T.C.
YEDİTEPE UNIVERSITY
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COMPARISON OF THE EFFECTS OF PILATES AND SCAPULA MOBILIZATION EXERCISES ON POSTURE, SLEEP, AND QUALITY OF LIFE IN PERSONS WITH NECK PAIN

MASTER THESIS

DİDEM APO, PT.

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SUPERVISOR
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APPROVAL

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

Prof. Dr. Bayram YILMAZ

Director of Institute of Health Sciences

DECLARATION

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

06.02.2023

DİDEM APO

DEDICATION

I want to dedicate my thesis to my beloved and loving parents, Hümeyra and Arif Apo and my brother Görkem Apo…

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I want to express my most profound appreciation to my Adviser Professor Feryal Subaşı who continually provides me with all support and guidance which makes this project possible. I am incredibly grateful to them for providing these opportunities.

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LIST OF SYMBOLS/ABBREVIATIONS

APPI: Australian Physiotherapy and Pilates Institute

CG: Control group

CNP: Chronic Neck Pain

CT: Computed tomography

EG: Experimental group

EMG: Electromyography

GH: Glenohumeral

IVD: Intervertebral Discs

MNP: Mechanical Neck Pain

MRI: Magnetic resonance imaging

NDI: Neck Disability Questionnaire

NP: Neck Pain

NYPRS: New York Posture Rating System

PSQI: Pittsburgh Sleep Quality Index

SF-12: Quality of Life Assessment Questionnaire

TENS: Transcutaneous Electrical Stimulation

VAS: Visual Analog Scale

ABSTRACT

Apo, D. (2022). Comparison of the Effects of Pilates and Scapula Mobilization Exercises on Posture, Sleep, And Quality of Life in Persons with Neck Pain. Yeditepe University Institute of Health Sciences, Department of Physiotherapy and Rehabilitation Master Thesis, Istanbul.

The aim of the study is to examine how pilates exercises alone or in combination with scapular mobilization exercises affect pain, posture, sleep and quality of life in people with neck pain. The study included 20 volunteers(20F;34,05±8,50 years) with chronic mechanical neck pain who frequently exercised at the Simyfit pilates studio (2 or more times per week) and were advised to exercise by a doctor. Between May 2022 and October 2022, our study was conducted in the Simyfit Pilates Studio in Istanbul Ataşehir. The patients were randomly divided into the Experimental Group (EG) (n=10) and the Control Group (CG) (n=10). Individual modified pilates sessions for each participant lasted for six weeks, consisting of 12 sessions, two sessions each week. Evaluations were recorded before starting exercise sessions and after completing 12 sessions. Pain, disability, sleep quality and quality of life were assessed by respectively Visual Analogue Scale (VAS), Neck Disability Index (NDI), Pittsburgh Sleep Quality Index (PSQI) and the SF-12 Quality of Life Assessment Questionnaire. New York Posture Rating System (NYPRS) was used to determine the posture of participants. The primary results of this study comparing two groups, EG and CG, indicated similar improvement in VAS, NDI, NYPRS and PSQI (respectively $p>0.05$, $p>0.05$, $p>0.05$, $p>0.05$). There was a statistically significant difference found between EG and CG in the mental component of the quality of life assessment(MCS-12)($p<0.05$). The findings of the study reported improvement in VAS, NDI NYPRS, PSQI and MCS-12 in EG (respectively $p=0.00$, $p=0.01$, $p=0.00$, $p=0.001$, $p=0.023$). The findings indicated improvement in VAS, NDI NYPRS, PSQI and physical component of the quality of life assessment(PCS-12) in CG (respectively $p=0.00$, $p=0.01$, $p=0.00$, $p=0.001$, $p=0.047$).

Keywords: chronic neck pain, pilates exercises, scapular mobilization

ÖZET

Apo, D. (2022). Boyun Ağrısı Olan Kişilerde Pilates ve Skapula Mobilizasyon Egzersizlerinin Postür, Uyku ve Yaşam Kalitesi Üzerine Etkilerinin Karşılaştırılması. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı Yüksek Lisans Tezi, İstanbul.

Bu çalışmanın amacı, boyun ağrısı olan kişilerde pilates egzersizlerinin tek başına veya skapular mobilizasyon egzersizleri ile birlikte ağrı, postür, uyku ve yaşam kalitesini nasıl etkilediğini incelemektir. Çalışmaya, Simyfit pilates stüdyosunda egzersiz yapan (haftada 2 veya daha fazla) kronik mekanik boyun ağrısı şikayeti olan ve doktor tarafından egzersiz yapması önerilen 20 gönüllü (20K;34,05±8,50 yıl) dahil edilmiştir. Çalışma, Mayıs 2022 – Ekim 2022 tarihleri arasında İstanbul Ataşehir'de bulunan Simyfit Pilates Stüdyosunda gerçekleştirilmiştir. Katılımcılar randomize olarak deney grubu (EG) (n=10) ve kontrol grubu (CG) (n=10) olmak üzere iki gruba ayrıldı. Her katılımcı için bireysel modifiye pilates seansları, her hafta 2 seans olmak üzere 6 hafta boyunca uygulandı ve toplam 12 seanstan oluştu. Değerlendirmeler egzersiz seanslarına başlamadan önce ve 12 seans tamamlandıktan sonra kaydedildi. Ağrı, özürlülük, uyku kalitesi ve yaşam kalitesi sırasıyla Visual Analog Skala (VAS), Boyun Disabilite İndeksi (NDI), Pittsburgh Uyku Kalitesi İndeksi (PSQI) ve SF-12 Yaşam Kalitesi Değerlendirme Anketi ile değerlendirildi. Katılımcıların postürlerini değerlendirmek için New York Postür Derecelendirme Sistemi (NYPRS) kullanıldı. EG ve CG olmak üzere iki grubu karşılaştıran bu çalışmanın ana sonuçları; VAS, NDI, NYPRS ve PSQI'de benzer iyileşme gösterdi (sırasıyla $p>0.05$, $p>0.05$, $p>0.05$, $p>0.05$). Yaşam kalitesi değerlendirmesinin mental bileşeninde EG ile CG arasında istatistiksel olarak anlamlı fark bulundu(MCS-12) ($p<0.05$). Çalışma sonucunda EG'de VAS, NDI NYPRS, PSQI ve MCS-12'de iyileşme bildirildi (sırasıyla $p=0.00$, $p=0.01$, $p=0.00$, $p=0.001$, $p=0.023$). Bulgular, KG'de VAS, NDI NYPRS, PSQI ve yaşam kalitesi değerlendirmesinin fiziksel bileşeninde(PCS-12) iyileşme olduğunu gösterdi (sırasıyla $p=0.00$, $p=0.01$, $p=0.00$, $p=0.001$, $p=0.047$).

Anahtar Kelimeler: kronik boyun ağrısı, pilates egzersizleri, skapular mobilizasyon

1. INTRODUCTION AND PURPOSE

Neck pain (NP), a musculoskeletal disorder with a prevalence of 70% in the population, alters motor and musculoskeletal functions in neck-related areas (1,2). Development or persistence-related risk factors of neck pain; psychological problems, low job satisfaction, occupation, physically demanding work environment, being a woman, genetics, back pain or other existing rheumatological conditions, trauma or previous neck injuries, poor self-assessment, sedentary lifestyle, smoking and headaches. (3,4).

The underlying pathology of mechanical neck pain(MNP) is unknown. Although there may be numerous causes of pain in this region due to the cervical region's greater mobility and susceptibility to damage compared to other sections of the spine, 90% of neck pain is described as having a mechanical origin. MNP is caused by the muscles, joint structures, ligaments, neural and non-neural structures, and intervertebral discs in the neck region (5,6).

Postural abnormalities develop as a secondary complication in people who have chronic neck pain due to improper anatomical structure interaction. The forward head position is recognized as one of the most common posture problems correlated with chronic neck pain (7). Pathologies in the neck extensors, trapezius, and serratus anterior have reportedly been associated with forwarding head posture (8). It is known that the muscles, ligaments, bones and joints of the posterior cervical spine are exposed to increased pressure if the forward posture of the head is maintained, which changes the kinematics and position of the scapula. Studies have indicated that the activation response of the superior part of the trapezius muscle is increased in people with neck disorders, and the activation responses of the inferior part of the trapezius and serratus anterior muscle are decreased. As a result of the studies, it was found that the scapulothoracic region was affected, and the scapular motion was reduced in people with neck pain. (9–11).

Sleep disorders are stated as another problem in chronic musculoskeletal disorders. In the literature, many studies have shown that sleep quality is associated with musculoskeletal problems. However, studies examining the relationship between neck disorders and sleep quality are insufficient (12–14).

The presence of neck pain affects overall health and quality of life. There are many studies examining this relationship. Studies have proven that quality of life concerning health produces poor physical and mental outcomes in individuals with NP (15–18).

A systematic study of neck discomfort incidence, diagnosis and management was carried out in 2015. The management of neck pain is discussed in this review under conservative, injection, and surgical procedures. Studies have looked into complementary and alternative medicine treatments for neck discomfort as a traditional measure (spinal manipulation, acupuncture, massage therapy, exercise therapy, traction, soft collar, electrotherapy, yoga)(19).

The integrity of the mind and body is the goal. There is compelling evidence that spine-strengthening and -stabilizing activities enhance posture, body mechanics, and pain relief. Pilates exercises include those that improve the cervical to sacral regions of the spine's static and dynamic stabilization during functional mobilityNumerous studies demonstrate the effectiveness of pilates exercises when looking at the practices used to alleviate neck discomfort(20–24).

There are studies with evidence value on the effectiveness of mobilization and manipulation techniques in treating neck pain (25). Some studies combined exercise and manual therapy and were effective(26). When studies on neck pain were examined, it was found that a study using the scapular mobilization technique decreased pain severity and improved quality of life (27).

For these reasons, the aim of this study is to examine how pilates exercises alone or in combination with scapular mobilization exercises affect pain, posture, sleep and quality of life in people with neck pain. Two hypotheses of this study were the following:

H0: Pilates exercises combined with scapula mobilization are not more effective on pain, posture, sleep and quality of life of people with neck pain than alone pilates exercises program.
H1: Pilates exercises combined with scapula mobilization are more effective on pain, posture, sleep and quality of life of people with neck pain than alone pilates exercises program.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Anatomy of the Cervical Region

2.1.1. Vertebral Column

Vertebral column; It is separated into five areas: cervical (7 vertebrae), thoracic (12 vertebrae), lumbar (5 vertebrae), sacral (fusion of 5 vertebrae), and coccygeal (fusion of 3-5 vertebrae)(28). The newborn's spinal column has 33 vertebrae and 23 intervertebral discs. The sacrum, which comprises five vertebrae in the sacral area, forms during childhood, as do the coccyx and the four vertebrae that comprise the coccygeal region. There are 26 vertebrae in a fully matured vertebral column (28).

There are three primary purposes for the vertebral column. These serve to give movement to the trunk, promote the body, and safeguard the spinal cord and spinal nerve roots. The vertebral column is a strong, flexible rod with parts that may move forward, backwards, side to side, rotate, and perform combinations of these movements. Additionally, it supports the head and envelops and shields the spinal cord. Numerous muscles and the pelvic girdle are attached to the ribs. The average vertebral column length in men is 71 cm, while it is 61 cm in women (29).

In the sagittal plane, the spinal column is three times curved. The curvature in the cervical region with the opening facing backwards is known as "cervical lordosis," the curvature in the thoracic region with the entrance facing forward is known as "thoracic kyphosis," and the curvature in the lumbar region with the opening facing backwards is known as "lumbar lordosis.". As the infant learns to support and hold the head, the cervical lordosis grows and curves with the head position. Congenital kyphosis affects the thorax. Additionally brought on by weight bearing, lumbar lordosis is influenced by the pelvic and lower extremity positions. A spinal column with normal lumbar, thoracic, and cervical curvatures has a ten times greater capacity to withstand axial loads than a straight bar, claims Kapandji. Thoracic and pelvic regions are the most inflexible, while cervical and lumbar regions are the most movable. The areas with the most mobility and susceptibility to injury are typically the C7-T1, T12-L1, and L5-S1 areas, marking the transition between the curves (28).

The vertebral body and the vertebral arch are the primary areas that make up a typical vertebra (neural arch or posterior arch). The anterior vertebral body has a cylindrical form. The posterior vertebral arch has an atypical form (29).

2.1.2. Cervical Vertebra

The cervical spine is one of the body's most complex articular systems, with 76 different joints. The maximum movement is possible in this part of the spine. Numerous nerves, blood arteries, and other vital tissues surround it. The lower cervical region (craniovertebral region) and the upper cervical region (region of the cervical spine) are the two morphological and functional regions of the cervical region, respectively. The term "typical vertebrae" refers to the lower cervical vertebrae (C3-C6), whereas the term "atypical vertebrae" refers to the upper cervical vertebrae (C1 and C2) and C7 (30).

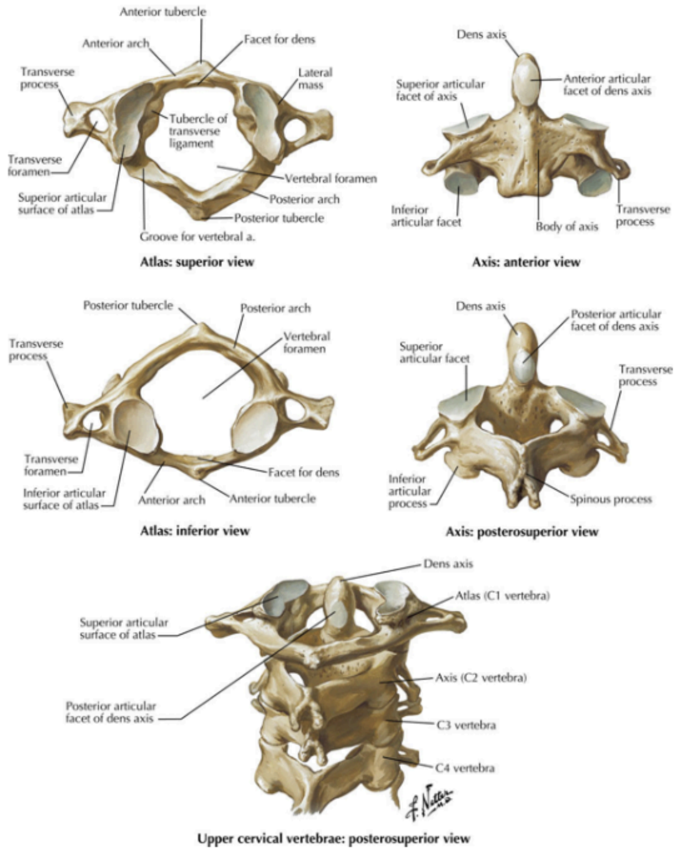


Figure 2.1. Atlas, Axis, and Upper Cervical Vertebrae (33)

Atlas (1st Cervical Vertebra, C1):

The atlas, the first cervical spine vertebra, is the only one without a vertebral body and is ring-shaped. The atlas' transverse processes are long and connected to the muscles that spin the head. Thus, head rotation is made more accessible by the leverage effect (Figure 2.1) (30,31).

Axis (2nd cervical vertebra. C2):

The dens (odontoid process), a component of the axis, extends from the upper face of the body. Robust and highly thick, its lamination. Pedicles are relatively short, and the spine is stout and bifid. Fast transverse processes are used. The lower vertebral notches are fairly deep, whereas the superior vertebral processes are lacking (Figure 2.1) (30).

Five major and five secondary ossification centres form the axis. Two principal centres are in the vertebral arch, two are dense, and one is in the vertebral body. On the anterior aspect of the design, there is an articular facet with hyaline lines. The transverse ligament has created a groove on its posterior surface. This groove on the back of the dens is where the transverse ligament makes the synovial joint. Trochoid (pivot) diarthrodial (synovial) joint is used to describe this complicated joint comprising the anterior and posterior joints between the atlas, odontoid, and transverse ligament. This joint allows the axis to rotate 45 degrees to the left and right. The left and right pedicles of the axis exhibit an apparent asymmetry. The medical-laminar junction is where the top articular processes of the axis meet. As opposed to that, it rests virtually flush with the pedicle. The configuration between C1 and C2 allows for extensive axial rotations (45°) thanks to a flimsy joint capsule at this level (32).

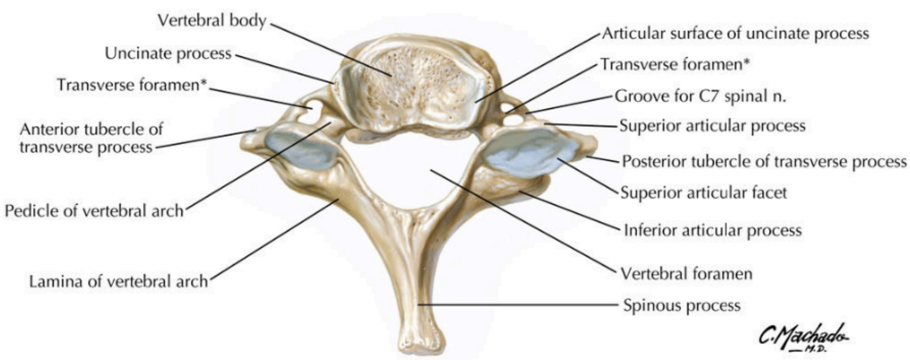


Figure 2.2. Vertebra Prominent (33)

Vertebra Prominens (7th Cervical Vertebra, C7):

Despite being lengthy and horizontal, the spinous process is not bifid. The foramen transversum is a tiny opening through which some varieties of important structures do not pass. Compared to the other cervical vertebrae, the transverse processes' distance from one another is the longest (Figure 2.2) (30).

2.1.3.Cervical Region Joints

2.1.3.1. Upper Cervical Joints

Atlanto-Occipital Joint: It is a joint of the ellipsoid type. It occurs between the occipital condyles and the superior facets of the atlas, which are concave and oriented medially (convex). Antero-posterior occipital membranes and joint capsules connect the occiput and atlas. The joint capsules' postero-lateral portion is thicker in this area, and there are also a few tiny intra-articular fat pads. It has intra-articular fibro adipose menisci and is a synovial joint (34).

Orientation: Almost horizontal.

Joint movements: Flexion, extension, minor lateral flexion, and axial rotation.

At the atlantooccipital joint, the combined flexion-extension angle is 10°-30°, the unilateral lateral flexion angle is 5º, and the unilateral axial rotation angle is 5°.

Atlanto-Axial Joint: It consists of 3 synovial joints, one median, and two lateral.

a) Median Atlanto-Axial Joint

It's a trochoid joint, located between the dens and the atlas. The joint is made up of holes and the structures that surround the caves in a ring. The shelters rotate within the circle that the anterior arch of the atlas creates. The transverse ligament and the anterior arch of the atlas are the two components that make up the ring. The median atlantoaxial joint comprises the oval-shaped hyaline joint cartilage that connects the Atlantic and odontoid processes. This oval articular surface is located horizontally in the atlas and longitudinally in the odontoid process. The design's posterior articular surface is oval and longitudinal, as in the anterior. Synovial fibrous capsules form different joint cavities in the anterior and posterior regions of the median atlantoaxial joint (28).

b) Lateral Atlanto-Axial Joints

Planar-jointed joint. It is situated between the superior facet of the axis and the atlas's inferior facet. It is a synovial joint with meniscoid discs and biconvex articular cartilage.

Axial rotation, flexion, extension, and lateral flexion movements occur within the joint. The atlantoaxial joint is responsible for 55% to 58% of the cervical region's axial rotation. The alar ligaments prohibit this joint from rotating. The atlantoaxial joint's combined flexion-extension angle, the unilateral lateral flexion angle, and the unilateral axial rotation angle are both 20°. In all, Atlas rotates 90° and 45° to one side (34).

2.1.3.2. Lower Cervical Region (C3-C7) Joints

Intervertebral (Symphysis) joints: Intervertebral joints are the joints that occur between the vertebral bodies, including the discs. They are saddle-type joints. Motion occurs in two planes. A small amount of translational movement occurs with rocking (34).

Facet (zygapophyseal) joints: The joints between the inferior facet of the upper vertebra and the superior aspect of the lower vertebra are referred to as facet joints and planar joints. They have fibro-adipose menisci and are synovial joints. Due to the flexibility of the joint capsules, there is an extensive range of motion. It is in charge of 40% of the rotation, from C2-3 to C5-6, flexion and extension rise before decreasing. The process to the same side causes lateral flexion. In the cervical joints, the combined flexion-extension angle is 91°, the unilateral lateral flexion angle is 51°, and the unilateral axial rotation angle is 33° for total normal joint motion (C2-T1) (35).

2.1.4. Ligaments of the Cervical Region

Upper cervical ligaments; The ligaments that attach to the front and sides of the atlas and axis are known as the occiput. The upper and lower cervical ligaments make up the cervical region's ligaments to the articular surfaces on the upper cervical bones (C1-C3); they cannot adequately stabilise the area. Hence the upper cervical ligaments are primarily responsible for the passive stabilization of the site (36–38). Therefore, severe cervical instability is frequently brought on by injury to these ligaments. Lower cervical ligaments are those in the lower cervical area that does not fit the upper cervical ligament description (39,40).

Upper Cervical Ligaments;

1. Posterior Atlanto-Occipital Membrane
2. Tectorial Membrane

3. Accessory Atlanto Axial Ligament
4. Cruciform Ligament
-Transverse Ligament
-Superior Longitudinal Ligament
-Inferior Longitudinal Ligament
5. Alar Ligament
6. Apical Ligament of the Odontoid Process
7. Anterior Atlanto-Occipital Membrane

Lower Cervical Ligaments;
1. Anterior Longitudinal Ligament
2. Posterior Longitudinal Ligament
3. Ligamentum Flavum
4. Interspinous Ligaments
5. Ligamentum Nuchae
6. Intertransverse Ligaments

Except for the anterior longitudinal ligament, every ligament stretches during flexion. The anterior longitudinal ligament is most severely stretched during extension. Also stretched is the anterior atlanto-occipital membrane. The ipsilateral capsular and the contralateral alar ligaments are stretched during axial rotation. The intertransverse ligament and contralateral ligament flavum are strained during lateral flexion (40).

2.1.5. Cervical Intervertebral Discs

The cervical intervertebral discs (IVD) account for more than 25% of the height of the cervical region and, because of their structure, provide a significant range of motion in this area. In contrast to other discs, cervical IVDs have different basic anatomical features (30). While cervical discs have a ring that is not permanently encircling the fibrocartilaginous nucleus, other discs have a fibrous ring that surrounds the gelatinous core. The annulus fibrosus in these discs has a fibrocartilage structure and resembles a crescent when viewed from above. The disc's fibres are denser in the front and thinner in the back. The threads taper toward the uncinate processes laterally. The thick, oblique anterior annulus fibres form an "inverted V" shape. The superior vertebra's axis of rotation is where the tip of this inverted V points. The annulus fibrosus has relatively few vertically arranged fibres and is nearly nonexistent posteriorly and laterally. The posterior longitudinal ligament is the only structure providing postero-lateral protection for the nucleus. There is no IVD between the occiput and the atlas or between the atlas and the axis in the cervical region. The C2-C3 range is where IVD first manifests itself. Therefore, the C3 spinal nerve is the higher nerve most impacted by disc protrusion (41,42).

2.1.6. Muscles of Cervical Region

The muscles that affect the spine are examined in their six layers (Table2.1.). All six layers contain the muscles supporting the cervical and spine areas. In addition, it is also known that the platysma, hyoid, sternocleidomastoid, scalene, and suboccipital muscles all have an impact on the cervical region. Like the table, the muscles are involved in motions that affect the spine (Table 2.2). The muscles of the cervical area can be separated into two functional categories: static and dynamic muscle groups. Using dormant muscles stabilises the head and neck in an upright position against gravity. Instead, dynamic muscles maintain the head erect when the body moves and performs activities like chewing, hearing, and vision. This helps to maintain the cervical spine's position. It stabilizes the head against rotation, acceleration, and deceleration (28,43).

Table2.1. Cervical Muscles by Layers

1st layer	Trapezius
2nd layer	Levator scapula Romboideus major Romboideus minör
3rd layer	Serratus Posterior Superior Serratus Posterior Inferior
4th layer	Splenius Capitis Splenius Service
5th layer	Longissimus Capitis Longissimus Service Spinalis Capitis Spinalis Service

	Iliocostalis Service
6th layer	Semispinalis Service Semispinalis Capitis Multifidus Service Rotatores Service

Table2.2. Cervical Muscles According to Their Movements

Flexion	Lateral Flexion	Extension	Rotation
Sternocleidomastoid	Sternocleidomastoid	Levator Scapula	**To same Side**
Longus Capitis	Scalenus Anterior	Splenius capitis	Splenius Capitis
Longus Colli	Scalenus medius	Splenius Service	Splenius Service
Scalenus Anterior	Scalenus posterior	Longisimus capitis	Longisimus Service
	Splenius Capitis	Longissimus Service	Iliocostalis Service
	Splenius Service	Spinalis Capitis	**On the other side**
	Levator Scapula	Spinalis Service	Sternocleidomastoid
	Longissimus Service	Iliocostalis Service	Semispinalis Service
	Iliocostalis Service	Semispinalis Service	Multifidus
	Semispinalis Service	Semispinalis Capitis	Rotator
	Trapezius	Multifidus	Scalenius Anterior
	Intertransversari	Interspinalis	Trapezius

2.1.7. Cervical Nerves

The meningeal branch, which innervates the local vertebral structures, is given by the cervical spinal nerves when they exit the spinal canal through the neural foramina and divide into the ventral and dorsal rami. The dorsal ramus innervates the facet joints and musculature of the posterior neck, while the ventral ramus creates the cervical nerve. The Cervical Plexus comprises ventral rami from C1 to C4, and the Brachial Plexus contains ventral rami from C5 to T1. The neck extensors in the suboccipital triangle are fully motorized and are located in the posterior ramus of C1. The "Greater Occipital Nerve" refers to the median branch, one of the five branches of the dorsal ramus of C2. By taking components from the dorsal rami, C1-C3 also receives the occipital region's cutaneous feeling and serves as the anatomical source of cervicogenic headaches. The "Third Occipital Nerve" innervates the C2-C3 facet joint and the lower portion of the occiput and is provided by C3 to the dorsal ramus as two distinct median branches. The facet joint and posterior cervical muscles are innervated at their level and a lower level by the posterior rami between C4 and C8 (43).

2.1.8. Neuromuscular Control of the Cervical Region

Cervical neuromuscular control provides mechanical stability that can respond to three-dimensional movement of the head. The cervical region is a dynamic area crucial for supporting and orienting the chair and transferring load to the trunk. The cervical area is vital for mobility and support. Still, it is also crucial for reflex reactions needed for postural stabilization, proprioception, vestibular function, and fixation of the head and eye (44).

One reaction containing receptors in the cervical region is the vestibulocolic reflex, which promotes balance by stabilizing the head concerning the object. It accomplishes this by reflexively contracting the neck muscles in the opposite direction of the spine's disturbance. In reaction to even the slightest head movements in the horizontal plane, it stabilizes the head using information from the semicircular canals, utriculus, and sacculus. The vestibulocolic reflex functions as a stretch reflex in this way. The muscles sternocleidomastoideus, splenius cervicis and capitis, and longus capitis have all been researched about this reflex. Global muscles are the muscles that generate a certain torque and are responsible for completing joint movement. These muscles work physically and cause restriction of movement in spasms and painful situations. Local stabilizer muscles are responsible for segmental control and joint positioning. They work as tonics (45).

Three main muscle groups support the posture and segmental mobility of the vertebral column: the deep neck muscles (longus colli and capitis), the deep neck extensors (semispinalis cervicis and multifidus), and the suboccipital muscles (rectus capitis posterior major & minor and oblique capitis superior & inferior). The deep neck flexors' coordination decreases, the superficial neck flexors become more active, and the deep neck extensors' endurance declines when the motor control of the cervical region is impaired. The suboccipital muscle group plays a crucial role in receiving proprioceptive information. It interacts with the vestibular and visual systems. Controlling craniocervical lordosis and minute head movements depends on these muscles. Sensory-motor loss, diminished kinesthesia, loss of balance, joint position inaccuracy, and loss of oculomotor control all result from function loss. Cervicogenic dizziness could result from these findings. While patients with neck pain experience delayed muscle activation during flexion, delayed muscle activation is seen during postural perturbations. Additionally, this results in decline in endurance (44).

It is well known that individuals with neck pain experience decreased motor control due to delayed muscle activation in the deep and superficial neck flexor muscles, which are involved in pain-related movements of the upper extremities. On the other hand, waited for muscle activity in the semispinalis cervix and multifidus is seen, as well as enhanced activation in the superficial neck extensor. The central nervous system, which controls this region, is allegedly affected because the feedforward mechanism is inefficient, especially in the longus colli and longus capitis muscles. Muscle atrophy has been observed in the anterior sternocleidomastoid, longus colli, and omohyoid muscles, as well as the posterior rectus capitis and splenius capitis muscles, in muscle biopsies done on neck pain patients. The sternocleidomastoid, anterior scalene, and upper trapezius muscles have been shown to have increased isometric contraction in electromyography(EMG) investigations. Pain, decreased brain input, proprioceptive loss, and reduced motor control are the causes of this. In this situation, there is a decrease in long-term chronic weakness, maximal muscle strength and contraction, endurance, decision-making during movement, and regaining posture (46,47).

2.2. Scapulothoracic Joint

The muscles on the anterior surface of the scapula and the posterior thorax form a physiological joint known as the scapulothoracic joint, which lacks a fundamental joint characteristic(48). The scapular plane refers to the scapula's resting position with its internal rotation at 30°–45°, 10°–20° upward trajectory, and 10°–20° anterior tilt. The sternoclavicular joint and the acromioclavicular joint work together to move the scapula. The scapula rotates up and down, tilts anteriorly and posteriorly, and rotates internally and externally when the shoulder is raised (49).

The scapula's primary functions are to provide a secure base for the muscles around the shoulder during shoulder motions, contribute to the degree of shoulder elevation, and ensure the most excellent possible harmony between the humeral head and the glenoid fossa. The muscles around the scapula must coordinate and contribute to the most significant amount of movement and stabilization to carry out all of these functions (50). Scapular stabilization is accomplished by compression of the muscles between the scapula and the thorax, which is accomplished by pushing the scapula to the thorax, and by the muscles between the vertebrae and the scapula, which is achieved by dragging the scapula towards the vertebrae (51).

Glenohumeral rhythm is produced by a healthy scapula moving in unison with the glenohumeral joint when the shoulder is moved. The glenohumeral (GH) joint and scapula move together during shoulder movements, forming the GH rhythm. During humerothoracic elevation, a normal scapula is in the scapular plane and has a range of motion of around 50° upward rotation, 30° posterior tilt, and 24° external wheel average; there are 500 upward rotations, 240 external rotations, and 300 rear tilt movements in the scapula along the humerothoracic elevation movement (52).

2.3. Chronic Neck Pain

With a point incidence of between 10% and 22% in the general population, neck discomfort is one of the most often reported musculoskeletal problems. Its lifetime prevalence ranges between 67 and 71 per cent. These findings indicate that almost 2/3 of the population will experience neck discomfort at some point. 10% of men and 17% of women experience chronic neck pain, which tends to become persistent. Neck pain significantly lowers productivity and increases the cost of care (53,54).

Pain and stiffness dorsal to the area between the occipital condyles and the C7 vertebra are frequent symptoms of neck pain. Pain is accompanied by pain in the shoulders, upper thorax, and occipital area. Individuals might not show any clinical signs of nerve root discomfort or compression. Additionally, it may be related to anterior chest, arm, and dorsal spine discomfort with a myotomal pattern (55,56).

Neck pain can be categorized in a variety of ways, such as severity, aetiology/structure, duration (acute, six weeks; subacute, ≤3 months; chronic, > three months), and kind (i.e. mechanical and neuropathic). The best outcome predictor among the various categorization schemes is probably time. A shorter duration has been discovered to be connected with a better prognosis than protracted pain for multiple treatments. The findings of cohort studies, which showed that overall, more significant disease load (such as higher baseline pain scores and disability) predicted worse outcomes for spinal pain, are consistent with the relationship between prolonged pain duration and worse prognosis (57).

Additionally, neck pain can be categorised as mechanical, neuropathic, or related to another condition based on the underlying mechanisms (such as referred pain from the heart or vascular pathology). Mechanical pain is a soreness that develops in the muscles and ligaments that support the spine or in the spine itself. Common manifestations of mechanical pain include myofascial pain, discogenic pain, and pain from the facet joints (such as arthritis). Neuropathic pain primarily describes discomfort brought on by diseases or injuries to the peripheral nervous system, typically including mechanical or chemical irritation of the nerve roots. Herniated discs, osteophytes, and radicular sensations from spinal stenosis are the most typical causes of peripheral neuropathic pain. Myelopathy or spinal cord pathology symptoms are examples of central neuropathic pain. Postlaminectomy (failed neck surgery) syndrome and degenerative discs that cause a mixture of mechanical pain from annular rupture and radicular symptoms from herniated nucleus pulposus are examples of mixed neuropathic-nociceptive pain disorders. The most crucial clinical distinction is probably separating neuropathic pain from mechanical pain because it affects how treatments are chosen at all levels (e.g., which drugs, injections, or surgical procedures) (19).

The term "mechanical neck pain" refers to the discomfort that does not have a specific pathology, such as an underlying neurological condition, tumour, or inflammation, and that develops in the cervical, occipital, or posterior scapular regions of the neck (58,59). The issue, whose mechanism and causation are not fully understood, is primarily brought on by biomechanical problems. The symptoms typically worsen with cervical motions, remaining in one posture for an extended period, and muscle palpation (60). Only 36% of the population could get rid of the pain, even if neck pain began immediately. It was found that 37% of the patients remained to experience discomfort without it changing. In some cases, the pain even increased, even if the conditions of the remaining 32% of the patients slightly improved (61).

2.3.1. Causes and Risk Factors For Chronic Neck Pain

People with chronic and mechanical neck pain show decreased strength and endurance in the deep group of the cervical flexors and extensors (62). These muscles also exhibit low and delayed muscular activation during cervical motions and are insufficient to control posture. Additionally, the cross-sectional area of the deep cervical extensors decreases in people with neck pain (63). Along with neck pain, changes in muscle fibre types also occur; in the deep group muscles, there are fewer Type-1 and more Type-2 fibres (64). In this situation, the muscles' resistance to exhaustion weakens due to the loss of their tonic qualities, and they cannot govern posture. On the other hand, the superficial cervical group muscles exhibit an increase in tone, which leads to muscle spasms, an increase in EMG activity, and the potential for trigger points in the power (65).

A variety of circumstances can cause neck discomfort. Neck pain-causing pathologies frequently seen in clinics include whiplash injury, myofascial pain syndrome, Klippel-Fiel syndrome, thoracic outlet syndrome, torticollis, cervical sprain, cervical strain, rheumatic diseases, malignancies, inflammatory diseases (55).

In the general population, it significantly impacts women more than men. Neck discomfort has been linked to several factors, including divorce, a large family, a history of low back or neck pain, trauma, poor general health, smoking, obesity, low socioeconomic status, and psychological stress (19).

Environmental factors have been recognized as risk factors for neck pain in the workplace, including long periods of forward neck flexion, working while seated, performing repetitive motions, temperature variations, and computer work (66).

2.3.2. Diagnosis and Evaluation

Neck discomfort is typically diagnosed using radiological imaging techniques like computed tomography (CT), magnetic resonance imaging (MRI), and myelography.

Radiological techniques: On anterior, posterior, lateral, and oblique radiographs, attempts are made to visualize changes in the cervical region. Disc gaps exist between the vertebrae, variations in the cervical lordosis, osteophytes, pedicles, foramen stenosis, listening uncovertebral joints, and facet joints. Direct radiography cannot provide information about neural tissues (67).

CT: The cross-sectional anatomy of the cervical region's bones and soft tissues is functional (67).

MRI: This non-invasive method demonstrates how different soft tissue and bone are. As a result, it provides details on the bone, bone marrow, disc, spinal cord, and nerve root (67).

Myelography is a helpful method for evaluating nerve roots and thecal compressions (67).

There are different evaluation methods for developing symptoms of people with chronic neck pain. A good evaluation is very important for the proper treatment approach.

History: It should include the patient's diagnosis, primary complaints, duration, history, medications, and risk factors for neck pain (gender, age, body mass index, mechanism of injury, employment, smoking, alcohol, and sports habits) (67,68).

Posture Analysis: It includes examining the patient with neck pain, especially the head, neck, shoulder girdle, and scapula position from anterior, posterior and lateral(67).

Palpation: It provides information about muscle spasms, tight bands, trigger points, tenderness, and joint dysfunction, which indicate the source of the pathology. Areas where palpation is recommended, especially in neck pain, are C2 and C7 spinous process, mastoid process, temporomandibular joints, SCM, trapezius, levator scapula, and scalene muscles (67).

Pain Assessment: Pain is a viral sensation that affects the patient's function. Localization of pain, type, duration, severity, factors that increase and decrease pain, pain threshold, and tolerance are recorded. One-dimensional or multi-dimensional scales can be preferred to evaluate the severity of pain. One-dimensional scales are Visual Analog Scale (VAS), Pain Thermometer, Verbal Category, and Numerical Scales (69,70).

Evaluation of Joint Movements: Cervical region regular joint movements (NEH) are essential for many daily activities (71). It is necessary to evaluate NEH in all planes and a particular order, leaving the most painful movements for last. There are various measurement methods in the evaluation of cervical region NEH. These are clinical goniometer, gravity goniometer, CROM (cervical range of motion) device, digital inclinometer, radiological methods, and three-dimensional analysis systems. A clinical goniometer is frequently preferred in clinics due to its practicality, cheapness, and easy accessibility (72).

Evaluation of Muscle Strength and Endurance: Muscle strength is assessed using a variety of techniques, including manual muscle testing, hand dynamometers, isokinetic dynamometers, and electromyography. The endurance of the neck muscles is assessed by recording the time that the force can maintain its contraction (73).

Evaluation of Nerve Root Findings: In cases of neurological involvement, sensory, motor, and reflexes should be evaluated in areas innervated by the nerve (74).

Proprioception Evaluation: One of the main reasons why people with CNP lose their sense of proprioception is pain. Proprioception is assessed with tests using angle retargeting. The user must actively or passively recreate the curves to position the joint at a particular angle. There is no universal agreement on how angle retargeting tests should be carried out, even though numerous studies have examined the proprioception of the cervical region. There are several ways to analyze angles in the repeating joints construction of figure eight, the figure of eight movements, the defined trunk rotation, and the head in a neutral position are all evaluation forms used in the literatüre (75–77).

Special Tests: In evaluating the cervical region, tests that provide the emergence or reduction of symptoms can be used. Tests frequently used in the clinic; Spurling Test, L'hermitte Sign, Valsalva Test, Compression Test, and Distraction Test (78).

2.3.3. Treatment

The correct diagnosis is crucial to setting up the treatment program because there are numerous causes of neck discomfort. Because each treatment is different, acute and chronic neck pain should be recognized from one another. In the critical stage, the primary goals are to preserve the injured area, reduce inflammation and edema, mobilize the injured area quickly, gradually resume weight bearing after a brief break, reduce pain, and implement the exercise program with patient education. During the chronic phase, the primary goals are to provide a painless full range of motion, balance, endurance, and proprioception, as well as to prevent the damage from returning and worsening (79,80).

The primary strategy for treating neck pain is conservative medicine. The parts of this treatment that are most frequently used include physical therapy and rehabilitation techniques (81). These include manual therapy, exercise methods, traction, support devices, patient education and safety precautions, heat agents, electrotherapy modalities, and support devices (82). Additionally, conservative techniques include pharmacological therapies such as analgesics, myorelaxants, anticonvulsants, and antidepressants (83). Additionally, there are various surgical treatment options available if there is neurogenic bowel or bladder dysfunction, deterioration of neurological functioning, or pain that does not respond to non-surgical treatments (84).

Upper extremity muscles and deep spinal postural muscles both lose strength and stabilization. By diminishing postural stability, this circumstance promotes impairment. Patient quality of life and physical activity are negatively impacted as a result. Regaining the patients' diminished physical abilities is crucial since it helps them resume their normal daily activities. Deep flexor muscle endurance activities, scapular exercises, neck and shoulder muscular belt stretching and strengthening exercises, and postural training are all critical for people with chronic neck pain who are the focus of a conservative approach. These applications are successful in reducing pain and dysfunction (20).

Education and Protective Interventions: It entails neck training, physical activity, ergonomic measures, and risk factor reduction. Therapeutic patient education is described by the World Health Organization as instruction that aids individuals in acquiring and maintaining the skills required to live their lives to the fullest. It is intended to promote patient independence in managing acute and chronic neck pain through patient education (85,86). Patient education includes suggestions for physical activity, posture training, early return to daily activities, range-of-motion exercises, painkillers such as heat, cold, and analgesics, coping mechanisms for pain and stress, job ergonomics, and lowering risk factors. Anatomy, biomechanics, activity training, and exercise regimens are all included in neck schools (86–88).

Heat Modalities: There are two categories: cold application and hot application. Cruelty treatment decreases metabolic activity and nerve conduction velocity in the acute phase, ends spasms and lessens discomfort and oedema. You can leave it on for 12 to 15 minutes. This treatment can be applied using cold gel packs, ice massages, cold compresses, and cold sprays. Increased circulation, metabolic activity, collagen tissue flexibility, and a reduction in muscle spasms are all benefits of hot application (80,89,90). Commonly utilized superficial heat treatments for neck issues include hot packs and infrared rays. Hot packs can be used for 20 to 30 minutes, and infrared light from 50 to 75 cm away can be used for 15 to 30 minutes. Deep heating techniques are frequently utilized, including ultrasound microwave diathermy and shortwave diathermy (89,90).

Electrotherapy: Galvanic current, iontophoresis, interference current, electromagnetic field therapy, neuromuscular stimulation and transcutaneous electrical stimulation (TENS) are used to treat pain. TENS therapy, which is often preferred, is used to treat both acute and chronic pain. In addition to promoting blood flow and relieving tense muscles through muscular stimulation, it inhibits pain by engaging spinal and supraspinal processes (91).

Laser: Laser rays are light rays enlarged by radiation excitation. Low-intensity lasers are often utilized in physical therapy for painful musculoskeletal disorders since they have no heat effect. Helium-Neon (HeNe wavelength 632.8 nm, tissue penetration 0.8 mm), Gallium-Arsenic (GaAs wavelength 904 nm, penetration 5 cm), and Gallium-Aluminum-Arsenic are the three main varieties that are typically utilized in clinics (GaAlAs waveform). 830 nm in length, 2-3 cm of penetration. Gallium-Arsenic (GaAs) laser is the most commonly used laser type because it has analgesic and anti-inflammatory properties. Laser therapy increases collagen production, vascularity, mitochondrial activity, and pain threshold, while also eliminating proinflammatory mediators. (55,57).

Biofeedback: By showing visual and aural cues, biofeedback therapy aims to restore average physiological performance to muscles that, in some sections of the body, lack sufficient functional power. Neck and low back pain have been successfully treated with electromyography-biofeedback, and the muscles have been retrained (79,80).

Traction: It is used to reduce pressure on nerve roots and discs, distract cervical joints, shift facet joints, enlarge the intervertebral foramen, and relieve pain and muscle spasms. It is not advised in tumours, infection, osteoporosis, subluxation, vascular compression problems, myelopathy, pregnancy, or uncontrolled hypertension. While traction is being given, it is advised that the neck is in a 30° flexion position. 10% of the person's weight should be used as the traction force. The paravertebral muscles and intervertebral ligaments are stretched by traction, and the neural for omens are dilated (79).

Supportive Devices: Although rigid orthoses, particularly in acute neck pain, seem useful for radicular or facet joint discomfort by maintaining the neck neutral or slightly flexed, they should not be worn for more than 1-2 weeks. Through sensory feedback, soft orthoses prevent abrupt and forceful neck motions; they limit neck flexion and extension by 26%. Both acute and subacute circumstances call for their use (80).

Exercise Therapy: Patients with neck pain can benefit from stretching, strengthening, posture, stabilization, proprioception, relaxation, and aerobic and joint mobility exercises. Early on, specific activities should be advised when the discomfort is the worst. During these times, performing the suggested exercises helps to hydrate the area and ease neck pain. Practices that support the spine by engaging the stabilizer muscles and aid in posture improvement by raising kinesthetic awareness have recently been advocated. Simple movements are followed by more sophisticated ones (90,92,93).

Manual Therapy: Its Greek translation is "manual therapy." It encompasses both therapeutic and diagnostic methods. It is mainly employed in the management of functional problems and musculoskeletal injuries. Manual treatment techniques are divided into two groups: soft tissue and joint mobilization techniques. Pain relief, joint and tissue mobility, inhibition of sympathetic reflex activity, normalization of muscle tone by lowering gamma-motor neuron activity, reduction of adrenaline release, relaxation of myofibroblasts, dissolution of adhesions, and peripheral sensory normalization are all goals of manual therapy. It is utilized to stifle inflammatory reactions and inhibit activity. A manual treatment technique called joint mobilization involves regularly repeating natural joint movements that are within physiological bounds. The Cyriax, Mennell, Maitland, Kaltenborn, and Mulligan procedures are frequently utilized for assessment and treatment. Spinal cord tumours, vascular diseases, fractures, osteoporosis, and rheumatoid arthritis should not be treated with these approaches (80,94,95).

2.4. Pilates

2.4.1. History of Pilates

In 1880, Joseph Hubertus Pilates was born in Germany. In order to enhance his health, he trained karate, boxing, yoga, and gymnastics. He began to create his "contrology" exercise program, which integrated Eastern and Western concepts (96).

When World War I started, Pilates and other Germans were imprisoned in an English prison camp for the duration of the conflict. The Spanish influenza pandemic occurred after the war. However, no prisoner or guardian died as a result of the disease in the prison camp. Everyone at the centre was required to perform his exercises. He continued improving his exercise routine at the centre and soon started instructing the guards and another inmate (97,98).

At this point, Pilates started using mattress springs to assist his fellow soldiers confined to beds. He attached the springs to the bedside tables so the prisoners could practice against or with assistance as needed (98).

Pilates exercises consist of two types of exercise systems: matwork pilates exercises and equipment-based pilates exercises (reformer pilates exercises). Matwork pilates exercises, which consist of exercises performed on the mat, are more known. The equipment-based pilates exercise system consists of a cadillac or trapeze table, a chair or wunda chair, a reformer, a barrel, and a spine corrector. In equipment-based pilates, spring resistance are used, allowing persons to support or oppose a workout (98).

2.4.2. Principles of Pilates

Concentration: One must concentrate mentally on the specific body part addressed during Pilates movements. One actively engages their mind while moving and visualizes the subsequent action instead of simply moving through the motions. The signal quality improves with increased movement awareness (96).

Control: Pilates movements require complete body control when appropriately done to reduce forces that cause injury and strengthen the mind-body connection. The workouts involve stretching, breathing, and concentration. Once the exercises have been learned at conscious and subconscious levels, the movements will become fluid and graceful (98,99).

Centering: The "core" was referred to as the "powerhouse" by Joseph Pilates. He thought that the fundamental component of all human movement was core control. Learning how to use the powerhouse properly can enhance movement quality, improve posture, and stabilize the spine, all of which contribute to a trimmer and flatter midsection. The lumbopelvic hip complex makes up the core (98,99).

The abdominal-hollowing exercise is recommended as the most effective approach to activate the deep abdominal muscles. This maneuver could be challenging to execute. Practitioners can use verbal and tactile cues to convey feedback (100,101).

Flow: As one exercise flows into the next, the flow of pilates movements might be likened to a dancing class. Activities are carried out without jerky motions and are fluid (102).

Precision: Pilates workouts should focus on quality over quantity. Instead of performing the exercises for a set number of repetitions, one acts them as many times as they can be done correctly. One might even need to perform a modified version of the exercise until one gains strength. Pilates' precision necessitates complete body control (103).

Breathing: During the activity, proper breathing is crucial. It is believed that breathing stimulates core stability. Although each Pilates practitioner may have their breathing method, most adopt a diaphragmatic style. One hand is placed on the sternum, and the other hand over the diaphragm to examine and observe one's breathing (102).

Relaxation: Pilates exercises need one body area to be worked while another is relaxed.This aids in reducing unneeded tension. For instance, clients might exercise the powerhouse while attempting to unwind and reduce stress on their shoulders (103).

Stamina: The core and the small stabilizing muscles get stronger and more resilient throughout pilates exercises. Clients will train for endurance by continually pushing these muscles during all activities. In core training, muscle endurance is more crucial than pure muscle strength since deep spinal stabilizers are always in operation (104).

2.4.3 Modified Pilates Exercises

Up until the 1980s, Pilates exercises were often popular among dancers. In the 2000s, the Australian Physiotherapy and Pilates Institute (APPI) changed these exercises and converted them into therapeutic tools. With these modified movements, traditional pilates' neuromuscular burden has been decreased. The lumbopelvic stabilizing muscles are activated during Modified Pilates, as are the scapula-thoracic stability, proper thoracic alignment, and lateral costal respiration. Pilates encourages a neutral cervical spine position with upper cervical flexion at the craniocervical area, which activates the deep neck flexor muscles. The principles of modified pilates exercises are similar to classical pilates. These principles are; centering, control, flow, breathing, concentration, precision, routine, integrated isolation (105,106).

Exercises in modified pilates are those designed to promote the integrity of the mind and body. The trunk muscles are first targeted in a fairly light yet challenging pattern during the exercises. More challenging activities are introduced once people's trunks have stabilized. The risk of harm decreases with time as body awareness advances. Pilates movements must be performed on a mat using only body weight, or they can be achieved with a variety of equipment that makes some of the exercises easier and others more challenging (107).

Balance, flexibility, pain reduction, and injury prevention are all enhanced by pilates exercises. Pilates has reportedly been shown to elevate mood and boost alertness (108,109).

3. MATERIALS AND METHODS

3.1. Subjects

The study sample was formed of patients with mechanical neck pain for three months who were advised to exercise by a doctor. Between May 2022 and October 2022, the study was conducted in the Simyfit Pilates Studio in Istanbul Ataşehir.

The study involved 20 patients with mechanical neck pain (20F;34,05±8,50 years). The patients who fulfilled the inclusion criteria were divided into two distinct groups Experimental Group (EG) and the Control Group (CG).

3.1.1. Inclusion Criteria

- Being between 18-50 years old
- Having neck pain that has been going on for at least three months
- Having a VAS score of 3 or more
- Not having surgery in the last three months
- Being diagnosed with mechanical neck pain by a doctor
- Being advised to exercise by a doctor
- Participating voluntarily in research

3.1.2. Exclusion Criteria

- Having had chiropractic, massage, or physical therapy within the last three months
- Presence of musculoskeletal injury requiring treatment in the last two months
- Having undergone surgery involving the spinal cord or that area
- History of traumatic fracture or dislocation of the spine
- Having been diagnosed with cervical hernia, neuropathy, whiplash
- Cervical radiculopathy and myelopathy symptoms (numbness, tingling, weakness)
- Cervical stenosis
- Cervical spondylosis
- Rheumatic or myopathic diseases
- Fibromyalgia
- Cardiovascular disease
- Unstable hipertension
- Having a vestibular or respiratory problem

- Having cognitive
- Diabetes
- Attending sessions or using any medication that affects balance
- Having scoliosis
- Osteopenia or Osteoporosis
- Not following the sessions regularly
- Pregnancy

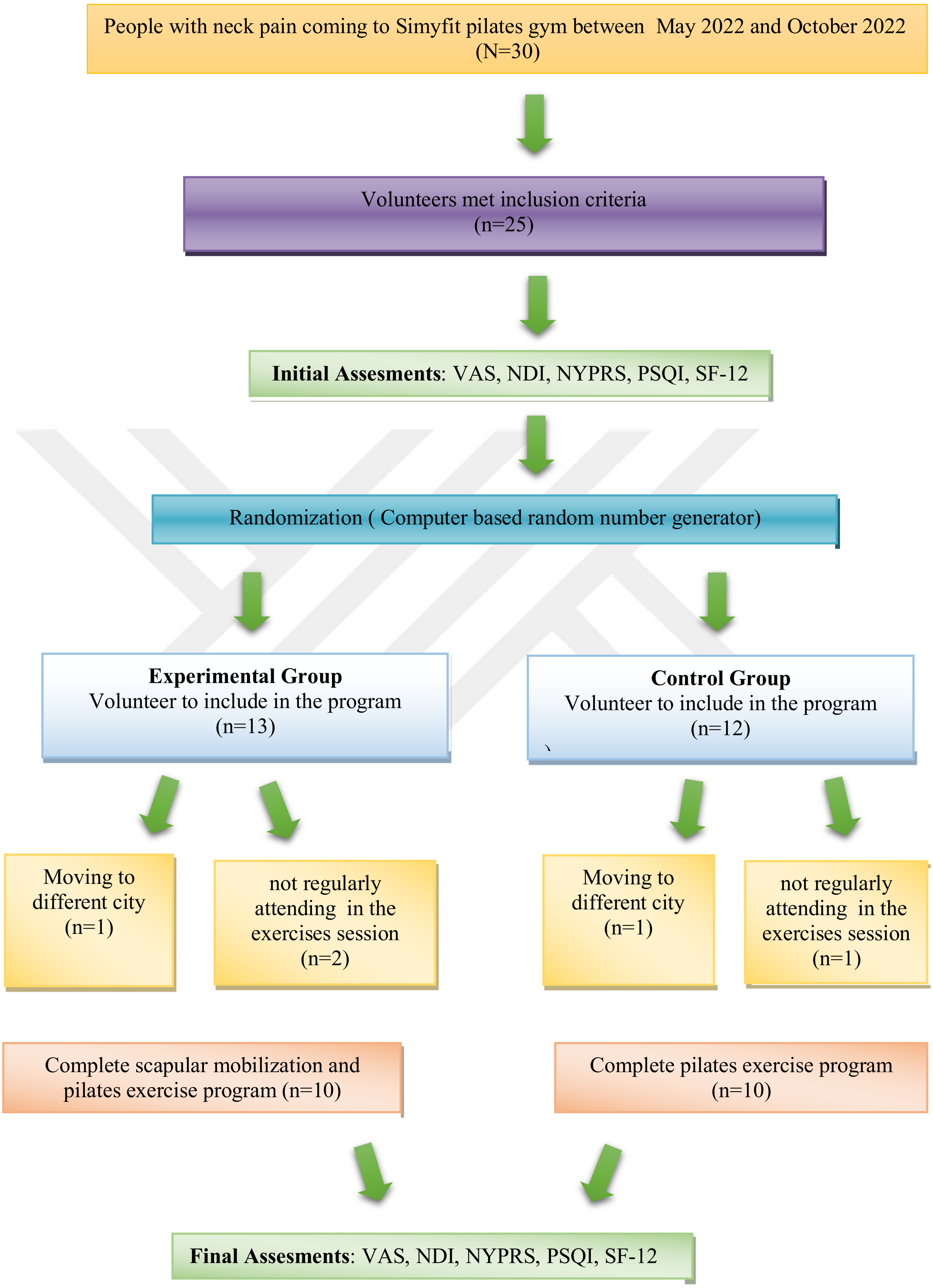
The study was evaluated as the application numbered 202203Y0222 at the 08.04.2022 meeting of the Yeditepe University Non-Interventional Clinical Research Ethics Committee, and approval was obtained (APPENDIX 1). The participants included in the study were informed, and the content of the study was described. The participants read the Informed Voluntary Consent form, and their signatures and approvals were obtained (APPENDIX 2).

3.1.3. Flow Chart: Study Process

A total of 20 people with neck pain for the EG and CG were included in the study according to the inclusion criteria. We questioned the people about their willingness to volunteer for our study. Participants who met the inclusion criteria (n=25) were included in our study. After initial assessments, subjects were randomly assigned to the Experimental Group (EG) (n=13) or the Control Group (CG) (n=12).

We excluded one of the participants who moved to another city; 2 of them were not regularly attending in the exercises session from EG. Moreover, we excluded one of the volunteers because one of them moved to another town and were not regularly participate in the exercises session from CG.

Table3.1: Flow Chart of Study



VAS: Visual Analog Scale, NDI: Neck Disability Index, PSQI: Pittsburgh Sleep Quality Index, SF-12:Quality of Life Assessment Questionnaire, NYPRS: New York Posture Rating System

3.1.4. Study Protocol

All participants were involved modified pilates exercise program, which is arranged according to The Australian Physiotherapy and Pilates Institute (APPI) criteria. The exercises were different from classical pilates; personalized and modified pilates exercises were performed by a physiotherapist. The evaluations and exercise sessions of the participants consisted of individual sessions. The pilates exercise program was involved twice-weekly sessions in a pilates studio with a physiotherapist for six weeks. No pre-application was done, and each pilates session lasted about 45 to 50 minutes. Scapula mobilization was performed by the physiotherapist while the participant was in the side-lying position. It was performed in ten sets, ten times each, in the medial-lateral, superior-inferior, and circumduction directions by grasping the superior border, inferior border, and medial border of the scapula.

Additionally, the experimental group (EG) participated in scapular mobilization combined with pilates exercises, as explained above. Physiotherapist performed scapular mobilization after each pilates exercise session. The Pilates exercise program consisted of exercises that hip twist exercise, shoulder bridge, a hundred exercises, scissors exercise, double-leg stretches, breaststroke exercise, swan diving exercise, arms opening exercise and spine rotation during six sessions. Reformer pilates exercises that consisted of footwork series, supine leg series and pulling straps exercise were added to the pilates exexercise program for the last six sessions. Each exercise was done with 8 to 12 repetitions depending on the participant's level of physical fitness.

Table 3.2: Interventions of Experimental Group and Control Group

EXPERIMENAL GROUP	CONTROL GROUP
Modified Pilates Exercises 2days/week for the duration 6 week	**Modified Pilates Exercises** 2days/week for the duration 6 week
Scapular Mobilization 10 repetition for 10 sets after each pilates exercise session	

3.2. Evaluation

3.2.1. Structured Questionnaire

A participant evaluation form containing sociodemographic data was used to determine if a person met the inclusion and exclusion criteria before enrollment in the study. There are questions on age, gender, height, weight, education level, occupation and marital status in the first section of the questionnaire. The second section of the survey focused on daily posture, sitting time at a desk, standing time, and exercise habits (APPENDIX 3).

3.2.2. Assessment of Pain

3.2.2.1. Visual Analogue Scale

The visual analogue scale (VAS) asks participants to rate the severity of their discomfort either at rest or during an activity on a scale from 0 to 10. The pain scale ranges from 0 (no pain) to 10 (extreme pain) (APPENDIX 4).

3.2.2.2. Neck Disability Index

The Neck Disability Index (NDI) gives insight into how discomfort interferes with a person's ability to carry out daily tasks. Divides neck discomfort into ten subheadings and evaluates it with ten questions. Pain severity, personal care (getting dressed and cleaning), weightlifting, reading, headaches, concentration, work, driving, sleeping, and leisure activities are some of these categories. Kesiktaş et al.'s validity and reliability analysis of the NDI in Turkey was created in 2012. The Turkish version of the NDI has an intra-class correlation coefficient (ICC) of 0.92 (APPENDIX 5) (110).

3.2.3. Evaluation of Posture

The New York Posture Rating System was used to determine whether a person's body components are aligned correctly or incorrectly when standing in an anatomical posture. NYAPRS evaluated the person's posture as 13 body parts, posterior and lateral side. The scoring of the test is as follows; A score of 5 is given if the person has a proper posture, 3 points if there is a moderate impairment, and 1 point if there is a severe disorder. Scores for whole-body alignment are added up and rated from 13 to 65. The overall score for this evaluation was calculated as follows: >45 "excellent," 40-44 "good," 30-39 "moderate," 20-29 "bad," and 19 "poor posture" (APPENDIX 6) (111).

3.2.4. Evaluation of Sleep Quality

The Pittsburgh Sleep Quality Index is a retrospective tool for evaluating the previous month's sleep quality and any sleep disorders. It distinguishes between excellent and bad sleep quality and helps in providing a rapid clinical assessment of various sleep disorders. There are 24 questions in this evaluation questionnaire. Nineteen of these questions are planned for self-evaluation. 5 of these are questions for a roommate or partner. In this study, 19 questions were used for self-assessment. The answers to 19 questions were used to assess the subject's level of sleepiness as well as the frequency and severity of various sleep issues. This questionnaire was used in previous studies on neck pain and sleep quality. Aargün et al. conducted validity and reliability studies on the scale in Turkey in 1996, and the scale's Cronbach's alpha internal consistency coefficient was discovered to be 0.804 (APPENDIX 7) (112,113).

3.2.5. Evaluation of Quality of Life

The SF-12 Quality of Life Assessment Questionnaire, a condensed version of the SF-36, measures the quality of life. Only a third of the original 36 objects are still present. The physical functionality, the physical part, the emotional component, and the mental health subscales are represented by two questions. The body pain, general health, vitality, and social functionality subscales are defined by one question each. Physical well-being (Physical Component Summary) and mental well-being are calculated as two summary scales (Mental Component Summary). Soylu et al. carried out the validity and reliability analysis of the scale in Turkish. They were manufactured in 2020. The Physical Component Summary (PCS-12) was found to have a Cronbach's alpha internal consistency coefficient of 0.72, while the Mental Component Summary (MCS-12) had one of 0.73 (APPENDIX 8) (114–116).

3.3. Interventions

The participants who fulfilled the inclusion criteria were involved in either EG or CG. All volunteers were evaluated in terms of pain, disability, posture, sleep quality and quality of life after that the participants performed pilates exercises program regardless of their group. Furthermore; the scapula mobilization was applied to EG.

3.3.1. Pilates Exercise Program

Depending on each participant's level of physical fitness, the exercises had 8 to 12 repetitions. Each exercise was done in only 1 set. Before beginning the exercises, the participant was positioned correctly and instructed on how to align their spine.

After six sessions, the levels of some exercises were increased, and some reformer pilates exercises were added.

Exercise regimen: It was determined according to the Australian Institute of Physiotherapy and Pilates (APPI) (107,117). The modified pilates exercise program was developed based on pilates exercises used in previous studies (118–123). The following exercises were performed on the pilates mat throughout the first three weeks (6 sessions):

1. **Hip Twist Exercise Level 1 and Level 2**

Figure 3.1. Hip Twist Exercise Level 1

Level 1: The participant was placed on her back with knees flexed, and one knee was slowly pulled away from the body while breathing. Any movement in the other stabilized knee was carefully avoided (Figure 3.1) (107).

Figure 3.2. Hip Twist Exercise Level 2

Level 2: The exercise was initiated in the supine position with the knees bent and the arms abducted at either side. Head turned to one side, and legs turned to the opposite. The stabilization of the participant's shoulders was preserved. The exercise was done for both sides (Figure 3.2) (107).

2. **Shoulder Bridge Exercise Level 1 and Level 2**

Figure 3.3. Shoulder Bridge Exercise Level 1

Level 1: The activity was initiated with the knees flexed while reclining. Between the knees was placed a tiny towel or the ball. The participant was prepared to inhale, pushing their lower back to the ground as they exhaled and lifting their vertebrae one at a time until at shoulder level. The participant was asked to inhale and exhale in this position. The vertebrae were returned to their original positions while being lowered to the ground one at a time (Figure 3.3) (107).

Figure 3.4. Shoulder Bridge Exercise Level 2

Level 2: The exercise was initiated with the knees flexed while supine. Between the knees was placed a tiny towel or the ball. A deep breath was taken, and while exhaling, the lower back was pushed to the floor and passed over the shoulders so that each vertebra rose separately from the ground. In this position, one leg was extended forward while being breathed in and out. After participants are inhaled and exhaled while holding this position, their legs will return to their original position. The vertebrae are then individually lowered to the ground and placed back in their original positions. Both legs were used in the exercise (Figure 3.4) (107).

3. Hundred Exercise Level 1 and Level 2

Figure 3.5. Hundred Exercise Level 1

Level 1: The knees were flexed, and the arms were raised at shoulder height parallel to the floor while the body was supine. The arms were raised and lowered by 2-3 cm in this position. Five inhales and five exhales were counted for each downward movement. There were 100 numbers produced in all (Figure 3.5) (107).

Figure 3.6. Hundred Exercise Level 2

Level 2: The exercise was initiated with the knees flexed while supine. Legs were slowly brought into table position one by one. The arms were moved up and down with the breath, like in level 1, after being raised parallel to the ground at shoulder height. There were 100 numbers produced in all. The motion was repeated with both legs (Figure 3.6) (107).

4. Scissors Exercise Levels 1 and Level 2

Figure 3.7. Scissors Exercise Level 1

Level 1: The activity was initiated with the knees flexed while reclining. One leg was raised to the position of a table while breathing in and out. The leg was dropped to the floor while inhaling and exhaling while in this position. The motion was repeated with each leg (Figure 3.7) (107).

Figure3.8. Scissors Exercise Level 2

Level 2: The exercise was initiated with the knees flexed while supine. The legs were raised one by one to the table position while inhaling and exhaling. One leg touched the mat and was brought back to the table position with each inhalation and exhalation (Figure 3.8) (107).

5. Double-Leg Stretches at Level 1 and Level 2

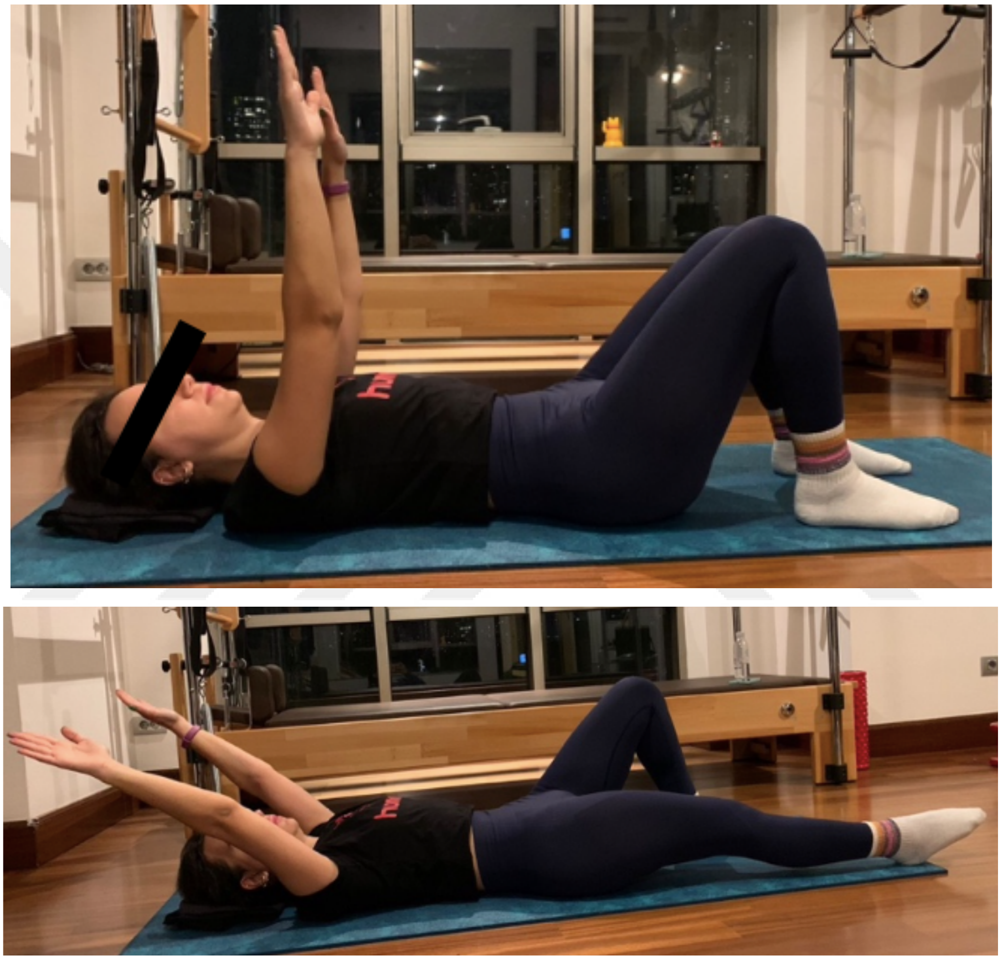


Figure 3.9. Double-Leg Stretches at Level 1

Level 1: In the supine posture, the movement was started with the legs flexed, the arms elevated 90 degrees, and the right heel dragged forward while the rib cage connection was taken backwards without breaking. The right heel was retracted as the arms formed a "D" shape. The motion was repeated with each leg (Figure 3.9) (107).

Figure 3.10. Double-Leg Stretches at Level 2

Level 2: The knees were flexed, the arms were elevated 90 degrees, and the movement was started while in the supine position. One by one, the legs were moved into the double-leg table shape. A "D" shape was formed by bringing the arms back without rupturing the rib cage connection (Figure 3.10) (107).

6. Breast Stroke Exercises Level 1 and Level 2

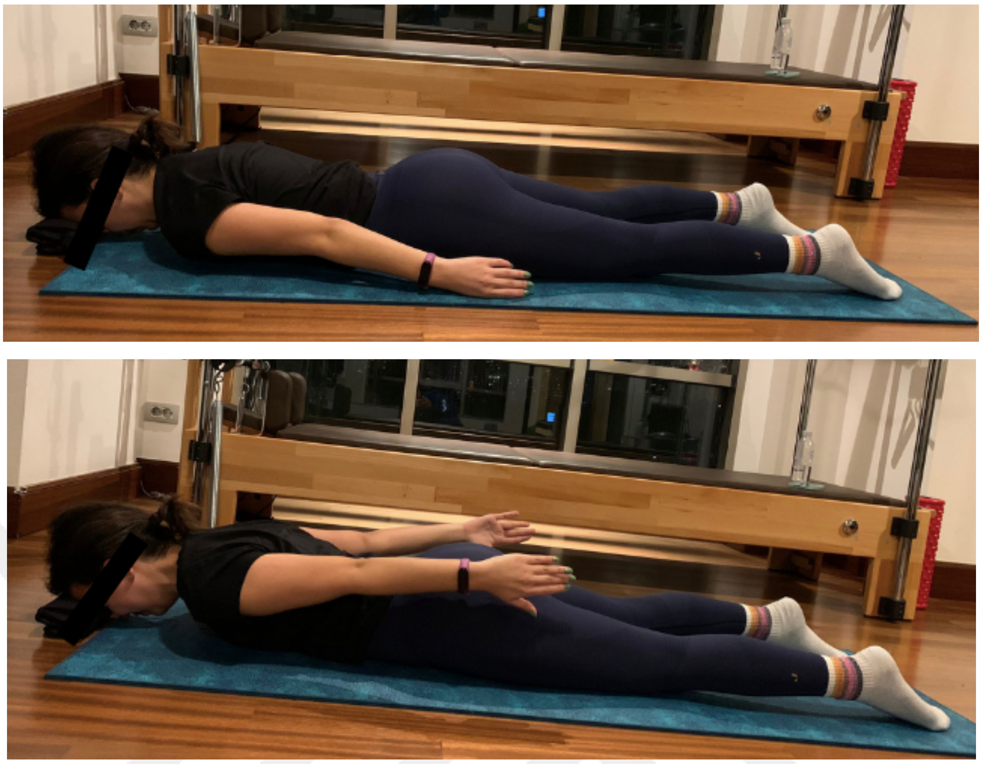


Figure 3.11. Breast Stroke Exercises Level 1

Level 1: A tiny towel was positioned under the forehead while lying on the floor to begin the practice. The arms were outstretched to the sides. With each breath, the scapula pushed the shoulder girdle downward, lifted the arms off the floor and directed the palms inward toward the body. In this position, participants took a breath in, took it out, and then came back to the beginning position (Figure 3.11) (107).

Figure 3.12. Breast Stroke Exercises Level 2

Level 2: To begin the exercise, a little towel was positioned under the forehead in the prone position. The arms were outstretched to the sides. The arms and head were elevated off the ground slightly, the palms were turned the trunk, and the shoulder girdle was pulled downward with the assistance of the scapulae. In this position, participants took a breath in, took it out, and then came back to the beginning position (Figure 3.12) (107).

7. Swan Diving Exercise Level 1 and Level 2

Figure 3.13. Swan Diving Exercise Level 1

Level 1 To begin the exercise, a little towel was positioned under the forehead in the prone position. The elbows were flexed at 90 degrees to the side of the trunk. While inhaling, the chest was lifted from the mat, and while exhaling, the head was lifted from the mat without disturbing the stabilization behind the neck. In this position, participants took a breath in, took it out, and then came back to the beginning position (Figure 3.13) (107).

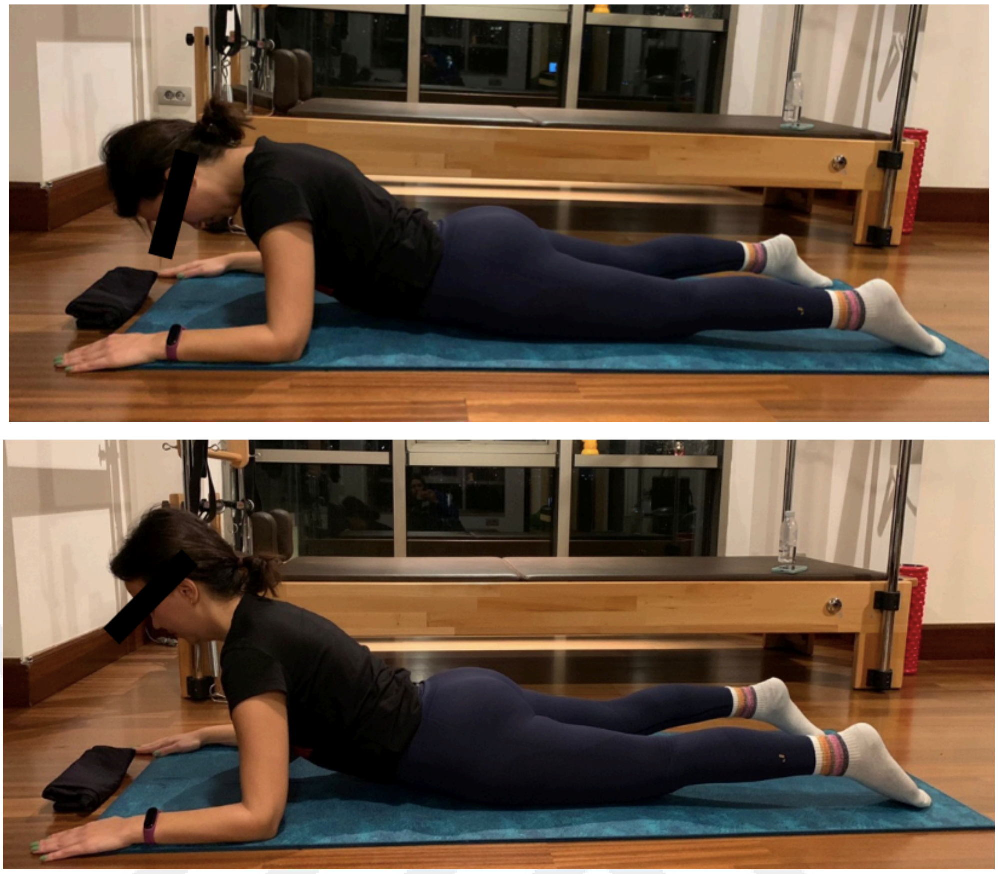


Figure 3.14. Swan Diving Exercise Level 2

Level 2: The exercise was initiated with the head and neck resting downward while participants lay on their forearms. The shoulder girdle was moved toward the waist, and the sternum, lower ribs, and waist were lifted off the floor. The extended neck position was achieved by elevating the head and neck from the base of the neck while inhaling and exhaling. Participants took a breath and slowly lowered their necks, and headed to the mat (Figure 3.14) (107).

8. Arm Opening Exercises Level 1 and 2

Figure 3.15. Arm Opening Exercises Level 1

Level 1: The head was supported by a pillow. The arms were crossed over each other, the hips were bent about 45 degrees, and the knees were flexed around 90 degrees when on the sideline. A space has separated the waist and mat. The upper arm was raised toward the ceiling during inhalation and exhalation, and the rib cage was rotated to open up toward the top. The hand motion was followed by the neck and head. The participant was returned to the beginning position by exhaling (Figure 3.15) (107).

Figure 3.16. Arm Opening Exercises Level 2

Level 2: The subject was brought to the beginning position. As the subject inhaled and exhaled, they drew a circle with the upper arm over the head. The subject was returned to the beginning position by exhaling (Figure 3.16) (107).

9. Spine Rotation

Figure 3.17. Spine Rotation

The participant was seated cross-legged. At chest level, the forearms were stacked on top of one another. The upper body was rotated to the right and left along the vertical axis while facing forward (Figure 3.17) (107).

The exercise levels of the participants who completed the Level 1 exercises and ensured their coordination with breathing were increased and new exercises were added. All of the participants completed the exercises in the first 3 weeks and switched to the new exercise program. The following new exercises were introduced after six sessions, and the following exercise regimen was continued for six more sessions;

1. Footwork Series (performed on a reformer pilates machine); The foot bar was elevated to the second level, the head was raised, and three springs were fastened to install the tool.

Figure 3.18. Footwork Series-1

a) The sole of the foot was placed into the centre of the foot bar. The participant was pushed the reformer back, extended their knees, and breathed out (Figure 3.18) (117).

Figure 3.19. Footwork Series-2

b) The toes were positioned in the middle of the foot bar. The gastrocnemius was begun to contract while the foot was in the plantar position. The participant pushed the reformer back, extended their knees, and breathed in. The participant was taken a breath and returned back to the starting position (Figure 3.19) (117).

Figure 3.20. Footwork Series-3

c) The heels were situated on the foot bar's centre. The tibialis anterior was begun to contract actively when the feet were in dorsiflexion. The participant pushed the reformer back, extended their knees, and breathed in. The participant was taken a breath and returned back to the starting position (Figure 3.20) (117).

Figure 3.21. Footwork Series-4

d) The foot was positioned with its plantar area gripping the foot bar. The plantar surface of the foot was contracted as though it were grasping the foot bar. The participant pushed the reformer back, extended their knees, and breathed out. The participant was taken a breath and returned back to the starting position (Figure 3.21) (117).

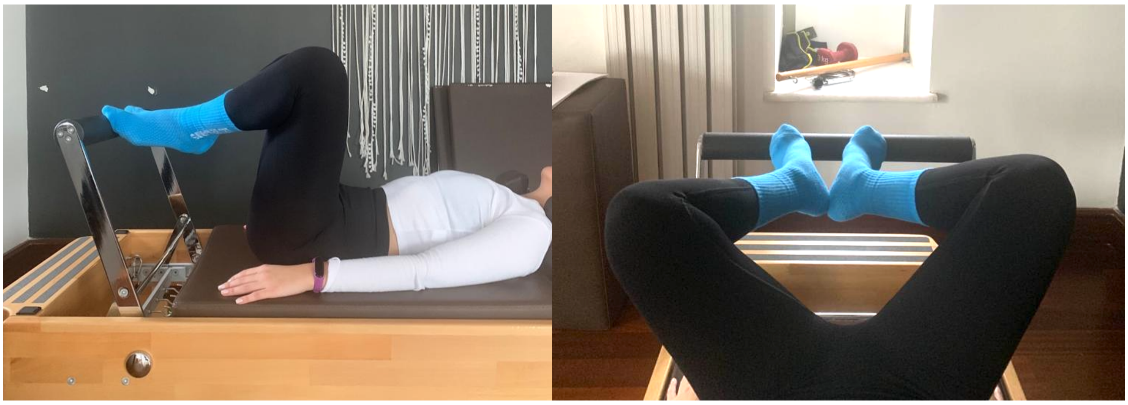


Figure 3.22. Footwork Series-5

e) The toes were put in the pilates "V" position on the foot bar and the knee angle of 90 degrees. The heels were connected, and there was a "V" shaped opening at the toes. The foot was plantarflexed, and the gastrocnemius was actively moved. The participant pushed the reformer back, extended their knees, breathed out and came back (Figure 3.22) (117).

Figure 3.23. Footwork Series-6

f) The heels were combined in the pilates "V" position on the foot bar, with the knee angle of 90 degrees, and there was a "V" shaped opening at the toes. The foot was in dorsiflexion, and the tibialis anterior actively started to move. The subject pushed the reformer back, extended their knees, breathed out and came back (Figure 3.23) (117).

Figure 3.24. Footwork Series-7

g) The toes were opened between the heels in the pilates "V" position on corners of the foot bar, with the knee angle of 90 degrees, and there was a "V" shaped angle on the toes. The foot was plantar flexed, and the gastrocnemius actively started to move. The participant pushed the reformer back, extended their knees, breathed out and came back (Figure 3.24) (117).

Figure 3.25. Footwork Series-8

h) The heels were opened in the pilates "V" position on the corners of the foot bar, with the knee angle of 90 degrees, and there was a "V" shape opened at the tips of the toes. The foot was in dorsiflexion, and the tibialis anterior actively started to move.

The subject pushed the reformer back, extended their knees, breathed out and came back (Figure 3.25) (117).

Figure 3.26. Footwork Series-9

i) The foot bar was centred with the toes in that position. The reformer was pushed back with the breath, the knees were extended, and the tendon stretch was completed (Figure 3.26) (117).

2. Supine Leg Series (were done on reformer pilates machine);

Figure 3.27. Leg Circles Exercise

a) Leg Circles Exercise

The foot bar was raised to the second level, the head hood was increased, and two springs were fastened in the reformer tool setup. The feet were fitted straps with legs were extended. The elbows were extended, the legs were extended upward, and the arms were located near to the trunk with palms facing the floor in the supine posture. After starting the circle with the legs down, the participant was breathed out. The circles were done reformer wide. The exercise was continued for the opposite side (Figure 3.27) (117).

Figure 3.28. Frog Exercise

b) Frog Exercise:

The foot bar was raised to the second level, the head hood was increased, and two springs were attached to the reformer tool setup. The feet were fitted straps with legs were extended. The elbows were extended, the legs were extended upward, and the arms were located near to the trunk with palms facing the floor in the supine posture. With the heels connected together and the knees spread, the subject was taken to the "frog" position. The straps were located between the knees. The feet were pushed forward, the knees were extended, and the breath was exhaled. The breath was inhaled and returned to the starting position (Figure 3.28) (117).

3. Hip Twist Exercise Level 1 and Level 2 (on pilates mat)

4. Shoulder Bridge Exercise Level 1 and Level 2 (on pilates mat)

5. Hundred Exercise Level 2 and Level 3 (on pilates mat)

Figure 3.29. Hundred Exercise Level 3

Level 3: The exercise was started with the knees flexed. The legs were carefully moved to the position of the tabletop one by one. The arms were moved up and down with the breath, like in Level 1, after being raised parallel to the ground at shoulder height. There were 100 numbers produced in all (Figure 3.29) (107).

6. Scissors Exercise, Level 2 and 3 (on pilates mat)

Figure 3.30. Scissors Exercise, Levels 3

Level 3: The practice was begun with flexed knees in the supine posture. The participant lifted one leg to the tabletop position with the breath was inhaled and exhaled. In this position, one leg was brought back to the tabletop position while the other leg was begun to move and was brought into contact with the mat. The motion was repeated on each two legs (Figure 3.30) (107).

7. Double Leg Stretching Exercise; Level 1, Level 2 (on pilates mat)

8. Pulling Straps Exercise (part of the Long Box Series, was performed on a reformer machine);

Figure 3.31. Pulling Straps Exercise

Reformer machine setup: The reformer box was long and rested on the shoulder pads, with the foot bar set at the lowest position. One spring resistance was attached. The subject was laid on the box with the face looked down, and the head was placed toward the straps. The head was positioned at the start of the movement, and the arms and knees were stretched. The legs were located in the back corners of the box, while the shoulders placed its the front corners. The straps were grasped with the hands, the shoulders and body were extended, the straps were stretched, and the arms were pulled straight back (Figure 3.31) (117).

9. Rib Cage Strike Exercise; Level 1, Level2
10. Swan Diving Exercise; Level 1, Level2
11. Opening The Arm Exercise; Level 1, Level 2
12. Spine Rotation

3.3.2. Scapular Mobilization Technique

Figure 3.32. Application of Scapular Mobilization Technique

After each pilates exercise session, the scapular mobilization technique was applied to the EG. The participants were positioned side-lying while their knee joints were flexed at 45°. The physiotherapist was positioned in front of the patient and located one hand's index finger under the medial scapula border while the other hand grasped the superior edge of the scapula on the acromion. The scapula was shifted mediolateral, superoinferior and was also rotated to improve mobility. These motions were performed in ten sets, ten times each. Every motion was held for 5 seconds and 30 seconds intervals between sets (Figure 3.32) (27,124–126).

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 26.0 was used to analyze the data. It was decided to test numerical variables using the Shapiro-Wilk test. The ratio (%) was used to represent categorical data, whereas the mean and standard deviation were used to summarize numerical data. Statistical analysis was carried out according to the first and last evaluation results for parametric and non-parametric data with Paired Sample T-test and Independent Sample T-test. The statistical significance level was accepted as $p<0.05$.

4. RESULTS

The study included 20 volunteers (N=20) people with chronic neck pain admitted to Simyfit Pilates studio between May 2022 and October 2022.

The physical features of the participants (age, weight, height, and body mass index(BMI)) are shown in Table 4.1. There were no statistically significant differences in age, weight, height, and BMI scores in the groups (p> 0,05).

Table 4.1. Physical features of participants

(N=20)	EG (n=10)	CG (n=10)	p-value
	mean±S.D	mean±S.D	
Age(year)	32.9±9.07	35.2±8.21	0.56
Weight(kg)	61.8±8.31	63.3±9.36	0.238
Height(cm)	165.9±6.43	169.4±6.39	0.709
BMI(kg/m^2)	22.62±4.16	22.05±2.96	0.728

Data expressed as mean ± standard deviation. BMI: Body mass index, EG: Experimental Group, CG: Control Group.

According to the data obtained from the participant's demographic information, participants were asked, 'do you stay in the same position for a long time during the day?', 'do you make repetitive movements in your work?', ' do you frequently forward bending during the day?' and the habits of wearing high-heeled shoes (3.5 cm and above) are shown in Table 4.2.

Table 4.2. Descriptive Findings of the study group

		N=20 % (n)
staying in the same position throughout the day	**Yes**	%65 (13)
	No	%35 (7)
making repetitive movements while working	**Yes**	%70 (14)
	No	%30 (6)
forward bending during the day	**Yes**	%85 (17)
	No	%15 (3)
using of high-heeled shoes (3.5 cm and above)	**Often**	%15 (3)
	Sometimes	%70 (14)
	Never	%15 (3)

Data expressed as % (n).

According to the data obtained from the Neck Disability Index, the disability levels pre and post evaluation are shown in Table 4.3.

Table 4.3. Disability Levels of Participants Pre-and Post Evaluation

Level of Disability	**Pre evaluation**	**Post evaluation**
no disability	%0 (0)	%5 (1)
mild dsability	%45 (9)	%80 (16)
moderate disability	%50 (10)	%10 (2)
severe disability	%5 (1)	%5 (1)

Data expressed as % (n).

According to the data obtained from the New York Posture Rating System, the posture levels pre and post-evaluation are shown in Table 4.4.

Table 4.4. Posture Levels of Participants Pre-and Post Evaluation

Level of posture	Pre evaluation	Post evaluation
very good posture	%10 (2)	%90 (18)
good posture	%35 (7)	%10 (2)
medium posture	%55 (11)	%0 (0)

Data expressed as % (n).

Since the data were normally distributed, the Paired Sample T-test was used for the group's Visual Analogue Scale (VAS) and Neck Disability Index (NDI) pre-post comparisons. Intra-group comparisons of the VAS and NDI in both groups are shown in Table 4.5. There was a statistically significant difference between the measurements of the two groups before and after the VAS Score and NDI Score (p <0,05, Table 4.5).

Table 4.5. Comparison of Pain and Disability For Intragroup Variables

		EG mean±S.D.	P value t	CG mean±S.D.	P value t
VAS Score	**Pre**	7.4±1.07	**p=0.000** t:9.00	7.1±0.73	**p=0.000** t:6.00
	Post	4.1±1.44		4.7±0.94	
NDI Score	**Pre**	15.5±5.60	**p=0.010** t:4.63	15.4±7.21	**p=0.010** t:5.16
	Post	8.7±3.43		10.5±5.94	

Data expressed as mean ± standard deviation.VAS: Visual analogue scale, NDI: Neck disability index, EG: Experimental Group, CG: Control Group.

Paired Sample T-test was used to determine for New York Posture Rating System (NYPRS) Score pre-post comparisons within the group. Intra-group comparisons of the NYPRS Score in both groups are shown in Table 4.6. There was a statistically significant difference between the measurements of the two groups before and after the NYPRS Score (p <0,05, Table 4.6).

Table 4.6. Intragroup Comparison of Pre -Post Posture Evaluation

		EG mean±S.D.	P value t	CG mean±S.D.	P value t
NYPRS Score	**Pre**	40.6±5.31	**p=0.000**	41.6±4.11	**p=0.000**
	Post	53.2±6.14	t:-8.61	55.5±6.48	t:-9.21

Data expressed as mean ± standard deviation. NYPRS: New York posture rating system, EG: Experimental Group, CG: Control Group.

Paired Sample T-test was used for Pittsburgh Sleep Quality Index (PSQI) score pre-post comparisons within the group. Intra-group comparisons of the PSQI Score in both groups are shown in Table 4.7. There was a statistically significant difference between the measurements of the two groups before and after the PSQI Score ($p < 0,05$, Table 4.7).

Table 4.7. Comparison of Sleep Qualities For Intragroup Variables

		EG mean±S.D.	P value t	CG mean±S.D.	P value t
PSQI Score	**Pre**	7.2±2.78	**p=0.001**	7.6±4.62	**p=0.001**
	Post	4.8±1.93	t:4.81	6.2±3.96	t:4.58

Data expressed as mean ± standard deviation. PSQI: Pittsburgh sleeps quality index, EG: Experimental Group, CG: Control Group.

To compare the quality of life of participants in EG and CG, Paired Sample T-test was used for the before-after score of the Quality of Life Assessment Questionnaire (SF-12 questionnaire). The pre-and post-measurements of the SF-12 questionnaire are shown as the mental component summary (MCS-12 Score) and the physical component summary (PCS-12 Score) (Table 4.8). A statistically significant difference was found in EG in the MCS-12 Score of SF-12 ($p<0,05$, Table 4.8). However, no statistically significant difference was found between pre-post measurements in MCS-12 score in CG ($p >0,05$, Table 4.8). In CG, a statistically significant difference was found between the pre and post-measurements in the PCS-12 of the SF-12 ($p<0,05$, Table 4.8). However, no statistically significant difference was found between pre-post measurements in PCS-12 score in EG (p>0,05, Table 4.8).

Table 4.8. Comparison of Quality of Life For Intragroup Variables

		EG mean±S.D.	P value t	CG mean±S.D.	P value t
PCS-12 Score	**Pre**	42.96±9.54	p=0.057 t:-2.17	42.18±11.34	**p=0.047** t:-2.30
	Post	49.06±8.64		48.14±9.49	
MCS-12 Score	**Pre**	41.19±10.45	**p=0.023** t:-2.73	35.19±8.61	p=0.075 t:-2.01
	Post	47.58±9.76		39.50±5.48	

Data expressed as mean ± standard deviation. PCS-12:Physical component summary, MCS-12:Mental component summary, EG: Experimental Group, CG: Control Group.

The Independent Sample T-test was performed to compare the intergroup pre and post- Visual Analogue Scale(VAS) and Neck Disability Index (NDI) scores. Intergroup comparisons of the VAS and NDI in both groups are indicated in Table 4.9. There was no statistically significant difference between the measurements of the two groups before and after the VAS Score and NDI Score (p>0,05, Table 4.9).

Table 4.9. Comparison between Pre/Post Pain and Pre/Post Disability For Intergroup Variables

		EG mean±S.D.	CG mean±S.D.	P value t
VAS Score	**Pre**	7.4±1.07	7.1±0.73	p=0.476 t:-7.28
	Post	4.1±1.44	4.7±0.94	p=0.288 t:1.09
NDI Score	**Pre**	15.5±5.60	15.4±7.21	p=0.973 t:-0.35
	Post	8.7±3.43	10.5±5.94	p=0.418 t:0.82

Data expressed as mean ± standard deviation.VAS: Visual analogue scale, NDI: Neck disability index, EG: Experimental Group, CG: Control Group.

The independent sample t-test shows intergroup comparisons of both groups' pre and post- New York Posture Rating System (NYPRS) scores in Table 4.10. There was no statistically significant difference between the measurements of the two groups before and after the NYPRS Score ($p>0,05$, Table 4.10).

Table 4.10. Comparison between Pre/Post Posture Measurements For Intergroup Variables

		EG mean±S.D.	CG mean±S.D.	P value t
NYPRS Score	**Pre**	40.6±5.31	41.6±4.11	p=0.644 t:0.47
	Post	53.2±6.14	55.5±6.48	p=0.426 t:0.81

Data expressed as mean ± standard deviation. NYPRS: New York posture rating system, EG: Experimental Group, CG: Control Group.

The Pittsburgh Sleep Quality Index (PSQI) scores of the two groups were compared using an Independent Sample T-test. Intergroup comparisons of the PSQI scores in both groups are shown in Table 4.11. There was no statistically significant difference between the measurements of the two groups before and after the PSQI Score (p>0,05) (Table 4.11).

Table 4.11. Comparison between Pre/Post Sleep Quality Measurements For Intergroup Variables

		EG mean±S.D.	**CG mean±S.D.**	**P value t**
PSQI Score	**Pre**	7.2±2.78	7.6±4.62	p=0.817 t:0.23
	Post	4.8±1.93	6.2±3.96	p=0.329 t:1.00

Data expressed as mean ± standard deviation. PSQI: Pittsburgh sleeps quality index, EG: Experimental Group, CG: Control Group.

An Independent sample t-test was used to compare the results of the Quality of Life Assessment Questionnaire (SF-12 questionnaire) for pre- and post-measurements between groups. The results are as two separate components mental(MCS-12) and physical component summary(PCS-12) Table 4.12. In the post-evaluation of the MCS-12 Score, a statistically significant difference between intergroup was detected Table 4.10 (p<0,05). However, no statistically significant difference was revealed between pre-post measurements in PCS-12 score between intergroup Table 4.12 (p>0,05).

Table 4.12. Comparison between Pre/Post Quality of Life Scores For Intergroup Variables

		EG mean±S.D.	CG mean±S.D.	P value t
PCS-12 Score	**Pre**	42.96±9.54	42.18±11.34	p=0.870 t:-0.16
	Post	49.06±8.64	48.14±9.49	p=0.823 t:-0.22
MCS-12 Score	**Pre**	41.19±10.45	35.19±8.61	p=0.178 t:-1.40
	Post	47.58±9.76	39.50±5.48	**p=0.035** t:-2.28

Data expressed as mean ± standard deviation. PCS-12:Physical component summary, MCS-12:Mental component summary, EG: Experimental Group, CG: Control Group.

5. DISCUSSION

The primary outcome of this study is that it compared the effect of pilates exercises and pilates exercises in combination with scapular mobilization; a program including pilates exercises in combination with scapular mobilization can lead to greater improvement in the mental component (MCS-12) of the quality of life assessment according to statistical analysis (Table 4.12), ($p<0.05$). EG and CG have shown similar improvement in pain, posture, and sleep quality within the two groups according to intergroup comparison (Table 4.9, Table 4.10 and Table 4.11)($p>0.05$). When the mean and standard deviation values of VAS, NDI, and PSQI scores were examined, the improvement was more remarkable in the experimental group. Still, no statistically significant difference was found between the two groups in terms of pain, sleep quality, and posture ($p>0.05$). Additionally, the physical component (PCS-12) of the quality of life assessment was revealed statistically significant in CG according to intragroup comparison (Table 4.8) ($p<0.05$).

A pilot study published in the literature by Mallin et al. found that people with neck pain who completed a 6-week Pilates program reported less pain and disability (20). Uluğ et al. examined how people with chronic neck pain responded to traditional isometric, yoga, and Pilates exercises on their neck muscles. The participants were divided into three groups and given traditional isometric, yoga, and Pilates exercises. Participants demonstrated that all groups experienced improvements in pain, disability, depression, and quality of life, but only the Pilates group experienced an increase in semispinalis capitis muscle thickness (24). This study's findings, consistent with the literature, show that both groups' pain and disability levels decreased after exercise sessions (Table 4.5) ($p<0.05$).

Dunleavy et al. found that after 12 weeks of weekly group exercise sessions, pilates and yoga group exercise therapies decreased disability and pain. However, neither the range of motion nor the postural factors showed any essential variations (21). Another study conducted by Sahiner et al. found that clinical pilates exercise improves pain, the degree of disability, deep neck flexor endurance, posture, range of motion, and proprioception in people suffering from chronic non-specific neck pain (118). In this study, Pilates and scapular mobilization exercises improved posture when applied together or alone (Table 4.6) ($p<0.05$).

Recent studies have revealed that neck pain and sleep quality are related (127–130). Studies also prove that Pilates exercises improve sleep quality (131–134). However, few studies have been conducted to investigate the impact of the pilates method on sleep quality in patients suffering from neck pain. In a study, Akodu et al. examined the effects of pilates exercises and neck stabilization on people with non-specific chronic neck pain. Their research revealed that in patients who had non-specific chronic neck pain, neck stability and pilates exercises improved sleep disturbance, neck disability, and kinesiophobia while reducing pain (135). In both groups of participants with neck pain, this study found a statistically significant increase in sleep quality following exercise sessions. Their study is consistent with our results (Table 4.7)($p<0.05$).

Cazotti et al. studied pilates and control groups that received only pharmacological treatment. They suggested that the Pilates method program improved pain, function, and some domains of quality of life. They assessed the quality of life using the SF-36 questionnaire. For the social and emotional function domains of the SF-36, there were no statistically significant differences between the groups. However, they found that the pilates group performed better in the areas of physical function, body pain, overall health, vitality, and mental health, where statistically significant differences between the groups were revealed (22). In another study, Scollay et al. investigated the differences between the combination of equipment pilates and home-based exercise program versus home-based exercise alone for neck pain. Their study indicated that two exercises program improved pain, disability, and well-being related to chronic neck pain. Their research demonstrated no statistical significance between the combined exercise program versus only home-based exercise about pain. However, their results showed that a combined exercise program had a greater statistically significant effect on disability and many aspects of well-being than home-based exercise alone. Quality of life score (SF-36) was improved by equipment pilates and home-based exercise, more so than home exercise alone. This was only clinically significant in a few domains, including physical health, energy/fatigue, and overall health (119). A study by Melda et al. compared two groups of pilates and home exercise. They used the Nottingham Health Profile questionnaire to assess the quality of life. They suggested that Pilates exercises are more effective than home exercises in reducing pain and disability, increasing physical activity and quality of life in the short and long term. It has been demonstrated that both exercise methods improve postural control similarly (136). In our study, we chose the SF-12 quality of life assessment questionnaire, developed from SF-36, which is more practical and has a shorter response time. According to the pre and post-measurements of the quality of life assessment, only MCS-12 improved in EG, while only the PCS-12 improved in CG (Table 4.8). A statistically significant difference was found between the two groups in the MCS-12 (Table 4.12)($p<0.05$). These reviewed studies are consistent with our study.

The systematic review conducted by Miller et al. researched the effects of manipulation or mobilization combined with exercise for adults. Low-quality evidence indicated long-term healing in pain, disability, and general perceived impact when a combination of manual and exercise therapy is compared to no treatment. High-quality evidence suggested that manual therapy plus exercise has more significant short-term pain relaxation than only exercise. Moderate quality evidence showed that manual therapy and exercise combination for pain relief increased quality of life better than only manual therapy for chronic neck pain (26).

In a study conducted by Aslıyüce et al., they examined the effects of combining manual therapy and cervical stabilization exercises. Their study found reductions in pain and NDI levels (137). In another study by Ghodrati et al., they applied combination therapy using manual therapy and exercise in individuals with chronic neck pain. They reported reductions in NDI levels and pain (138).

The systematic review and meta-analysis study performed by Fredin et al. demonstrated that exercise alone is as beneficial as manual therapy and exercise in reducing neck pain intensity at rest, reducing neck pain, and improving quality of life in adults with grade I-II neck pain (139).

In a study, Alshami et al. investigated the impact of adding scapular mobilization with active neck motion to the scapulothoracic exercise and taping program in people with scapular dyskinesis and neck pain. The experimental group applied scapulothoracic mobilization with training, corrective exercises, and tape. Divided participants into two groups comparison group used corrective exercises and tape. They claimed that using exercises and corrective tapes, either with or without mobilization with movement to the scapula, enhanced the participants' pain, disability, cervical and scapular ROM (140). When Pilates exercises were used alone and combined with scapular mobilization, no significant statistical differences could be found. These findings are consistent with the current study.

Celanay et al. indicated that stabilization exercises combined with manual therapy (cervical and scapular mobilization) are better than only stabilization exercises for decreasing disability level, pain, cervical rotation motion, and quality of life in people with mechanic neck pain (27) .

They used not only the scapular mobilization technique but also cervical mobilization techniques in their study. The results may change statistically as a result of this. They included 102 participants in their study, and 51 were split between the two groups. In contrast to our study, exercise sessions were held three days a week. This result created the idea that if we had increased our study's exercise frequency and sample size, we could have achieved a clinically significant difference. In a similar study, in people with mechanical neck pain, the effects of scapulothoracic mobilization in addition to physical therapy and only physical therapy were compared. In the study by Shirzadi et al., physical therapy included isometric neck exercises, hot packs, and transcutaneous electrical nerve stimulation. They claimed that in people with mechanical neck pain and scapular dyskinesia, scapulothoracic mobilization, together with physical therapy, reduced pain intensity and NDI scores in comparison to physical treatment alone (124). The findings of this study are different from our results. According to our study, there was no statistically significant difference between the groups. However, the increase in the mean and standard deviations of pain, disability, and sleep quality scores was more remarkable in EG in pre-post assessments. In the study of Shirzadi et al., the sample size was forty-six. They did it five days a week for two weeks. In our study, 20 participants applied twice weekly for a period of six weeks. The fact that it was different results from their study made us think that our study should be done with a larger sample size. Furthermore, scapular dyskinesia was not evaluated in our study. The application of scapular mobilization may have shown a more straightforward reduction in perceived pain levels when applied in people with scapular dyskinesia. Our study needs a larger sample size, more frequent exercise sessions, and longer-duration studies to find statistically significant differences between the two groups.

The studies reviewed above are relatively similar and informative to our study, using stabilization and therapeutic exercises. This study found no statistically significant difference between the two groups in pain, disability, posture, and sleep quality parameters when Pilates and scapular mobilization exercises were used together or alone ($p>0.05$). There was a significant difference in the mental component of quality of life between the two groups ($p<0.05$).

Moreover, exercises from both mat and reformer pilates were used in our study. When the literature is examined, studies are found in which mat and reformer pilates exercises are combined to treat low back pain. While most studies show that reformer pilates exercises are superior to mat pilates exercises in reducing low back pain (141–143), another research has found similar results in the two groups (144). However, we found only one study on reformer pilates exercises to treat neck pain (119). The study by Scollay et al. showed results consistent with our study.

In addition, when scapular mobilization was added to exercise therapy in the experimental group, there were statistically significant results in the mental component of quality of life compared to the pilates exercise alone.

Limitations of study

The small number of people in our study could not reveal the difference between the two groups. Reviewing previous studies shows us that exercise sessions lasting more than 12 may reveal the difference between the two groups. In previous studies, group sessions were conducted. One-on-one sessions were held in our study because the area where the study was conducted was not suitable for group sessions. Sessions were held two days a week with 20 participants. For the study coordinator, this amounted to an average of 40 sessions per week. Getting more participants to exercise sessions two days a week and scheduling appointments was difficult. Since our study was conducted during the summer period and after the pandemic, long-term follow-up of the participants could not be performed. Larger samples and more extended studies may be needed to understand better the effect of pilates exercises and scapular mobilization techniques when used together in treating chronic mechanical neck pain.

6. CONCLUSION

Our study investigated the effect of the scapula mobilization exercise program and pilates exercises on pain, posture, sleep, and quality of life in people with neck pain.

In conclusion,

- When pilates and the scapular mobilization technique were used combined, there was no statistically significant difference in pain, disability, posture, or sleep quality when compared to the group that performed pilates exercises alone.

- When the results of the two groups were compared, only the mental component of the quality of life assessment revealed a statistically significant difference between the two groups.

- Both exercise programs have improved pain, disability, sleep, and quality of life parameters.

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APPENDIX 1: ETHICAL COMMITTEE APPROVAL

YEDİTEPE ÜNİVERSİTESİ
GİRİŞİMSEL OLMAYAN KLİNİK ARAŞTIRMALAR
ETİK KURULU

Versiyon No 2.0
13.02.2022
Sayfa 1 / 2

KARAR FORMU

12.04.2022

ETİK KURUL BİLGİLERİ	Etik Kurulun Adı	Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu
	Açık Adres	Yeditepe Üniversitesi Kayışdağı Kampüsü, Tıp-Mühendislik Binası, Sağlık Bilimleri Enstitüsü, İnönü Mah. Kayışdağı Cad. 326A, 26 Ağustos Yerleşimi 34755 Ataşehir, İstanbul
	İnternet Sayfası	http://goetik.yeditepe.edu.tr/
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	E-posta	goetik@yeditepe.edu.tr

DEĞERLENDİRİLEN BELGELER	Islak imzalı başvuru dosyası, CD'si ve elektronik başvuru	☒
	Araştırma başlığı ve araştırmacıların isimleri	☒
	Başvuru dilekçesi	☒
	Başvuru Formu- Araştırmanın;	☒
	• Niteliği	☒
	• Önemi ve özgün değeri	☒
	• Amaç ve hedefleri	☒
	• Yöntemi	☒
	• Yönetimi	☒
	• Yaygın etkisi	☒
	• Araştırma bütçesi (Mevcutsa)	☒
	• Süresi ve uygunluğu (Zaman cetveli)	☒
	• Kaynakları	☒
	Bilgilendirilmiş Gönüllü Olur Formu (yapılan araştırmaya özel olarak hazırlanmış)	☒
	Taahhütname-1 Araştırmanın yapılacağı kurumdan izin alma sorumluluğunun araştırmacılara ait olduğuna dair taahhüt	☒
	Taahhütname-2 Dünya Tıp Birliği Helsinki Bildirgesinin son versiyonunun ve Sağlık Bakanlığı'nın ilgili tüm kılavuzlarının okunmasına dair taahhüt	☒
	Taahhütname-3 Daha önce yapılmış etik kurul başvuruları mevcut olup olmadığına dair taahhüt	☒
	Taahhütname-4 Araştırma sırasında araştırma bütçesinde yer almayan ve gönüllünün kendisine veya Sosyal Güvenlik Kurumuna ek yük getirecek hiçbir işlem uygulanmayacağına dair taahhüt	☒
	Taahhütname-5 COVID-19 hastalarında tedavi yaklaşımları ve bilimsel araştırmalar genelgesi okunmasına dair taahhüt	☒
	Taahhütname-6 Milli Eğitim Bakanlığı Araştırma Uygulama İzinleri konulu yazının okunmasına dair taahhüt	☒
	Araştırmacıların her birisine ait özgeçmiş formu	☒
	Ek belgeler (Varsa kullanılan ölçek izinleri vb.)	☒

KARAR BİLGİLERİ	Başvuru Numarası	202203Y0222
	Toplantı Tarihi	08.04.2022
	Toplantı Yeri	Çevirim içi (Google Meet)
	Karar No	11

Araştırmanın Başlığı	Boyun Ağrısı Olan Kişilerde Pilates ve Skapula Mobilizasyon Egzersizlerinin Postür,Uyku ve Yaşam Kalitesi Üzerine Etkilerinin Karşılaştırılması
Araştırmacılar	Didem Apo,Prof.Dr.Feryal Subaşı

APPENDIX 1: ETHICAL COMMITTEE APPROVAL

YEDİTEPE ÜNİVERSİTESİ
GİRİŞİMSEL OLMAYAN KLİNİK ARAŞTIRMALAR
ETİK KURULU

Versiyon No 2.0
13.02.2022
Sayfa 3 / 2

BAŞVURU NUMARASI: 202203Y0222

12.04.2022

KARAR

☒**KABUL**	☐ **RET** ☐ *KAPSAM DIŞI (GİRİŞİMSEL)* ☐ *BİLİMSEL VE/VEYA ETİK KURALLARA AYKIRI* ☐ *BİR SORUMLU ARAŞTIRMACININ (TEZ İSE DANIŞMAN), BİR TOPLANTIYA* ***İKİ (2) ADETTEN FAZLA ÇALIŞMA BAŞVURUSUNDA*** *BULUNMASI* ☐ *KURUM İÇİ BAŞVURULARINDA* ***KURUMSAL E-POSTA HESABI*** *İLE GİRİŞ YAPILMAMIŞ OLMASI* ☐ *ŞARTLI KABULDE BELİRTİLEN REVİZYONLARIN ZAMANINDA VE/VEYA İSTENİLDİĞİ ŞEKİLDE YAPILMAMIŞ OLMASI*

Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu adına
Prof.Dr.Didem Özdemir ÖZENEN
Başkan

Araştırmanın Başlığı	Boyun Ağrısı Olan Kişilerde Pilates ve Skapula Mobilizasyon Egzersizlerinin Postür,Uyku ve Yaşam Kalitesi Üzerine Etkilerinin Karşılaştırılması
Araştırmacılar	Didem Apo,Prof.Dr.Feryal Subaşı

APPENDIX 2: INFORMED WRITTEN CONSENT

BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU

Sayın katılımcı,

Davet edildiğiniz ‘‘Boyun Ağrısı Olan Kişilerde Pilates ve Skapula Mobilizasyon Egzersizlerinin Postür, Uyku ve Yaşam Kalitesi Üzerine Etkilerinin Karşılaştırılması ’’ isimli bu çalışma; **Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Bölümü** tarafından yürütülen bir araştırmadır. Araştırmanın yürütücüsü Didem Apo ve Sorumlu araştırmacı Prof. Dr. Feryal Subaşı'dır.

Bu çalışmanın temel amacı, boyun ağrısı olan kişilerde pilates egzersizlerinin tek başına ve skapular mobilizasyon egzersizleri ile birlikte uygulandığında; ağrı, postür, uyku ve yaşam kalitesini nasıl etkilediğini araştırmaktır. Bu çalışmada katılımcılar kendilerine yazılı olarak verilen değerlendirme anketlerini dolduracak ve postür analizleri yapılarak tüm değerlendirmeler skorlanacaktır. Değerlendirmeler yaklaşık olarak 10-15 dk sürecektir. Bu çalışmaya 18 kişinin katılması hedeflenmektedir. Çalışmamızda katılımcılar randomize olarak iki gruba ayrılacaktır. İlk gruptaki katılımcılar, pilates egzersizleri ve skapular mobilizasyon tekniğinden oluşan programa alınacaktır. Egzersiz seansları yaklaşık olarak 45-50 dk sürecektir. Egzersizler tamamlandıktan sonra her seans sonunda araştırma yürütücü tarafından 10 tekrarlı skapular mobilizasyon tekniği uygulanacaktır. İkinci gruptaki katılımcılar ise sadece pilates egzersizlerini yapacaktır. Skapular mobilizasyon tekniği; kürek kemiği hareketliliğini arttırmak ve çevresindeki kasları gevşetmek için, yan yatış pozisyonunda fizyoterapist tarafından uygulanan bir mobilizasyon tekniğidir. Pilates egzersizleri, bedenin dengeli tutulmasına yardımcı olan ve omurgayı desteklemekte önemli işlevi olan temel kaslar üzerine yoğunlaşılan egzersizlerden oluşur. Mat pilates ve aletli(reformer) pilates olarak ikiye ayrılır. Çalışmamızda mat ve aletli pilates egzersizlerinden oluşan bir egzersiz programı izlenecektir. Egzersiz programı her iki grup için de aynı olacak ve katılımcılar seanstan önce egzersizler hakkında bilgilendirileceklerdir. Tüm katılımcılar, 6 hafta boyunca haftada 2 seans olacak şekilde 12 seansa alınacaktır. Seanslarını tamamlayan katılımcıların tekrar değerlendirmeleri yapılacaktır. Seanslara düzenli katılmayan ve son değerlendirmelerini tamamlamayan katılımcılar çalışmadan dışlanacaktır.

Katılımın isteğe bağlı olduğunu ve katılmayı reddetmenin herhangi bir cezaya veya herhangi bir menfaat kaybına yol açmayacağını belirtmek isteriz. Aynı şekilde istediğiniz zaman araştırmadan çekilebilirsiniz. Araştırmamızda katılımcılara uygulanan değerlendirmelerin ve uygulanacak olacak egzersiz programı ve mobilizasyon tekniğinin bilinen herhangi bir zararı bulunmamaktadır. Araştırmamız katılımcı açısından her hangi bir risk teşkil etmemektedir. Araştırmaya katılmak size yardımcı olabileceği gibi araştırma sonuçlarımızın gelecekte hastalara veya bilim için faydaları olacağı umulmaktadır. Araçtırmaya katılarak herhangi bir parasal yük altına girmeyeceksiniz ve aynı şekilde size bir ödeme yapılmayacak.

Araştırmada yapılan değerlendirmelerin sonuçları yalnızca araştırma kapsamındaki çalışmalarda kullanılcaktır. Kişisel bilgileriniz herhangi bir amaçla, kurum yöneticileri veya üçüncü kişilerle kesinlikle paylaşılmayacaktır. Araştırma bir kongrede ya da bir dergide yayın olarak kabul edilse bile kimliğinizi ortaya çıkarabilecek kayıtlar gizli tutulacaktır. Katılımınız için teşekkür ederiz.

APPENDIX 2: INFORMED WRITTEN CONSENT

Visüel Analog Skala: Ağrı yoğunluğunu 0'dan 10'a kadar bir değerlendirilmesi istenir.
Boyun Özürlülük İndeksi: Günlük yaşam aktiviteleri sırasında ağrıyı değerlendirmek için, 10 alt başlığa ayrılmış 10 soruluk bir ankettir.
Pittsburgh Uyku Kalitesi İndeksi: Son bir aydaki uyku kalitesi ve uyku bozukluklarını değerlendirmek için katılımcıların 19 soru cevaplayacağı bir değerlendirmedir.
SF-12 Yaşam Kalitesi Değerlendirme Anketi: Yaşam kalitesi değerlendirmek için 12 sorudan oluşan bir ankettir.
New York Postür Derecelendirme Sistemi: Katılımcının anatomik bir pozisyonda ayakta dururken postürünü değerlendirmek için kullanılacaktır. Katılımcının arkadan ve yandan araştırmacı tarafından postür analizi yapılacaktır.

SORUMLU ARAŞTIRMACILAR

Danışman

Prof. Dr. Feryal SUBAŞI
Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Bölümü

Araştırmacı

Fzt. Didem APO
Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Yüksek Lisans Programı

ONAY FORMU

Bilgilendirilmiş gönüllü olur formundaki tüm açıklamaları okudum. Bana yukarıda konusu ve amacı belirtilen araştırma ile ilgili yazılı ve sözlü açıklama Fzt. Didem APO tarafından yapıldı. Araştırmaya katılmaya gönüllü olduğumu, istediğim zaman gerekçeli veya gerekçesiz olarak araştırmadan ayrılabileceğimi biliyorum. **''Boyun Ağrısı Olan Kişilerde Pilates ve Skapula Mobilizasyon Egzersizlerinin Postür, Uyku ve Yaşam Kalitesi Üzerine Etkilerinin Karşılaştırılması**''ni inceleyen bu çalışmaya hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı kabul ediyorum.

Gönüllü: Adı Soyadı/ Telefon Numarası / Tarih / Adres / İmza	
Araştırmacı: Adı Soyadı/ Telefon Numarası / Tarih / Adres / İmza	
Tanık: Adı Soyadı/ Telefon Numarası / Tarih / Adres / İmza	

APPENDIX 3: STRUCTURED QUESTIONNAIRE

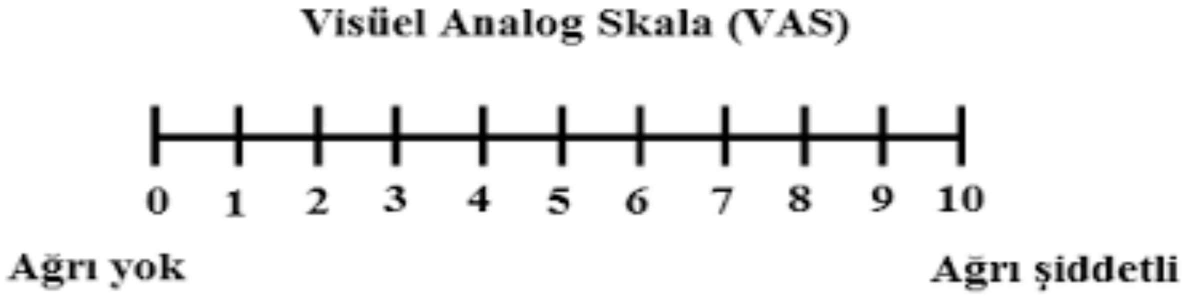
Katılımcı Değerlendirme Formu

Tarih:…./…../……

1. **Adı ve Soyadı:**
2. **Cinsiyet: A)** Kadın **B)** Erkek
3. **Yaş: Boy: Kilo:**
4. **Dominant taraf A)** Sağ **B)** Sol
5. **Medeni durumu**: **A)** Evli **B)** Bekar **C)** Ayrı Yaşıyor **D)** Eşi ölmüş
6. **Eğitim durumu: A)** İlkokul **B)** Ortaokul **C)** Lise **D)** Üniversite **E)** Yüksek Lisans
7. **Çocuğunuz : A)** Var **B)** Yok Varsa kaç çocuğunuz var?.......
8. **Sigara kullanıyor musunuz? A)** Evet **B)** Hayır
9. **Meslek Grubunuz ? A)**Ev hanımı **B)** Masa başı çalışan **C)** Serbest/esnaf **D)** Emekli **E)**İşsiz **F)**Öğrenci **G)** Diğer
10. **Haftalık çalışma saatiniz? A)** 20-30 saat **B)** 30-40 saat **C)**41 ve üzeri
11. **Yaptığınız işte uzun süre ayakta duruyor musunuz? A)** Evet **B)** Hayır
12. **Yaptığınız işte uzun süre aynı pozisyonda kalıyor musunuz? A)** Evet **B)** Hayır
13. **Gün içinde masa başında ne kadar vakit geçiriyorsunuz ?**
 A)günde 2 saatten az **B)** günde 3-5 saat **C)** günde 6-8 saat **D)** günde 9 saat ve üzeri
14. **Yüksek topuklu ayakkabıyı(3.5 cm ve üzeri) ne kadar sıklıkta giyiyorsunuz?**
 A) Her zaman **B)** Sık sık **C)** Bazen **D)** Hiçbir zaman
15. **Yaptığınız işte tekrarlayıcı hareketler yapıyor musunuz? A)**Evet **B)** Hayır
16. **Çalıştığınız işte veya gün içerisinde ağırlık kaldırıyor musunuz? A)** Evet **B)**Hayır
17. **Sık sık öne doğru eğilme yapıyor musunuz? A)** Evet **B)** Hayır
18. **Sık sık itme ve çekme hareketleri yapıyor musunuz? A)** Evet **B)** Hayır
19. **Düzenli egzersiz yapıyor musunuz? Yapıyorsanız ne sıklıkta?**
 A)Yapmıyorum **B)**Ayda bir kezden az **C)** Ayda 2 kez ve fazla **D)** Haftada 1 kez **E)** Haftada 2-3kez **F)** Haftada 4-5 kez **G)** Her gün
20. **Doktor tarafından teşhisi konmuş herhangi bir hastalığınız var mı? A)** Evet **B)**Hayır
21. **Cevabınız evet ise teşhis edilen hastalığınızı kısaca belitiniz:** …………………….
22. **Düzenli kullandığınız bir ilaç var mı? A)** Evet **B)** Hayır İlaç ismi:
23. **Daha önce medikal operasyon geçirildi mi? A)** Evet **B)** Hayır Bölge ve işlem:
24. **Son 12 ay içinde boyun ağrınız oldu mu? A)** Evet **B)** Hayır
25. **İlk boyun ağrısı deneyiminizi ne zaman yaşadınız?** …………….
26. **Daha önce boyun ağrısı için tedavi aldınız mı? A)** Evet **B)** Hayır
27. **Cevabınız evet ise bugüne kadar hangi tedavileri aldınız:**

28. **Herhangi bir kas iskelet sistemi probleminiz var mı? A)** Evet **B)** Hayır
29. **Cevabınız evet ise kısaca belirtiniz:**

APPENDIX 4: VISUAL ANALOGUE SCALE (VAS)



APPENDIX 5: NECK DISABILITY INDEX (NDI)

Boyun Özürlülük Sorgulama Anketi

(Neck Disability Index)

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

Bu sorgulama formu boyun ağrınızın günlük yaşam aktivitelerinizi yerine getirme yeteneklerinizi nasıl etkilediğini anlamamıza yardımcı olacak şekilde tasarlanmıştır. Lütfen her bölümdeki bir kutucuğu işaretleyiniz. Bir bölümde birden çok yanıtı kendinize yakın hissetseniz bile, şu anki durumunuza en yakın olan seçeneği işaretleyiniz

1 Boyunda Ağrı Yoğunluğu

A - Şu anda hiç boyun ağrım yok.
B - Şu anda çok hafif derecede boyun ağrım var.
C - Boyun ağrım orta derecede ve gelip gidiyor.
D - Boyun ağrım orta şiddette ve değişkenlik göstermiyor.
E - Boyun ağrım şiddetli fakat gelip gidiyor.
F - Boyun ağrım şiddetli ve değişkenlik göstermiyor.

2 Kişisel Bakım (giyinme ve temizlenme)

A - Ek bir ağrıya neden olmadan kendime bakabiliyorum.
B - Kendime normal olarak bakabiliyorum fakat bu ek bir ağrıya neden oluyor.
C - Kendi bakımımı yaparken ağrım artıyor, yavaşlıyorum ve dikkatli oluyorum.
D - Biraz yardıma ihtiyacım var fakat kişisel bakımımın çoğunu yapabiliyorum.
E - Kişisel bakımım ile ilgili işlerin çoğunda her gün yardıma ihtiyacım var.
F - Giyinemiyorum. Zorlukla yıkanıyorum ve yataktan çıkmıyorum.

3 Yük Kaldırma (boyun ağrınız olmadığı zamanlarda kaldırdığınız ağır yüklere eşit ağırlıkta)

A - Ek bir ağrı hissetmeden ağır yükleri kaldırabiliyorum.
B - Ağır yükleri kaldırabiliyorum, fakat ek bir ağrıya neden oluyor.
C - Ağrı yükleri yerden kaldırmama engel oluyor, fakat yükler, örneğin masa üstü gibi uygun bir yere yerleştirilirse kaldırabiliyorum.
D - Ağrı ağır yük kaldırmama engel oluyor, fakat hafif ve orta ağırlıktaki yükler örneğin masa üstü gibi uygun bir yere yerleştirilirse kaldırabiliyorum.
E - Çok hafif yükleri kaldırabiliyorum.
F - Hiçbir şeyi kaldıramıyorum ve taşıyamıyorum.

4 Okuma

A - Hiç boyun ağrısı hissetmeden istediğim kadar okuyabiliyorum.
B - Hafif bir boyun ağrısı hissederek istediğim kadar okuyabiliyorum.
C - Orta derecede boyun ağrısı hissederek istediğim kadar okuyabiliyorum.
D - Boynumda orta derecede ağrı nedeniyle istediğim kadar okuyamıyorum.
E - Boynumda şiddetli ağrı nedeniyle istediğim kadar okuyamıyorum.
F - Boyun ağrısı nedeniyle hiç okuyamıyorum.

5 Baş ağrıları

A - Hiç baş ağrım yok.
B - Sık olmayan hafif baş ağrılarım var.
C - Orta derecede baş ağrılarım var.
D - Sık gelen orta derecede baş ağrılarım var.
E - Sık gelen ağır derecede baş ağrılarım var.
F - Hemen hemen her zaman baş ağrılarım var.

6 Konsantrasyon

A - İstediğim zaman dikkatimi hiç zorlanmadan istediğim kadar toplayabiliyorum.
B - Hafifçe zorlanarak dikkatimi toplayabiliyorum.
C - İstediğim zaman biraz zorlanarak dikkatimi toplayabiliyorum.
D - İstediğim zaman epeyce zorlanarak dikkatimi toplayabiliyorum.
E - İstediğim zaman dikkatimi toplamakta çok fazla zorlanıyorum.
F - Dikkatimi hiç toplayamıyorum..

7 İş (Herhangi bir işte çalışmıyorsanız lütfen G seçeneğini işaretleyiniz)

A - İstediğim kadar iş yapabilirim.
B - Her günkü işlerimi yapabilirim, ama daha fazlasını yapamam.
C - Her günkü işlerimin çoğunu yapabilirim, daha fazlasını yapamam.
D - Her günkü işlerimi yapamam.
E - Herhangi bir işi zorlukla yapabilirim.
F - Hiçbir iş yapamam

8 Araba Kullanma

A - Boyun ağrısı hissetmeden araba kullanabiliyorum.
B-Boynumda hafif bir ağrı hissi ile istediğim kadar araba kullanabiliyorum.
C - Boynumda orta derecede ağrı nedeni ile istediğim kadar araba kullanamıyorum.
D - Orta derecede bir boyun ağrısı nedeniyle istediğim kadar araba kullanamıyorum.
E - Boynumda şiddetli ağrı nedeniyle güçlükle araba kullanabiliyorum.
F - Boyun ağrısı nedeniyle hiç araba kullanamıyorum.

9 Uyku

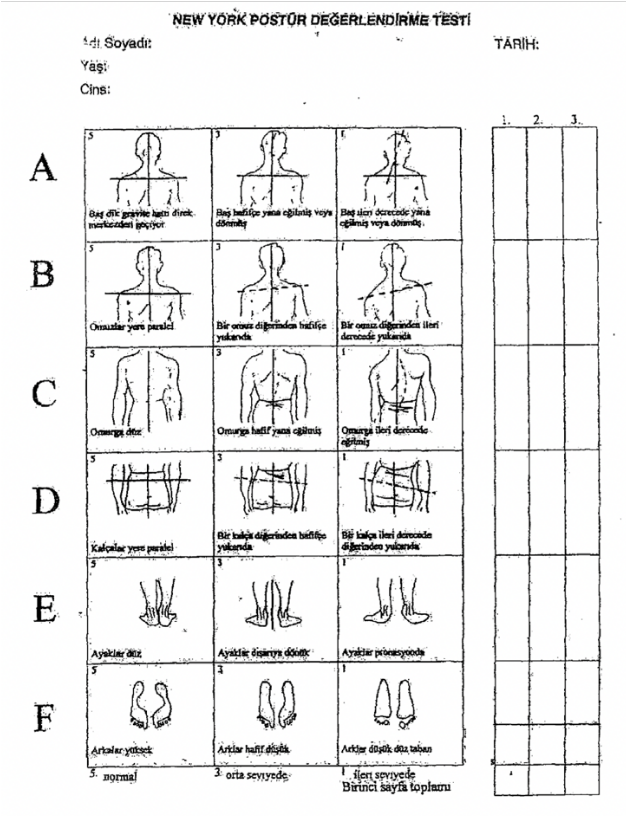
A - Uyku problemim yok.
B - Uykum çok hafif bozuk (bir saatten az süreyle biraz bozuk).
C - Uykum hafif bozuk (1-2 saat uykusuzluk).
D - Uykum orta derecede bozuk (2-3 saat kadar süren uykusuzluk).
E - Uykum çok bozuk (3-5 saat süreyle uykusuzluk).
F-Uykum tamamen bozuk (5-7 saat süresince uykusuzluktur).

10 Boş zaman aktiviteleri

A - Tüm boş zaman aktivitelerine boynumda ağrı hissetmeden katılabiliyorum.
B - Tüm boş zaman aktivitelerine boynumda biraz ağrı hissederek katılabiliyorum.
C-Boynumdaki ağrı nedeni ile tüm boş zaman aktivitelerinin bir kısmına katılabiliyorum.
D-Boynumdaki ağrı nedeni ile boş zaman aktivitelerinin çok az bir kısmına katılabiliyorum.
E-Boynumdaki ağrı nedeni ile boş zaman aktivitelerine hemen hemen hiç katılamıyorum.
F - Hiç bir aktiviteye hiç bir şekilde katılamıyorum.

Clinimetric properties of the Turkish translation of a modified neck disability index. Kesiktas NI, Ozcan E, Vernon H BMC Musculoskelet Disord. 2012 Feb

APPENDIX 6: NEW YORK POSTURE RATING SYSTEM



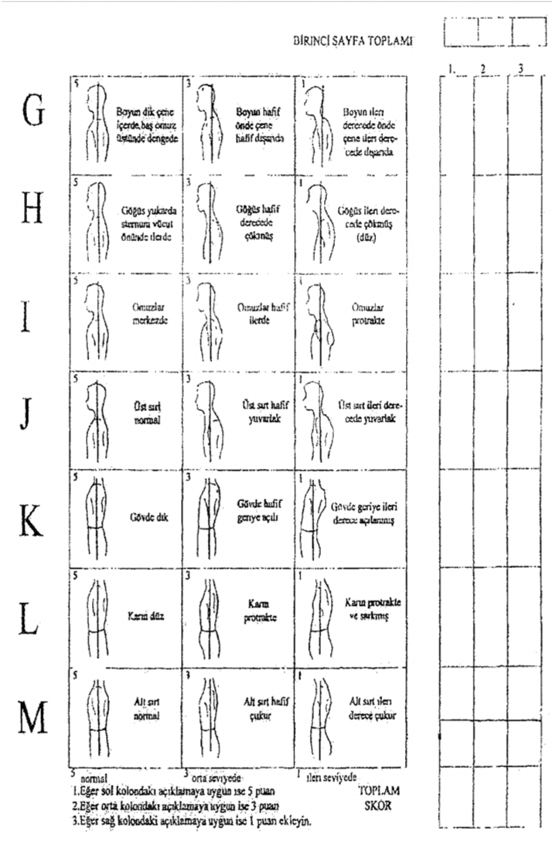
NEW YORK POSTÜR DEĞERLENDİRME TESTİ

Adı Soyadı: TARİH:

Yaşı:

Cins:

	5	3	1	1.	2.	3.
A	Baş dik gravite hattı direk merkezden geçiyor	Baş hafifçe yana eğilmiş veya dönmüş	Baş ileri derecede yana eğilmiş veya dönmüş.			
B	Omuzlar yere paralel	Bir omuz diğerinden hafifçe yukarda	Bir omuz diğerinden ileri derecede yukarıda			
C	Omurga düz	Omurga hafif yana eğilmiş	Omurga ileri derecede eğilmiş			
D	Kalçalar yere paralel	Bir kalça diğerinden hafifçe yukarda	Bir kalça ileri derecede diğerinden yukarda			
E	Ayaklar düz	Ayaklar dışarıya dönük	Ayaklar pronasyonda			
F	Arkalar yüksek	Arklar hafif düşük	Arklar düşük düz taban			
	5. normal	3. orta seviyede	1. ileri seviyede Birinci sayfa toplamı			



BİRİNCİ SAYFA TOPLAMI

	5	3	1	1.	2	3
G	Boyun dik çene içerde,baş omuz üstünde dengede	Boyun hafif önde çene hafif dışarıda	Boyun ileri derecede önde çene ileri derecede dışarıda			
H	Göğüs yukarda sternum vücut önünde ilerde	Göğüs hafif derecede çökmüş	Göğüs ileri derecede çökmüş (düz)			
I	Omuzlar merkezde	Omuzlar hafif ilerde	Omuzlar protrakte			
J	Üst sırt normal	Üst sırt hafif yuvarlak	Üst sırt ileri derecede yuvarlak			
K	Gövde dik	Gövde hafif geriye açılı	Gövde geriye ileri derece açılanmış			
L	Karın düz	Karın protrakte	Karın protrakte ve sarkmış			
M	Alt sırt normal	Alt sırt hafif çukur	Alt sırt ileri derece çukur			
	5 normal	3 orta seviyede	1 ileri seviyede			

1.Eğer sol kolondaki açıklamaya uygun ise 5 puan

2.Eğer orta kolondaki açıklamaya uygun ise 3 puan

3.Eğer sağ kolondaki açıklamaya uygun ise 1 puan ekleyin.

TOPLAM SKOR

APPENDIX 7: PITTSBURGH SLEEP QUALITY INDEX

Pittsburgh Uyku Kalite İndeksi (PUKİ)

Pittsburgh Sleep Quality Index (PSQI)

Hastanın Adı Soyadı: ______________________________ Tarih: ____/____/____

Aşağıdaki sorulara vereceğiniz cevaplar için son bir ayı göz önünde bulundurun.
Lütfen tüm soruları cevaplandırın.

1 Geçen ay geceleri genellikle ne zaman yattınız? ______________________

2 Geçen ay geceleri uykuya dalmanız genellikle ne kadar zaman (dakika) aldı? ______________ dakika

3 Geçen ay sabahları genellikle ne zaman kalktınız? ______________________

4 Geçen ay geceleri kaç saat uyudunuz (bu süre yatakta geçirdiğiniz süreden farklı olabilir) ______________________ saat

5 Geçen ay aşağıdaki durumlarda belirtilen uyku problemlerini ne sıklıkla yaşadınız?

	Haftada	Hiç	1'den az	1 - 2 kez	3'ten Çok
a	30 dakika içinde uykuya dalamadınız	☐$_0$	☐$_1$	☐$_2$	☐$_3$
b	Gece yarısı veya sabah erkenden uyandınız	☐$_0$	☐$_1$	☐$_2$	☐$_3$
c	Tuvalete gittiniz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
d	Rahat bir şekilde nefes alıp veremediniz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
e	Aşırı derecede üşüdünüz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
f	Aşırı derecede sıcaklık hissettiniz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
g	Kötü rüyalar gördünüz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
h	Ağrı duydunuz	☐$_0$	☐$_1$	☐$_2$	☐$_3$
i	Diğer nedenler	☐$_0$	☐$_1$	☐$_2$	☐$_3$
j	Öksürdünüz veya gürültülü bir şekilde horladınız	☐$_0$	☐$_1$	☐$_2$	☐$_3$

6 Geçen ay uyku kalitenizi bütünü ile nasıl değerlendirirsiniz.

☐$_0$ Çok iyi ☐$_1$ Oldukça iyi ☐$_2$ Oldukça kötü ☐$_3$ Çok kötü

7 Geçen ay uyumanıza yardımcı olması için ne sıklıkta (reçeteli veya reçetesiz) uyku ilacı aldınız?

☐$_0$ Hiç ☐$_1$ Haftada 1'den az ☐$_2$ Haftada 1 - 2 kez ☐$_3$ Haftada 3'ten çok

8 Geçen ay araba sürerken, yemek yerken veya sosyal bir aktivite esnasında ne kadar sıklıkla uyanık kalmak için zorlandınız?

☐$_0$ Hiç ☐$_1$ Haftada 1'den az ☐$_2$ Haftada 1 - 2 kez ☐$_3$ Haftada 3'ten çok

9 Geçen ay bu durum işlerinizi yeteri kadar istekle yapmanızda ne derecede problem oluşturdu?

☐$_0$ Hiç problem oluşturmadı ☐$_2$ Bir dereceye kadar problem oluşturdu
☐$_1$ Yalnızca çok az bir problem oluşturdu ☐$_3$ Çok büyük bir problem oluşturdu

10 Bir yatak partneriniz veya oda arkadaşınız var mı?

☐$_0$ Bir yatak partneri veya oda arkadaşı yok ☐$_2$ Partneri aynı odada fakat aynı yatakta değil
☐$_1$ Diğer odada bir partneri veya oda arkadaşı var ☐$_3$ Partner aynı yatakta

11 Eğer bir oda arkadaşı veya yatak partneriniz varsa son bir ayda ona aşağıdaki durumları ne sıklıkta yaşadığınızı sorun.

	Haftada →	Hiç	1'den az	1 - 2 kez	3'ten çok
a	Gürültülü horlama	☐$_0$	☐$_1$	☐$_2$	☐$_3$
b	Uykuda nefes alıp verme arasında uzun aralıklar	☐$_0$	☐$_1$	☐$_2$	☐$_3$
c	Uyurken bacaklarda seğirme veya sıçrama	☐$_0$	☐$_1$	☐$_2$	☐$_3$
d	Uyku esnasında uyumsuzluk veya şaşkınlık	☐$_0$	☐$_1$	☐$_2$	☐$_3$
e	Diğer huzursuzluklarınız:	☐$_0$	☐$_1$	☐$_2$	☐$_3$

APPENDIX 8: SF-12 QUALITY OF LIFE ASSESSMENT QUESTIONNAIRE

SF-12 Yaşam Kalitesi

SF-12 YAŞAM KALİTESİ

YÖNERGE: Bu tarama formu size sağlığınızla ilgili görüşlerinizi sormaktadır. Bu bilgiler sizin nasıl hissettiğinizi ve her zamanki faaliyetlerinizi ne rahatlıkla yapabildiğinizi izlemekte yardımcı olacaktır.

Bütün soruları belirtildiği şekilde cevaplayın. Eğer bir soruyu ne şekilde cevaplayacağınızdan emin olamazsanız, lütfen en yakın cevabı işaretleyiniz.

1. Genel olarak sağlığınızı nasıl değerlendirirsiniz?

1	2	3	4	5
Mükemmel	**Çok iyi**	**İyi**	**Fena değil**	**Kötü**

Aşağıdaki maddeler normal olarak gün içerisinde yapıyor olabileceğiniz bazı faaliyetlerdir. Şu sıralarda sağlığınız sizi bu faaliyetler bakımından kısıtlıyor mu? Kısıtlıyorsa ne kadar?

	Evet, oldukça kısıtlıyor	**Evet, biraz kısıtlıyor**	**Hayır, hiç kısıtlamıyor**
2. **Orta zorlukta faaliyetler,** örneğin masa kaldırmak, süpürmek, yürüyüş gibi hafif spor yapmak	1	2	3
3. **Birkaç** kat merdiven çıkmak	1	2	3

Geçtiğimiz bir ay (4 hafta) içerisinde işinizde veya diğer günlük faaliyetlerinizde bedensel sağlığınız nedeniyle aşağıdaki sorunların herhangi biriyle karşılaştınız mı?

	EVET	**HAYIR**
4. Yapmak istediğinizden **daha azını** yapabilmek (bitmeyen projeler, temizlenmeyen ev gibi…)	1	2
5. Yapabildiğiniz iş **türünde** ya da diğer faaliyetlerde kısıtlanmak	1	2

APPENDIX 8: SF-12 QUALITY OF LIFE ASSESSMENT QUESTIONNAIRE

Geçtiğimiz bir ay (4 hafta) içerisinde işinizde veya diğer günlük faaliyetlerinizde duygusal problemleriniz nedeniyle (üzüntülü ya da kaygılı olmak gibi) aşağıdaki sorunların herhangi biriyle karşılaştınız mı?

	EVET	HAYIR
6. Yapmak istediğinizden **daha azını** yapabilmek (bitmeyen projeler, temizlenmeyen ev gibi…)	1	2
7. İş ya da diğer uğraşları her zaman gibi **dikkatlice** yapamamak	1	2

8. Son bir ay (4 hafta) içerisinde, ağrı normal işinize (ev dışında ve ev işi) ne kadar engel oldu?

1	2	3	4	5
Hiç olmadı	**Biraz**	**Orta derecede**	**Epey**	**Çok fazla**

Aşağıdaki sorular geçtiğimiz bir ay (4 hafta) içerisinde kendinizi nasıl hissettiğinizle ve işlerin sizin için nasıl gittiği ile ilgilidir. Lütfen, her soru için nasıl hissettiğinize en yakın olan cevabı verin. Geçtiğimiz 4 hafta içindeki sürenin ne kadarı:

	Her zaman	**Çoğu zaman**	**Epeyce**	**Arada sırada**	**Çok ender**	**Hiçbir zaman**
9. Sakin ve huzurlu hissettiniz?	1	2	3	4	5	6
10. Çok enerjiniz oldu?	1	2	3	4	5	6
11. Mutsuz ve kederli oldunuz?	1	2	3	4	5	6

12. Geçtiğimiz bir ay (4 hafta) içerisinde, bu sürenin ne kadarında bedensel sağlığınız ya da duygusal problemleriniz, sosyal faaliyetlerinize (arkadaş, akraba ziyareti gibi) engel oldu?

1	2	3	4	5
Her zaman	**Çoğu zaman**	**Bazen**	**Çok ender**	**Hiçbir zaman**

APPENDIX 9: CV

Kişisel Bilgiler

Adı	Didem	**Soyadı**	Apo
Doğum Yeri		**Doğum Tarihi**	
Uyruğu	T.C.	**TC Kimlik No**	
E-mail		**Tel**	

Öğrenim Durumu

Derece	**Alan**	**Mezun Olduğu Kurumun Adı**	**Mezuniyet Yılı**
Yüksek Lisans	Fizyoterapi ve Rehabilitasyon	**Yeditepe Üniversitesi**	Tez aşamasında
Lisans	Fizyoterapi ve Rehabilitasyon	**Yeditepe Üniversitesi**	2019
Lise	-	**Bursa Tunçsiper Okulları**	2014

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Görevi	**Kurum**	**Süre (Yıl - Yıl)**
Fizyoterapist	Simyfit	2019-halen

Bilgisayar Bilgisi

Program	**Kullanma becerisi**
Microsoft Office	Orta