WARDA KHALID PHYSIOTHERAPY & REHABILITATION MASTER THESIS 2023

T.C.

YEDITEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF PHYSIOTHERAPY & REHABILITATION

EFFECTS OF CORRECTIVE EXERCISES AND POSTURAL EDUCATION ON FORWARD HEAD POSTURE- A RANDOMIZED CONTROLLED TRIAL

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WARDA KHALID, PT

ADVISER
ASSIST. PROF. EBRU AKBUĞA KOÇ, PT

İSTANBUL-2023

THESIS APPROVAL FORM

Institute : Yeditepe University Institute of Health Sciences

Programme : Master’s Program in Physiotherapy and Rehabilitation

Title of the Thesis : Effects of Corrective Exercises and Postural Education on Forward Head Posture- A Randomized Controlled Trial

Owner of the Thesis : PT. Warda Khalid

Examination Date : 18.07.2023

This study has approved as a Master Thesis in regard to content and quality by the Jury.

	Title, Name-Surname (Institution)
Chair of the Jury:	Dr. Öğr. Üyesi Elif DEVELİ Yeditepe Üniversitesi
Supervisor:	Dr. Öğr. Üyesi Ebru Akbuğa KOÇ Yeditepe Üniversitesi
Member/Examiner:	Dr. Öğr. Üyesi Aybüke ERSİN Atlas Üniversitesi
Member/Examiner:	

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

With this statement, I hereby declare that this thesis is my original work and that, to the best of my knowledge and belief, I have not violated any patent and copyright laws in its conduct and its writing. I confirm that I have presented the evaluation and results in accordance with the scientific ethics and moral principles. All sources of information have been duly acknowledged and cited.

18.07.2023
WARDA KHALID, PT.

DEDICATION

“This thesis is
dedicated to my beloved
family who have always been a source of
inspiration, encouragement and strength
to undertake my higher studies and
to face the eventualities of life
with zeal, enthusiasm
and fear of
God.”

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to all those who have contributed to the successful completion of my master's thesis. Their support, guidance, and encouragement have been invaluable throughout this academic journey.

First and foremost, I am deeply grateful to my supervisor, Asst. Prof. Ebru AKBUGA KOC, for her unwavering support, expert guidance, and invaluable insights. Her dedication to my research, along with their constructive feedback and patience, has been instrumental in shaping the outcome of this thesis. I am truly indebted to her for continuous support and mentorship.

I extend my heartfelt thanks to the faculty members of Yeditepe University for their commitment to my academic excellence. Their knowledge, expertise, and willingness to engage in insightful discussions have greatly enriched my research experience. I am grateful for the opportunity to learn from their expertise and for their contributions to my intellectual growth.

In addition, I would like to acknowledge the invaluable support and understanding of my family. Their unwavering belief in my abilities, encouragement, and sacrifice have been the driving force behind my achievements. Their love and support have provided me with the strength and determination to persevere through the ups and downs of this journey.

Lastly, I extend my gratitude to the participants who generously dedicated their time and commitment to contribute to my research. Their willingness and compliance to share their insights and experiences has been integral to the success of this study.

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LIST OF SYMBOLS AND ABBREVIATIONS

CE	Corrective Exercise
CEP	Corrective Exercise Program
CG	Control Group
CGH	Cervicogenic Headache
CS	Cervical Spine
CVA	Craniovertebral Angle
ED	Electronic Devices
FHP	Forward Head Posture
FSP	Forward Shoulder Posture
LOG	Line of Gravity
MTPs	Myofascial Trigger Points
PAS	Postural Assessment Software
PE	Postural Education
QOL	Quality of Life
RCT	Randomized Controlled Trial
ROM	Range of Motion
SA	Shoulder Angle
SAI	Sub-acromial Impingement
SCM	Sternocleidomastoid
SD	Scapular Dyskinesis
SF-36	36-Item Short Form Quality of Life Survey
SPSS	Statistical Package Analysis for Health Sciences
TMD	Temporomandibular Disorders
TMJ	Temporomandibular Joint
UT	Upper Trapezius

ABSTRACT

Khalid, W. (2023). Effects of Corrective Exercises and Postural Education on Forward Head Posture- A Randomized Controlled Trial
Yeditepe University Institute of Health Sciences, Department of Physiotherapy & Rehabilitation Master Thesis, Istanbul.

Forward head posture is a common postural abnormality that can lead to musculoskeletal discomfort and impairments in daily functioning. This study is aimed to investigate the effects of a corrective exercise program and postural education on craniovertebral & shoulder angle, pain and quality of life in individuals with forward head posture. A baseline and post-intervention design were employed, and participants were included on the basis of their CVA and SA angles (≤ 50° and ≤ 52°) respectively. A total number of forty-six (n=46), (n=25 female; n=21 male) participants completed this study. Participants were randomly divided into three groups, a corrective exercise group (CE=17), a postural education group (PE=17) and a control group (CG=12). Measurements of craniovertebral angle and shoulder angles were done using photogrammetry, and self-reported pain levels and quality of life were obtained at baseline and following 6-week after the program. Participants were given comprehensive instructions about the study. CE group performed FHP corrective exercises in the form of stretching and strengthening exercises. Also, PE group followed postural guidelines and CG were given no treatment. After 6 weeks, significant increases were observed within the group comparisons for CVA (P=0.001), SA (P=0.005) and pain (P=0.001) in CE and PE groups while CG showed increase in CVA (P=0.001) and NPRS (P=0.002) but not in SA (P>0.05). Pre- and Post-measurement of quality of life (SF-36) showed no significant differences (P>0.05) except the physical functioning component for all groups (P<0.05). In conclusion, tailored corrective exercise program that utilizes different positions for the same exercises and postural awareness has been found to be effective. Thus, this program is effective in terms of improving forward head posture.

Keywords: Forward head posture, corrective exercise, postural education, craniovertebral angle, shoulder angle, neck pain.

ÖZET

Khalid, W. (2023). Baş Önde Postüre Sahip Erişkinlerde Düzeltici Egzersizler ve Postüral Eğitimin Etkilerinin Karşılaştırılması – Randomize Kontrollü Bir Çalışma
Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Fizyoterapi ve Rehabilitasyon Anabilim Dalı Yüksek Lisans Tezi, İstanbul.

Başın normalden fazla öne doğru durması, kas-iskelet sisteminde rahatsızlıklara ve günlük işlevsellikte bozulmalara yol açabilen yaygın bir postüral anormalliktir. Bu çalışmanın amacı, düzeltici egzersiz programı ve postüral eğitimin kraniovertebral açı, omuz açısı, ağrı ve yaşam kalitesi üzerindeki etkilerini karşılaştırmaktır. Dahil edilme kriterlerine uyan toplam kırk altı (n=46) (n=25 kadın; n=21 erkek) birey tedavi öncesinde ve sonrasında tek bir fizyoterapist tarafından değerlendirilmiştir. Katılımcılar düzeltici egzersiz grubu (CE=17), postüral eğitim grubu (PE=17) ve kontrol grubu (CG=12) olmak üzere rastgele olarak üç gruba ayrılmıştır. CE grubu, germe ve kuvvetlendirme egzersizlerini içerecek şekilde FHP düzeltici egzersiz programına dahil edilirken, PE grubuna postüral eğitim yönergesi verilmiştir. Ayrıca, CG'ye ise herhangi bir tedavi uygulanmamıştır. Tedavi öncesi ve 6 hafta sonra bireyler kraniovertebral açı omuz açısı, ağrı düzeyleri ve yaşam kalitesi açısından değerlendirilmiştir. Sonuç olarak, 6 hafta sonrasında grup içi karşılaştırmada; CE ve PE gruplarında CVA (P=0.001), SA (P=0.005) ve ağrı (P=0.001) açısında istatistiksel olarak anlamlı artış gözlenirken, CG'da ise CVA (P=0.001) ve NPRS'de (P=0.002) artış görülmüştür Yaşam kalitesi (SF-36) öncesi ve sonrası ölçümünde, tüm gruplar için fiziksel işlevsellik bileşeni dışında (P<0.05) anlamlı bir fark ortaya çıkmamıştır (P>0.05). Sonuç olarak, aynı egzersizler için farklı pozisyonların kullanıldığı kişiye özel düzeltici egzersiz programının ve postüral farkındalığın CVA, SA ve ağrı üzerinde etkili olduğu görülmüştür. Bu nedenle, düzeltici egzersiz programının öne doğru baş postürünün düzeltilmesi açısından etkili olabileceği söylenilebilir.

Anahtar Sözcükler: Öne doğru baş duruşu, düzeltici egzersiz, postüral eğitim, kraniovertebral açı, omuz açısı, boyun ağrısı.

1. INTRODUCTION & PURPOSE

Posture is a relative and comparative arrangement of the body parts at any one moment, is a composite of the positions in a specific direction of the different joints of the body at that time. The positioning of each joint has an impact on where the other joints are [1]. The posture that puts the least amount of stress on each joint is the ideal posture. Poor posture is defined as any static position that places extra stress on the joints. There are primarily two categories of posture [2]:

Static posture is when the body parts are positioned and kept in certain alignment. Standing, sitting, lying, and kneeling are a few examples. Dynamic posture: Walking, running, lifting, throwing and jumping are all examples of movement of the body or its parts [3].

The muscles of the head and neck are continuously contracted due to the need to maintain a stationary posture for long periods of time during various tasks [4]. Protraction and retraction movements of the neck are also carried out in the sagittal plane in addition to neck flexion and extension motions. Six percent of the body's weight is made up by the head, which is connected to the cervical spine and all other joints through the kinematic chain by a number of muscles [5].

In general, the cervical spine is lordotic, Protraction and retraction motions of the neck also occur in the sagittal plane in addition to the neck's flexion and extension movements. While protraction is a movement brought on by the extension of the upper cervical spine and flexion of the lower cervical spine, retraction happens as the upper cervical spine bends and the lower cervical spine extends. The forward head posture (FHP), which is considered to be a deviation from neutral or normal posture, can result from the cervical spine being kept in a protracted position for an extended period of time. FHP is a type of poor posture that can affect head posture [6,7].

A musculoskeletal abnormality known as forward head posture (FHP) is characterized by the head's forward position in the sagittal plane relative to the neck. It is connected to lower cervical spine flexion (C4-C7) and hyper-extension of the upper cervical spine (C1-C3) [8,9]. Adopting this posture throughout the course of everyday activities runs the risk of permanent adoption, muscle remodeling alterations, and muscle imbalances. The head displacement from the vertical mid-line may cause increase muscle contraction to maintain stability, which may limit blood flow, cause fatigue, damage tissues, and ultimately cause pain and discomfort [10].

According to researchers, the prevalence of FHP ranges from 11.4% to 67% among college-age students and from 52% to 68% among teenagers [11,12]. FHP has been linked to protracted or rounded shoulders, more pronounced kyphosis at the thoracic spine, and forward shoulder posture (FSP) [13,14]. All these postural deviations when combined, often referred to as a “slouched posture” [7]. Poor posture can have detrimental effects on one's health. Slouching or slumping over has the potential to misalign the musculoskeletal system, increase pressure on the spine, and render it more susceptible to injury and degeneration. This can lead to neck, shoulder, and back pain, along with decreased flexibility and compromised joint mobility [15,16]. Additionally, poor posture can affect balance, increase the risk of falling, and impede the digestion of food. Furthermore, it has been shown to induce breathing disorders and impact surrounding structures such as the heart and phrenic nerve [17].

Espousing this poor posture throughout the course of everyday activities runs the risk of permanent adoption, muscle remodeling alterations, and muscle imbalances. Neck functional disability and quality of life (QOL) are also significantly impacted by FHP [18]. Causes of forward head and forward shoulder posture may include excessive use of smartphones [9] and computers [19], mouth breathing, carrying heavyweight bags, rounded upper back, and rounded shoulders [20]. In addition to the handheld electronic devices, prolonged computer use has been found to be associated with the development of FHP, especially while in a hunched-over position or while seated in an uncomfortable chair, can also promote the development of FHP and FSP [21,22].

FHP can cause a number of different types of pain, including a headache, shoulder pain, neck pain, craniofacial pain, radiating pain to the scalp, and may lead to TMJ dysfunction, impingement syndrome, limited cervical spine range of motion, cervical instability, and scapular or shoulder dyskinesis [7]. As a result, it is necessary to avoid and treat this postural abnormality [20,23]. The failure to address FHP during young or middle adulthood may result in its permanent manifestation due to spinal degeneration and remodeling [24,25]. Hence, there is a pressing need for the prevention and restoration of this postural deviation since it is connected to the emergence of a number of painful medical conditions that affect the shoulders, head, and neck [20,23,26,27].

A reliable and valid clinical approach to acquiring an objective measurement of forward head posture (FHP) involves the evaluation of the craniovertebral angle (CVA) [20,28]. To obtain CVA, one can use a photograph of an individual's head and neck in the sagittal view, (Figure 1.1) which is derived from measuring the angle between the intersection of two lines drawn through specific anatomical landmarks. The first line is drawn from the tragus of the ear to the spinous process of the seventh cervical vertebra, while a horizontal line is drawn through the spinous process of the seventh cervical vertebra [28,29].

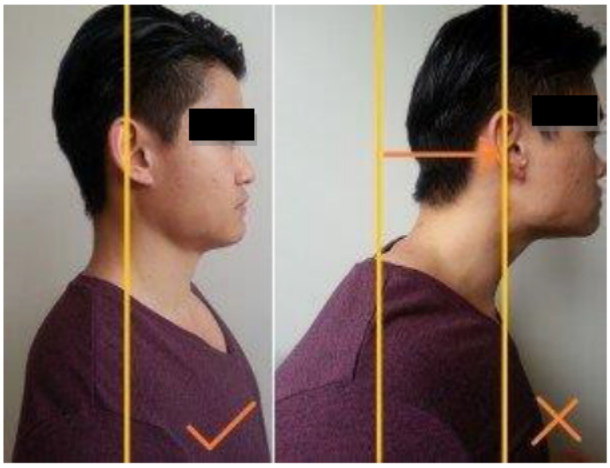

Figure 1.1. Normal vs Forward Head Posture[1]

Two most common and advantageous methods used by health and fitness professionals to address FHP include postural education (PE) and the implementation of a corrective exercise program [8,30]. Finally, based on the literature, the most rigorously researched and evidenced stretches and exercises for remedying FHP have been identified, providing an evidence-based foundation for the interventions to be integrated into the present study.

Postural education (PE) typically encompasses various topics, including the health hazards associated with forward head posture (FHP), correct postural guidelines when utilizing equipment, and recommendations for rest break frequency. By increasing an individual's awareness of the health risks associated with FHP, it can lead to better mindfulness of their body position while using computerized technology [31].

The corrective exercise protocol consisted a total of three stretching exercises and three strengthening exercises. The program was formulated based on the supposition that therapeutic exercises are efficacious in rectifying particular neck and

[1] *Adapted from, Posture Direct- How to Fix Forward Head Posture,*
https://www.posturedirect.com/forward-head-posture-correction/

shoulder postures, as supported by several academic researches [32-37]. The strengthening exercises were aimed at activating the rotator cuff, specifically the infraspinatus and teres minor, serratus anterior, the scapular stabilizers, including the trapezius (primarily the middle and lower trapezius), the rhomboids, and the deep flexors in cervical region. The stretching exercises targeted the neck muscles, pectoralis minor, sternocleidomastoid, scalenus and upper trapezius [33,34,38].

Muscle stretching is a common practice to address the adaptation of muscles to a shortened position, resulting in a reduction in muscle length. Several studies have demonstrated the effectiveness of a stretching program targeting shortened muscles in restoring neutral posture [26]. Muscle Strengthening Exercises have been shown to have a significant impact on correcting postural abnormalities associated with Forward Head Posture (FHP). FHP is known to predispose the development of underactive and overly lengthened muscle groups in the head and neck region, resulting in muscle imbalance and loss of upright head and neck posture [12,36]. The details for the exercise program and postural education guidelines are explained in Chapter 4.

The aim of this study was to evaluate the effects of corrective exercises and postural education on craniovertebral angle (CVA) and shoulder angle (SA) and their effect on pain and quality of life in people with FHP.

1.1. Research Question & Hypothesis:

H0: Corrective exercises cannot be effective for FHP, pain and improving quality of life

H1: Corrective exercises can be effective for FHP, pain and improving quality of life

H0: Postural Education cannot be effective for FHP, pain and improving quality of life

H1: Posture Education can be effective for FHP, pain and improving quality of life

2. GENERAL INFORMATION

Normal posture can be described as an alignment of the body in which the line of gravity (LOG) passes through the external auditory meatus, the cervical vertebrae, and the acromion process anterior to the thoracic spine (Figure 2.1) [34]. The internal movement created by numerous muscles and other soft tissue components around a joint often balances out the external movement caused by gravity and ground reaction forces. In order to counteract the external impact caused by gravity, which is enhanced by the displaced position of the center of gravity, it may be necessary to exert greater internal forces when having postural mis-alignments [7].

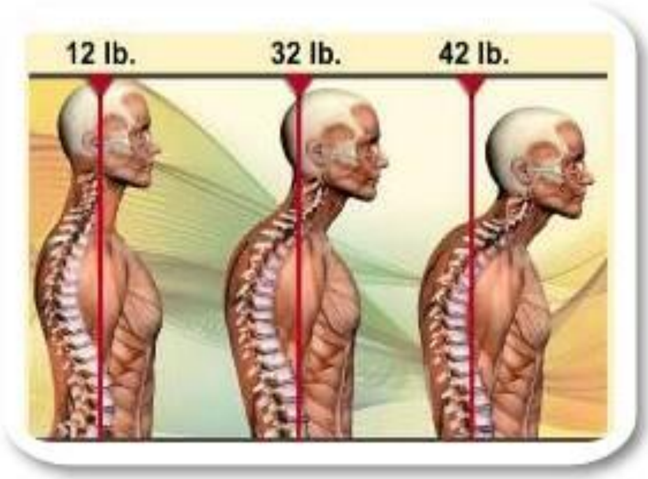

Figure 2.1. Relationship of Line of gravity and posture[2]

According to Latalski et al., posture is a muscular habit that is influenced by specific morphological and functional factors. As such, posture reflects the mechanical effectiveness of the muscular balance, kinetic sense, and neuromuscular coordination. Any deviation from these factors can lead to poor posture, characterized by an unnatural spinal position and emphasized curves that induce stress on the muscles, joints, and vertebrae. long-standing poor postures consequently result in a buildup of pressure in the adjacent structures [39].

During sitting, individuals exhibit a variety of head positions, which are influenced by several factors including age-related bodily changes, musculoskeletal

[2] *Adapted from* The Core walking "Forward head posture and your cervical spine" https://www.corewalking.com/forward-head-posture-cervical-spine/

structures, occupation, motor abilities, and cultural norms [40]. Several risk factors for postural dysfunctions include lack of knowledge about correct posture, occupational demands, sedentary lifestyles, decreased quality of life and fitness, joint stiffness, muscle weakness, lack of core stability, and inadequate ergonomic workstations. Untreated poor posture can result in stress, depression, poor breathing, problems with digestion, neck or back pain, and tension headaches [11].

Prolonged neck flexion facilitates an abnormal posture known as forward head posture (FHP), which pertains to the anterior displacement of the head relative to the shoulders. In the sagittal plane, FHP is the most common cervical postural anomaly, found with varying degrees of severity in among all populations [41,42]. Forward Head Posture (FHP) is the anterior position of the head relative to the line of gravity in the sagittal plane. This is a result of habitual postures adopted over time [34]. The postural mal-alignment of the head on the trunk imposes massive loads on the muscles and joints of the cervical vertebrae. Consequently, various musculoskeletal disorders may arise due to this misalignment [43].

FHP has been linked to greater deficits in cervical ROM, particularly rotation and flexion of neck [44]. Additionally, forward head appears to have an adverse effect on balance control in asymptomatic adults [45]. The most common areas of pain associated with poor posture include the neck (53%), wrists (33%), shoulders (38%) and lower back (63%) [46,47]. Poor posture can also impede the ability of the lungs to expand. Sustaining a fixed position for extended periods can cause the agonist muscles to tighten and the antagonist muscles to weaken, resulting in cramped posture. This can lead to other posture abnormalities i.e., thoracic kyphosis, excessive pelvic tilt, rounded shoulder, and other imbalances. Long periods of time spent sitting while using electronics like phones, laptops, and televisions or video games is a substantial risk factor for altered postural alignment [48].

Forward head position accompanied by thoracic kyphosis and anterior shoulder positions, resulting from poor sitting posture been found to be linked to altered scapular positions, kinematics, and muscle activities, which can ultimately cause pain, numbness, loss of function, and other neuromuscular symptoms that primarily affect the upper body [49].

The forward inclination of head during sitting is a result of a combination of upper cervical extension, lower cervical flexion, and rounded shoulders. Reduced muscle fiber lengths and extensor torque are caused by these variables in the area of the upper cervical joint. Furthermore, this unnatural position can result in musculoskeletal abnormalities such as reduced scapular upward rotation, increased internal rotation, and anterior tilting, which can make it challenging to maintain an upright sitting posture [40,41].

Forward Head Posture (FHP) extend to various aspects such as decreased cervical proprioception, increased reaction times, impingement syndrome of shoulder complex, thoracic outlet syndrome, and hypo-function of vestibular system. Therefore, it is evident that the FHP correction can play a significant role in preventing and managing these consequences. Several studies have shown to explore the impact of various electrotherapeutic modalities and exercises on FHP, which include exercises for stabilization of scapula, stretching and strengthening exercises, proprioceptive training, resistive band exercises, stabilization exercises for cervical spine, dynamic neuromuscular stabilization exercises and sensorimotor training thus demonstrating the positive effects of different exercises for improving FHP [38].

2.1. Conditions associated with forward head posture

Chronic Forward Head Posture (FHP) is known to potentially increase the susceptibility of various physical disorders in the human body. The most prevalent musculoskeletal conditions that are generally associated with FHP comprise of generalized neck pain, text neck syndrome or nerd neck, myofascial trigger points, headaches, shoulder abnormalities, cervical spine degeneration, spinal postural abnormalities i.e. (kyphosis), temporomandibular (TMJ) disorders, and respiratory impairments.

2.1.1. Neck Pain

Neck pain is a prevalent musculoskeletal condition that can be predisposed by Forward Head Posture (FHP) [50]. FHP is known to increase compression forces within the cervical spine (CS) and reduce pain thresholds, which can promote neck pain development. Several postural studies have provided evidence for a relationship between generalized neck pain and forward head posture in individuals who are under the age of 50. For instance, a study involving adolescents between the ages of 15-17 years found that neck pain prevalence was greater in participants with FHP than in their peers with normal posture. Similarly, two exploratory postural studies on individuals between the ages of 20-50 years revealed that subjects experiencing generalized neck pain had smaller cervical vertebral angles (CVAs) than the pain-free group, indicating a greater degree of FHP. However, a relationship between neck pain and FHP was only observed in individuals who were 50 years or younger [51].

2.1.2. Text Neck Syndrome

Physicians have observed a recent upsurge in patients, particularly young adults, who have been complaining of neck pain due to excessive use of hand-held electronic devices (ED) while the medical community has introduced the new diagnosis of "text neck syndrome" [25,52]. To describe this overuse injury or repetitive stress which is caused by sustained flexion of neck and lack of upper extremity support during repetitive finger movements on electronic devices. Several studies have established a relationship between excessive ED use and the development and severity of text neck syndrome. For instance, four studies involving college-age participants have successfully found positive association between neck pain levels and the duration of ED use [9,52-54]. Additionally, one of the studies found that students who used their EDs for more than four hours each day were 24 times more likely to experience neck pain than those who used them for less than an hour daily [55]. The weight of the head on the spine is significantly increases when a person has forward head, and its effect and the weight are progressively increased as the head moves forward to varied degrees [56]. When an individual is engaged in texting, there is a tendency of an average angle of 37-47 degrees flexion at the cervical spine. This habit, if prolonged, can trigger debilitating health consequences [57]. The findings of a study revealed that the weight of the head can increase up to “18.14 kg at 30 degrees and 22.23 kg at 45 degrees” [56]. This excessive weight can cause inflammation of the tendons, muscles, ligaments, and nerves in the neck. Moreover, it can lead to permanent arthritic damage and an augmented curvature of the spine [50]. Another study that included a wider age range of participants (11 to 61 years) reported that 10% of respondents experienced chronic neck pain, while 42% reported intermittent pain when using their smartphones for extended periods. However, this study's limitation was that the time of technology use was not objectively defined with numbers [58].

2.1.3. Myofascial Trigger Points

Myofascial trigger points (MTPs) are tender and hyper-irritable palpable nodules located within a taut band of fascia or skeletal muscle that are sensitive to applied pressure and have the ability to generate radiating pain, referred pain, and autonomic overactivity [36,59]. The pathogenesis of MTPs is thought to be due to localized hypoxia within myofascial tissue resulting from either acute trauma or prolonged muscle contractions [59,60]. Continuing to maintain forward head posture (FHP) promotes chronic low-level muscle activation and the formation of MTPs in the cranio-cervical musculature, including the sternocleidomastoid (SCM), sub-occipitals, and upper trapezius (UT) [36,61]. A study done by Ferracini et al. in 2016, concluded that the cervical posture of subjects experiencing migraines and active (painful) MTPs in the sub-occipitals, SCM, and UT was evaluated with radiographs. Greater FHP was found in subjects with active MTPs and the number of active MTPs in the cranio-cervical musculature was linked to the degree of upper cervical extension, as well as the loss of cervical lordosis [62].

2.1.4. Headaches

FHP represents the most prevalent postural deviation that increases the likelihood of developing headache [63]. FHP is associated with two types of headaches, namely, cervicogenic headaches (CGH) and tension headaches. Cervicogenic headache is a secondary headache disorder caused by structures within the cervical spine, such as vertebral discs and facet joints. Individuals with CGHs often exhibit impairments in cervical spine range of motion (ROM) [64].

FHP predisposes Tension headaches, which represent the most common and expensive form of headache [65]. Although the causes of tension headaches may be multifactorial, stress often triggers it, and a key feature is the presence of increased tenderness to peri-cranial myofascial tissue [63]. Individuals who experience Tension headaches commonly present with active MTPs in the upper trapezius (UT) and suboccipital muscles, which are associated with FHP [65]. Two research studies conducted on adults diagnosed with chronic Tension headaches support the relationship between FHP and chronic Tension headaches. In one of these studies, the head posture of participants experiencing chronic Tension headaches was compared to a control group of headache-free subjects [65] while in the second study, postural comparisons were made to a group of individuals experiencing episodic Tension headaches [63]. After analyzing CVAs, it was discovered that participants with chronic Tension headaches demonstrated greater FHP compared to headache-free individuals as well as those experiencing episodic tension headaches [63,65,66].

2.1.5. Shoulder Abnormalities

Forward Head Posture (FHP) is accompanying by a number of shoulder abnormalities, including Forward Shoulder Posture (FSP), Scapular Dyskinesis (SD), and Sub-acromial Impingement (SAI) [6,67].

2.1.5.1. Forward Shoulder Posture

The occurrence of forward shoulder posture (FSP) might be associated with various factors, including carrying heavyweight backpacks, repetitive overhead activity, computer or laptop use, and sitting for prolonged study hours [25,68,69]. FSP is identified by protracted scapulae in conjunction with rounded shoulders held in internal rotation [25]. FSP can cause muscle imbalance, resulting in the lengthening of the posterior shoulder muscles, including the rhomboids, middle and lower trapezius, and pectoralis minor and major, and the shortening of the anterior shoulder muscles serratus anterior and upper trapezius [14]. Muscle imbalances as such can impact the not only the orientation of but the kinematics of shoulder joint complex and scapula, thereby elevating the risk for the development of non-specific arm pain, shoulder pain, and neck pain [70]. Moreover, this can result in a reduced ROM and motor function loss, as reported by Singla et. al in a systematic review done in 2017. The study highlighted that reduction in the length of pectoralis minor muscle can cause scapular kinematics alteration, leading to sub-acromial impingement syndrome. “Patients with subacromial impingement present scapular abduction, elevation, anterior tilting, and internal rotation, which is similar to postural alterations occurring with FSP” [7]. It has been found that protracted shoulder impairs the brachial plexus cords, elevating strain on nerves passing through the upper extremity, particularly the median nerve [71]. Additionally, malposition and pain of coracoid process along with scapular and shoulder dyskinesis, and prominence of the inferomedial border of the scapula have been reported, defined as “SICK scapula” [72].

2.1.5.2. Shoulder Dyskinesia

Shoulder Dyskinesia (SD) is characterized by altered movement patterns of the scapula, which can lead to shoulder injury due to excessive upward rotation and anterior tilting. During the active shoulder movements, an abnormal control of the trapezius and serratus anterior muscles has been found to be associated with SD [73]. Studies utilizing electromyography demonstrated a relationship between altered neuromuscular activity and forward head posture in these two muscles. Hyperactivity in the upper trapezius was observed in individuals with FHP who performed overhead activity or resisted shoulder flexion between the angle range of 30-120°, while hypoactivity of the SA was observed during these same two conditions [6,73].

2.1.5.3. Sub-acromial Impingement

FHP has also been linked to an increased risk of developing subacromial impingement (SAI) which is the most common shoulder disorder, predisposes individuals to pathologies such as tendinitis, bursitis, and rotator cuff tears. SAI is linked with reduced space between the head of humerus and the acromion process of the scapula [74]. Several studies have provided support for a relationship between SAI and FHP. Individuals who maintain a slouched body position when using EDs and computers for extended periods commonly develop both FHP and FSP. Further research is necessary to investigate sex influences on postural SAI, as well as to explore other potential sub-group influences. The results of three experimental studies involving healthy volunteering adults offer substantiation for a correlation between FSP and a decrease in shoulder range of motion [75]. Each participant's maximum active shoulder flexion (MASF) was assessed in an upright and slouched position while either sitting or standing. In both sitting and standing conditions, the maximum active shoulder flexion was reduced when subjects slouched. These outcomes are significant in demonstrating the detrimental effects poor posture can have on joint mobility [74-76].

2.1.6. Cervical Spine Degeneration

Spinal degeneration is characterized by the deterioration of anatomical structures due to abnormal stresses, strains, and alterations in spinal curvature. Studies have shown that sustained FHP hyper-extends the upper cervical spine, reduces the natural lordotic curvature in the lower cervical spine, and promotes cervical spinal degeneration [77].

This negative cascade of events restricts movement within the vertebral facet joints, leading to neck stiffness and degenerative changes such as cervical spondylosis, disc herniation, and osteoarthritis [78]. Research has also established a clear relationship between cervical spine degeneration and aging, with older adults being more susceptible to sagittal alignment changes in the cervical spine. Positive correlations have been found between cervical disc degeneration and loss of cervical lordosis in individuals between the ages of 19-93 years [61].

Prior to the advancement of medical technology, degenerative changes of the cervical spine were not frequently observed in younger age populations. However, recent studies have demonstrated an association between excessive mobile electronic device use and early onset of cervical spine degeneration in young adults [79].

2.1.7. Spinal Postural Abnormality (Thoracic Kyphosis)

Increased thoracic kyphosis is widely recognized as one of the most commonly observed abnormalities in individuals, often found in association with other disorders such as low back pain, lumbar lordosis, and osteoporosis, among others [7]. Increased thoracic kyphosis results in the shortening of upper abdominal muscles and the anterior longitudinal ligament of the spine, leading to compression of the anterior aspect of vertebral bodies and increases the intra-discal pressures. Moreover, the extensor muscles and posterior ligaments located within the dorsal spine are stretched in addition to the capsules of the facet joints and the posterior fibers of the annulus fibrosus [2]. This chronic muscle imbalance resulting from FHP is a risk factor for a more distinct spinal postural deformity like kyphosis [80].

2.1.8. Temporomandibular Disorders

Temporomandibular disorders (TMD) refer to a specific category of orofacial anomalies that entail craniofacial pain and/or limited mandibular mobility due to impairments in one or both temporomandibular joints [81]. While diverse factors, such as bruxism, facial asymmetry, psychologic stress, and changes in dental occlusion, can instigate TMD, mounting evidence advocates for forward head posture (FHP) as a significant contributing factor, FHP is linked to abnormal "length-tension relationships in the head and neck musculature" [23,25]. which impairs the functioning of mechanical structures [81]. Evidence substantially supports the association between FHP and TMD across various age groups. Children with FHP reportedly have almost three times higher TMD prevalence than children with normal head posture [81-83]. In various studies involving adolescents, over half of the participants experiencing muscular-related TMD also exhibited FHP compared to the healthy controls [23,82,83]. Furthermore, a comparison of cervical spine radiographs of young adults with and without TMD revealed greater anterior translation distances between C2-C7 vertebrae (indicating greater FHP) in those with TMD than in age-matched peers without TMD [81].

FHP causes excessive tension in the suprahyoid musculature, which can disturb the normal resting position of the hyoid bone mandibular condyle and the "location where the upper and lower teeth come together"[83]. Moreover, muscular imbalances in the head and neck can trigger the formation of MTPs, which are contributory to the development of facial pain [25].

2.1.9. Respiratory Impairments

The Forward Head Posture has also been found to hinder the respiration by decreasing the activity and mobility of the diaphragm muscle, leading to a reduced inspiration and expiration [84]. Supported by multiple studies, FHP leads to reduced diaphragmatic activity causes an overuse of accessory respiratory muscles, such as the SCM, which contributes to the abnormal elevation of the upper thoracic cavity during inspiration [25,55,84]. Additionally, FHP was negatively correlated with rib mobility in the transverse, frontal, and sagittal planes during inhalation [85]. Another study observed lower predicted forced vital capacities and decreased predicted forced expiratory volume at one second in individuals with FHP compared to age-matched controls with normal head posture [86].

2.2. Craniovertebral Angle

The craniovertebral angle (CVA) was initially defined in 1937 by Wickens and Kipputh, and has since been recognized as the standard for a sagittal plane measurement of the head and neck posture [87,88]. While x-rays offer greater clarity for landmarks used in CVA assessment, this method is not preferred for postural analysis in clinical settings due to cost, time, and radiation delivery [10,89]. The most common method of CVA assessment, utilized in both research and clinical practice, involves the use of lateral-view photography. This method has been shown to be both reliable and valid for objective CVA measurement when compared to radiographic methods [10,29,89,90]. According to a research by Kim et al., there is a significant correlation between the degree of the FHP and the craniovertebral angle (CVA), which may be used to estimate the functional impairment of the neck as a result. Additionally, it was said that the CVA is connected to the way in which neck pain manifests itself and that the degree of functional incapacity is proportional to how bad the pain is. As a result, there is a close associated of FHP with the functional limitations and the manifestation of pain which can also determine by CVA [91].

CVA is measured by the intersection of a horizontal line passing through the spinous process of the C7 and another line drawn from the tragus of the ear to the C7 in the sagittal plane. (Figure 2.2) However, due to the lack of a standardized protocol for CVA assessment there are substantial inconsistencies in the literature regarding guidelines for subject body position during photography [10,92].

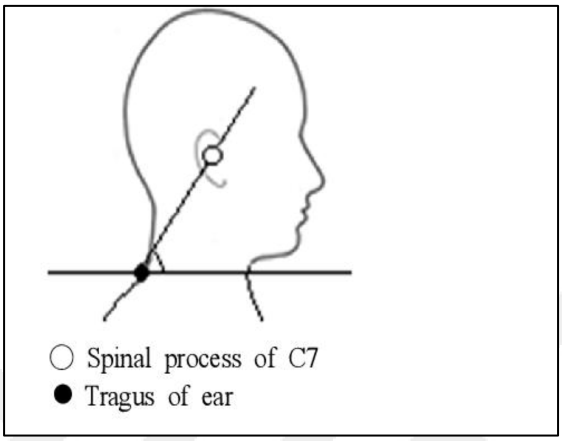

Figure 2.2. Craniovertebral Angle Measurement (CVA) [93]

The utilization of CVA cut point values as a criterion for the classification of head posture has been found to vary across different research studies. In order to denote a "normal" head posture, some studies have identified CVA values greater than 53°, [94] while others have reported values of equal to or greater than 55° [11]. The range of CVAs indicating FHP has been identified as being between less than or equal to 44° [37] to 54° [95]. It should be noted that there is diversity in subcategories of FHP, as moderate FHP has been documented to range between 40° to 48° or between 50-54° [11,94]. Meanwhile, According to Salahzadeh (2014), severe FHP has been identified as CVAs less than 40°, Dehqan (2020), suggests CVA cutoff value less than 45° and Ramalingam (2019), proposed less than 50° CVA is considered FHP [11,75,94]. The presence of a CVA less than 50° has been linked to an increased risk for pain and pathology in the cervical spine [20]. Failure to prevent or treat FHP can lead to negative impacts on anatomical structures within the cervical spine, as well as in the superior and inferior regions [24,25].

2.3. Shoulder Angle

The lack of alignment between the vertical axis of the body and the head can result in subsequent mal-alignments, FHP and an increased thoracic kyphosis, in order to recompense for the altered line of gravity. It can ultimately lead to additional impairments such as rounded shoulders [7]. A protracted shoulder (PS) or forward shoulder posture (FSP) which is a forward displacement of the acromion with respect to the seventh cervical spinous process and can be measured by forward shoulder angle. It is commonly accompanied by shoulder changes that can cause pain, as well as protracted, anteriorly inclined, and internally rotated scapula, as well as a tightness of the pectoralis minor muscle [20,96]. The misalignment of the shoulders leads to an upsurge in torque production caused by gravitational forces. However, this is balanced out by the amplified internal forces generated by the muscles and other soft tissues surrounding the shoulder [2]. The shoulder angle (SA) is established at the confluence of a line that connects the horizontal line that passes through the midpoint of the humerus and the spinous process of C7 vertebrae. FSP is considered if the angle was 52° or less [12]. (Figure 2.3)

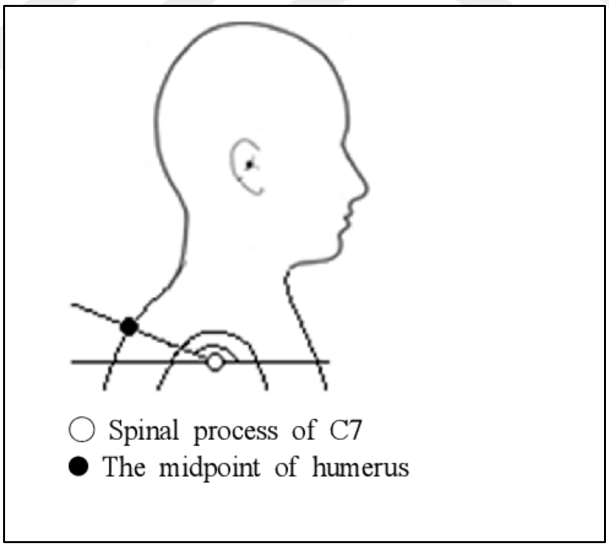

Figure 2.3. Shoulder Angle Measurement [93]

2.4. Neck Pain

Neck pain has always been a prevalent issue among the population and has significant impact on people, their families, communities, businesses and healthcare systems [100]. In general, neck pain can occur as high as 86.8%, and it is characterized by episodic incidences with various recovery rates between episodes. Furthermore, it is considered the most obstinate and long-lasting musculoskeletal pain syndrome [101]. Neck pain can be attributed with various conditions such as neurological and other musculoskeletal problems, infections, tumors, fractures of the cervical spine, or it can be idiopathic (neck pain without any known cause) [102].

The prolonged upkeep of a forward-head posture and repetitive movements are significant factors associated with neck pain [103]. The increased utilization of new information and communication technologies has led to more time spent on mobile phones or computers, while assuming poor postures for prolonged periods of time, may have a long-lasting effect on neck pain, likely due to neck flexion for prolonged hours [53].

The scale used in this study is called numeric pain rating scale (NPRS). This scale is easy to administer and score and, as a result, is commonly used as a pain measure in the clinical settings and also in the research settings [104].

2.5. Quality of life (QOL) measurement

The short-form health survey has gained widespread usage as one of several measures employed in research pertaining to health-related quality of life [97]. In general medical practice, it is considered a self-administered questionnaire, which has demonstrated stability of psychometric measures for patients [98]. SF-36 scores have been observed to be closely associated with physician’s perceptions of symptom severity. The clinical soundness of the scores has been established by evident contrasts in self-reported health status between the general populace and individuals with prevalent medical conditions [97].

The SF-36 questionnaire comprises 36 items and is designed to evaluate an individual's self-perceived health across eight discrete domains. The questionnaire further generates corresponding scales for each of these domains. Functional status is represented by four scales, while well-being is represented by three. The other domain pertains to the general health of an individual. The assessment of functional status comprises four scales, namely physical functioning which denotes constraints in physical activities due to health problems, social functioning which denotes limitations in social activities due to either physical or emotional problems, physical role which refers to limitations in activities attributable to physical health issues, and emotional role which pertains to limitations in activities due to emotional problems. On the other hand, well-being is measured through three scales, namely mental health, vitality which is associated with energy and fatigue, and bodily pain. The general health scale is used to provide an overall evaluation of health. Each scale generates a score ranging from 0 (worst health) to 100 (best health) [99].

2.6. Interventions for FHP

Debates continue to persist among health and fitness professionals regarding the most effective approaches to address forward head posture (FHP). Two prevalent methods include postural education (PE) and corrective exercise program (CEP), as evidenced by various studies [8,25,30,36]. On the other hand, PE constitutes an ergonomic intervention that involves raising awareness of risk factors and offering postural recommendations when working with equipment or devices [31].

Maintaining an upright and neutral position can serve two important functions. First, it has the potential to reduce the loads placed on the joints cervical spine that are caused by poor head postures. Secondly, this practice can train the deep stabilizing muscles of the spine to improve the ability to support static and dynamic postures. Therefore, adopting a correct head position is a commonly employed method for treating neck and shoulder pain [105]. Additionally, different sitting positions can result in varying shoulder kinematics and muscle activities. Notably, it can reduce upper trapezius activation. Previous research suggests that achieving a neutral upright posture without manual or verbal feedback can be challenging [106]. Hence, this study has established evidence-based recommendations for posture and implemented weekly assessments to ensure adherence to these guidelines.

Recent research suggests that there is a correlation between the position of head and neck with other musculoskeletal disorders. As a result, it has been postulated that correcting posture by treating forward head posture (FHP) may be an effective strategy for managing these conditions [107]. Various interventional approaches, including movement control exercises, muscle stretching, strengthening have been proposed for the treatment of FHP. Additionally, several investigations have revealed that corrective exercise regimens can result in the improvement of Forward Head Posture (FHP) and its associated symptoms. In particular, exercise training protocols have been found to be efficacious in improving craniovertebral angle, head tilt, cranial or cervical range of motion, neck disability, and pain. Additionally, enhancing the effectiveness of exercise training for FHP can be achieved by engaging in physical activities that target other adjacent body segments to the cervical spine, such as the thoracic spine [8].

An ideal head posture was found to improve muscular activity and shoulder kinetics in individuals with forward head posture with protracted shoulders during an overhead reaching task [93]. Prior research has highlighted the significance of serratus anterior, upper trapezius, and lower trapezius activities in individuals with FHP and PS. The SA, in particular, is responsible for controlling various movements, such as upward or downward rotation and anterior or posterior tilting of scapula. Furthermore, it has been observed that both forward head posture (FHP) and protracted scapula (PS) can contribute to thoracic kyphosis, which can lead to a reduction in upward scapular rotation. This can result in abnormal scapular movement, which requires the serratus anterior (SA) to increase its activity to counteract the passive tension around the scapulae [73].

In contrast, trapezius activity is typically elevated in individuals with FHP. This is due in part to the shortened, tense levator scapula muscle that is commonly observed in these individuals. Given that the levator scapula and trapezius muscles are responsible for antagonistic and agonistic actions during scapular upward rotation, respectively, compensatory activation of the trapezius is necessary to offset the abnormal mechanisms caused by the forward head posture. Furthermore, in conjunction with the serratus anterior, the trapezius can produce a coupling force that alters movement patterns, leading to excessive upward rotation and anterior tilting [6].

In summary, the outcomes of this research uphold the concept that different head positions may engender dissimilar impacts on head and shoulder kinetics and muscular activity. Notably, postural modifications linked to Forward Head Posture (FHP) can considerably alter scapular kinetics and muscle activities among affected persons. Therefore, a successful treatment for FHP involves a combination of postural education aimed at encouraging correct posture, along with strengthening of the deep cervical flexors and scapular stabilizers, as well as stretching the shortened muscles such as levator scapulae, upper trapezius, sternocleidomastoid and pectorals. [27,73].

As supported by various studies, the implementation of this particular management approach has been recommended as a means to correct postural alignment [12]. The current study is opted for a 6-week intervention program. As other studies have also been conducted to assess whether a shorter duration of intervention can still yield comparable results with other studies which considered longer durations [108]. It is to be noted that no previous study has explored the effects of a 6-week exercise training program that is customized and flexible in means of exercise positions and timetable for the participants, and covers multiple aspects of FHP and its effect on pain and quality of life, making this study unique in its approach.

Gaps within the existing literature are prevalent with regards to the practical knowledge of the optimal intervention for the adult population who have forward head posture and are at risk of developing future pain and/or pathology. As reported by Titcomb (2022), the influence of postural education on the craniovertebral angle (CVA), is suboptimal as compared to an exercise program.[25] This study aims to identify the optimal exercise program encompassing various recommended positions from the existing literature, allowing participants to perform it conveniently and flexibly. The objective is to compare and contrast the program's effects on CVA, SA, pain and quality of life.

3. MATERIALS AND METHODS

3.1. Study Design

A prospective, randomized controlled trial (RCT) design was utilized to assess the effects of correctives exercises (CE) and postural education (PE) on craniovertebral angle (CVA), shoulder angle (SA), pain and quality of life (QOL) in participants with forward head posture. The study was conducted for 6-weeks. Participants were randomly divided into three parallel groups, a corrective exercise group (n=17), or postural education group (n=17), and or a control group (n=12).

3.2. Participants

This study included 56 volunteer participants between 20-40 years of age with forward head posture (FHP). The rationale behind selecting this age group is due to a lack of literature in this specific age range. Additionally, selecting this age group allowed for a targeted examination of musculoskeletal issues without the confounding factors associated with younger or older populations

3.2.1. Inclusion Criteria

- Volunteer participation in the study.
- Young & middle-aged adults between the ages of 20-40 years.
- Craniovertebral angle, less than or equal to 50° [28].
- Shoulder Angle less than or equal to 52° [29].

3.2.2. Exclusion Criteria

- History of Trauma.
- Acute Neck Injuries i.e., Whiplash.
- Surgical history.
- Diagnosed balance disorders.
- Aggressive structural abnormality e.g., scoliosis, kyphosis.

3.3. Ethics

The study protocol was approved by Marmara University (Faculty of Health Sciences) Ethical committee (Protocol number: **“56-2023”),** and all procedures used in this study were completed under the declaration of Helsinki. The clinical trial is recorded in the ClinicalTrials.gov with the following registration number **NCT05894941**. The participation in this study was voluntary. The study objectives and methodology were clarified and explained, and after adequate information, written consent, was obtained from every participant.

3.4. Sample Size

The sample size of this study was determined utilising G*Power version 3.1.9.7, (Heinrich-Heine-Universität Düsseldorf, Düsseldorf Germany) software. Based on calculated results, a sample size of at least 42 participants is necessary for 80% power (1-β = 0.80) with an effect size of d = 0.5, [25] and an alpha level (type I error) of 0.05. For matched pair t-test a sample size of at least 19 participants is necessary for 80% power (1-β = 0.80) with an effect size of d = 0.6, [25] and an alpha level (type I error) of 0.05.

3.5. Intervention

The participants who were assigned in the intervention/exercise group commenced a 6-week program that encompassed both stretching and strengthening exercises. The participants were advised to exercise 3-5 times a week.

3.5.1. Muscle Stretching

The most common form of stretching prescribed for postural abnormalities is static stretching, which involves holding a muscle and its connective tissues in a lengthened state to improve flexibility and joint range of motion [26]. It is recommended to hold a muscle in a lengthened end-range state for 20 to 30 seconds, for one to four repetitions. The frequency of static stretching required to produce chronic mobility changes remains uncertain due to influencing variables such as age, activity level, shape of surrounding joints, and the degree of muscle length and tension. However, improvements in flexibility and ROM have been demonstrated in static stretching frequencies ranging from three to seven days per week [25,32]. (Table 3.1)

3.5.1.1. Scalene & Upper Trapezius Stretch

The scalene are a set of three pairs of muscles in the lateral neck: scalenus anterior, scalenus medial, and scalenus posterior. The trapezius is a large, flat, superficial muscle stretching from the cervical to thoracic area on the posterior portion of the neck and trunk. [109]. Scaleni and upper trapezius stretches are aimed relieving tension in neck and upper back. It is an effective technique to address FHP, cervical dysfunction and neck pain. [110].

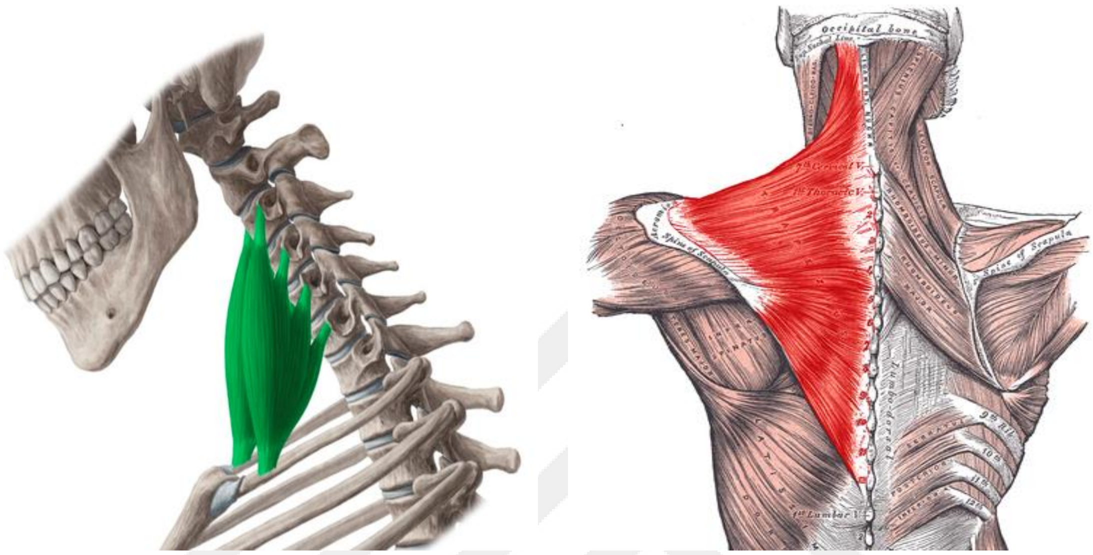

Figure 3.1. Scalene & Trapezius[3]

3.5.1.2. Sternocleidomastoid Stretch

A paired superficial muscle known as the sternocleidomastoid (SCM) is located at the front of the neck. It has two heads that project from the medial third of the superior surface of the clavicle and the anterolateral side of the manubrium, respectively, and insert on the lateral surface of the mastoid process. [111]. It flexes the head and rotates it towards the opposite side. When both muscles act together it flexes the neck and extends the head. In FHP, the superior aspect of the SCM translates forward to become vertically aligned over the anterior aspect of the clavicle. This changes the angle of the SCM, puts it on slack, and increases shortening therefore, it is logical to include stretching of SCM.

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[3] **Note:** *Adapted from Scalene, Trapezius by Physiopedia,* https://www.physiopedia.com/Trapezius?utm_source=physiopedia&utm_medium=search&utm_campaign=ongoing_internal,https://www.physiopedia.com/Scalene?utm_source=physiopedia&utm_medium=search&utm_campaign=ongoing_internal

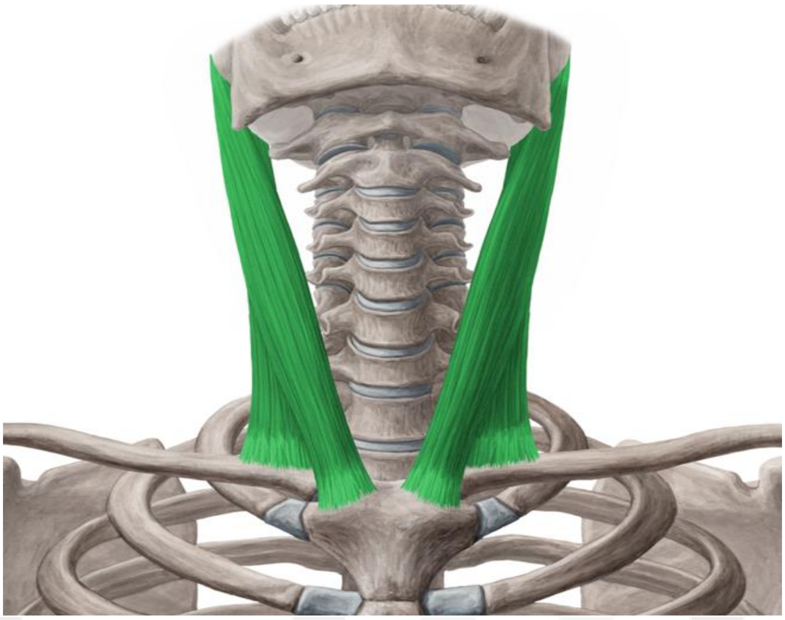

Figure 3.2. Sternocleidomastoid[4]

3.5.1.3. Pectoralis Minor Stretch

The pectoralis minor, possessing a triangular shape, is situated beneath the pectoral major and together they constitute the anterior wall of the axilla. Its origin is from the margins of the third to fifth ribs, in close proximity to the costo-chondral junction. The principal functions of this muscle involve stabilizing, depressing, abducting or protracting, internally rotating, and downward rotation of the scapula [109]. A shortened pectoral minor restricts shoulder flexion by limiting scapular rotation causing forward shoulder pulling leading to rounded shoulders, FHP and impingement syndrome [7,73].

[4] **Note:** *Adapted from kenhub, by Yousun Koh, 2023,*
https://www kenhub.com/en/library/anatomy/sternocleidomastoid-muscle

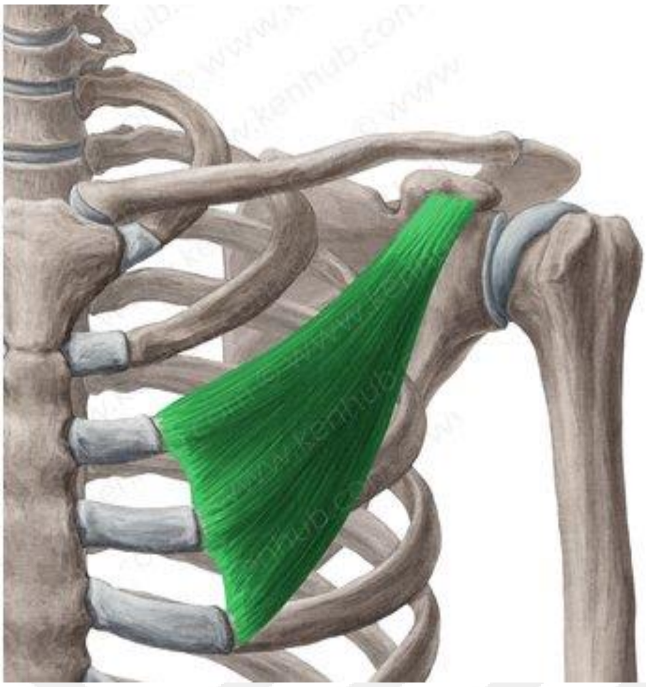

Figure 3.3 Pectoralis Minor[5]

Table 3.1. Description and Instructions of Stretching Exercises

Exercise	Principal Muscle	Description
• Scalene & Upper Trapezius Stretch	▪ Scalene & Upper Trapezius	▪ Do it either in a sitting or standing position. Put one hand behind your back and the other on the opposite side of your head. Now lower the head so that it rests on your shoulder. To get a deeper stretch, gently press your head down with the hand on top. Aim for 2-3 repetitions while holding the position for 20–30 seconds on each side.
• SCM Stretch	▪ Sternocleidomastoid	▪ Bring your ear down to your shoulder and place one hand on the side of your head that is opposite it. Leaning your head forward, scan the ceiling. To increase the stretch, pull your head back with your hand. Aim for 2-3 repeats while holding for 20–30 seconds then switch sides once again.
• Unilateral/Bilateral Pectoral Stretch	▪ Pectoralis minor	▪ Approach a wall with one arm extended behind you, palm facing the wall at a 90° angle. Lean forward and away from the outstretched arm slightly at this point. Your chest should feel stretched. Aim for 2-3 repeats while holding for 20–30 seconds. Do this stretch bilaterally

[5] **Note:** *Adapted from Kenhub by Carolyn Perry, 2022,*
https://www kenhub.com/en/library/anatomy/pectoralis-minor-muscle

3.5.2. Muscle Strengthening

Numerous studies have investigated the potential benefits of exercises focused on strengthening elongated muscles, with results indicating that such exercises can help improve length-tension relationships and enhance muscle force production [45,112] (Table 3.2).

3.5.2.1. Chin Tuck Exercise

Chin tucks, also known as cervical retraction exercises, are often employed to correct neck posture and strengthen the musculature that supports the cervical spine. The Longus Capitis and Longus Colli muscles, which are deep flexors in the upper cervical area, are primarily targeted by this exercise. [12]. The postural deviation linked with FHP at the atlanto-occipital and atlanto-axial joints is commonly accompanied by the flattening of the lower cervical spine, as well as possible reversal of mid cervical lordosis. This particular position leads to joint dysfunction that ultimately results in the manifestation of abnormal afferent information, which directly and indirectly affects the tonic neck reflex while encouraging the gradual adoption of FHP [113].

Chin tuck is a low-intensity exercise which includes holding inner-range cranio-cervical flexion postures that specifically engage and activate the deep cervical flexors. To correct FHP and to reduce compression on cranio-cervical structures, chin tucks are the most frequently recommended postural exercise [113]. Chin tucks can be done in a seated, standing or in supine position [114,115].

3.5.2.2. YTWL Exercise

The YTWL exercise comprises a sequence of maneuvers that specifically aim to target the musculature of the shoulders and scapular region. The exercise entails executing four distinct arm orientations, each denoted by a corresponding alphabetical letter in the exercise name: Y, T, W, and L. These movements contribute to improving postural alignment, strengthening the muscles surrounding the scapulae, and enhancing the stability of the upper body.

This set of exercises activates and engage a whole or parts of the different muscles surrounding the shoulder and scapular region. The W and L exercises were found to activate the lower trapezius to a great extent, with some contribution from the upper trapezius. The T exercise, on the other hand, resulted in high activation levels of supraspinatus all three parts of the trapezius and the. Y exercise highly activates serratus anterior. In conclusion, YTWL exercises have the potential to strengthen the rotator cuff partitions and periscapular muscles [116].

3.5.2.3. Resisted Neck Extensions

The deep neck extensors are responsible for providing stability and control for the neck. These muscles include the Semispinalis Cervicis, a cervical extender that helps to maintain proper head posture, and the Multifidus, a segmental stabilizer for the spine [117]. Together with the deep neck flexors, these muscles serve to provide posterior cervical lordosis support, preventing a forward head posture. Along with the deep cervical flexors, they have the anatomical capacity to control segmental motions of the cervical spine. The neck extensors play a crucial role in neck controlling the head, which has an average weight of 4.5 kilograms, and therefore, requires adequate muscular strength [118].

Several studies show that resisted neck extensions improve ROM, function, neck disability, CVA, and muscle strength. It can also help with chronic mechanical neck pain. [118-120].

Table 3.2. Description and Instructions of Strengthening Exercises

Exercise	Principal Muscle	Description
▪ Chin tucks	▪ Longus Capitis ▪ Longus Colli	▪ Put 2 fingers at the bottom of your chin. Retract your head back and gently tuck your chin in. Use your fingers to keep the chin tucked in the entire time while doing this. Hold this position for 3-5 seconds. Relax your neck for a moment (Let the neck come forward). -Aim for 2-3 sets of 10-15 repetitions. -Do it either standing, sitting or lying in the bed.
▪ YTWL Exercise	▪ Rhomboids ▪ Middle Trapezius ▪ Lower Trapezius ▪ Posterior Deltoid ▪ Rotator Cuff (Supraspinatus) ▪ Serratus Anterior	▪ Can be done either standing or prone lying. Raise your arms straight to make a 'Y' Lower your arms to 90° to make 'T' with your body. Bent your elbows & tuck your arms close to your torso to make a 'W'. Now straighten your elbows to 90° to make 'L', keeping your arms tucked. -Hold each position for 5-10 seconds -Aim for at least 10-15 repetitions.
▪ Resisted Neck Extensions	▪ Middle trapezius ▪ Lower trapezius ▪ Serratus anterior	▪ Put the palm of your hand against the back of your head (Use either one or both hands). Press your head against your hand while resisting the movement with your hand/s. Hold this position for 5-10 seconds. -Aim for 2-3 sets of 10-15 repetitions.

3.5.3. Postural Education

The primary posture-related health risks that are addressed in PE are musculoskeletal disorders of the spine and extremities. Postural guidelines for EDs include sitting or standing in an upright position and to avoid slumping, elevating the device towards the face to prevent bending the head forward, and supporting the elbows either on an armrest, thighs or table while sitting [121].

To reduce muscular fatigue, relieve pressure on inter-vertebral discs, and avoid repetitive motion injuries in the hands, it is recommended to take rest breaks between prolonged sittings and using devices [50]. A rest break of 20 minutes is suggested to avoid the fatigue onset in muscles surrounding shoulder and cervical spine. Guidelines for computer-based work include standing up for a short (30-180 second) rest break after 20 minutes of seated computer use to help alleviate musculoskeletal discomfort. Adding one to two minutes of walking during the rest break is also encouraged to help reduce musculoskeletal symptoms and mental fatigue by facilitating blood flow [122].

PE has been shown to be an effective means of improving FHP posture. The participants in the PE group followed the guidelines while sitting for long hours and using mobile devices, laptops and computers [31,123]. (Table 3.3, 3.4) In general, any activity that promotes FHP can be corrected using these postural guidelines.

Table 3.3. Postural Guidelines for Computer Use (Desktop)

Body Region	Postural Guidelines
▪ Head	▪ Head should be positioned vertically over the spine with the neck in neutral rotation (looking straight ahead). Eyes should be at same height as top of the monitor.
▪ Spine	▪ Sit up straight in the chair. The low back should rest against the backrest of the chair and should be supported by the chair or a lumbar pad. Slouching on the armrests should be avoided.
▪ Shoulders	▪ Shoulders should be relaxed in a neutral position (not elevated by the arm rest) resting against the backrest of the chair. Upper arms should rest at the side of the body
▪ Forearms/ Elbow	▪ Forearms should rest lightly on the armrests if present, parallel to the floor with elbows flexed at 90 degrees.
▪ Wrist	▪ Wrists should be maintained in neutral position if possible (avoiding exaggerated extension or flexion). Resting the hand on the mouse when not in use should be avoided.
▪ Hips	▪ Hips should be flexed at 90 degrees and thighs should be parallel to the floor.
▪ Knees	▪ Knees should be flexed 90 degrees and level with the hips. The back of the knees should be 2-3 inches away from the end of the seat.
▪ Feet	▪ Both feet should rest level on the floor. A footrest should be used if the feet do not touch the floor.

Note: Adapted from “Prevention: Computers,” by National Institutes of Health, 2021, https://ors.od.nih.gov/sr/dohs/HealthAndWellness/Ergonomics/Pages/prevention.aspx# Computers.

Table 3.4. Guidelines for using hand-held devices and prolonged sitting

Guidelines	Description
▪ Guidelines for using Smartphones and other handheld devices	▪ To avoid slouching or awkward postures, sit or stand in an upright position ▪ Instead of bending the head, raise your device to your eye-level. ▪ When sitting, support your elbows on an armrest, thighs or a table. ▪ Avoid static postures for prolonged periods.
▪ Guidelines for using Laptops and Tablets	▪ Use a desk and desk chair to utilize the same body posture as a desktop computer. Use of a laptop stand or angled riser to improve head and neck posture ▪ Use of wireless keyboard to enhance wrist posture. ▪ Avoid using a laptop in awkward or un-supported positions such as the couch, bed, or floor.
▪ Guidelines for Rest Breaks	▪ To avoid the onset of fatigue in the shoulder and neck muscles caused by the prolonged use of smartphones and other mobile devices, it is recommended to take a break every 20 minutes. ▪ During this break, it is advisable to focus your eyes on objects that are at least 20 feet away for a minimum of 20 seconds to prevent eye strain and headaches. ▪ If during the use of such devices, your neck was flexed downwards, it is strongly recommended to take a 20-minute rest break while maintaining a neutral posture, i.e., looking straight ahead, to aid in the recovery of the fatigued neck muscles.

3.5.4. Control Group

Following the initial assessment of baseline CVA, SA, QOL and Pain, the participants assigned to the control group (CG) were notified that, they will not receive any intervention. They were instructed not to initiate any new exercise regimen or to make changes to their existing physical activity level for the duration of the next six weeks.

3.6. Consort Flow Chart

Participants were recruited between January 2023 and March 2023. The study was carried out for 6 weeks. The participants in the corrective exercise group performed FHP corrective exercises 3-5 days a week while the participants in the postural education group followed the postural guidelines which were provided to them via email in a form of a pamphlet. The participants meeting the inclusion criteria were divided randomly and equally into three groups. Written informed consent was obtained.

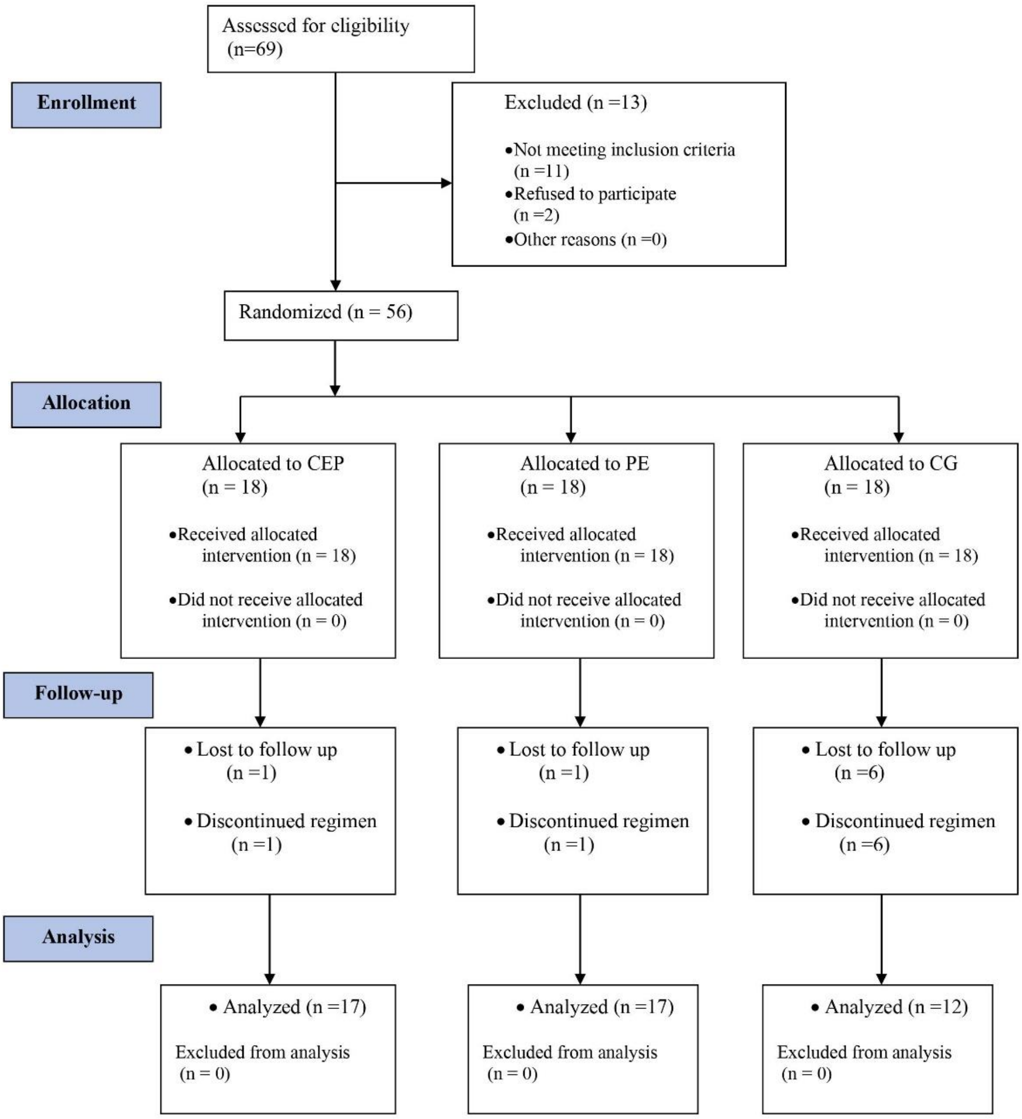

Figure 3.4. Study Flow chart

3.7. Outcome Measures

All the primary and secondary outcome measures were taken at baseline and within 3-days after the 6-week intervention period.

3.7.1. Socio-demographics

The study objectives and methods were explained to the participants, and a structured questionnaire was developed to gather demographic information. This questionnaire was designed in line with the study protocol and covered details such as age, height, weight, education level, presence of systemic diseases and impairments, medication use, exercise habits, socio-demographic status, and history of traumas of the participants.

3.7.2. Craniovertebral Angle (CVA)

The evaluation of the CVA is a reliable and valid clinical method for determining an objective measurement of FHP [28,29]. The measurement of the angle was done with the help of a postural assessment software (PAS). This software has been proven to be highly reliable and valid [90]. The CVA was obtained by measuring an angle formed by the intersection of two lines drawn through particular anatomical landmarks and can be obtained using an image of the sagittal view of a person's head and neck. The first line starts from the tragus of the ear and ends at the spinous process of the C7 vertebrae, while the second line is drawn horizontally through the spinous process of the C7 vertebrae. Although there is no specific threshold for identifying FHP, individuals with smaller craniovertebral angles i.e., less than 50 degrees generally exhibit forward head posture [94,124].

3.7.3. Shoulder Angle (SA)

It is defined as the angle formed by a horizontal line passing between the spinous process of seventh cervical vertebra and a line passing from the shoulder joint's midpoint to the C7 spinous process. [90].

3.7.4. Short Form-36 (SF-36)

The 36-Item Short Form Survey (SF-36) is a well-established and extensively researched self-reported measure of health outcomes that is frequently employed. Its primary function is to gauge the quality of life (QOL) of individuals [125]. Research indicates SF-36 to be one of the most responsive questionnaires to assess the changes in people with musculoskeletal disorders. Both Turkish and English versions of this questionnaire were used in this study. Permission had been acquired in order to use the questionnaire.

3.7.5. Numeric Pain Rating Scale (NPRS)

The Numeric Pain Rating Scale (NPRS) (an outcome measure) that is a unidimensional measure of pain intensity in adults. This 11-point numeric scale ranges from '0' representing one pain extreme (e.g., “no pain”) to '10' representing the worst pain imaginable [126].

3.8. Statistical Analysis

Statistical analysis was performed by using SPSS (IBM SPSS Statistics 25) program. The characteristics of the study groups were defined using descriptive statistics. The Shapiro-Wilk test was performed to determine the normality of variables. The chi-square test was used to test whether there is a relationship between the two variables. Descriptive statistics for all continuous variables were calculated with mean, standard deviation and median. A non-parametric alternative of one-way ANOVA, the Kruskal Wallis test was used to determine intergroup analysis to see any difference within groups. The Friedman 2-Way ANOVA test was used to test the equality of measurements and to compare the data of the intragroup before and after treatment. Kendell’s coefficient was also calculated to analyze the effect size of the primary outcome measures.

4. RESULTS

Forty-six participants (31 female, 15 male), mean age 26.54 (S.D: ±.5.12) and mean weight 61.89 kg (S.D. ±11.37) volunteered for this study. The participants were divided into 3 groups, CE group (n=17), PE group (n=17) and CG (n=12). The measurements were taken baseline and after 6-week post-intervention for all three groups.

The demographic distribution of the participants is shown in (Table 5.1). There was no statistically significant difference between the groups.

Table 4.1. Comparison of Descriptive Statistics of Demographics at baseline

Variables	CE group X±S.D. (Median)	PE group X±S.D. (Median)	CG X±S.D. (Median)	Z	p
Age	27.00±4.330 (27)	27.18±5.992 (27)	25.00±4.899 (24)	1.931	0.381
Height	168.62±10.518 (169)	165±9.496 (160)	163.00±4.991 (163)	2.217	0.330
Weight	65.53±14.693 (60)	59.82±9.221 (59)	59.67±22.537 (60)	1.235	0.539
BMI	23.143±5.053 (22.22)	21.983±3.496 (21.36)	22.537±3.362 (23.10)	.495	0.781
Gender	1.53±.514 (2)	1.53±.514 (2)	1.25±.452 (1)	.348	0.555
Education	1.53±.624 (2)	0.88±.781 (1)	0.35±.493 (1)	2.913	0.233
Marital Status	0.24±.437 (0)	1.00±.739 (0)	0.25±.452 (0)	8.696	**0.003***

Data expressed as Mean±Standard deviation, Median, BMI: Body mass index, *Z:* Chi-square, *p<0.01

Pre-intervention analysis of baseline demographics and anthropometric measures show no significant differences across group (p> 0.05). Only marital status is significant at (p<0.01). (Table 5.1).

Table 4.2. Baseline inter-group measurement for CVA, SA & Pain

Tests	X±S.D.	Median	H	P
CVA	41.61±4.489	42.00	.426	.808
SA	45.33±4.217	45.00	.915	.633
NPRS	3.09±.694	3.00	4.108	.128

Data expressed as Mean±Standard deviation, Kruskal Wallis-H Test for baseline measures across the groups. CVA: Craniovertebral Angle, SA: Shoulder Angle, NPRS: Numeric Pain Rating Scale, Z: Chi-square, P<0.05

For baseline measurements of craniovertebral angle, shoulder angle and pain, Kruskal Wallis-H test was used. It showed no significant difference across the groups. For CVA *H (2) = .429, p=.808,* SA, *H (2) = .915, p=.633,* & NPRS *H (2) = 4.12, p=.128.*

Table 4.3. Baseline inter-group measurement for quality of life (SF-36)

Tests/Groups	X±S.D.	Median	H	P
Physical Functioning	64.12±25.510	70.00	4.670	.097
Limitation due to Physical Health	54.35±33.460	50.00	.777	.678
Limitation due to Emotional Problems	50.00±39.597	66.67	.737	.692
Energy/Fatigue	55.76±16.498	57.50	2.077	.354
Emotional Well-being	62.78±17.545	64.00	1.217	.544
Social Functioning	64.40±17.474	62.50	.133	.936
Pain	73.42±21.949	77.50	.591	.744
General Health	55.87±16.340	55.00	.745	.689

Data expressed as Mean±Standard deviation, Kruskal Wallis-H Test for baseline measures across the groups. P<0.05

For baseline measurements of SF-36 (QOL) components Kruskal Wallis-H test was used. It showed no significant difference across the groups ($p>0.05$).

Table 4.4. Post-intervention inter-group measurement for CVA, SA & Pain

Tests	**X±S.D.**	**Median**	**H**	**P**
CVA	46.70±6.370	45.50	2.451	.294
SA	53.74±7.943	53.50	12.615	**.002****
NPRS	1.11±.795	1.00	6.978	**.031***

Data expressed as Mean±Standard deviation, Kruskal Wallis-H Test for post-intervention measures across the groups. CVA: Craniovertebral Angle, SA: Shoulder Angle, NPRS: Numeric Pain Rating Scale, ** $P<0.01$ *$p<0.05$

Kruskal Wallis-H test is used in order to measure the inter-group post-intervention change in the CVA, SA and NPRS. It shows significant difference in shoulder angle ($p<0.01$) and pain ($p<0.05$) while showed no difference for craniovertebral angle ($p>0.05$).

Table 4.5. Post-intervention inter-group measurement for QOL (SF-36)

SF-36 (n=46)	X±S.D.	Median	H	P
Physical Functioning	84.78±16.565	90.00	9.891	**.007****
Limitation due to Physical Health	67.03±28.651	75.00	6.754	**.034***
Limitation due to Emotional Problems	69.57±36.397	83.33	2.060	.357
Energy/Fatigue	60.98±13.192	60.00	1.342	.511
Emotional Well-being	61.43±15.053	60.00	4.293	.117
Social Functioning	67.66±18.585	68.75	3.098	.212
Pain	74.35±18.039	77.50	2.623	.269
General Health	50.98±9.166	50.00	1.615	.446

Data expressed as Mean±Standard deviation, Kruskal Wallis-H Test for post-intervention measures across the groups **$P<0.01$ *$p<0.05$

Kruskal Wallis-H test is used to measure the post-intervention change in the quality of life of participants, shows significant difference in physical functioning ($p<0.01$) and physical health limitations ($p<0.05$) while showed no significant difference in any other component.

Table 4.6. Comparison of Baseline and post-intervention intra-group measurements of CVA, SA & Pain

Test/Groups	**CE (*n*=17) X±S.D. (Median)**		**Z**	**P**	**W**	**PE (*n*=17) X±S.D. (Median)**		**F**	**P**	**W**	**CG (*n*=12) X±S.D. (Median)**		F	**P**	**W**
	Baseline	**Post-intervention**				**Baseline**	**Post-intervention**				**Baseline**	**Post-intervention**			
CVA	41.47±4.719 (40)	47.65±7.913 (47)	77.403	**0.001***	.779	41.29±4.793 (42)	44.76±5.032 (45)	78.209	**0.005***	.667	42.25±4.003 (42)	48.08±5.368 (49)	48.195	**0.005***	.457
SA	44.82±4.142 (45)	56.59±7.624 (58)	77.403	**0.001***	1.00	45.12±4.328 (45)	55.65±7.897 (55)	78.209	**0.001***	1.00	46.33±4.335 (48)	47.00±3.885 (47)	48.195	1	0.001
NPRS	2.88±.697 (3)	.71±.686 (1)	16	**0.001***	.941	3.35±.606 (3)	1.35±.702 (1)	17	**0.001***	1.00	3.00±.739 (3)	1.33±.888 (1)	10	**0.002***	.831

Data expressed as Mean±Standard deviation, F: Friedman test, W: Kendell's coefficient *P<0.05

Baseline and post-intervention of craniovertebral angle, shoulder angle and pain rating scale were measured using Friedman's test. There is a significant difference found in pre- and post- measurements of CVA, SA and NPRS ($p<0.01$) within corrective exercise and postural education group. CVA and NPRS is also significant for Control group. ($p<0.01$) Kendell's W is also computed to see the effect size of this difference as these were the primary outcome measures of this study. It indicates large effect for all measurements. There was not a significant difference found for SA in control group.

Table 4.7. Comparison of Baseline and post-intervention intra-group measurement of SF-36

Test/Groups	**CE (*n*=17) X±S.D. (Median)**		**F**	**P**	**PE (*n*=17) X±S.D. (Median)**		**F**	**P**	**CG (*n*=12) X±S.D. (Median)**		**F**	**P**
SF-36	**Baseline**	**Post-intervention**			**Baseline**	**Post-intervention**			**Baseline**	**Post-intervention**		
Physical Function	72.88±21.780 (75)	90.88±15.231 (95)	7.118	**.009***	58.04±21.329 (55)	78.53±20.13 (85)	6.25	**.012***	60.32±33.451 (63)	85.00±8.790 (85)	6.4	**.011***
Limitation-Physical Health	58.82±36.380 (50)	80.88±24.254 (100)	1.333	.248	50.00±31.869 (50)	60.78±30.157 (50)	2	.157	54.17±33.428 (50)	56.25±26.382 (50)	.001	1
Emotional Problems	52.94±37.377 (67)	78.43±35.240 (100)	10	**.002***	52.94±44.188 (67)	62.75±38.877 (100)	0.667	.414	41.67±37.939 (33)	66.67±34.816 (67)	1.286	.257
Energy/ Fatigue	51.76±17.672 (50)	63.53±17.672 (65)	2.571	.109	55.88±18.048 (60)	60.00±15.811 (60)	3.00	.083	61.25±11.307 (60)	58.75±11.104 (58)	.091	.763
Emotional Well-being	66.12±18.554 (60)	67.76±16.761 (68)	.25	.617	59.06±18.576 (64)	57.65±15.624 (60)	.077	.782	63.33±14.755 (68)	57.83±8.066 (60)	3	.083
Social Function	65.44±16.846 (63)	73.53±17.412 (78)	1.471	.225	63.24±19.995 (63)	63.24±20.649 (68)	.529	.467	64.58±15.841 (63)	65.63±16.241 (68)	.001	1
Pain	73.53±24.575 (78)	80.15±12.452 (78)	2.273	.132	70.44±23.539 (68)	70.29±18.872 (68)	.001	1	77.50±15.954 (74)	71.88±22.440 (78)	.011	.739
General Health	53.24±15.098 (55)	50.59±8.993 (45)	.067	.796	57.65±12.762 (60)	49.41±9.824 (50)	2.882	.09	57.08±22.508 (53)	53.75±8.561 (55)	0.4	.527

Data expressed as Mean±Standard deviation, F: Friedman test, *P<0.05

Baseline and post-intervention of quality of life was measured using Friedman's test. A significant different was found for both baseline and post-intervention measurements of physical function component within all three groups ($p<0.01$). It also shows a difference in emotional problem component in the corrective exercise group. ($p<0.01$) Other components of this measure shows no significant effect.

5. DISCUSSION

Poor posture results from muscle imbalance which occurs when muscles are weak, tight, too long or too short to perform effectively and hold the body in correct alignment. Good posture decreases the risk of developing musculoskeletal disorders. It also reduces the injury risk as a result of repeated stress and strain on musculoskeletal structures. To maintain a health and good posture, having strong and flexible muscles is necessary [127].

This study was aimed at the effect evaluation of the of postural education and corrective exercise program on craniovertebral angle and shoulder angle. Hence in order to see if they have any difference on the pain levels and changes in the quality of life of participants. The current study is a randomized controlled trial conducted on the duration of 6-weeks. Participants who met the inclusion criteria of age and had forward head posture were included in this study. A total of 56 participants were selected and divided into 3 groups. A total of 10 subjects were excluded at the end due to lack of follow-up and the results for 46 participants were analyzed.

5.1. Rationale for Selection of Specific Age Group

A literature gap concerning the age-range of the participants was filled by this study. It has been mentioned in several of the studies to include adult participants as most of the previous studies done on FHP assessment and intervention included children or adolescents [128]. The rationale for including participants within the age range of 20-40 years is based on several factors. By focusing on the 20-40 age range, we aim to capture a homogeneous group of young to middle-aged adults, minimizing potential confounding variables associated with age-related physiological variations But, these findings may not be generalizable to other age groups, particularly the geriatric population, in light of age-associated musculoskeletal and physiological modifications. Consequently, a gap in literature remains on the efficacy of both interventions in the treatment of older patients [129].

Furthermore, including participants above the age of 40 may introduce additional factors such as an increased likelihood of underlying conditions like arthritis or other degenerative diseases. These conditions can potentially influence the outcomes of the study, complicating the interpretation of results and compromising the internal validity. Therefore, limiting the age range to 20-40 years enhances the clarity and specificity of the study's findings within a specific demographic group, ensuring a more reliable and focused analysis.

5.2. Craniovertebral Angle

The primary outcome measure used in this study for FHP is craniovertebral angle. The most common technique of CVA assessment in research and clinical practice incorporates the use of lateral-view photography and has been demonstrated as both a valid and reliable method for objective CVA measurement when compared to radiographic [10,29]. In a study comparing photographic and radiographic CVA assessment, high levels of intra-examiner reliability of photographic measures of CVA were found. The intraclass correlation co-efficient of 0.98, with 95% CI, ($p < .01$), as well as a moderate agreement ($r = 0.68$, $p < .01$) between the two methods [130]. Although, there are studies which have used only CVA as their primary outcome measure to assess forward head and it still is the most widely accepted and commonly used measure for FHP [25,38,131]. In this study, participants were asked to capture a photo of their upper body in a sagittal position while standing. Several studies show that photogrammetry is a reliable method and has high interrelated reliability to measure angles of upper body [90]. The angles are then measure by a postural assessment software [132].

In the literature, there are studies that report no differences in the CVA between sitting and standing positions [10] as well as several that do not provide subject position information during posture assessment [35,92,133]. Some researchers promote the standing position after observing smaller CVA measurements (indicating greater forward head posture) in sitting compared to standing [20,35,89,90,92,94]. On the other hand, some researchers argue that a standing position may diminish the trustworthiness of cervical posture assessment due to the influence of postural sway and therefore, recommend photographing subjects in a seated position during CVA assessment to promote greater reliability [134]. Although a standardized protocol for assessing CVA is still required, a significant amount of literature supports the measurement of CVA in a standing position. Consequently, participants were directed to assume an upright standing position while capturing their photographs as part of the study protocol. Subsequently, the CVA of the participants was measured in the standing position.

The results of this study showed no significant differences in baseline inter-group or intra-group analysis of CVA ($p>0.05$) but a post-intervention difference in both CE (p=0.001) and PE group (p=0.005). There is a significant difference found in CG (p=0.005) as well but Kendell's coefficient shows large effect size for CE and PE groups and small effect size for CG group. As CG received no treatment, the effect size explains the difference in baseline and post-intervention values.

5.3. Shoulder Angle

The shoulder angle is formed when a horizontal line across the shoulder in a sagittal plane intersects a line drawn from the C7 vertebrae to the shoulder. To some extent, It shows how round the shoulders are. A forward or protracted shoulder would result in a smaller angle. Protraction/retraction angle, sagittal shoulder posture, sagittal plane shoulder alignment, shoulder angle, and forward shoulder posture are additional names for this angle [29].

The International Journal of Occupational Medicine published a systematic review in July 2020 which presented significant research on the effect of head position on the human body. The researchers analyzed data collected from 16 papers and found that the head position has a considerable impact on muscle activity, proprioception, breathing patterns, and neck pain [135]. Habitual forward head posture elicits widespread effects on the body, manifesting as protracted and medially rotated scapulae, increased facet joint pressure caused by forces inducing upper cervical extension and lower cervical flexion, and an exaggerated thoracic kyphosis and lumbar lordosis. These mal-positions displace the head anteriorly relative to the center of gravity, with the eyes and head maintaining a level and forward-directed orientation. Consequently, this engenders diverse musculoskeletal dysfunctions and ultimately gives rise to considerable consequences, including the development of various physical ailments.

A high inter-rater reliability was found for shoulder angle in the sagittal plane [136]. Based on the available evidence, it can be deduced that individuals suffering from FSP exhibit a considerably reduced shoulder angle in comparison to those without the condition. In a study done by Lewis (2005), the mean shoulder angle value 61.9° ± 10.4° is considered normal [137]; Thigpen and colleagues have reported that a total of 310 participants were assessed for their shoulder angle in a standing position, and they found the normal range to be 52.6° ± 15.3° [6]. This finding is consistent with the report by Raine and Twomey who evaluated 160 participants for shoulder angle in a standing position, and found that the normal range was 53.7° ± 11.5° [138].

In our study, there was no baseline differences found across the groups or within the groups. The post-intervention inter-group analysis showed significant change in SA (p=0.002) and intra-group (p=0.001) for CE and (p=0.001) for PE groups. There was no baseline or post-intervention change in control group (p>0.05).

5.4. Numeric Pain Rating Scale

Various studies have been conducted to explore the relationship between forward head posture and neck pain and its relation with other postural deformities such as protracted or rounded shoulder posture and kyphosis [7]. The research has indicated that the reduced length of muscle fibers and decreased ability of muscles to produce tension in the Forward Head Posture (FHP) result in severe neck discomfort. Apart from severe neck pain and muscular disparity, FHP displays symptoms such as exhaustion, limited range of motion, temporomandibular joint dysfunction, respiratory issues, teeth grinding, nerve compression, myofascial pain syndrome, headache, migraine, numbness, tingling in the arms and hands, cervical instability, and muscle spasms, which ultimately impede daily activities and impact quality of life [18]. The failure to recognize the importance of body posture during work is a significant contributor to improper positioning of the head and neck [25].

Individuals with neck pain are seen with alteration in the head posture, muscular imbalance [91]. Studies have shown a notable correlation between neck pain and FHP. It is widely accepted that this abnormal posture is linked with the origination and perpetuation of numerous spinal discomforts and a variety of bio-mechanically-induced disorders [129]. Lau et al. [77] in a 2010 study defined that about 60% of people with neck pain had FHP.

According to the results of our study, there was no difference found in baseline measurements of all 3 groups. Although, post-intervention report for inter-group analysis showed significant change in pain (p=0.031). The intra-group analysis showed a substantial difference and large effect size for both CE and PE groups (p=0.001; W=0.941) & (p=0.001; W=1) respectively.

5.5. Quality of life Measurement

The SF-36 Survey is widely utilized as a tool to assess quality of life in research studies. It is a questionnaire that individuals complete on their own, and it has shown consistent reliability in general medical practice. SF-36 scores have been found to align closely with general physician’s assessments of symptom severity. Moreover, the questionnaire has been validated by demonstrating clear distinctions in self-reported health between the general population and individuals with common medical conditions [98].

In the current study, no significant difference has been found in baseline measurements of quality of life ($p>0.05$) and shows a post-intervention difference in only the physical functioning component of this scale ($p=0.11$).

5.6. Corrective Exercise Program

Forward head posture is associated with Shortness of the cervical extensors and pectoralis muscles, as well as weakness in the deep cervical short flexors and mid-thoracic scapular retractors. The proper muscular balance between agonist and antagonist muscles can be restored to treat FHP [35]. In the present study, an intervention protocol as a form of three strengthening (Chin tucks, YTWL-shoulder retractor exercise, resisted neck extensions) and three stretching (Upper trapezius-middle Scale, sternocleidomastoid and pectorals) exercises were designed. The CE group performed all of the above-mentioned exercises these exercises 3-5 times per week for 6 weeks. In contrast to other investigations, the current study demonstrated that shorter treatment duration was still successful in correcting the FHP. For instance, Ruivo et al. (2014), explained the value of a focused exercise program that included strengthening and flexibility exercises over a 32 week period in reducing FHP in adolescents [20]. Diab et al. (2015), [108] in two of their studies reported that a 10 week program of stretching and strengthening exercises was also successful in correcting the FHP. Heydari et al. (2017), found that an 8 week exercise program with five strengthening exercises targeting (deep cervical flexors, neck extensors, and shoulder retractors) and two stretching exercises involving (SCM and pectoral muscles) improve postural alignment associated with FHP [38].

A meta-analysis done in 2018 by Sheikhhoseini et al, included seven randomized controlled trials comprising a total of 627 participants. These exercises included in these trials included variety of positions for same exercises and yielded similar and beneficial results for FHP. [8] This study is distinct and unique in that it provides participants with the opportunity to exercise in their preferred positions. By accommodating individual preferences, this research acknowledges the importance of personal comfort and promotes a more inclusive and tailored approach to physical activity. This unique aspect of the study not only enhances the participants' engagement and adherence but also contributes to a more comprehensive understanding of the effects of exercise. By considering participants' preferences, this research addresses a significant gap in the literature and offers valuable insights into the role of individual choice in optimizing exercise experiences.

Ranjbar et al. in a 2020 study, compared the effects of a 12-week muscle strengthening vs a 12-week muscle stretching on FHP in the adolescent population [139]. The exercises included in the program targeted both neck and upper back muscles, were backed up by many studies and evidently have promising effect on FHP. An investigative study conducted in September 2021 aimed to explore the impact of exercise programs. A cohort of 32 individuals, employed in office settings, (13 male and 19 female), with an average age of 36.63 years were selected randomly for this study. The individuals were assigned to control and experimental groups with equal allocation. The experimental group engaged in scapular stabilization and thoracic extension exercises, while the control group underwent cervical stabilization and stretching exercises. The findings of this study suggest that the combination of scapular stabilization and thoracic extension exercises can effectively enhance the posture, respiration, neck pain, and disability of individuals with forward head posture, even though it was not directly targeted towards the cervical spine [140].

The results of our current study also found an increase in CVA, SA and a decrease in pain levels, showing a significant difference ($p<0.05$) in baseline and post-intervention measurements. The CVA and SA measures were substantially increased following the corrective exercise intervention.

5.7. Postural Education

The significance of head and cervical posture has increased over the years owing to the intricate biomechanical interplay between the structures. The manifestation of forward head posture (FHP) results in a gradual elongation of the posterior neck ligaments, a phenomenon commonly referred to as ligament creep. This, in turn, has been linked to a range of dysfunctions within the musculoskeletal, vascular and neural systems [141]. In a more recent study, conducted in February 2023, a group of Italian researchers discussed the legitimate concerns the effects of head posture and workplace ergonomics on overall health of IT professionals. The researchers highlighted the necessity of implementing proactive measures to mitigate the risk of neck disability and to enhance the ergonomics of the workspace [142].

Postural education (PE) commonly covers various topics, including educating individuals about health risks associated with FHP, provision of correct postural guidelines for when using electronic devices, and recommending frequency of rest breaks [31]. Enhancing individuals' awareness of the health risks linked to FHP can promote mindfulness of their body positioning while using computer technology. The most prevalent posture-related health risks addressed in PE are musculoskeletal disorders affecting the spine and limbs [121]. A study done by Shon et. al. in (2012) studied the effects of postural education on CVA concluded that postural education can be an effective intervention for improving FHP [143]. Postural guidelines for using electronic devices include maintaining an upright sitting or standing position, avoiding slouching, elevating the device to eye level to prevent forward head bending, and providing support to the elbows using armrests, tables, or thighs while sitting. The present study incorporates the postural guidelines recommended by the National Institutes of Health (NIH).

The results of our study showed significant post-intervention improvement of posture in the PE group. The increase in craniovertebral angle ($p=0.005$); shoulder angle ($p=0.001$); and decreased pain ($p=0.001$).

5.8. Limitations:

A primary limitation of this current study is the intervention duration and having small sample. As this study was conducted online, another limitation was the inability to control the physical activity level of participants. It is plausible that some participants may have engaged in a greater or lesser degree of physical activity than others during the 6-week period, which could have potentially impacted the study outcomes. Additional limitations of this study include the lack of researcher blinding and absence of a long-term follow-up to assess any sustained effects. Lastly, the study's findings are constrained by the fact that it exclusively examined static posture without any consideration for neuro-muscular or musculoskeletal pathology, thereby limiting its generalization to dynamic postures.

6. CONCLUSION

As a result of the intervention for forward head posture, this study showed a substantial improvement in the craniovertebral angle, shoulder angle, and discomfort within the groups. To the best of our knowledge, this is the first study to investigate the effects of both corrective exercises and postural education not only on CVA but on craniovertebral angle but on shoulder angle, pain and quality of life of the participants. These findings support the effectiveness of corrective exercises in addressing postural alignment and associated discomfort.

Funding

No external or internal funding was received for this work.

Conflict of interests

The author declares no conflict on interest.

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8. APPENDICES

8.1. Ethical Approval Form

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

PROJENİN ADI	: "Baş Önde Postüre Sahip Erişkinlerde Düzeltici Egzersizler Ve Postüral Eğitimin Etkilerinin Karşılaştırılması-Randomize Kontrollü Bir Çalışma"
PROJENİN YÜRÜTÜCÜSÜ	: Dr. Öğr. Üyesi Ebru AKBUĞA KOÇ
PROJEDEKİ ARAŞTIRICILAR	: Warda KHALID
ONAY TARİHİ VE SAYISI	: 27.04.2023/56

Sayın: Dr. Öğr. Üyesi Ebru AKBUĞA KOÇ

"56" protokol numaralı "Baş Önde Postüre Sahip Erişkinlerde Düzeltici Egzersizler Ve Postüral Eğitimin Etkilerinin Karşılaştırılması-Randomize Kontrollü Bir Çalışma" İsimli projeniz Fakültemiz Etik Kurulu tarafından incelenmiş oy birliği ile etik yönden uygun olduğuna karar verilmiştir.

[redacted]

EFQM Mükemmelliyette Yetkinlik EUA IPV

Marmara Üniversitesi Sağlık Bilimleri Fakültesi 34854 Başıbüyük/Maltepe /İSTANBUL
0 (216) 399 62 42 (Faks)
0 (216) 777 57 86
Ayrıntılı bilgi için:
Melek KARADAĞ AKYOL
sbfetikkurul@gmail.com
http://sbf.marmara.edu.tr

8.2. Informed Written Consent

T.C. YEDİTEPE ÜNİVERSİTESİ

BİLGİLENDİRİLMİŞ GÖNÜLLÜ ONAM FORMU

Araştırmanın Adı: "Baş Önde Postüre Sahip Erişkinlerde Düzeltici Egzersizler ve Postüral Eğitimin Ağrı, Yaşam Kalitesi, Kraniovertebral ve Omuz Açılarına Etkisinin Karşılaştırılması"

Sayın Katılımcı,

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

Bu çalışmada, baş önde postürü olan bireylerde düzeltici egzersizler ve postüral eğitimin ağrı, yaşam kalitesi, kraniovertebral ve omuz açıları üzerindeki etkisinin karşılaştırılması amaçlanmıştır. Çalışmaya katılmaya gönüllü olan bireylere; araştırmacılar tarafından geliştirilmiş sosyodemografik anket, tedavi uyum formu, yaşam kalitesi anketi, ağrı derecelendirme skalası araştırmacı tarafından sorulacak ve cevaplar kaydedilecektir.

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 bilinen herhangi bir zararı bulunmamaktadır. Değerlendirme sürecinde herhangi bir beklenmedik hasar olması durumunda, bilgiler size derhal verilecektir. Katılımcıların herhangi bir zarar görmesi durumunda gerekli başvurular herhangi bir rücu olmaksızın araştırmacılar tarafından karşılanacaktır. Bunun için ne sizden ne de sosyal güvenlik sigortanızdan herhangi bir ücret talep edilmeyecektir. Araştırmaya katılmak size hemen yardımcı olmamakla birlikte, araştırma sonuçlarımızın gelecekte organizasyon, toplum veya bilim için faydaları olacağı umulmaktadır. Araştırmanın amaçları veya bağlı olduğunuz sosyal güvenlik kurumu için sizden herhangi bir ücret alınmayacaktır.

Bilgilendirme formundaki tüm açıklamaları okudum. Bana, yukarıda konusu ve amacı belirtilen çalışma ile ilgili yazılı ve sözlü açıklama araştırmacı tarafından yapıldı. Araştırmaya katılmaya gönüllü olduğumu, istediğim zaman gerekçeli veya gerekçesiz olarak araştırmadan ayrılabileceğimi biliyorum. Söz konusu çalışmaya hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı ve sonuçlarımın kullanılmasını kısıtlamamayı, yayın, rapor ve benzeri bilimsel dokümanlarda kullanılmasını kabul ediyorum.

Katılımcı:	**Danışman:**	**Araştırmacı:**
	Dr. Öğr. Üyesi Ebru Akbuğa Koç	**Fzt. Werda Khalid**
	Yeditepe Üniversitesi	Yeditepe Üniversitesi
	Sağlık Bilimleri Fakültesi	Sağlık Bilimleri Enstitüsü
	Fizyoterapi ve Rehabilitasyon	Fizyoterapi ve Rehabilitasyon
	Bölümü	Yüksek Lisans Programı
	Tlf: 0216 578 0000/3851	
Tarih/İmza:	Tarih/İmza:	Tarih/İmza:

8.3. Socio-Demographic Questionnaire

Genel Bilgi Değerlendirme Formu

TARİH:…/…./……

1) Doğum Tarihi:………………..

2) Cinsiyet: ( ) Kadın ( ) Erkek

3) Boy uzunluğu (cm): …………….

4) Vücut ağırlığı (kg) :…………

5) Vücut Kitle İndeksi:………….

6) Eğitim Durumunuz:

İlköğretim \ Ortaöğretim \ Lise \ Üniversite \ Yüksek Lisans

7) Herhangi bir kronik hastalığınız var mı?

( ) Evet ise belirtiniz…………….. ( ) Hayır

8) Düzenli olarak kullandığınız bir ilaç var mı?

( ) Evet ise belirtiniz……........... ( ) Hayır

9) Herhangi bir cerrahi geçirdiniz mi?

( ) Evet ise belirtiniz……………………. ( ) Hayır

10) Düzenli Egzersiz yapıyor musunuz?

( ) Evet ise belirtiniz……………………. ( ) Hayır

11) Eğer egzersiz yapıyorsanız

( ) Haftada 1 kez ( ) Haftada 2-3kez ( ) Haftada 4-5 kez ( ) Her gün

8.4. Pre-Intervention Questionnaire

Tarih: ___________

Isim: ______________ Yaş: ____ Boy uzunluğu (cm): ______ Vücut ağırlığı (kg) _________

E-posta: _______________________

Duruş ekranınızdan sonra, öne doğru baş duruşuna sahip olduğunuz belirlenirse, rastgele bir müdahale veya kontrol grubuna atanacaksınız. Egzersiz içeren bir müdahale grubuna atandıysanız, duruşunuzu etkileyip etkilemediğini görmek için 6 hafta boyunca haftada 5 kez statik esneme ve 6 hafta boyunca haftada 5 kez egzersiz eğitimi yapmanız istenebilir.Please read the questions below and choose an appropriate option.

1. Şu anda herhangi bir egzersiz yapıyor musunuz?

- Evet, çok aktifim
- Evet, orta derecede aktifim
- Hayır, hiç egzersiz yapmıyorum.

2. Son altı ay içinde başınızda, omuzlarınızda veya omurganızda kas-iskelet sistemi yaralanması oldu mu? Evet Hayır

Evet ise, burada açıklayabilirsiniz (isteğe bağlı):____

3. Size hiç servikal omurganız (boyun), torasik omurganız veya üst ekstremiteleriniz (kollar) ile ilgili bir patoloji teşhisi kondu mu? Evet Hayır

Evet ise, burada açıklayabilirsiniz (isteğe bağlı):____

8.5. Post-Intervention Questionnaire

1- **Bir egzersiz grubunun parçası olsaydınız, belirlenmiş ev programınızı ne kadar tutarlı bir şekilde takip ettiniz**?

a) Tutarlı. Oturumların en az %75'i tamamlandı
b) Orta Derecede Güvenilir. Oturumların %50 ila 75'i tamamlandı
c) Tutarsız. Oturumların %50'den azı tamamlandı

2- Duruş eğitimi grubundaysanız, bilgisayar ve mobil elektronik kullanırken duruş yönergelerini ne kadar tutarlı bir şekilde takip ettiniz?

a) Tutarlı. Talimatları zamanın en az %75'inde takip ettim.
b) Orta Derecede Güvenilir. Zamanın %50-75'inde kurallara uydum.
c) Tutarsız. Zamanın %50'sinden fazlasında kurallara uymadım.

3- Çalışmaya katılmayı bıraktınız mı?

a. Evet b. Hayır

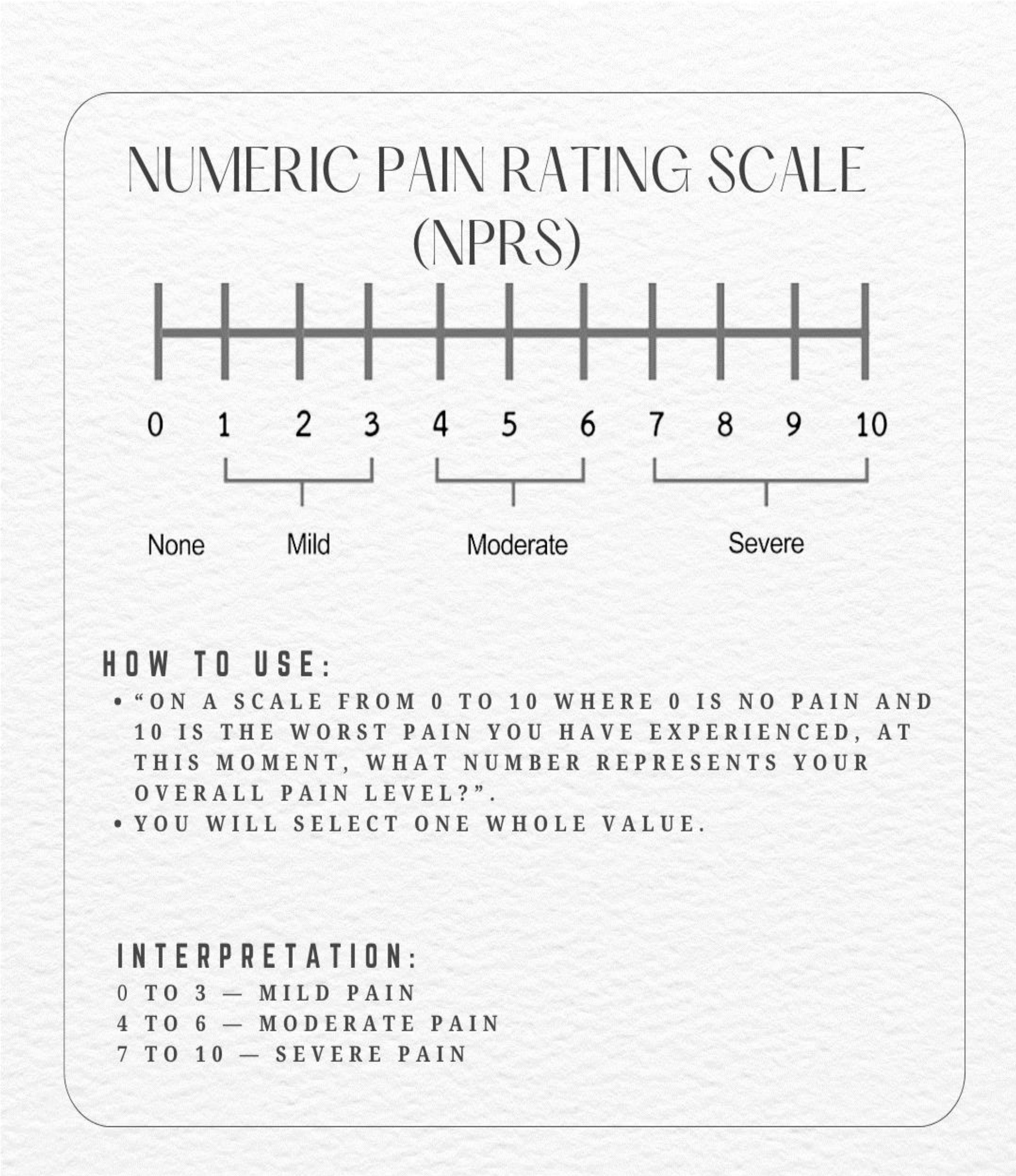
EVET'i seçtiyseniz, kısaca bir neden belirtebilirsiniz (İsteğe bağlı): ______________________________

4- **Bu çalışmanın başlangıcından bu yana, size verilen ev programının parçası olmayan başka bir egzersiz programına başladınız mı veya bıraktınız mı**?

a. Evet b. Hayır

EVET'i seçtiyseniz, kısaca bir neden belirtebilirsiniz (İsteğe bağlı):______________________________
____
_____

8.6. Numeric Pain Rating Scale



8.7. Short- Form Sf-36 Survey

RAND 36 ITEM HEALTH SURVEY 1.0

Patient Name: ____

1. In general, would you say your health is: **(Circle One Number)**

Excellent 1
Very Good 2
Good 3
Fair 4
Poor 5

2. **Compared to one year ago**, how would you rate your: general health right **now** ? **(Circle One Number)**

Much better than one year ago 1
Somewhat better than one year ago 2
About the same 3
Somewhat worse now than one year ago 4
Much worse now than one year ago 5

The following items are about activities you might do during a typical day: Does **your health now limit you** in these activities? If so, how much? **(Circle One Number on Each Line)**	**Yes, Limited A Lot**	**Yes, Limited A Little**	**No, Not Limited at All**
3. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
4. **Moderate activities**, such as moving a table pushing a vacuum cleaner, bowling or playing golf..........	1	2	3
5. Lifting or carrying groceries	1	2	3
6. Climbing **several** fights of stairs..........	1	2	3
7. Climbing **one** flight of stairs	1	2	3
8. Bending, kneeling or stooping	1	2	3
9. Walking **more than a mile**..........	1	2	3
10. Walking **several blocks**..........	1	2	3
11. Walking **one block**	1	2	3
12. Bathing or dressing yourself..........	1	2	3

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health** ?: **(Circle One Number on Each Line)**	**Yes**	**No**
13. Cut down the amount of time you spend on work or other activities	1	2
14. Accomplish less than you would like	1	2
15. Were limited in the kind of work or other activities	1	2
16. Had difficulty performing the work or other activities (for example, took extra effort)	1	2

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** ?: (depressed, anxious) **(Circle One Number on Each Line)**	**Yes**	**No**
17. Cut down the amount of time you spend on work or other activities	1	2
18. Accomplish less than you would like	1	2
19. Didn't do work or other activities as carefully as usual..........	1	2

20. During the **past 4 weeks**, to what extent has your physical health or emotional: problems interfered with your normal social activities with family, friends, neighbors or groups? **(Circle One Number)**

Not at all.......... 1
Slightly.......... 2
Moderate.......... 3
Quite a bit.......... 4
Good.......... 5

21. How much **bodily** pain have you had during the **past 4 weeks**:
(Circle One Number)

None	1
Very Mild	2
Mild	3
Moderate	4
Severe	5
Very Severe	6

22. During the **past 4 weeks**, how much did pain interfere with your normal work (including both work outside the home and housework ?
(Circle One Number)

Not at all	1
Slightly	2
Moderately	3
Quite a bit	4
Extremely	5

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks . . . **(Circle One Number on Each Line)**	**All of the Time**	**Most of the Time**	**A Good Bit of the Time**	**Some of the Time**	**A Little of the Time**	**None of the Time**
23. Did you feel full of pep?	1	2	3	4	5	6
24. Have you been a very nervous person?	1	2	3	4	5	6
25. Have you felt so down in the dumps that nothing could cheer you up ?	1	2	3	4	5	6
26. Have you felt calm and peaceful?	1	2	3	4	5	6
27. Do you have a lot of energy?	1	2	3	4	5	6
28. Have you felt downhearted and blue?	1	2	3	4	5	6
29. Did you feel worn out?	1	2	3	4	5	6
30. Have you been a happy person?	1	2	3	4	5	6
31. Did you feel tired?	1	2	3	4	5	6

32. During the **past 4 weeks**, to what extent has your **physical health or emotional problems** interfered with your normal social activities like visiting with family, friends, relatives, etc.?
(Circle One Number)

All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

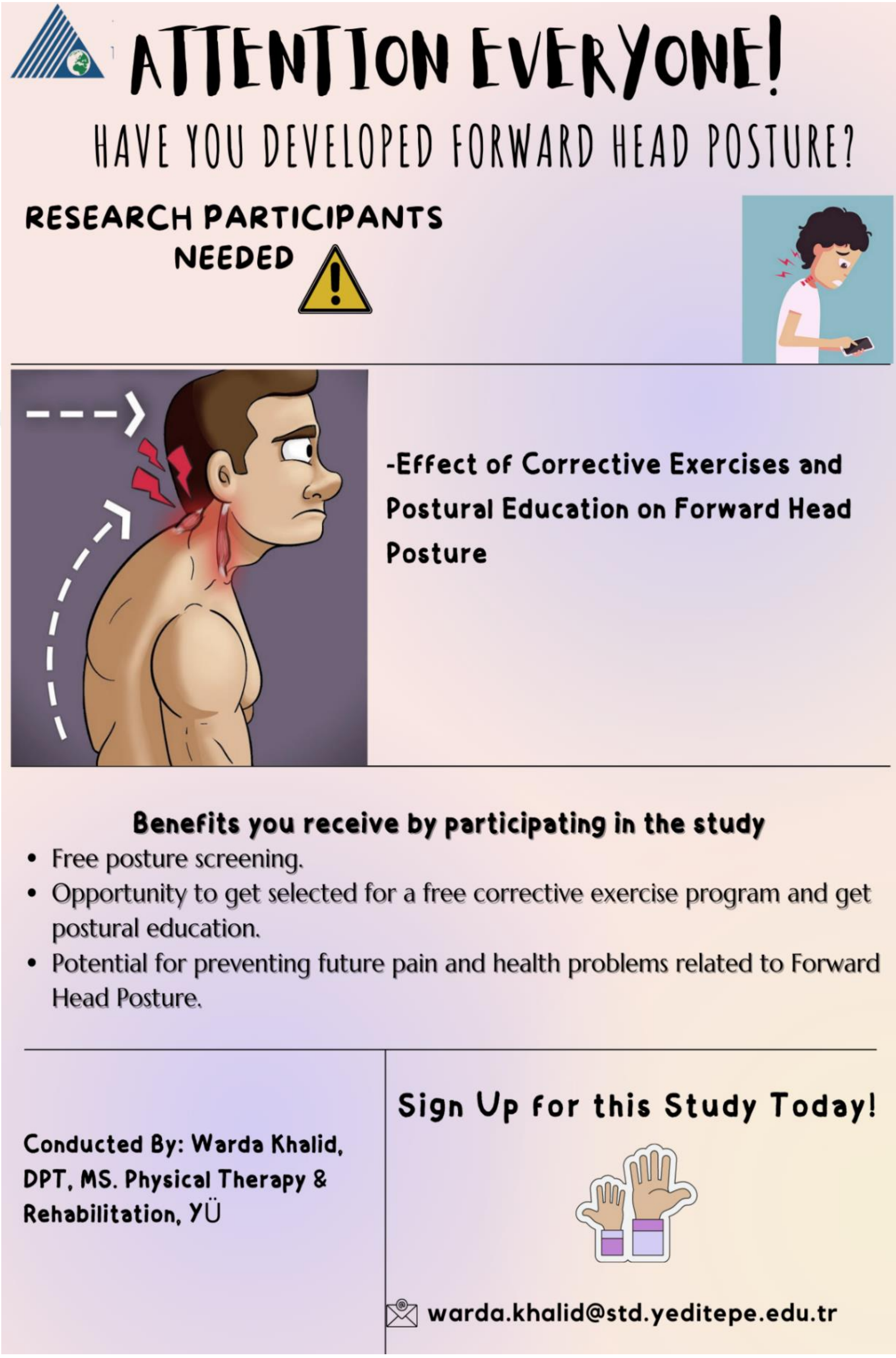
How TRUE or FALSE is each of the following statements for you? **(Circle One Number on Each Line)**	**Definitely True**	**Mostly True**	**Don't Know**	**Mostly False**	**Definitely False**
33. I seem to get sick a little easier than other people	1	2	3	4	5
34. I am as healthy as anybody I know	1	2	3	4	5
35. I expect my health to get worse	1	2	3	4	5
36. My health is excellent	1	2	3	4	5

Comments: ____

____

Patient Signature: ______________________ Date ____________

8.8. Promotion Flyer



8.9. Postural Guidelines

POSTURAL GUIDELINES

WHILE SITTING AT A DESK

Source https://ors.od.nih.gov/sr/dohs/HealthAndWellness/Ergonomics/Pages/prevention.aspx#Computers.

1) HEAD

The head should be positioned vertically over the spine with the neck in a neutral position (looking straight ahead). Eyes should be at the same height as the top of the monitor.

2) SPINE

Sit up straight in the chair. The low back should rest against the backrest of the chair and should be supported by the chair or a lumbar pad. Slouching on the armrests should be avoided.

3) SHOULDERS

Shoulders should be relaxed in a neutral position (not elevated by the arm rest) resting against the backrest of the chair. Upper arms should rest at the side of the body.

4) FOREARMS/ELBOW

Forearms should rest lightly on the armrests if present, parallel to the floor with elbows flexed at 90 degrees.

5) WRISTS

Wrists should be maintained in a neutral position if possible (avoiding exaggerated extension or flexion). Resting the hand on the mouse when not in use should be avoided.

6) HIPS

Hips should be flexed at 90 degrees and thighs should be parallel to the floor.

7) KNEES & FEET

- Knees should be flexed 90 degrees and level with the hips. The back of the knees should be 2-3 inches away from the end of the seat.
- Keep your feet on the floor or on a footrest, if they don't reach the floor.

REST BREAK GUIDELINES

- Standing for a short (30-180 sec) rest break after 20 minutes of seated computer use to help diminish musculoskeletal discomfort.
- If possible, add one to two minutes of walking during rest breaks to help facilitate blood flow, reduce mental fatigue, and prevent the onset of musculoskeletal symptoms.

POSTURAL GUIDELINES

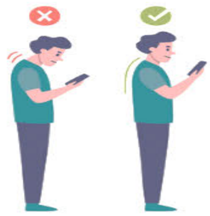
HEALTH RISKS OF FORWARD HEAD POSTURE & GUIDELINES FOR USING MOBILE ELECTRONIC DEVICES

HEALTH RISKS ASSOCIATED WITH FORWARD HEAD POSTURE

- Text neck syndrome
- Spinal degeneration
- Myofascial trigger points
- Headaches
- Temporomandibular disorders
- Shoulder abnormalities
- Respiratory impairments

GUIDELINES FOR USING SMARTPHONES & MOBILE ELECTRONIC DEVICES

- Sit or stand in an upright position to avoid slouching or awkward postures.
- Raise your MED upwards to avoid bending the head downward or forward.
- Support your elbows on an armrest, table, or thighs when sitting.
- Avoid prolonged static postures.



GUIDELINES FOR USING LAPTOPS AND TABLETS

- Use a desk and desk chair to utilize the same body posture as a desktop computer. Use of a laptop stand or angled riser to improve head and neck posture
- Use of wireless keyboard to enhance wrist posture.
- Avoid using a laptop in awkward or unsupported positions such as the couch, bed, or floor.

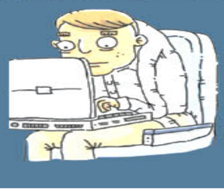
REST BREAK GUIDELINES

- Take a break from smartphones and other mobile devices every 20 mins to help prevent the onset of fatigue in the shoulder and neck muscles.
- During the rest break, focus your eyes on objects at least 20 feet away for at least 20 seconds to help prevent eye strain and headaches.
- If your neck was flexed (bent down) during device usage (which is not advised), take a 20-min rest break keeping your head in a neutral posture (looking straight ahead) to help your neck muscles recover from fatigue.

8.10. Corrective Exercise Handout

CORRECTIVE EXERCISES

FIX FORWARD HEAD POSTURE

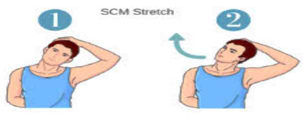


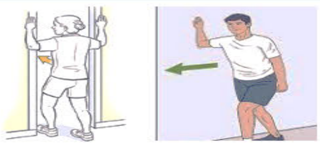
1) Scalene & Trapezius Stretch

- Either in a standing or seated position.
- Place one hand on the opposite side of your head and tuck the other hand behind your back.
- Now bring the head down towards your shoulder.
- Use the hand on top to press your head down – to get a deeper stretch (Not too hard).
- Hold for 20-30 seconds and do both sides & aim for 2-3 repetitions.

2) SCM STRETCH

- Put one hand on the opposite side of your head and bring your ear down to the shoulder.
- Tilt your head up to look at the ceiling. Use your hand to pull your head back to increase the stretch.
- Hold for 20-30 seconds & aim for 2-3 repetitions.



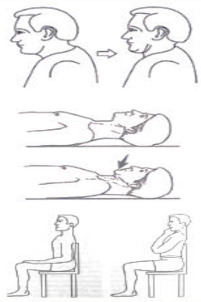


3) PECTORAL STRETCH

- Come close to a wall and stretch one arm behind you with the palm on the wall.
- Now lean forward and slightly away from the extended arm.
- Feel the stretch in your chest area.
- Hold for 20-30 seconds & aim for 2-3 repetitions.
- Do it unilaterally or bilaterally as shown.

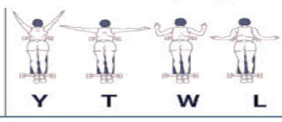
4) CHIN TUCKS

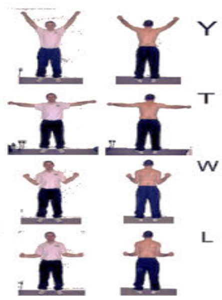
- Place 2 fingers at the bottom of your chin.
- Gently tuck your chin in and retract your head backwards. At the same time, use your fingers to keep the chin tucked in the entire time.
- Hold the end position for 3-5 seconds.
- Relax your neck for a moment (Let the neck come fwd).
- Aim for 2-3 sets of 10-15 repetitions.
- Do it either standing, sitting or lying in the bed.



5) YTWL EXERCISE

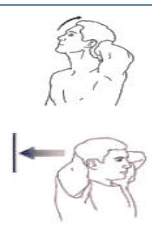
- Can be done either standing or prone lying **(lying with face down)**
- Raise your arms straight to make a 'Y'
- Lower your arms to 90° to make 'T' with your body
- Bent your elbows & tuck your arms close to your torso to make a 'W'
- Now straighten your elbows to 90° to make 'L', keeping your arms tucked.
- Hold each position for 5-10 seconds
- Aim for at least 10-15 repetitions.





6) RESISTED NECK EXTENTION

- Press the palm of your hand against the back of your head **(Use either one or both hands)**
- Press your head against your hand while resisting the movement with your hand/s.
- Hold this for 5-10 seconds.
- Aim for 2-3 sets of 10-15 repetitions.



8.11. Curriculum Vitae

Personal Informations

Name	Warda	**Surname**	Khalid

Education

Degree	Department	The name of the Institution Graduated From	Graduation year
Doctorate			
Master	Physical Therapy & Rehabilitation*	**Yeditepe University**	2023
University	Doctor of Physical Therapy	**University of Health Sciences**	2020
High school	F.Sc. (Pre-Medical)	**Suffa Educational Complex**	2014

Languages	**Grades (#)**
English, Urdu	National Language
Turkish	TÖMER (B2)

Work Experience (Sort from present to past)

Position	**Institute**	**Duration (Year - Year)**
Associate Physical Therapist	Hamid Latif Hospital	2020
Rehabilitation Aid	Mayo Hospital	2020
Internship	Arif Memorial Hospital	2017-2018

Computer Skills

Program	**Level**
Microsoft Office	Excellent
SPSS	Good

***Excellent, good, average or basic**

Scientific works

The articles published in the journals indexed by SCI, SSCI, AHCI

Articles published in other journals

Proceedings presented in international scientific meetings and published in proceedings book.

Journals in the proceedings book of the refereed conference / symposium

Others (Projects / Certificates / Rewards)

Certified Manual Therapist; Burn Rehabilitation; Basic Life Support Training; Amputation Rehabilitation; Disc Bulge Rehabilitation; Cerebral Palsy Rehabilitation Training.

8.12. Thesis Checklist

Following checks must be done before finalizing and replicating the thesis.

☒ The title obtained as MSc. or Ph.D. is written on cover and inner cover page. (The name of advisor should not be written on cover page)

☒ The name of PROGRAM to be graduated (not the name of DEPARTMENT) is written on cover page.

☒ The name-surname, name of institute, program and year are written on the back part of thesis cover as mentioned in the guide (attention about direction of writing!)

☒ On thesis cover; only title of thesis is written by 18 point and bold. For the name of INSTITUTE and DEPARTMENT 14 point, for other writings 12-point fonts are used.

☒ The approval page (earned titles as MSc or Ph.D. must be included) is properly prepared and signed. (The signature of the Director of Institute is also necessary, pay attention about the color of pen, it must be same color while signing.

☒ The printouts are taken only one side of paper by using computer that provide a high-quality output.

☒ The index is prepared as explained in the guide.

☒ On front pages, i, ii, iii etc. are put in Roman numerals.

☒ The page numbers are prepared as explained in guide.

☒ The page layout is prepared as specified in guide.

☒ The main text is printed in Times New Roman by using 12 points fonts.

☒ The footnote letter is printed in 8-10 points font.

☒ The main text is written by using 1.5 line spacing.

☒ Turkish and English abstracts are written in compatible with each other.

☒ The proper keywords are used in Turkish and English summary.

☒ The abbreviations and symbols are appropriately made.

☒ In sources list, each source is numbered. It is written in accordance with source presentation principles and citation rules.

☒ All sources that used in thesis are provided.

☒ Appendixes are given with appropriate titles, starting from separate pages, according to the order of presentation in the thesis.