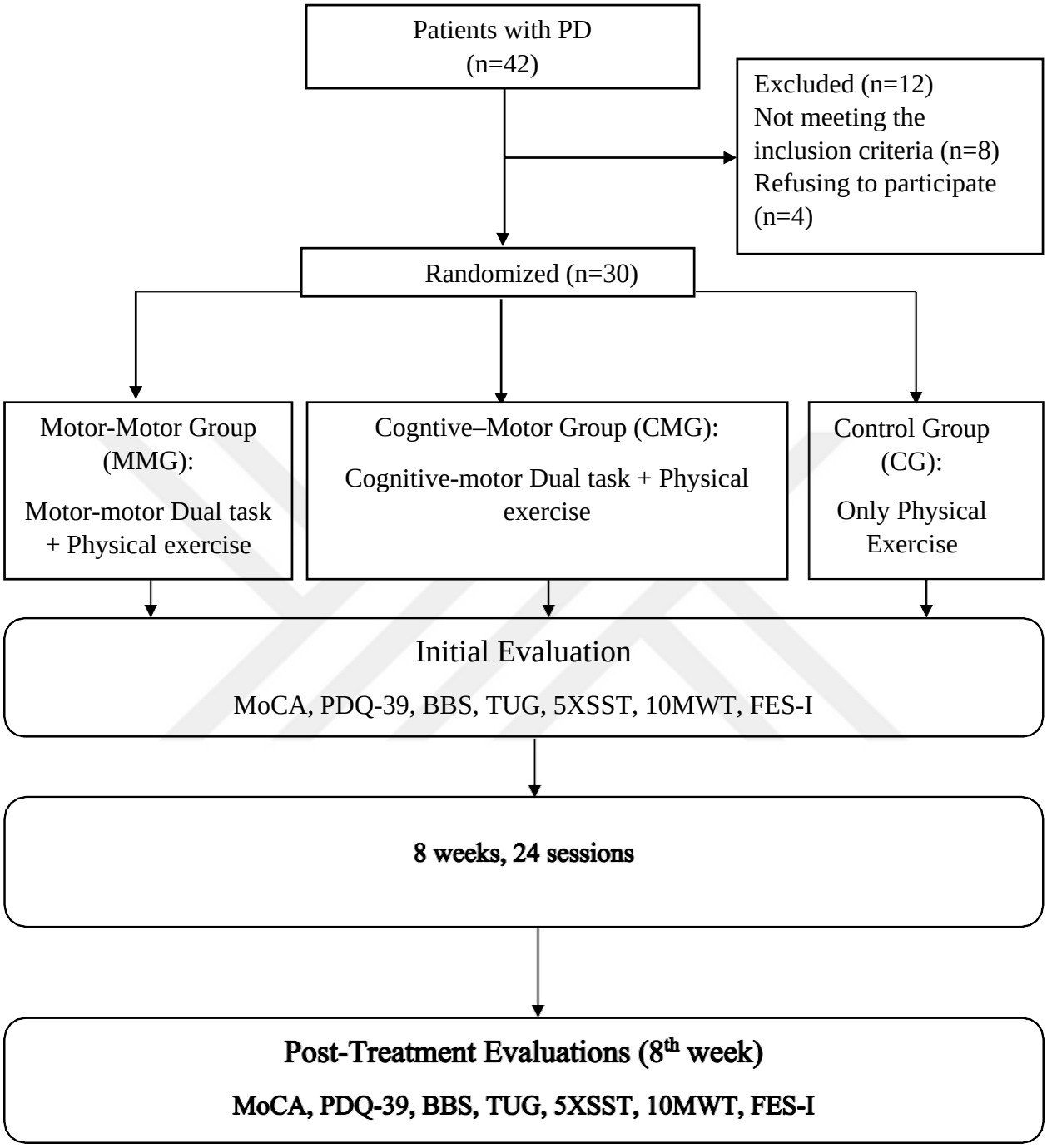
We invited all the patients with PD (N= 30) in the male and female to particapate to study voluntarily and we provided with information regarding the purpose and procedures of the study. Informed consent was obtained from each participant prior to their participation to the study (Appendix 2).

Thirty people who met the admission criteria from 42 people with Parkin who applied to Maltepe University Faculty of Medicine, Department of Neurology were included in the study and were randomly assigned to three groups after they were numbered according to the order of arrival application. The exercise level of the patients was determined as 1-3 hours per week.

The power of the study was analyzed in the G-power program based on information from studies in Parkinson's patients. According to the results of this analysis, it was calculated that 95% power would be obtained if individuals were included in the 6-week study for at least 5 weeks, according to the Inter-Observer Berg Balance Scale 0.05 margin of error with 95% confidence interval.

The minimum number of people required for each group is calculated as 10. Patients in the first group (n=10) Cognitive-Motor Group (CMG): Cognitive-motor Dual task + Physical exercise, patients in the second group (n=10) Motor-Motor group (MMG): Motor-motor Dual task + Physical exercise. The patients in the third group (n=10) were only included in the Physical exercise program (Control Group).

3.1.4 Flow Chart of Research



MoCA: Montreal Cognitive Assessment, PDQ-39: Parkinson Disease Questionnaire, BBS: Berg Balance Scale, 5XSST: 5 Times Sit to Stand Test, 10MWT: 10 Meter Walk Test, FES-I: Fall Efficacy Scale International

3.1.5 Demographics

Patients' demographic details, including gender, age, height, weight, level of education, place of employment, and marital status, were inquired about. We gathered background medical data on the patient, including associated comorbidities, disease duration, dominant hand, initial symptom, medicines used, and medical care.

3.1.6 Treatment Protocol

Three randomized groups were included in the study. Group 1 was given Motor-motor Dual task. While performing the exercise sessions, motor task instructions were given. The sessions were shown to the individuals by video conferencing (Zoom Inc.) method by a physiotherapist with 3 years of experience, and the exercises were done online simultaneously.

Group 2 was given Cognitive-motor Dual task. Cognitive instructions were given while performing the exercise sessions.

Group 3 was the control group and only physical exercise (online) program was applied. Exercise sessions were planned for 8 weeks, 3 times a week, once a day, 60 minutes / 1 hour remote video conference method under the supervision of an experienced physiotherapist.

In cognitive-motor Dual Task group, cognitive tasks related to verbal fluency, mental monitoring, working memory task, and arithmetic calculation were given throughout the physical exercise. In motor-motor Dual Task group, he was asked to perform one more motor task during the physical exercise.

Cognitive tasks were planned with increasing difficulty and more complex levels according to the patient's condition. When the patient completes a level and there is a decrease in the number of errors; tasks that required greater strength, fluency, and accuracy were given. For example; The patient was asked to count forward 5 by 5 beforehand. When the patient completed this task, he was asked to count down 3 by 3 starting from a different number.

Motor tasks were planned according to the patient's condition and with increasing difficulty and more complex levels. When the patient completes a level and there is a decrease in the number of errors; Tasks that required more power were given. For example, before the patient was asked to carry a closed, 0.5 liter bottle half filled with water, if the patient was able to do this, he was asked to carry a fully open 0.5 liter bottle.

Warm-up Period (5 minutes)

Stepping in place with support (moderate speed)

Moderate forward and sideways walking in an area where the person feels safe

Training Period (50)

Motor-motor Dual task + Physical exercise

In addition to the Physical Exercises, motor tasks have been added.

While standing on a hard floor with eyes open and closed, feet shoulder-width apart and feet in tandem position for 30 seconds (sec), arm swing

Right-left weight transfer while standing on one leg for 15 seconds

Carrying a standardized 0.5 liter water-filled, closed bottle while transferring weight back and forth with eyes open and closed, feet shoulder-width apart and feet together

Cross the arms in front of the chest while sitting and standing on the chair 5 times in a row

Carrying a standardized 0.5 liter water-filled, closed bottle while walking 10 meters distance back and forth and sideways with eyes open

Raise your arms toward the ceiling while tiptoeing up

Carrying a standardized 0.5 liter water-filled closed bottle while walking 10 steps forward and turning 180 degrees

While performing all walking exercises, the patient was asked to carry a standardized 0.5-liter water-filled, closed-mouth bottle in his hand.

Cognitive-motor Dual task + Physical exercise

In addition to physical exercises, cognitive tasks were added.

Counting the days of the week for 30 seconds (sec) standing on a hard floor with eyes open and closed, feet shoulder-width apart and feet in tandem position

Performing a simple addition while standing on one leg for 15 seconds

Counting back from 100 while transferring weight to the front and back with eyes open and closed, feet shoulder-width apart and feet together

Singing while sitting on the chair 5 times in a row

Counting months while walking a distance of 10 meters back and forth and sideways with eyes open

Counting animal names while tiptoeing

Counting the alphabet while walking 10 steps forward and turning 180 degrees

While doing all walking exercises, the patient was asked to count from 2 to two

Cool down Period (5 minutes)

Stepping in place with support (moderate speed)

Moderate forward and sideways walking in an area where the person feels safe

Patients in both treatment groups received a 60-minute physical exercise program and a motor or cognitive task. Patients in the control group received a 60-minute physical exercise program. The treatment sessions were applied for a total of 24 sessions, 3 days a week for 8 weeks. Patients were given short rest periods (<5 minutes) during their sessions in line with their demands

3.2 Evaluations

Treatment groups were evaluated at baseline and after treatment. Demographic data of patients, dominant hand, initial symptom and disease duration were recorded at baseline. The patient's quality of life with the Parkinson's Disease Questionnaire (PDQ-39) and functional balance was evaluated with the Berg Balance Scale. Cognitive function was evaluated with the Montreal Cognitive Assessment (MoCA) and the risk of falling and independence were evaluated with the Fall Efficacy Scale International (FES-I) in terms of patients' compliance to the study. Initial evaluations of 10 meters walking speed, Timed Up and Go Test (TUG), 5 times Sit-Up Test (5XSST) were made.

Walking speed of 10 meters was used as the primary evaluation criteria. Timed Up and Go Test, Montreal Cognitive Assessment (MoCA), Parkinson's Disease Questionnaire 39 (PHA-39), Fall Efficacy Scale International (FES-I) and 5 times Sit-Up Test (5XSST) were used as secondary assessment criteria. Evaluations were made before and after treatment. All

treatment protocols and evaluations were applied when the patients were in the 'ON' period after taking their medications.

3.3 Assessment Tools

3.3.1 Parkinson's Disease Quality of Life Questionnaire

The Parkinson's Disease Quality of Life Questionnaire (PHA-39) was used to assess quality of life. Turkish validation of the scale by Dereli E. et al (121). PHA-39 is a self-report questionnaire that uses a 5-point Likert scale to assess quality of life such as severity of symptoms of mobility, activities of daily living, emotional well-being, social support, cognition, and communication. The total score is between 0-100, and a higher score indicates a lower quality of life. In this study, reverse scoring was used on this scale (122). (See Appendix III)

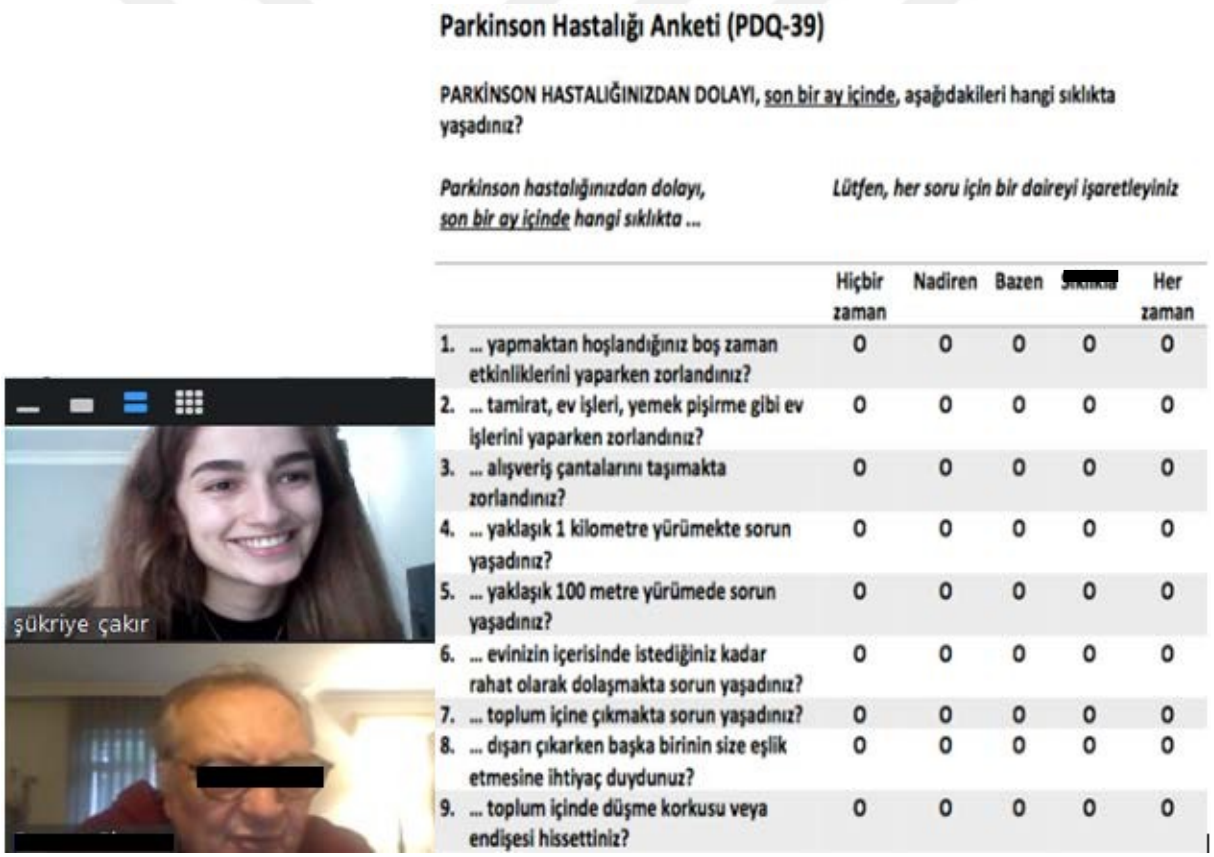


Figure 3.1: Implementation of Parkinson's Disease Questionnaire with Zoom application

3.3.2 Montreal Cognitive Assessment Scale (MoCA)

Cognitive status will be assessed with the Montreal Cognitive Assessment Scale (MoCA). MoCA is a rapid cognitive screening test that evaluates various functions such as space and time orientation, memory, attention, executive functions, visuospatial functions,

language skills, abstract thinking, calculation. Turkish validation of the scale in Parkinson's Diseases Özdilek B. et al. made by patients with a score of 21 and above on the MoCA test will be included in our study (123). (See Appendix IV)

3.3.3 Berg Balance Scale (BBS)

The Berg Balance Scale was first developed by Katherine Berg in 1989 to measure static and dynamic balance in individuals. The Turkish validity and reliability of the BDI was determined by Sahin et al. Published by (Sahin, et al., 2008). It evaluates the ability of individuals to maintain their balance while performing their functional activities. It is a scale that includes 14 instructions and is given 0-4 points for each instruction. 0 points are given when the patient cannot do the activity at all, and 4 points are given when the patient completes the activity independently. The highest score is 56, 0-20 points indicating balance disorder, 21-40 points acceptable balance, 41-56 points good balance. Filling the scale takes between 10 and 20 minutes and is an extremely reliable measurement method (See Annex V).

Figure 3.2: Berg balance test with Zoom app standing on one leg

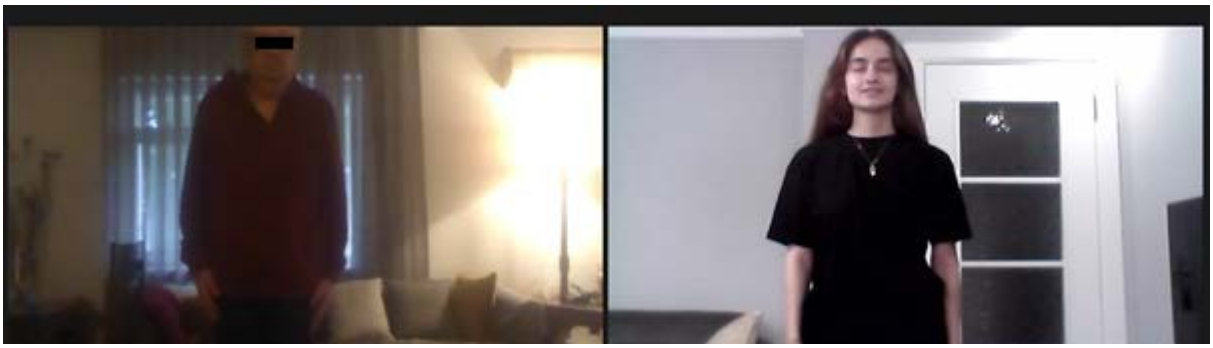


Figure 3.3: Berg balance test with Zoom app standing with eyes closed

3.3.4 10-Meter Walking Speed Test

The 10-meter walking speed test (10MWT) is an easy-to-apply test used in Parkinson's patients and measures changes in walking speed. The person is asked to walk at their normal pace in a pre-measured 10-meter area. The time starts when the person's foot is on the starting line and ends when they cross the finish line. Three measurements are made and the best value is recorded in meters/second (m/s) (124).

3.3.5 Timed Up and Go Test

TUG was first published by Podsiadlo and Richardson in 1991 (Podsiadlo & Richardson, 1991). It is a test that evaluates fall risk, mobility and physical performance in the elderly. A chair and a stopwatch are required to administer the test. To perform the test, participants need to get up from a standard chair, walk comfortably to a place 3 meters off the ground, turn and return to the chair, and sit in the same chair. The result will be recorded in seconds (sec). If the elderly person completes this test in more than 14 seconds, there is a risk of falling (125).

3.3.6 Fall Efficiency Scale – International

The scale created according to the theory of self-efficacy allows the person to question the fear of falling. The Fall Efficiency Scale-International (FES-I) assesses the degree of confidence a person perceives to avoid falling in their current situation. in the elderly population and it has been reported to be useful in the evaluation of fear of falling in Parkinson's patients. It consists of 16 items each item is given a score between 1-4. A minimum of 16 points and a maximum of 64 points are obtained. The validity and reliability study of the Turkish version was performed by Ulus et al. (126) (See Appendix VI).

3.3.7 Five Times Sit to Stand Test

In order to determine the level of physical fitness in elderly individuals, a 46 cm high armless chair sit-stand test will be performed. With this test, the lower extremity trunk strength and muscle endurance of the individual will be evaluated. Subjects participating in the study will be instructed to cross their arms over their chest and sit with their backs against the back of the chair. They will be asked to sit and stand up five times as soon as possible, while the elapsed time will be recorded in seconds. The performance of this test in individuals with PD has been found to be associated with balance and bradykinesia and has been recommended as a reliable method (See Appendix VII).

Figure 3.4: 5 times sit to stand test with zoom application

3.4 Statistical Analysis

The data were evaluated in the statistical package program of IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp. Armonk. New York. USA). Descriptive statistics were given as unit count (n), percentage (%), mean ± standard deviation (Mean±SD), median (M), minimum (min) and maximum (max) values. Normal distribution of numerical variables controlled with Skewness and Kurtosis values. Parametric tests were used since numerical descriptive features and variables showed normal distribution. Chi-square tests (Pearson chi-square/Fisher exact test) were used for the comparison of the categorical descriptive features while One-way ANOVA was used for the comparison numerical descriptive features between the groups. One-way ANOVA and Paired Sample t-test were used for in-group and between-group comparisons of clinical indices, and Bonferroni correction was used to compare main effects in the analyses. A value of $p<0.05$ was considered statistically significant.

4. RESULTS

4.1 Demographic and Clinical Characteristics

Our study consisted of three groups. While doing physical exercise, a motor task was applied to the motor-motor dual task physical exercises group, and a cognitive task was applied to the cognition –motor dual task physical exercises group while doing physical exercise. Only physical exercise was suitable for the control group. The Dual Task Cognitive Group (DTG-C) that receives physical exercise will be called the "Dual Task Motor Group (DTG-M)", the group that receives motor task and physical exercise, and the group that only receives exercise therapy will be called "Control".

Table 4.1. Comparison of the descriptive characteristics of the patients according to the groups

	Group			Test Statistics	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	Test Value	*p*
Age, (*year*)					
Mean±SS	65.3±12.89	66.30±8.00	74.90±6.31	3.093 ‡	0.062
M (*min-max*)	69 (40-79)	67 (55-78)	75 (67-87)		
Gender, *n* (%)					
Female	4 (%40)	2 (%20)	3 (%30)	0.952 †	0.621
Male	6 (%60)	8 (%80)	7 (%70)		
Height, (*cm*)					
Mean±Sd	170.8±8.92	169.20±8.98	169.40±8.76	0.096 ‡	0.909
M (*min-max*)	169.5 (158-182)	171 (152-180)	171 (155-185)		
Weight, (*kg*)					
Mean±Sd	75.80±13.73	78.00±20.77	74.10±7.20	0.171 ‡	0.844
M (*min-max*)	77 (52-98)	77.5 (47-119)	74.5 (60-87)		
BMI, (kg/m^2)					
Mean±Sd	25.84±3.19	26.83±4.87	25.89±2.56	0.233 ‡	0.794
M (*min-max*)	26.3 (18.6-30.2)	26.6 (20.3-36.7)	25.2 (21.3-30.1)		
Education, *n* (%)					
Primary school	7 (%70)	8 (%80)	4 (%40)	0.274 †	0.601
High school	0 (%0)	0 (%0)	4 (%40)		

University	3 (%30)	2 (%20)	2 (%20)		
Working status, *n* (%)					
Working	2 (%20)	2 (%20)	0 (%0)	2.308 †	0.315
Not working	8 (%80)	8 (%80)	10 (%100)		
H&Y Staging					
Mean±Sd	1.15±0.24	1.20±0.26	1.20±0.35	0.101 ‡	0.904
M (*min-max*)	1 (1-1.5)	1 (1-1.5)	1 (1-2)		

‡: One Way ANOVA (*F*); †: Chi Square Test (χ^2); Summary statistics are given as *mean* ± *standard deviation* and *Median (minimum, maximum)* for numerical data, *Number (Percentage)* for categorical data.

According to Table 4.1, a total of 30 patients, 10 in the cognitive task group, 10 in the motor task group and 10 in the control group were included in the study. The median age of the patients was 69 years in the cognitive task group, 67 years in the motor task group, and 75 years in the control group. The differences between the ages of the patients in the groups were not statistically significant (p>0.05). The number of men was 6 (60%) in the cognitive task group, 8 (80%) in the motor task group, and 7 (70%) in the control group. The distribution of genders in the groups was similar (p>0.05). The mean body mass index of the patients was 25.84±3.19 kg/m^2 in the cognitive task group, 26.83±4.87 kg/m^2 in the motor task group and 25.89±2.56 kg/m^2 in the control group. The differences between the mean BMI of the patients in the groups were not statistically significant (p>0.05). The differences between the mean HY Staging of the patients in the groups were not statistically significant (p>0.05).

4.2 Evaluation of Treatment Outcomes

Table 4. 1. Comparison of PDQ-39 scores according to groups at measurement times

	Grup			Test statistics †		
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*p*	η^2
PDQ-39						
Pre-test	28.50±12,26 [a]	33.60±7.63 [a]	45.90±21.31 [a]	3.258	0.055	0.400
Post-test	25.00±10.61 [c]	31.00±6.96 [bc]	31.60±7.29 [b]	3.216	0.200	0.259
Test statistics ¥	***F*=10.00 *p*=0.002 η^2=0.607**	***F=10.00 p*=0,002 η^2=0.460**	***F*=5.00 *p*=0.025 η^2=0.607**			
Difference & (Son-Ön)	3.50±2.01	2.60±1.07	0.40±0.51	19.887	**0.00**	0.064

Mixed Pattern ANOVA (F), Effect Size (η2), ϕ Intra-group comparison, †Intergroup comparison, &Intergroup comparison of First and Final score differences, Descriptive statistics were given as mean ± standard deviation. The parts determined in bold are statistically significant (p<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (p<0.05).

According to Table 4.2, shows the comparison of PDQ-39 measurements according to the groups at follow-up times. While the pre-test PDQ-39 mean scores of the participants did not show a statistically significant difference between the groups in the measurements taken during the follow-up period (p>0.05), the cognitive task group was statistically lower than the control group in the post-test measurements (p<0.05). The motor task group was not statistically different from the control and cognitive task groups (p<0.05). While there was no significant difference between the groups in the quality of life before the treatment, a significant difference was found after the treatment. In the cognitive task, motor task and control groups, the PDQ-39 averages obtained in the posttest were statistically lower than the pretest time (p<0.05). Similar decline was seen in the cognitive task and control groups, while a slower decline was observed in the motor task group.

Table 4.3. Comparison of MOCA scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*p*
MOCA					
Pre-test	24.00±1.94	25.00±1.41	24.10±1.79	2.399	0.301
Post-test	25.60±3.20	26.10±0.99 [a]	24.50±1.72 [b]	4.976	0.083
Test statistics ¥	***t* = 9.000** ***p* = 0.003**	***t* = 8.000** ***p* = 0.005**	*t* = 3.00 *p* = 0.083		
Difference& (post-pre)	1.60±0.84 [a]	1.10±0.74 [a]	0.30±0.48 [b]	11.503	**0.003**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean* ± *standard deviation*. The parts determined in bold are statistically significant (*p*<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (*p*<0.05).

According to Table 4.3, post-test MOCA scores of the patients in the motor task group were statistically higher than the patients in the control group (*p*<0.05). There was no significantly difference between the groups for MOCA in terms of pre-test scores (*p*>0.05). MOCA averages obtained in the post-test were statistically higher than the pre-test scores for cognitive task and motor task groups (*p*<0.05). While there was no significant difference between the groups in cognition before the treatment, a significant difference was found after

the treatment. The cognitive and motor group also showed significant results within the group. While similar increases were observed in the cognitive task and motor task groups, the increases in these two groups were statistically higher than the control group patients (p<0.05).

Table 4. 4. Comparison of BBS scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive n=10	Motor n=10	Control n=10	F	p
BBS					
Pre-test	38.30±8.10	41.90±5.97	36.00±9.66	2.319	0.314
Post-test	44.10±7.23 ^{a}	45.00±5.96 ^{a}	36.20±9.44 ^{b}	5.416	0.067
Test statistics ¥	***t* = 10.00** ***p* = 0.002**	***t* = 10.256** ***p* = 0.002**	t = 2.00 p = 0.157		
Difference& **(post-pre)**	5.80±2.74 ^{a}	3.10±0.88 ^{b}	0.50±0.53 ^{c}	22.769	**0.000**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean* ± *standard deviation*. The parts determined in bold are statistically significant (p<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (p<0.05).

According to Table 4.4, there was no significant difference for both pre-test and post-test results of BBS scores between the groups (p>0.05). While BBS averages obtained in the post-test were statistically higher than the pre-test scores in the cognitive and motor task groups, it was not change significantly in the control group (p>0.05). BBS score increase in cognitive task group was significantly higher than motor task and control groups (p<0.05). The BBS score increase for motor task group was significantly higher than control group (p<0.05). At the same time there was no significant difference between the groups in balance before and after the treatment. The cognitive and motor group also showed significant results within the group. The cognitive task group showed more improvement than the motor task group.

Table 4. 5. Comparison of 10m walk test scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*p*
10m walk. (*m/s*)					
Pre-test	0.47±0.18 ^{b}	0.57±0.09 ^{b}	0.47±0.15 ^{b}	3.382	0.184
Post-test	0.59±0.24 ^{a}	0.65±0.08 ^{a}	0.49±0.14 ^{a}	6.617	**0.037**
Test statistics ¥	***t* = 10.00** ***p* = 0.002**	***t* = 9.00** ***p* = 0.003**	*t* = 3.00 *p* = 0.083		
Difference& **(post-pre)**	0.12±0.07 ^{a}	0.08±0.06 ^{a}	0.02±0.02 ^{b}	16.227	**0.000**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean* ± *standard deviation*. The parts determined in bold are statistically significant (p<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (p<0.05).

According to Table 4.5, while there was no significant difference for pre-test results of 10m walk test scores between the groups, a significant difference found in post-test results (p>0.05). In the cognitive task and motor task groups, the 10m walk averages obtained in the post-test were statistically higher than the pre-test scores (p<0.05). While similar increases were observed in the cognitive task and motor task groups, the increases in both groups were statistically higher than the control group (p<0.05).

Table 4. 6. Comparison of TUG scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*P*
TUG					
Pre-test	15.10±7.17	10.80±1.69	14.10±4.43	3.382	0.148
Post-test	12.30±6.36	9.20±1.40	15.20±6.27	7.298	**0.026**
Test statistics ¥	***t* = 10.00** ***p* = 0.002**	***t* = 9.798** ***p* = 0.001**	*t* = 0.00 *p* = 1.00		
Difference & **(post-pre)**	-2.80±1.32 ^{a}	-1.60±1.03 ^{a}	1.10±3.31 ^{b}	21.844	**0.000**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean* ± *standard deviation*. The parts determined in bold are statistically significant (p<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (p<0.05).

According to Table 4.6, while there was no significant difference for pre-test results of TUG scores, a significant difference found between the groups in post-test results (p>0.05). In the cognitive task and motor task groups, the TUG averages obtained in the post-test were statistically lower than the pre-test scores (p<0.05). At the same time, there was found nonsignificantly increase in the TUG averages of the control group (p>0.05).

Table 4.7. Comparison of FES-I scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*P*
FES-I					
Pre-test	28.80±9.07 ^{b}	35.90±11.72	45.00±11.60 ^{a}	1.699	0.428
Post-test	24.60±7.71 ^{b}	33.20±12.11 ^{b}	44.60±11.46 ^{a}	11.706	**0.003**
Test statistics ¥	***t* = 10.00** ***p* = 0.002**	***t* = 9.060** ***p* = 0.003**	*t* = 0.667 *p* = 0.414		
Difference& (post-pre)	-4.20±1.69 ^{c}	-2.70±1.06 ^{b}	-0.60±0.52 ^{a}	22.326	**0.000**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean ± standard deviation*. The parts determined in bold are statistically significant (p<0.05). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference (p<0.05).

According to Table 4.7, When evaluating the fear of falling, while there was no significant difference for pre-test results of FES-I scores between the groups (p>0.05), a significant difference was found after the treatment. There was also improvement in the cognitive and motor groups according to intragroup analysis.

FES-I score decrease in cognitive task group was significantly higher than motor task and control groups (p<0.05). The FES-I score decrease for motor task group was significantly higher than control group (p<0.05).

Table 4.8. Comparison of 5XSST scores according to groups at measurement times

	Group			Test statistics †	
	Cognitive *n*=10	Motor *n*=10	Control *n*=10	*F*	*P*
5XSST					
Pre-test	25.60±9.88 *a*	15.60±2.50 *b*	22.00±8.93	3.270	0.195
Post-test	22.10±8.52 *a*	13.90±1.81 *b*	21.90±8.77 *a*	4.291	**0.012**
Test statistics ¥	***t* = 10.00** ***p* = 0.000**	***t* = 5.667** ***p* = 0.000**	*t* = 1.000 *p* = 0.317		
Difference& (post-pre)	-3.50±2.01 *c*	-1.70±0.95 *b*	-0.10±0.48 *a*	18.052	**0.000**

¥Comparison within groups (Paired Sample t-test), †Comparison between groups (One-way ANOVA), &Comparison of the pre-test and post-test score differences between groups (One-way ANOVA). Descriptive statistics were given as *mean* ± *standard deviation*. The parts determined in bold are statistically significant ($p<0.05$). a>b>c: Different letters or letter combinations on the same line represent statistically significant difference ($p<0.05$).

According to Table 4.8, there was no significant difference for pre-test results of 5XSST scores between the groups ($p>0.05$). For the post-test 5XSST scores, the means of cognitive task and control groups were significantly higher than the motor task group ($p<0.05$). In the cognitive task and motor task groups, the 5XSST averages obtained in the post-test were statistically lower than the pre-test scores ($p<0.05$).

5XSST score decrease in cognitive task group was significantly higher than motor task and control groups ($p<0.05$). The 5XSST score decrease for motor task group was significantly higher than control group ($p<0.05$).

5. DISCUSSION

As a result of our study, in which we aimed to compare the effects of telerehabilitation-based Cognitive and motor dual-task exercises on cognitive function, balance, walking, fall risk and quality of life parameters in patients diagnosed with Parkinson's Disease (PD), Berg Balance Test (BBS), Timed Up and Go Test (TUG), The Montreal Cognitive Assessment (MOCA), 10m walk test, Five-Times Sit to Stand Test (5XSST), Falls Efficacy Scale International (FES-I) and The Parkinson's Disease Questionnaire (PDQ-39) were found significantly improved in the in both groups.

The results of our study indicate that both the cognitive task group and the motor task group exhibited statistically significant improvements in PDQ-39 scores in the post-test compared to the pre-test assessments. The Parkinson's Disease Questionnaire (PDQ-39) is a widely recognized instrument employed to evaluate health-related quality of life in individuals with PD. Lower PDQ-39 scores are indicative of better quality of life and fewer disease-related difficulties (129,130). Several studies have reported improvements in quality of life outcomes following cognitive and motor interventions in PD patients. For instance, a randomized controlled trial conducted by Li Z, et al. (2022) investigated the therapeutic effect of Wuqinxi Qigong vs. stretching on single- and dual-task gait, motor symptoms, and quality of life in people with mild and moderate Parkinson’s disease (PD). 40 Participants completed 12 weeks (two sessions/week) of intervention. According to conclusion of the study, Wuqinxi Qigong results in better mobility, balance and quality of life compared to stretching alone. A systematic review by Chen et al. (2022) examined Effect of Exercise on Quality of Life in PD and reported that lasting 12 weeks or longer exercise interventions resulted significant improvements in PDQ-39 scores (133). Furthermore, a study by Valenzuela et al. (2020) evaluated Effects of Dual-Task Group Training on Gait, Cognitive Executive Function, and Quality of Life in People with PD (134). Dual task exercises were given as cognitive and motor to the participantsin this study for a hour, 2 days/week for 10 weeks and implied that dual task training improvesQoL. This highlights the potential of targeted cognitive and motor interventions in improving the overall well-being and quality of life in individuals with PD.

Contrary to this study da Silva A. Z, et al (2023) investigated that the effects of a dual-task aquatic exercise program on the ADL, motor symptoms, and QoL of individuals with PD. 25 individuals completed in 10-week program. Assessments were made before treatment, immediately after treatment, and 3 months after treatment. At the same time, Carrol et al (2017) researched aquatic exercise therapy for people with PD and found that there was non-significant

little improvement on QoL (132). Also, they attributed that 6-week exercise program does not change the PDQ-36 score. Contrary to our study PDQ-39 scale results obtained did not show significant values after the training program. Unlike our study a greater decrease on the averages of the motor-motor dual task when compared to the CG was observed.

The Berg Balance Scale (BBS) is a widely utilized clinical tool for assessing balance and fall risk in individuals with various neurological conditions, including PD. The impaired balance control in individuals with PD puts them at a higher risk of falls, leading to increased morbidity, reduced quality of life, and healthcare costs (136). According to our findings, there was no significant difference in BBS scores between the groups in terms of both pre-test and post-test results, while the BBS averages obtained in the post-test were found to be statistically higher than the pre-test scores in the cognitive and motor task groups. In addition, BBS score increase in cognitive task group was significantly higher than motor task and control groups while the BBS score increase for motor task group was significantly higher than control group in our study. This suggests that the observed differences in BBS score increases among the three groups suggest that the specific nature of the interventions implemented in each group may have contributed to the differential effects on balance outcomes. These findings are consistent with previous research that has demonstrated the positive effects of both cognitive and motor interventions on balance outcomes in individuals with PD. A systematic review andmeta-analysis done by Li et al (2020) researched the effect of dual task training on balance in patients with PD. They implied that dual-task training had a significant improvement on balancefunction compared with that of the control groups (134). At the same time, a systematic reviewand meta-analysis study by Wang et al. (2016) examined the effectiveness of different types ofexercise interventions on balance outcomes in Parkinson's disease (135). The review reported significant improvements in balance measures, including the BBS, following both cognitive and motor interventions, supporting the notion that these interventions can positively influencebalance in individuals with PD.

Contrary, Gubner H, et al.(2022) investigated the effect of individualized physiotherapy or treadmill training on gait during dual-task performance (136). There was no significant result on balance of 10 individual intervention sessions in individuals diagnosed with Parkinson's. Although the interventions showed improvement over time, a significant effect for group was not present. Similarly, in our study, no conclusive result was reached between the pre- and post-treatment groups. Within the group, cognitive interventions in the cognitive task group may have targeted cognitive processes related to balance control, such as

attention, executive functions, and motor planning, which may explain the greater improvements in balance observed in this group. On the other hand, motor interventions in the motor task group may have focused more directly on motor control, coordination and strength, resulting in significant improvements in balance compared to the control group. The control group, which did not receive any particular intervention, experienced a smaller increase in BBS scores, possibly due to the natural progression of Parkinson's disease.

According to the findings of our study, The Montreal Cognitive Assessment (MoCA) scores obtained in the post-test were found to be statistically higher than the pre-test scores for both the cognitive task and motor task groups. These findings indicate an improvement in cognitive function following the interventions in these groups. Furthermore, the increases in MoCA scores were statistically higher in the cognitive task and motor task groups compared to the control group. Improvements in cognitive function among individuals with PD are of great importance as cognitive impairments, such as attention, executive function, and memory deficits, commonly coexist with the motor symptoms of PD (137). This suggests that the improvements observed in the cognitive task and motor task groups in our study can be attributed to interventions rather than spontaneous changes over time. These findings are in line with previous studies showing the potential for cognitive interventions and motor training to improve cognitive performance in individuals with PD. Bahrudin et al. (2022) examined the brain training game activities for PD patients and they found that MoCA scores are better for the cognitive task group compared with the control group (138). On the other hand, Chan et al. (2019) found that interactive cognitive-motor training on eye-hand coordination and cognitive function increased MoCA score (139). Furthermore Wollesen et al. (2020) made a systematic review and meta-analysis study about the effects of cognitive-motor training interventions on executive functions in older people. The findings of this study showed both training methods improved MoCA score (140).

Contrary, study by Valenzuela C S M, et al. (2020) investigeted that he effects of a dual-task group program, to compare it with the effects of a single-task group program, and to analyze the effects of functional secondary tasks (141). In this study, which lasted 20 sessions in which 40 people participated, cognitive functions were measured using the Frontal Assessment Battery and Trail Making Test. According to results, DT group showed no changes in test score, the ST group required more time to run the test after training.

The findings of the study indicate that the Timed Up and Go (TUG) test scores significantly improved in both the cognitive task and motor task groups in the post-test compared to their pre-test scores. These improvements suggest that the interventions implemented in these two groups had a positive impact on mobility and functional performance in individuals with PD. Higher TUG scores reflect longer time and increased difficulty in performing the task, indicating poorer mobility and increased fall risk. In our study the control group, which did not receive any interventions, did not show significant improvements in TUG scores. This suggests that the observed improvements in the cognitive task and motor task groups can be attributed to the interventions rather than spontaneous fluctuations over time.

Several studies have reported improvements in mobility outcomes following cognitive and motor interventions in PD patients. For instance, a study by Brusito et al. (2018) investigated the effect of DT training in a sample of older adults. In the study with 60 participants, individuals were divided into 3 groups: Control (CG), single-task (ST) training and DT training group. ST group received balance and walking training twice a week for16 weeks, while DT training group performed the same training with additional motor tasks. After intervention DT showed better scores in overall TUG in 16 weeks. Results suggested that 16 weeks of motor DT training, using motor additional tasks as manipulation of common objects of everyday life, could improve mobility in older age (142). Another study by Milman Uzi et al. (2014) hypothesized that a cognitive remediation program would enhance gait and mobility. 18 people participated in this 12-week study, compared to pre-training values, TUG significantly improved after the training. In summary that cognitive training can improve cognitive function and has a beneficial carryover effect to certain aspects of mobility in patients with PD (143). In the study of da Silva et al. (2019) the effect of aquatic exercises on functionality in patients with parkinosis was examined. At the end of the 10-week randomized controlled study, dual-task aquatic exercise program improved functional mobility in Parkinson patients (144).

Unlike to our stduy, a rondomized controlled study by Pereira-Pedro K P, et al. (2022) investigated that verify the influence of a cycling exercise program combined with the performance of a cognitive task, on the cognitive and physical aspects in PD patients (145). Under the three conditions, the TUG test was performed: (1) walking normally, (2) walking saying animal names and (3) walking reciting a mental calculation. According to results, despite not being significant, CG improved the time in the three conditions, while EG

deteriorated in conditions 2 and 3 (where there was a physical and cognitive task) and improved in condition 1, the physical only TUG.

According to other findings of the study, in both the cognitive task and motor task groups, the 5X Sit-to-Stand Test (5XSST) averages obtained in the post-test were significantly lower than the pre-test scores. This indicates an improvement in the performance of the 5XSST task following the interventions. Additionally, the study found that the decrease in 5XSST scores in the cognitive task group was significantly greater than in the motor task and control groups. The significant decrease in 5XSST scores in the cognitive task group compared to the motor task and control groups may be attributed to the specific effects of cognitive interventions on motor planning, coordination, and muscle activation.

Cognitive interventions, such as dual-task training and cognitive-motor integration exercises, aim to improve the cognitive processes involved in motor tasks. These interventions may enhance attention, executive function, and motor planning, leading to improved performance in tasks requiring lower limb strength and coordination. These findings are consistent with previous research demonstrating the positive effects of cognitive and motor interventions on functional mobility outcomes in individuals with PD. For instance, a study by King et al. (2015) examined the effects of a multimodal exercise program, including both cognitive and motor components, on functional mobility in individuals with PD. The findings revealed significant improvements in sit-to-stand performance, indicating enhanced lower limb strength and functional mobility (146). These results are consistent with the findings of the present study, highlighting the positive effects of cognitive and motor interventions on sit-to-stand performance in individuals with PD. The study by Tomlinson et al. (2017) implemented a multimodal exercise intervention combining cognitive and motor activities in individuals with PD (147). Similar to the present study, they observed a significant improvement in sit-to-stand performance, as assessed by the 5XSST, in the multimodal exercise group compared to the control group. These findings support the notion that the combination of cognitive and motor activities in interventions can enhance lower limb strength and functional mobility in individuals with PD.

In contrast to these studies, Li K. Z, et al. (2010) investigated whether healthy older adults who completed five sessions of non-motor cognitive dual-task training would show significant improvements in dual-task standing balance and mobility measures compared with an untrained control group (148). Twenty healthy older adults were assigned to either training or control groups. According to results, there was no significant difference between the groups.

The reason for this is argued in the study that the individuals participating in the study are composed of fit individuals.

The findings of the present study indicate that both the cognitive task and motor task interventions resulted in statistically significant improvements in the 10m walk test scores compared to the pre-test scores. This aligns with previous research highlighting the positive effects of cognitive and motor interventions on gait performance in individuals with PD. A study by A study by Rochester et al. (2009) investigated the effects of a cognitive dual-task training program on gait in individuals with PD (149). The results demonstrated significant improvements in gait velocity and stride length following the intervention. These findings suggest that engaging individuals with PD in cognitive tasks while walking can lead to improvements in gait parameters, emphasizing the importance of integrating cognitive components in rehabilitation programs. Another study by Ridgel et al. (2012) explored the effects of a combination of cognitive and motor training on gait and balance in individuals with PD (150). The results demonstrated significant improvements in gait speed and stride length, as well as balance measures, after the intervention. These findings highlight the potential synergistic effects of cognitive and motor interventions in improving gait and balance outcomes in individuals with PD. Additionally, a study by Agmon et al. (2019) investigated the effects of a virtual reality-based cognitive-motor training program on gait performance in individuals with PD. The results revealed significant improvements in gait speed, step length, and cadence following the intervention (151). These findings suggest that incorporating virtual reality technology and cognitive-motor tasks can be an effective approach to improving gait performance in individuals with PD.

Contrastly, a study by do Nascimento Silva showed that 6-minute walk test results of 16 seasons of dual task training, no significant difference was found after the treatment. The results demonstrated significant improvements in gait speed and stride length following the intervention. These findings are consistent with the present study, suggesting that the combination of cognitive tasks during walking can lead to enhanced gait performance in individuals with PD (152). Similarly, in another study by Kim H, et al (2022) compared the effects of robot-assisted gait training (RAGT) and treadmill training (TT) on gait speed, dual-task gait performance, and changes in resting-state brain functional connectivity in individuals with PD (153). The study with 44 participants lasted 12 sessions. According to the results, there was no significant difference between the post-treatment groups.

In short, all these studies are considered together, we can say that the findings obtained from these studies together with the current study are important for the positive effects of both cognitive and motor interventions on walking performance in Parkinson's patients. reflects improved walking speed and efficiency required for independence. It is important to note that the improvements observed in the cognitive task and motor task groups in our study were significantly higher than the control group. This suggests that cognitive and motor interventions have a more pronounced effect on walking performance than no intervention. These findings highlight the potential benefits of incorporating cognitive and motor tasks into rehabilitation programs for individuals with PD to optimize walking outcomes.

According to the findings of the study both the cognitive task and motor task interventions had a positive impact on reducing fear of falling, as evidenced by the statistically lower Falls Efficacy Scale International (FES-I) scores in the post-test compared to the pre-test scores. Moreover, the results demonstrate that the decrease in FES-I scores was significantly higher in the cognitive task group compared to both the motor task group and the control group, while the decrease in the motor task group was also significantly higher than the control group.

These findings align with previous research that has examined the effects of cognitive and motor interventions on fear of falling in individuals with PD. Mak et al. (2017) explored the effects of a combined cognitive and physical training program on fear of falling in individuals with PD (155). The results demonstrated significant reductions in fear of falling scores, suggesting that the integrated approach targeting both cognitive and physical domains can effectively address fear-related concerns. This study emphasizes the synergistic effects of combining cognitive and motor interventions to enhance individuals' confidence, balance, and mobility. Furthermore Conradsson et al. (2017) examined the effects of a dual-task training program on falls and fall-related concerns in individuals with PD (156). The results demonstrated a significant reduction in falls and improvements in balance confidence after the intervention. This indicates that the integration of cognitive tasks alongside motor training can effectively address fall-related concerns in individuals with PD, similar to the findings in the cognitive task group of the present study. By targeting cognitive and motor aspects, these interventions may address underlying factors such as confidence, self-efficacy, and movement control, which contribute to fear of falling. Pourkhani et al. (2020) showed similar results with our study. In this 10-week study, improvement was observed in Fes-I scores in both cognitve and motor groups (156). Reducing fear of falling is particularly important in individuals with Parkinson's disease, as fear of falling can lead to activity restriction, decreased mobility, and a

decline in overall quality of life. By decreasing fear of falling, individuals may feel more confident and secure in engaging in daily activities and physical exercises, which can further contribute to improved physical functioning and overall well-being.

Our thesis study, which was planned as a prospective, randomized and controlled 8-week follow-up, has many strengths. The presence of a control group in addition to Dual task cognitive and Dual task motor groups is one of the strengths of our study.

The strengths of our study are that the study was conducted under the control of a physiotherapist, easy access to rehabilitation services with the telerehabilitation method and use of valid and reliable scales.

In addition, the homogeneity of demographic characteristics such as age, BMI, marital status, educational status, disease duration, and functionality, which may affect the results of the study, among the groups, and the homogeneity of all evaluation criteria among the three groups in the initial evaluation is one of the other strengths of our study.

6. CONCLUSION

In our study, it was found that dual-task training programs with physical exercises were effective in increasing the quality of life and walking speed and improving cognitive function. When the superiority of cognitive-motor dual-task physical exercises and motor-motor dual-task physical exercises were examined, the cognitive-motor dual-task exercises group was found to be significantly superior in improving balance and reducing the fear of falling.

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8. APPENDIXES

8.1. APPENDIX 1: Ethical Committee Approval

T.C.
MARMARA ÜNİVERSİTESİ
Sağlık Bilimleri Fakültesi
Girişimsel Olmayan Klinik Çalışmalar Etik Kurulu

PROJENİN ADI	: "Parkinson Hastalarında Telerehabilitasyon Temelli Motor Ve Bilişsel İkili Görev Egzersizlerinin Etkilerinin Karşılaştırılması-Randomize Kontrollü Bir Çalışma"
PROJENİN YÜRÜTÜCÜSÜ	: Dr. Öğr. Üyesi Ebru AKBUĞA KOÇ
PROJEDEKİ ARAŞTIRICILAR	: Prof. Dr. Nilgün ÇINAR, Şükriye ÇAKIR
ONAY TARİHİ VE SAYISI	: 25.05.2023/74

Sayın: Dr. Öğr. Üyesi Ebru AKBUĞA KOÇ

"74" protokol numaralı İsimli "Parkinson Hastalarında Telerehabilitasyon Temelli Motor ve Bilişsel İkili Görev Egzersizlerinin Etkilerinin Karşılaştırılması-Randomize Kontrollü Bir Çalışma" projeniz Fakültemiz Etik Kurulu tarafından incelenmiş oy birliği ile etik yönden uygun olduğuna karar verilmiştir.

Prof. Dr. Me[illegible]IM
Etik Kurul Başkanı

Prof. Dr. Ayşen GARGILI KELE

Prof. Dr. Şule ECEVİT ALPAR

Prof. Dr. S. Burak BEK

Prof. Dr. Zübeyir SARI

Prof. Dr. Saime EROL

Doç. Dr. M. Emin ALŞAHİN

Doç. Dr. [illegible] DIZ ÖZER

Doç. [illegible] KARAKOÇ

Doç. Dr. [illegible] BAYRİ BİNG[illegible]

Doç. Dr. [illegible] Sule AKTAÇ

Dr. Öğr. Üyesi [illegible] Burcu ÇALIK [illegible] M

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8.2. APPENDIX 2: Informed Written Consent

Araştırmanın Adı: Parkinson Hastalarında Telerehabilitasyon Temelli Motor ve Bilişsel İkili Görev Egzersizlerinin Etkilerinin Karşılaştırılması – Randomize Kontrollü Bir Çalışma

Sayın Katılımcı,

Yukarıda adı yazılı araştırmaya katılmak üzere davet edilmiş bulunmaktasınız. Bu araştırmada yer almayı kabul etmeden önce, araştırmanın ne amaçla yapılmak istendiğini anlamanız ve bu bilgilendirme sonucunda kararınızı vermeniz gerekmektedir. Aşağıdaki bilgileri lütfen dikkatlice okuyunuz, sorularınız olursa sorunuz ve açık yanıtlar isteyiniz.

Bu araştırma ile Parkinson Hastalığı olan bireylerde, telerehabilitasyon yöntemi ile fiziksel ve bilişsel beceri ikili görev egzersizinin Parkinson Hastaları üzerinde bilişsel fonksiyon, denge, yürüme, düşme riski ve yaşam kalitesi üzerinde etkilerinin karşılaştırılması olarak belirlenmiştir.

Sizden bu çalışmada haftada 3 gün olacak şekilde online olarak egzersiz yapmanız istenilecektir. Bu egzersiz uygulaması fizyoterapist gözetiminde 60 dakika sürecek olup, toplamda 6 hafta sürecektir. Ayrıca katılımcı birey yine Fizyoterapist tarafından birkaç değerlendirmeye tabii tutulacaktır. Bu değerlendirmede; katılımcı bireyin, denge durumu, mobilitesi, fiziksel performansı, alt ve üst uzuvlarının kuvvetliliği, günlük yaşam aktivite durumları ve yaşam kalitesi ölçümlenecektir. Bunun size ve yakınınıza hiçbir zararı olmayacaktır. Çalışmaya katılmakla parasal yük altına girmeyeceksiniz ve size de herhangi bir ödeme yapılmayacaktır.

Bu araştırmaya katılıp katılmamakta tümüyle özgürsünüz. Gerek duyduğunuz tüm bilgileri istemeye ve doğru, açık, anlaşılır bilgi almaya hakkınız vardır. Araştırmaya katılmayı istemezseniz burada size verilen hizmet olumlu veya olumsuz şekilde etkilenmeyecektir. Gerekli gördüğü takdirde araştırmanın herhangi bir kısmında katılımcı araştırmadan çıkabilir, araştırmacı çalışmayı sonlandırabilir. Araştırmanın tüm aşamalarında kimlik bilgileriniz gizli tutulacaktır. Araştırma kapsamında elde edilen bilgiler bilimsel amaçlarla kullanılabilir gizlilik kurallarına uymak kaydıyla sunulabilir ve yayınlanabilir.

Araştırma ile ilgili daha fazla bilgiye ihtiyaç duyarsanız araştırmacıya sukriye.cakir@std.yeditepe.edu.tr e-posta adresi veya [redacted] numaralı telefondan ulaşabilirsiniz.

Yukarıda yer alan ve araştırmaya başlamadan önce katılımcılara verilmesi gereken bilgileri içeren metni okudum (ya da sözlü olarak dinledim). Araştırma kapsamında elde edilen şahsıma ait bilgilerin bilimsel amaçlarla kullanılmasını, gizlilik kurallarına uyulmak kaydıyla sunulmasını ve yayınlanmasını, hiçbir baskı ve zorlama altında kalmaksızın, kendi özgür irademle kabul ettiğimi beyan ederim

İmza/Tarih

Katılımcının adı soyadı

8.3. APPENDIX 3: Structured Questionnaire for Patient's Demographic Characteristics

GENEL BILGI DEĞERLENDIRME FORMU

1. Adı Soyadı

2. Cinsiyet: Kadın ( ) Erkek ( )

3. Boy uzunluğu(cm)

4. Vücut ağırlığı(kg)

5. Medeni Durum: 1- Evli 2- Bekar 3- Dul 4- Boşanmış/Ayrı yaşıyor

6. Eğitim Süresi:……..(Yıl olarak) 1- Okur-yazar-İlkokul 2- Ortaokul-Lise 3- Üniversite 4- Lisans

7. Mesleki Durum: 1- İşsiz 2- Ev hanımı 3- İşçi 4- Memur 5- Serbest meslek 6- Emekli

8. Evde birlikte yaşadığı kişiler var mı? 1- Yalnız 2- Eşiyle birlikte 3- Eşi ve çocuklarıyla birlikte 4- çocuklarıyla birlikte 5- Evli çocuklarıyla birlikte

9. Sağlık Sigortası: 1- Var 2- Yok

10. Sağlık sigortası var ise türü: 1- SSK 2- Emekli Sandığı 3- Bağ-kur 4- Yeşil Kart 5- Özel Sağlık Sigortası

11. Halen ücret karşılığı bir işte çalışıyor mu? 1- Çalışıyor 2- Parkinsona bağlı olarak Çalışmıyor 3- Başka bir nedenle Çalışmıyor .....(Hangi nedenle)

12. Gelir Durumu:

1-İyi 2- Orta derecede iyi 3- Ancak geçinebiliyor

13. Oturduğu evin tipi?

1- Apartman dairesi (Katı....)

2- Tek katlı/müstakil ev

3- Gecekondu

14. Evde kendisine ait odası var mı?

1- Evet 2- Hayır

15. Ne tür yatakta yatıyor?

1- Yün yatak 3- Yaylı yatak

2- Sünger yatak(çek-yat) 4- Pamuk yatak 5- Ortapedik yatak

16. Oturmak için genellikle neyi tercih ediyor?

1- Yumuşak bir koltuk 3- çek-yat /divan

2- Kolsuz sandalye 4- Sert zeminli ve kollu sandalye

17. Kullandığı banyo tipi?

1- Küvet(yatarak) 3- Taburede oturarak

2- Duş şeklinde 4- Yarım küvet/küvete monte edilmiş sandalye

18. Boş zamanlarında gerçekleştirdiği aktiviteleri var mı?

.....

19. Hastalığın adını doğru biliyor ve söylüyor mu?

1- Doğru 2- Yanlış

20. Hastalığın süresi .....(Yıl olarak)

21. 1- 1-4 yıl 2- 5-9 yıl 3- 10 yıl ve ¸zeri

22. Doktora ilk kez hangi şikayetlerle başvurmuş? (Birden fazla madde işaretlenebilir)

1- Ellerde titreme

2- Kol ve bacaklarda ağrı

3- Hareketlerin yavaşlaması

4- Kasların sertleşmesi

5- Ayaklarını sürüyerek yürümesi

6- Yürürken kolları sallamama

7- Dilde titreme ve tükürük salgısının artması

8- Ses tonunun azalması ve konuşma bozukluğu

9- Terleme krizleri ve ciltte yağlanma

23. Ailesinde Parkinson hastalığı olan var mı?

1- Evet 2- Hayır

24. Parkinson hastalığı risk faktörlerine maruz kalmış mı?

1- Kafa travması 2- Tarım ilaçları

3- Menenjit ¸ 4- Hayvancılık

5- Diğer:……..

25. Sigara içiyor mu?

1- Evet 2- Hayır

26. Sigarayı hala içiyor/bırakmış ise ..... paket/yıl

27. Alkol kullanıyor mu?

1-Evet 2- Hayır

28. Hastalığı hakkında bilgi almış mı?

1- Evet 2- Hayır

29. Parkinson tanısı konulduktan sonra ilaçlarını düzenli kullanıyor mu?

1- Evet 2- Hayır

30. 31. soruya yanıtınız hayır ise neden ilaçlarını düzenli kullanmıyor?

1-Maddi yetersizlik 2- Yan etkileri nedeniyle

3- Unutkanlık 4- İlaçların iyileştirdiğine inanmıyor

31. Kullandığı ilaç grupları nelerdir?

32. Psikolojik destek alıyor mu?

1- Evet 2- Hayır

33. Herhangi bir egzersiz programı uyguluyor mu?

1- Evet 2- Hayır

34. Hekim kontrol¸ne düzenli olarak gidiyor mu?

1- Evet 2- Hayır

35. 36. sorunun cevabı hayır ise nedeni?

1- Getiren birinin olmaması 2- Şikayetin olmaması

3- Maddi yetersizlik 4- Sağlık sigortasının olmaması

5- Diğer……..

36. Yardım gereksinimi duyduğunuz günlük yaşam aktivitesi/aktivitelerini

önem sırasına göre numaralandırarak sıralayınız.

( ) Çevre güvenliğini sağlama ve sürdürme

( ) İletişim

( ) Solunum

( ) Yeme-i.me alışkanlığı

( ) Boşaltım

( ) Kişisel temizlik ve giyim

( ) Beden ısısının kontrol¸

( ) Hareket

( ) Çalışma ve boş vakitlerini değerlendirme

( ) Cinselliği ifade etme

( ) Uyku

37. Var olan diğer sağlık sorunları nelerdir?

1- Yüksek tansiyon

2- Şeker hastalığı

3- Kalp hastalığı

4- Solunum sistemi hastalığı

5- Romatizmal hastalıklar

6- Diğer.....

38. Genel olarak sağlığını nasıl algılıyor?

1-İyi 2- Orta 3- Kötü

39. Son 3 aydır düzenli bir egzersiz yapıyor musunuz?

( ) Hayır ( ) Haftada 3 kereden az ( ) Haftada 3 kereden fazla

40. Egzersiz yapıyorsanız;

Aktivite türü:……

Dakika:……..

41. Halen veya önceden ilgilendiğiniz bir spor var mıydı?

8.4. APPENDIX 4: The Parkinson's Disease Questionnaire (PDQ-39)

Parkinson Hastalığı Anketi (PDQ-39)

PARKİNSON HASTALIĞINIZDAN DOLAYI, son bir ay içinde, aşağıdakileri hangi sıklıkta yaşadınız?

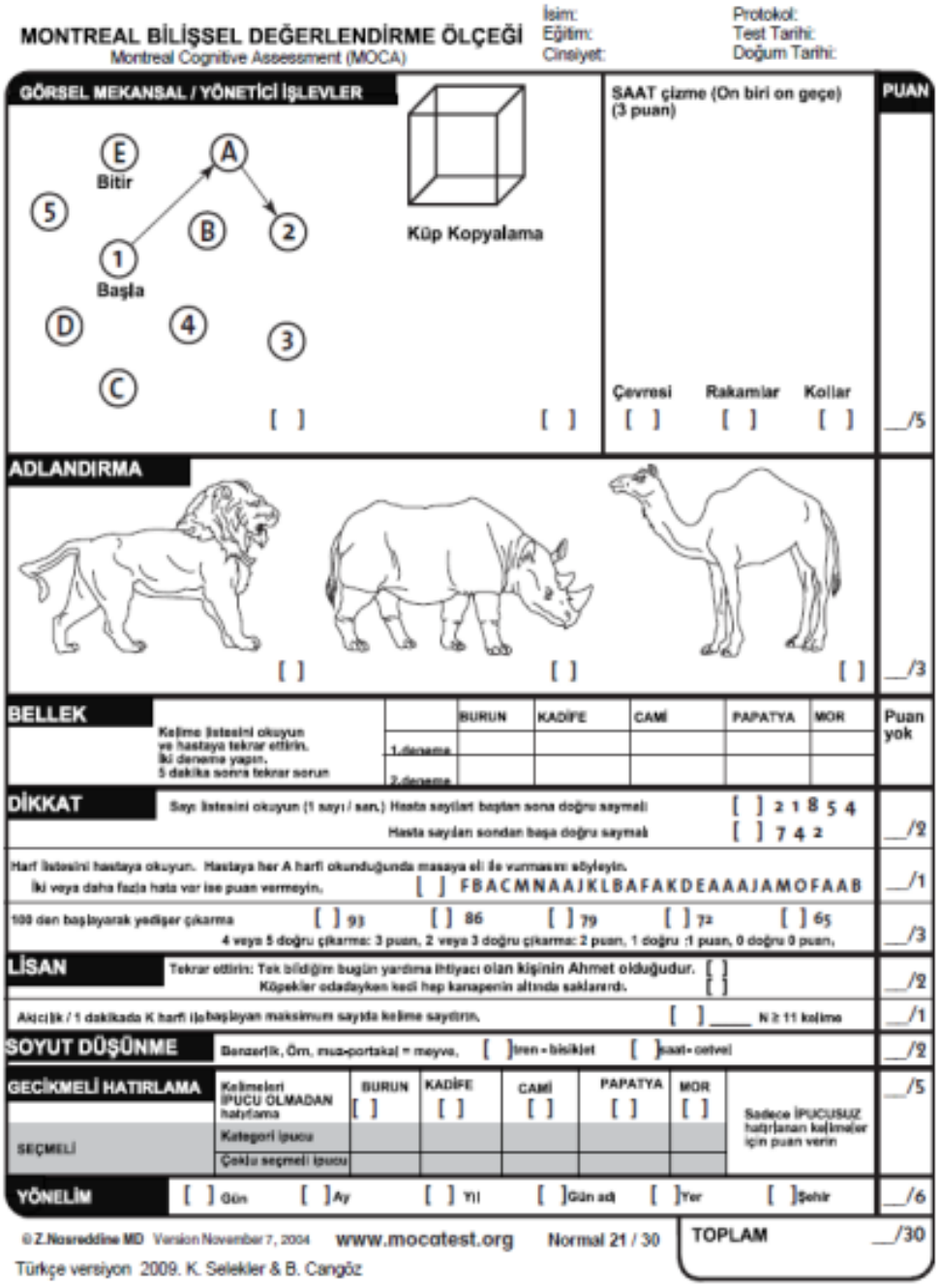
Parkinson hastalığınızdan dolayı, son bir ay içinde hangi sıklıkta ... ***Lütfen, her soru için bir daireyi işaretleyiniz***

	Hiçbir zaman	Nadiren	Bazen	Sıklıkla	Her zaman
1. ... yapmaktan hoşlandığınız boş zaman etkinliklerini yaparken zorlandınız?	O	O	O	O	O
2. ... tamirat, ev işleri, yemek pişirme gibi ev işlerini yaparken zorlandınız?	O	O	O	O	O
3. ... alışveriş çantalarını taşımakta zorlandınız?	O	O	O	O	O
4. ... yaklaşık 1 kilometre yürümekte sorun yaşadınız?	O	O	O	O	O
5. ... yaklaşık 100 metre yürümede sorun yaşadınız?	O	O	O	O	O
6. ... evinizin içerisinde istediğiniz kadar rahat olarak dolaşmakta sorun yaşadınız?	O	O	O	O	O
7. ... toplum içine çıkmakta sorun yaşadınız?	O	O	O	O	O
8. ... dışarı çıkarken başka birinin size eşlik etmesine ihtiyaç duydunuz?	O	O	O	O	O
9. ... toplum içinde düşme korkusu veya endişesi hissettiniz?	O	O	O	O	O
10. ... istediğinizden daha fazla eve bağımlı kaldınız?	O	O	O	O	O
11. ... yıkanmakta zorlandınız?	O	O	O	O	O
12. ... giyinmekte zorlandınız?	O	O	O	O	O
13. ... düğme iliklemede veya ayakkabı bağlarını bağlamada sorun yaşadınız?	O	O	O	O	O
14. ... okunaklı yazı yazmakta sorun yaşadınız?	O	O	O	O	O
15. ... yiyeceklerinizi kesmekte zorlandınız?	O	O	O	O	O
16. ... bir içeceği dökmeden tutmakta zorlandınız?	O	O	O	O	O
17. ... kendinizi kederli hissettiniz?	O	O	O	O	O
18. ... kendinizi terkedilmiş ve yalnız hissettiniz?	O	O	O	O	O
19. ... kendinizi ağlamaklı hissettiniz veya ağladınız?	O	O	O	O	O

20. … kendinizi kızgın veya huysuz hissettiniz?	O	O	O	O	O
21. … kendinizi endişeli hisseniz?	O	O	O	O	O
22. … geleceğiniz hakkında endişelendiniz?	O	O	O	O	O
23. … Parkinson hastalığınızı başkalarından gizlemek zorunda hissettiniz?	O	O	O	O	O
24. … toplum içinde yemek yemeniz veya bir şey içmeniz gereken durumlardan kaçındınız?	O	O	O	O	O
25. … toplum içinde Parkinson hastalığınızdan dolayı utanç duydunuz?	O	O	O	O	O
26. … diğer insanların size göstereceği tepki nedeniyle endişelendiniz?	O	O	O	O	O
27. … yakın kişisel ilişkilerinizle ilgili sorun yaşadınız?	O	O	O	O	O
28. … eşinizden gerek duyduğunuz desteği alamadığınız oldu? *Eşiniz yoksa işaretleyiniz* O	O	O	O	O	O
29. … ailenizden veya yakın arkadaşlarınızdan gerek duyduğunuz desteği alamadığınız oldu?	O	O	O	O	O
30. … gün içerisinde beklenmedik şekilde uykuya daldınız?	O	O	O	O	O
31. … okurken, televizyon izlerken vb. dikkatinizi toplamakta zorlandınız?	O	O	O	O	O
32. … hafızanızı kötü hissettiniz?	O	O	O	O	O
33. … geceleri kabuslar veya gündüzleri hayaller gördünüz?	O	O	O	O	O
34. … konuşma güçlüğünüz oldu?	O	O	O	O	O
35. … insanlarla uygun bir şekilde iletişim kuramadığınızı hissettiniz?	O	O	O	O	O
36. … insanlar tarafından önemsenmediğinizi hissettiniz?	O	O	O	O	O
37. … ağrılı kas kramplarınız veya spazmlarınız oldu?	O	O	O	O	O
38. … eklemlerinizde veya vücudunuzda ağrınız veya acınız oldu?	O	O	O	O	O
39. … nahoş şekilde sıcaklık veya soğukluk hissettiniz?	O	O	O	O	O

Lütfen, her soru için bir daireyi işaretlediğinizi kontrol ediniz.

8.5. APPENDIX 5: Montreal Cognitive Assessment (MoCA)



MONTREAL BİLİŞSEL DEĞERLENDİRME ÖLÇEĞİ
Montreal Cognitive Assessment (MOCA)

İsim:
Eğitim:
Cinsiyet:

Protokol:
Test Tarihi:
Doğum Tarihi:

GÖRSEL MEKANSAL / YÖNETİCİ İŞLEVLER — PUAN

E Bitir, A, 5, B, 2, 1 Başla, D, 4, 3, C

[ ] [ ]

Küp Kopyalama

SAAT çizme (On biri on geçe) (3 puan)

Çevresi [ ] Rakamlar [ ] Kollar [ ]

__/5

ADLANDIRMA

[ ] [ ] [ ]

__/3

BELLEK

Kelime listesini okuyun ve hastaya tekrar ettirin. İki denemeyi yapın. 5 dakika sonra tekrar sorun

	BURUN	KADİFE	CAMİ	PAPATYA	MOR
1.deneme					
2.deneme					

Puan yok

DİKKAT

Sayı listesini okuyun (1 sayı / sn.) Hasta sayıları baştan sona doğru saymalı [ ] 2 1 8 5 4

Hasta sayıdan sondan başa doğru saymalı [ ] 7 4 2

__/2

Harf listesini hastaya okuyun. Hastaya her A harfi okunduğunda masaya el ile vurmasını söyleyin. İki veya daha fazla hata var ise puan vermeyin. [ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

__/1

100 den başlayarak yedişer çıkarma [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 veya 5 doğru çıkarma: 3 puan, 2 veya 3 doğru çıkarma: 2 puan, 1 doğru :1 puan, 0 doğru 0 puan,

__/3

LİSAN

Tekrar ettirin: Tek bildiğim bugün yardıma ihtiyacı olan kişinin Ahmet olduğudur. [ ]
Köpekler odadayken kedi hep kanepenin altında saklanırdı. [ ]

__/2

Akıcılık / 1 dakikada K harfi ile başlayan maksimum sayıda kelime sayılırın. [ ] ____ N ≥ 11 kelime

__/1

SOYUT DÜŞÜNME

Benzerlik, Örn. muz-portakal = meyve, [ ] tren - bisiklet [ ] saat - cetvel

__/2

GECİKMELİ HATIRLAMA

Kelimeleri İPUCU OLMADAN hatırlama	BURUN [ ]	KADİFE [ ]	CAMİ [ ]	PAPATYA [ ]	MOR [ ]	Sadece İPUCUSUZ hatırlanan kelimeler için puan verin
SEÇMELİ Kategori ipucu						
Çoklu seçmeli ipucu						

__/5

YÖNELİM

[ ] Gün [ ] Ay [ ] Yıl [ ] Gün adı [ ] Yer [ ] Şehir

__/6

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TOPLAM __/30

Türkçe versiyon 2009. K. Selekler & B. Cangöz

8.6. APPENDIX 6: Berg Balance Scale

SORU TANIMI	PUAN
1. Oturur durumdayken ayağa kalkmak	_____
2. Desteksiz ayakta durmak	_____
3. Desteksiz oturmak	_____
4. Ayaktayken oturma pozisyonuna geçme	_____
5. Yer değiştirmek	_____
6. Gözler kapalı vaziyette ayakta durmak	_____
7. Ayaklar bitişik vaziyette ayakta durmak	_____
8. Ayaktayken Kollar gergin öne uzanmak	_____
9. Yerden nesne almak	_____
10. Geriye bakmak için dönmek	_____
11. 360 derece dönmek	_____
12. Diğer ayağı tabureye koymak	_____
13. Bir ayak önde ayakta durmak	_____
14. Tek ayak üstünde ayakta durmak	_____
TOPLAM	_____

GENEL YÖNERGE

Lütfen her hareketi gösterin ve/veya yazılı yönergeyi okuyun. Değerlendirirken lütfen her soru için en düşük cevap kategorisini kaydedin.

Soruların çoğunda denekten belirtilen pozisyonda belli bir süre kalması istenmektedir. Denek zaman ve mesafe şartlarını tutturamadığı, hareketinin denetlenmesi gerektiği, dışarıdan destek ya da değerlendirmeyi yapan kişiden yardım aldığı her sefer puanı eksilir. Denekler hareketleri yaparken dengelerini sağlamak zorunda olduklarını bilmelidirler. Hangi ayak üzerinde duracağı ya da ne kadar uzanacağı deneğe bırakılmıştır. Yerinde olmayan karar, performansı ve değerlendirmeyi aksi yönde etkileyecektir.

Muayene sırasında ihtiyaç duyulan malzemeler bir saniye ölçer ya da saat ve bir cetvel ya da 5, 12,5 ve 25 cm'lik mesafeleri ölçebilecek herhangi bir ölçü aletidir. Muayene sırasında kullanılan sandalyeler makul yükseklikte olmalıdır. 12. soru için bir basamak ya da ortalama basamak yüksekliğinde bir tabure kullanılabilir.

1. OTURMA POZİSYONUNDAYKEN AYAĞA KALKMAK
YÖNERGE: **Lütfen ayağa kalkın. Ellerinizden 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. DESTEKSİZ 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.

Eğer bir olgu 2 dakika boyunca desteksiz ayakta durabiliyorsa, desteksiz oturma için tam puan verin. 4. maddeye geçin.

3. AYAKLAR YERDE YA DA BİR TABURE ÜSTÜNDEYKEN ARKAYA YASLANMADAN OTURMAK (DESTEKSİZ OTURMA)
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 POZİSYONUNA 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 KAPALIYKEN DESTEKSİZ 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 BİTİŞİKKEN DESTEKSİZ 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 GERGİN ÖNE DOĞRU UZANMAK

YÖNERGE: **Kollarınızı 90 derece kaldırın. Parmaklarınızı uzatın ve öne doğru uzanabildiğiniz kadar uzanın. (Gözetmen eller 90 derecedeyken hastanın parmak uçları hizasında bir cetvel tutar. Öne uzanırken hastanın parmakları cetvele değmemelidir. Hastanın en ileri uzanabildiği noktada parmak uçlarının katettiği 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/dışarıdan 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 ÜZERİNDEN DÖNEREK GERİYE 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 Her iki vücut yanından da arkaya bakabiliyor ve ağırlık aktarımı iyi.

3 Sadece bir yanından arkaya bakabiliyor, diğer yandan olan bakışta denge aktarımı çok iyi değil

2 Yanlara dönebiliyor ama dengesini koruyor

1 Dönerken gözetime gereksinimi var

0 Dengesini kaybetmemek veya düşmemek için yardıma gereksinimi var.

11. 360 DERECE DÖNMEK

YÖNERGE: **Tam daire çizecek 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.

1 Yakın gözetime ya da sözlü uyarıya ihtiyacı vardır.

0 Dönerken yardıma ihtiyacı vardır.

12. DESTEKSİZ AYAKTA DURURKEN ALTERNE OLARAK AYAĞI BASAMAK VEYA TABUREYE YERLEŞTİRMEK

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.

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.

13. BİR AYAK ÖNDE OLARAK DESTEKSİZ 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 adımındaki 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.

1 Adım atmak için yardıma ihtiyacı var ama 15 saniye durabiliyor

0 Adım atarken veya ayakta dururken yardıma ihtiyacı var.

14. TEK AYAK ÜSTÜNDE AYAKTA DURMAK

YÖNERGE**: Tek ayak üzerinde tutunmadan durabildiğiniz kadar durun.**

4 Bacağını bağımsız olarak kaldırıp > 10 saniye tutabiliyor

3 Bacağını bağımsız olarak kaldırıp 5-10 saniye tutabiliyor

2 Bacağını bağımsız olarak kaldırıp ≥ 3 saniye tutabiliyor.

1 Bacağını kaldırmağa çalışıyor, 3 saniye tutamıyor ama bağımsız olarak ayakta durabiliyor.

0 Deneyemiyor ve düşmemek için yardıma gereksinimi var.

( ) Toplam Puan (Maksimum = 56)

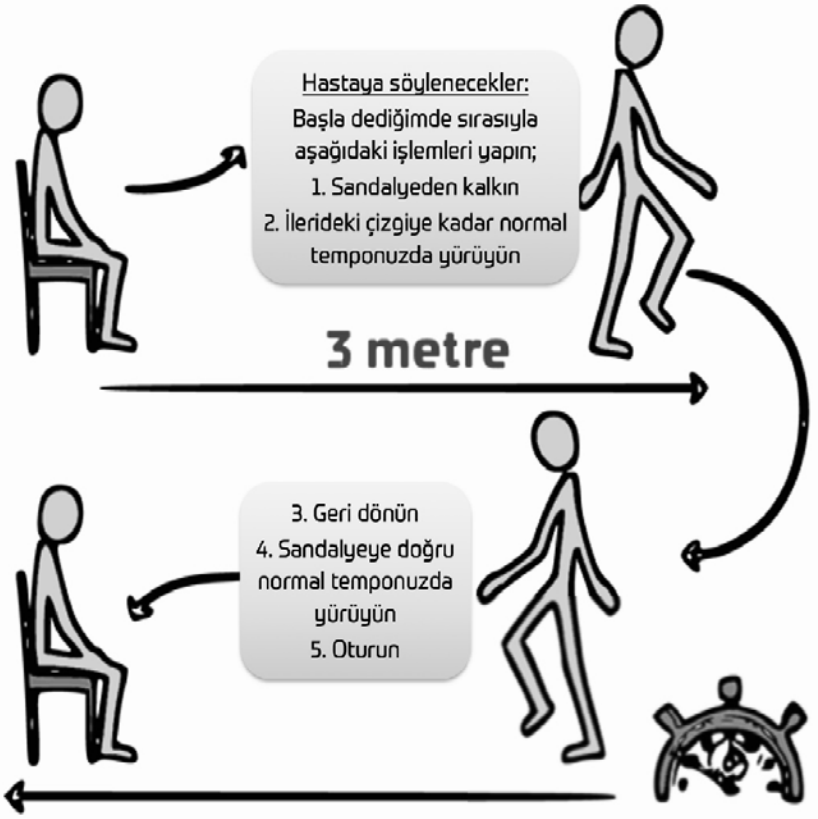
8.7. APPENDIX 7: Timed Up and Go Test (TUG)

Zamanlı Kalk Ve Yürü Testi

The Timed Up and Go (TUG) Test

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

Yaşlılarda düşme riskini ve mobiliteyi değerlendiren testin uygulanışı için bir sandalye ve bir kronometre gereklidir. Test hastanın herzaman 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

8.8. APPENDIX 8: Falls Efficacy Scale International-I

Düşme Etkinlik Ölçeği-Uluslararası (DEÖU)

Şimdi size, düşme olasılığı hakkında ne kadar endişe duyduğunuzla ilgili bazı sorular sormak istiyoruz. Lütfen bu aktiviteleri ne sıklıkta yaptığınızı düşünerek cevap veriniz. Eğer son zamanlarda bu aktiviteyi yapmıyorsanız (örneğin, sizin alışverişinizi başka birisi yapıyorsa) lütfen bu aktiviteyi yapsaydınız düşme konusunda endişe duyup duymayacağınızı düşünerek cevap veriniz. Aşağıdaki her bir aktivite için, lütfen bu işi yapsaydınız düşmekten ne kadar endişelendiğinizi gösterecek şekilde, kendi görüşünüze en yakın cevabı işaretleyiniz.

	Hiç endişelenmiyorum	Biraz endişelenıyorum	Oldukça endişeleniyorum	Çok endişeleniyorum
1. Ev temizlemek (örneğin silmek, elektrikli süpürge ile süpürmek veya toz almak)	O	O	O	O
2. Giyinmek veya soyunmak	O	O	O	O
3. Basit yemekler hazırlamak	O	O	O	O
4. Banyo yapmak veya duş almak	O	O	O	O
5. Dükkana (alışverişe) gitmek	O	O	O	O
6. Sandalyeye oturmak veya sandalyeden kalkmak	O	O	O	O
7. Merdivenlerden inmek veya çıkmak	O	O	O	O
8. Mahallede yürüyüş yapmak	O	O	O	O
9. Başınızın üzerindeki veya yerdeki bir şeye uzanmak	O	O	O	O
10. Telefonun çalması bitmeden cevap vermek	O	O	O	O
11. Kaygan bir zeminde yürümek (örneğin ıslak veya buzlu)	O	O	O	O
12. Bir arkadaş veya akrabayı ziyaret etmek	O	O	O	O
13. Kalabalık bir yerde yürümek	O	O	O	O
14. Düzgün olmayan bir zeminde yürümek (örneğin taşlı zeminde, bakımsız kaldırımda)	O	O	O	O
15. Yokuş yukarı veya yokuş aşağı yürümek	O	O	O	O
16. Sosyal bir etkinliğe katılmak (örneğin ibadet etmek, aile veya arkadaş toplantıları)	O	O	O	O

Lütfen, her soru için bir daireyi işaretlediğinizi kontrol ediniz

8.9. APPENDIX 9: Five Times Sit to Stand Test (5XSST)

5 Defa Oturup Kalkma Testi

5X Sit-to-Stand Test (5XSST)

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

Bu test alt ekstremitenin fonksiyonel gücünü, geçişken hareketleri, dengeyi ve düşme riskini değerlendirir.

Gerekli materyaller:	Kronometre, yaslanma yeri düz olan standart ebatlarda bir sandalye (yüksekliği: 43-45 cm)
Uygulanışı:	Uygulayıcı hastanın sandalyeye sırtını yaslayarak oturmasını sağlar. Her oturup kalkışta kaçıncı olduğunu söylenir. 5 kez oturup kalkıncaya kadar olan süre kronometre ile belirlenir.
Yönerge:	Hastaya "Lütfen kollarınızı diğer omuzunuzu tutacak şekilde çaprazladıktan sonra hiç durmadan, yapabildiğiniz en hızlı ve düz bir şekilde 5 kez oturup kalkın. Kronometre ile sürenizi ölçeceğim, hazır olduğunuzda başlayalım" denir.

Yaşa göre norm süreler	
Yaş	Ortalama süre
60-69	11.4 saniye
70-79	12.6 saniye
80-89	14.8 saniye

Düşme riski varlığına işaret eden süreler	
Yaşlı	>12 sn. (>15 ise tekrarlayıcı)
Vestibüler hastalık	>15 saniye
Parkinson	>16 saniye

Mong, Y., Teo, T. W., Archives of Physical Medicine and Rehabilitation 91(3): 407-413. 2010

Toplam Süre (saniye): _____

8.10. APPENDIX 10: Curriculum Vitae

Kişisel Bilgiler

Adı	Şükriye	**Soyadı**	Çakır
Doğum Yeri	İstanbul	**Doğum Tarihi**	20.04.1998
Uyruğu	T.C	**TC Kimlik No**	[redacted]
E-mail	sukriye.cakir@std.yeditepe.edu.tr	**Tel**	[redacted]

Öğrenim Durumu

Derece	Alan	Mezun Olduğu Kurumun Adı	Mezuniyet Yılı
Doktora	-	-	-
Yüksek Lisans	-	-	-
Lisans	Fizyoterapi ve Rehabilitasyon	Yeditepe Üniversitesi	2020
Lise	-	Kazım Karabekir İmam Hatip Liseasi	2015

Bildiği Yabancı Dilleri	Yabancı Dil Sınav Notu
İngilizce	85.20

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Görevi	Kurum	Süre (Yıl - Yıl)

Bilgisayar Bilgisi

Program	Kullanma becerisi
Microsoft Office Program	İyi
SPSS	İyi

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

Diğer (Görev Aldığı Projeler/Sertifikaları/Ödülleri)