T.C.

YEDİTEPE UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

EVALUATION OF THE EFFECTS OF SMARTPHONE USE ON POSTURE, PAIN, FUNCTION AND QUALITY OF LIFE IN YOUNG ADULTS

MASTER THESIS

SILA YILMAZ, PT.

İSTANBUL-2020

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APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated 17.01.2020 and numbered 2020/01-04

Prof. Dr. Bayram Yılmaz

Director of Institute of Health Sciences

DECLARATION

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

Sıla YILMAZ

DEDICATION

I would like to dedicate my thesis to my beloved and loving parents and grandfather.

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LIST OF SYMBOLS AND ABBREVIATIONS

°	Degree
%	Percentage
ATBÖ-KF	Akıllı Telefon Bağımlılığı Ölçeği-Kısa Form
BMI	Body Mass Index
CNFDS	Copenhagen Neck Functional Disability Scale
cm	Centimeter
E	Erkek
ESUG	Excessive Smartphone Use Group
F	Female
FHP	Forward Head Posture
K	Kadın
KBFÖS	Kopenhag Boyun Fonksiyonel Özürlülük Skalası
kg	Kilogram
m	Meter
M	Male
ns	Non-significant
NSUG	Non-excessive Smartphone Use Group
NYPRC	New York Posture Rating Chart
OÖS	Omuz Özürlülük Sorgulaması
SAS-SV	Smartphone Addiction Scale-Short Version
SD	Standard Deviation
SDQ	Shoulder Disability Questionnaire
SPSS	Statistical Package Analysis for Social Sciences
VAS	Visual Analogue Scale / Vizüel Analog Skala
WHOQOL-Bref	World Health Organization Quality of Life Instrument-Short Form

ABSTRACT

Yılmaz, S. (2020). Evaluation of the Effects of Smartphone Use on Posture, Pain, Function and Quality of Life in Young Adults, Yeditepe University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Master Thesis. Istanbul.

The aim of the study is to determine the effects of the use of smartphone on the neck and shoulder posture, pain, and functions, and the quality of life in young adults. The study included 106 university students (84F, 22M; 19,67±1,32 years) from Yeditepe University Faculty of Health Sciences and Istanbul Gedik University Faculty of Health Sciences. The sociodemographic features of participants were recorded by using a structured questionnare. In the assessment of pain level, the Visual Analogue Scale (VAS) was used. Functional levels of the neck and shoulders were evaluated with the Copenhagen Neck Functional Disability Scale (CNFDS) and the Shoulder Disability Questionnaire (SDQ). World Health Organization Quality of Life Instrument-Short Form (WHOQOL-Bref) was utilized to assess the quality of life. Postural analyzes of the participants were fulfilled with the New York Posture Rating Chart (NYPRC). According to the scores they got from the Smartphone Addiction Scale-Short Version (SAS-SV), all participants were divided into two groups as Excessive Smartphone Use Group (ESUG) (n=53) and Non-excessive Smartphone Use Group (NSUG) (n=53). Participants whose scores were higher than 30 were included to the ESUG and whose scores were 30 or less were included to the NSUG. It was found that the lateral neck and shoulder posture scores were lower, the neck and shoulder VAS scores were higher, the CNFDS and SDQ scores were higher, and the WHOQOL-Bref psychological health scores were lower in the ESUG when compared with the NSUG (respectively p=0.00, p=0.00, p=0.00, p=0.00, p=0.00, p=0.00, $p<0,05$). According to these results, the ESUG had statistically significant differences in terms of the neck and shoulder posture, pain, and function, and the quality of life than the NSUG. In conclusion, it was indicated that the use of smartphone has negative effects on posture, pain, function and quality of life in young adults.

Key Words: smartphone, neck, shoulder, posture, pain, function, quality of life, young adult

ÖZET

Yılmaz, S. (2020). Genç Erişkinlerde Akıllı Telefon Kullanımının Postür, Ağrı, Fonksiyonel Durum ve Yaşam Kalitesi Üzerine Etkilerinin İncelenmesi, Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı, Yüksek Lisans Tezi. İstanbul.

Bu çalışmanın amacı; akıllı telefon kullanımın genç erişkinlerde boyun ve omuz postürü, ağrısı, fonksiyonel durumu ve yaşam kalitesi üzerine etkilerini belirlemektir. Çalışmaya Yeditepe Üniversitesi Sağlık Bilimleri Fakültesi ve İstanbul Gedik Üniversitesi Sağlık Bilimleri Fakültesi'nde eğitim gören 106 gönüllü öğrenci (84K, 22E; 19,67±1,32 yıl) dahil edilmiştir. Katılımcıların sosyodemografik özellikleri yapılandırılmış bir anket kullanılarak sorgulanmıştır. Ağrı seviyesinin değerlendirilmesinde Vizüel Analog Skala (VAS) kullanılmıştır. Boyun ve omuz fonksiyonel durumu Kopenhag Boyun Fonksiyonel Özürlülük Skalası (KBFÖS) ve Omuz Özürlülük Sorgulaması (OÖS) ile değerlendirilmiştir. Yaşam kalitesini değerlendirmek için Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu (WHOQOL-Bref) kullanılmıştır. Katılımcıların postür analizi New York Postür Değerlendirme Testi kullanılarak yapılmıştır. Tüm katılımcılar, Akıllı Telefon Bağımlılığı Ölçeği-Kısa Form'dan (ATBÖ-KF) aldıkları skora göre akıllı telefonu fazla kullananlar (ESUG) (n=53) ve akıllı telefonu az kullananlar (NSUG) (n=53) olarak iki gruba ayrılmıştır. ATBÖ-KF skoru 30'un üstünde olan katılımcılar akıllı telefonu fazla kullananlar grubuna, 30 ve altında olan katılımcılar akıllı telefonu az kullananlar grubuna dahil edilmiştir. Gruplar karşılaştırıldığında, akıllı telefonu fazla kullanan grupta, az kullanan gruba göre; lateral boyun ve omuz postür skorlarının daha düşük olduğu, boyun ve omuz VAS skorlarının daha yüksek olduğu, KBFÖS ve OÖS skorlarının daha yüksek olduğu ve WHOQOL-Bref psikolojik sağlık skorlarının daha düşük olduğu görülmüştür (sırasıyla $p=0.00$, $p=0.00$, $p=0.00$, $p=0.00$, $p=0.00$, $p=0.00$, $p<0,05$). Buna göre, akıllı telefonu fazla kullanan grubun boyun ve omuz postürü, ağrısı, fonksiyonel durumu ve yaşam kalitesi akıllı telefonu az kullanan gruba göre anlamlı ölçüde farklı bulunmuştur. Sonuçta, genç erişkinlerde akıllı telefon kullanımının postür, ağrı, fonksiyonel durum ve yaşam kalitesi üzerine olumsuz etkileri olduğu gösterilmiştir.

Anahtar Kelimeler: akıllı telefon, boyun, omuz, postür, ağrı, fonksiyon, yaşam kalitesi, genç erişkin

1. INTRODUCTION AND PURPOSE

Nowadays, smartphones have created a new culture since they have become progressively widespread by becoming capable of doing almost all the work done on the computer (1). They have transformed into indispensable devices in order to ensure and to maintain communication both in business and daily life (2). Correspondingly, over the last years, the number of people using smartphone has increased consistently all over the world (3). Besides, recent researches have shown the fact that a smartphone user spends an average of 2,7 hours in a day using smartphone (2). All in all, with the increment in both the number of smartphone users, and the time of they use smartphone, thoughts and worries have also arisen about that this situation may lead to increase the risk of development some musculoskeletal deficits such as poor posture, pain, muscle fatigue, and loss of muscle strength and function (2,3,4,5).

Generally, people use their smartphones by holding them close to their laps when sitting, and close to their bodies when standing (6). In this position, they round the shoulders forward, and flex the neck to look at their smartphones they hold below with their both hands. Most of the time, they sustain this posture for long hours that they continue to use their smartphones (7). Maintanence of these positions may become a habit over time, and cause some musculoskeletal deformities both in the skeletal structures and in the soft tissues, which sometimes results in severe pain (5,8). Because of the posture that people possess while they are using smartphone, it is estimated that the neck and shoulders are the specifically affected regions by the using smartphone and that, these two areas may be predisposed to have high risk of smartphone-related pain (6).

Neck pain is a serious health problem such that can affect people's quality of life critically (9,10). Furthermore, it is thought that %20 to %77 of the whole population will suffer from neck pain in any period of their lives (11). According to a study findings, it has been reported that symptoms became permanent and casued disability in %37,3 of individuals with neck pain, and %9,9 of these people experienced an aggravation within a year. Moreover, 54,2% of adult population experience neck pain every 6 months, and activity limitations are also seen in 4,6% of these people due to neck problems (12). Taking these points into considerations, it can be said that the neck pain is a major musculoskeletal problem which needs to be taken seriously.

While 21. century's young adults were growing up, mobile phones were a significant part of their daily lives (13). Accordingly, using smartphone for prolonged period of time is more prevalent among this group which includes also today's university students (6). Although the fact that the neck pain generally increases with age, in these days, the incidence of neck pain in younger population has reached the all-time high (4). Specifically, 30% of young adults state that they wake up with neck pain at least one time per week (14). It is thought that the rapid increase in the neck pain rates seen in the young adults may be related to new habits that took place in our daily lives especially in recent years, such as using smartphones for long durations (1,3,15). Not only in the neck region, latest researches conducted in university students have shown that young adults who are smartphone users report pain in various parts of their bodies. Further, it has also been seen in these studies that the duration of using smartphone and the severity of symptoms were correlated (3,4,16).

As well as the pain, the results of several studies conducted in the young adults have shown that using smartphone for long periods of time may negatively affect many other musculoskeletal factors such as the activity and fatigue level of muscles, proprioception, the pain threshold and level, posture, and most importantly, functions in daily activities, which can affect the quality of life, and is considered as the cardinal measure of any health problem (1,3-8,17).

Although it is predicted that the use of smartphones may have this much impact on human health in relation to so many different parameters, most of the studies that have been done until now is about the neck pain and the neck posture in large part only (1,3,5,6). In fact, since the shoulders are one of the major areas which are affected by the smartphone use posture, the relationship between the shoulder posture or shoulder pain and the use of smartphone should also be examined in detail (6). Moreover, since a postural disorder in any part of the body can affect the alignment of its adjacent segments and also other regions afterwards, a postural disorder in the neck region is also likely to affect the shoulder region (10). On the other hand, because the postural misalignments can cause to pain, and the pain may affect the functional situation of that region, these all parameters related to neck and shoulders should be evaluated comparatively. However, according to the literature review, as well as there is only a few studies evaluating the relationship between the shoulder posture or shoulder pain and the use of smartphone, a study comparing the neck and shoulders in terms of posture, pain, and function among smartphone users was not found in the literature.

More importantly, posture, pain, functioning, and quality of life are the parameters that can affect each other, and are closely related to each other. Any disorder in posture may cause pain, while pain can lead to a decrease in the functional level and the quality of life (1,11). Although there are many studies in the literature evaluating the effects of smartphone use on different musculoskeletal factors, a study examining the effects of smartphone use on all of these features in young adults has not been conducted yet.

Taking into account all of these, the aim of this study is to determine the effects of the use of smartphone on the neck and shoulder posture, pain, and functions, and the quality of life in young adults.

Two hypotheses identified in the study are as follows:

H0: There is no relationship between the use of smartphone and the neck and shoulder posture, pain, and functions, and the quality of life in young adults**.**

H1: There is a significant relationship between the use of smartphone and the neck and shoulder posture, pain, and functions, and the quality of life in young adults**.**

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. History of the Use of Smartphone

The communication age we are living in has led to an increase in the need for devices that enable rapid communication in daily life, and the developing technology has made possible to invent and so, to be included in our lives many different communication devices which can meet this need (18). The process of the development of telephone technology, which can be considered the most important one among all communication devices since it provides one-to-one and direct communication between two people unlike other means of communications, began with the invention of the first telephone by Graham Bell in 1876 (19). In the evolution process of the phone, the history of mobile phones, which can be easily carried anywhere thanks to their size, dates back to the development of the first mobile phone in 1973 by Martin Cooper, who were working in Motorola as an engineer (20). In 1990s, mobile phones that got into the Turkish market replaced land phones by becoming widespread very quickly. After all these developments, the Apple company, in 2007, released to the market a new model called "Iphone" known as the first smartphone. There has been a significant increase in the use of mobile phones around the world with coming into the market of smartphones (21). Nowadays, smartphones, which are increasing in use every day, settled in our lives with many different functions, and became one of the fastest developing sectors in the World (19). As well as the fact that the use of smartphones are more common among young population, according to the data which is published by the Turkish Statistical Institute, while the rate of having a mobile/smartphone of households was 53.7% in 2004, this rate reached to 96,2% in 2014, and 96.9% in 2016, with an increase of close to 100% (21-23).

2.2. Smartphone Addiction

Addiction is defined in the dictionary as inability to stop doing something or to stop using something (24). Although, when addiction is mentioned, smoking, alcohol and substance addiction comes to mind first, when considering how much the technological tools changed our life style, and they became an inseparable part of daily life, that can be said it is inevitable to encounter technological addictions currently (25).

Considering technological devices in general, it can be said that television was the first technological device that succeed to enchain people, thanks to its ability to provide entertainment in their own homes. After, the computers, which are the tools as well as enabling activities such as playing games, watching movies and videos, and also providing convenience through its many different functions both in business and in daily life, catched on and became devices that people, especially youngs, spend a large part of their time on. Finally, smartphones became the devices we need and use because they make our work easier in all fields of life by both providing the entertainment service of televisions, and making all the functions of computers portable (26).

Today, smartphones have become devices that are constantly used in all fields of our lives thanks to the features of getting access both the internet and social media, and to allow to use a wide range of applications (27). That this situation can turn into a habit over time, and this habit may result in the addiction in later stages, has led to the inclusion of the smartphone addiction term in our lives (28).

Smartphone addiction, which can significantly affect the daily lives of individuals, has been defined by Kwon et al. as the difficulty of controlling the use of smartphone, the craving for using smartphone, and the excessive use of the smartphone (28). Smartphone addiction is one of a behavioral addictions, which is a term using to define the addictions to some actions such as love, shopping or games, without the chemical substance intake (29). In behavioral addiction, the behavior repeats continuously, and while there is a state of enjoyment when the behavior is sustained, when it is not done, there is a state of suffering. Accordingly, people with high levels of addiction feel nervous, anxious and uncomfortable when they are unable to use their smartphones (30). Although the frequency or rate of smartphone addiction is not known exactly, it is a fact that it is rapidly increasing in all cultures and societies (31).

The rate of smartphone addiction among the young population is higher in relation to the fact that young people spend much more time with their smartphones (18). The study conducted by Akodu et al. in 2018 showed that the students are more susceptible to smartphone addiction (6). According to the results of researches conducted in different countries of the world, the smartphone addiction rates of students have been reported as 6% in Italy, 18.8% in Japan, 25% in the United States, 27.4% in Hong Kong, 28.7% in the Netherlands, and 44% in India (32-37). In a study conducted in Turkey, it has been observed that the students spend 5 hours or more in a day on their smartphones (38). The Turkish Statistical Institute has reported that the average age of children to start using mobile/smartphones is 10 (39). Also, in the studies examining the use of smartphones by gender, it has been shown that, in male students the games played on smartphones, and in female students the social media usage, are the factors causing addiction (40,41).

In conclusion, it can be said that the smartphone addiction is more common among smartphone users who have their first smartphone at an early age, and use their smartphones to access social networks particularly (38,42).

2.3. Negative Effects of the Use of Smartphone on Health

Concerns about the possible impacts of the use of smartphone are also growing with the increasing number of people use smartphone, and the time spent by them using smartphone. According to studies until today, it has been shown that the use of smartphone has negative effects on both psychological and physical health (3,41,43-47).

2.3.1. Psychological Problems Associated with the Use of Smartphone

The word 'Nomophobia', which is the English acronym of 'No Mobile Phobia' phrase, means fear of being away from the smartphone. This term was first reported in the researches that conducted in United Kingdom in 2008, and in these researches it was showed that 66% of the adolescents have nomophobia (18,48).

According to the existing literature, nomophobia and smartphone addiction are closely related to each other (49). In the study conducted by Rosen et al. in 2014, it was revealed that university students who were separated from their smartphones showed anxiety symptoms and that these symptoms were more pronounced in the students who use smartphone excessively. It has also been noted that concerns about being separated from their smartphones were at the same level as separation anxiety (44).

In several studies, it has been concluded that psychiatric comorbidities such as nomophobia, anxiety, depression, insomnia, dizziness, headache, and decreased quality of life, and that behavioral comorbidities such as internet addiction and gambling may accompany smartphone addiction (31). Besides, compulsive behavior, functional impairment and withdrawal symptoms are known to be associated with excessive use of smartphone (45,50,51). It has also been observed in researches that social phobia, low self-confidence, exclusion, stress and loneliness in smartphone users increase predisposition to smartphone addiction (38,42,52).

The study conducted on college students in 2016, an in another study conducted on 540 high school students in the same year revealed a positive relationship between smartphone addiction and loneliness (53,54). According to the results of another study, conducted with the participation of 630 high school students in 2017, in which smartphone addiction and loneliness among high school students were examined, smartphone addiction scores of the students with high level of loneliness were found to be higher than others (18).

2.3.2. Musculoskeletal Problems Associated with the Use of Smartphone

It is known that the use of smartphone can cause some musculoskeletal problems such as postural disorders, biomechanical changes, pain, and proprioceptive deficits. The primary reason of the formation of these problems is thought to be the misalignment of the person's body parts during the use of the smartphone (1,3,4,6,7).

That keeping ears aligned with the shoulders while having the scapula retracted are two main characteristics of good posture. In correct alignment, which is the most proper and effective position for spine, spinal stress is decreased (6). However, the person using smartphone maintains a posture in which the neck is flexed, and the shoulders are protracted for long periods of time to look at the device (55). Beside this, it is also known that when the neck is in flexion, loads on the cervical spine increase depending on the degree of flexion (18). According to the study conducted by Hansraj et al. in 2014, the loads on the cervical spine conspicuously increases when flexing the neck at greater degrees. In neutral position, avarege weight of an adult's head is 10-12 pounds. During progressive degrees of the neck flexion, the loads on the cervical spine rise to 27, 40, 49 and 60 pounds at 15°, 30°,45° and 60° respectively (56) (Figure 2.1). Considering this, because of that the sustained neck flexion for a long period of time while using smartphone will increase the loads on the cervical spine, it can be assumed that, during the use of smartphone, the bone structures, joints, and muscles in the neck remain under greater stress than normal (7). This situation affects working mechanisms of both the skeletal and muscular structures in also peripheral regions.

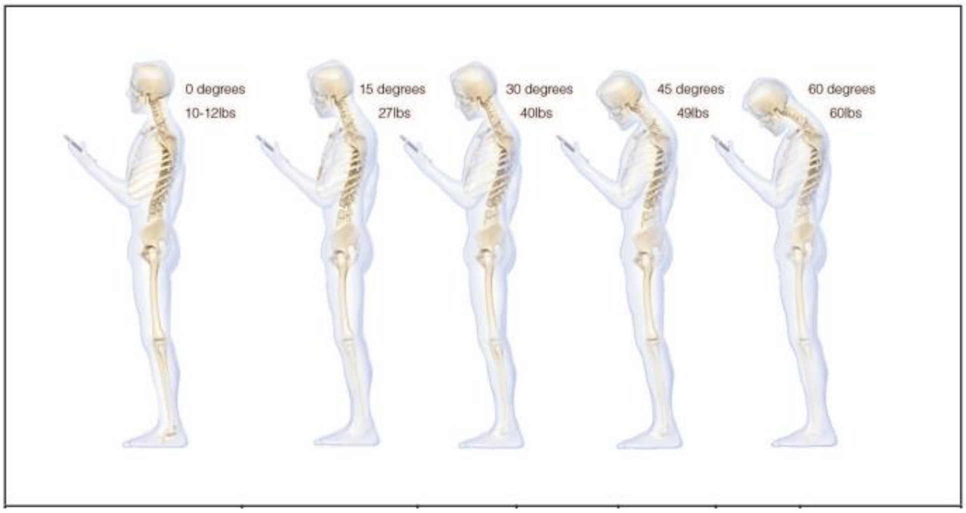

Figure 2.1. Change of loads on the cervical spine according to different degrees of neck flexion during smartphone use (56)

Maintaining the neck flexion posture extended period of time causes the lower cervical spine to lose its natural lordosis in time. Also, to counterbalance this forces, the posterior curve increases in the upper thoracic spine, which results in the kyphosis in this area. This misalignment of the head and neck is named as Forward Head Posture (FHP) or Turtle Neck Posture (15).

FHP generates an additional flexion force to the neck, which causes a bigger load both on the neck extensor muscles and the adjacent connective tissues of the neck (2). Overactivity of neck muscles while using smartphone, especially of the cervical erector spinae and the upper trapezius, which are the main muscles that provide stabilization of the neck and shoulder joints by counterbalancing external forces, has been shown in different researches before. The situation that contracting the neck muscles continually to keep FHP while using smartphone extended period of time, is thought to cause fatigue in these muscles. Increase in the level of fatigue of the neck muscles may also result in pain in this region in the end. It is also known that neck pain may occur as a result of stretching of the facet joint capsules due to prolonged and repeated neck flexion (2,5,17,57,58).

"Text-neck", caused by the use of smartphone sustained period of time, is the name of repetitive stress injury or overuse syndrome that causes neck pain and damage to the structures around the neck area. According to a systematic review, if the text-neck is not treated, it can cause several critical irreversible deformations such as arthritis, disc pathologies, nerve damages, and some other disorders in other different parts of the body (7,15). For instance, postural disorders caused by the use of smartphone can be seen not only in the neck region, but also in the shoulder region, and the rest of the spine, since the muscle imbalance which can occur because of the use of smartphone excessively, also affects the regions which are associated with the neck. In researches, it has been observed that a deformation especially that occurs in the cervical region may also affect negatively the structures in the lumbal region due to the interconnection of spine sections (8).

Furthermore, in several studies, it has been reported that using smartphone for prolonged duration can affect proprioception both of the cervical and lumbal spine in a negative way (4,5). Moreover, the study conducted in young adults by Akodu et al. in 2018 showed that when the smartphone addiction level is high the craniovertebral angle which is an indicator of the head and neck posture, reduces. This situation causes the FHP that leads to developlement of scapular dyskinesis changelessly (6).

2.4. General Overview to Spine and Structure of Spine

The spine formed of 33 bones called vertebrae (59). The vertebrae are named as cervical, thoracic, lumbal, sacral and coccygeal according to body regions they are located in (60). 24 of all 33 vertebrae are mobile including 7 cervical (C1-C7), 12 thoracic (T1-T12) and 5 lumbal (L1-L5), and 9 of them are immobile including 5 sacral (S1-S5) and 4 coccygeal. In adults, 5 sacral vertebrae have combined to form sacrum, and 4 coccygeal vertebrae have combined to form coccyx. The number of vertebrae in the cervical, thoracic, and lumbal regions does not change lifelong (61).

During intrauterine period and at birth, the spine is concave. After birth, the first convexity forms in the cervical region as a result of providing the head control, and the second convexity forms in the lumbal region as a result of starting to stand upright. While the natural curves in the cervical and lumbal regions are called lordosis, the natural curves in the thoracic and sacral regions are called kyphosis (62). When looking at the spine from the front or back, it is seen as a straight line (63) (Figure 2.2).

The most important task of spine, which is a movable column that ensures the axial skeleton to stand upright, is to protect the spinal cord, which is in it, against external factors (60,64).

While the length of vertebral column is 72 cm on average in an adult male, it is stated that it is 7-10 cm less than this value in females (65).

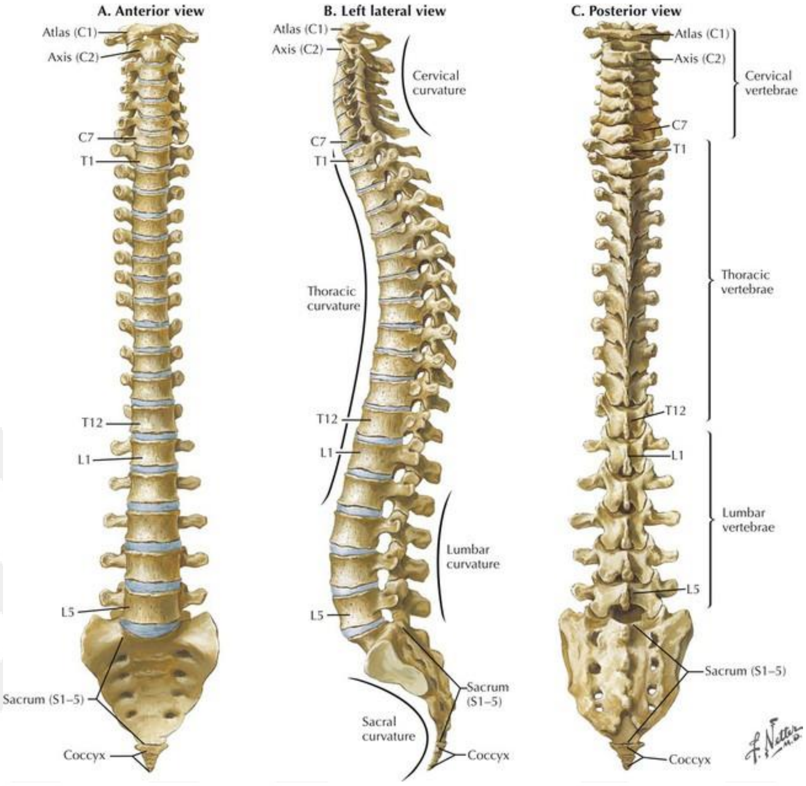

Figure 2.2. View of vertebral column from anterior, lateral, and posterior (63)

2.4.1. Structure of Vertebrae

The morphology of vertebrae differs according to their functions and the regions in which they are located (60,62). As the load on the vertebrae increases from the cervical region to the lumbal region, the size of vertebrae also grows in accordance to this. The biggest vertebrae are fifth lumbal and first sacral vertebrae (64).

Other vertebrae, except atlas (C1) and axis (C2), are similar in terms of some features. A typical vertebra has a vertebral body and a vertebral arch consisting of lamina and pedicle (60). The points where the vertebral arch and vertebral body merged are called as pedicles. There are specialized structures called as superior and inferior vertebral notches on upper and lower parts of the pedicles (66). The vertebral arch has a total of 7 bone protrusions, one of them is spinous process, 2 of them are transverse processes, and 4 of them are articular processes as two of them are above and two of them are below (60). The pedicles on both sides, starting from the vertebral arch, continue backwards with two laminae and finally end with a spinous process. The spinous process is a bony protrusion at the back of vertebra that can be felt under the skin when palpated by hand. The transverse processes, which are the sites of attachment for muscles and ligaments of the spine, as well as the points of articulation of the ribs in thoracic spine, are the bony protrusion of both sides of vertebral arch (64). Transverse processeses extend sideways, and vary in shape and length depending on the region in which they are located (65). The articular process is the region where the one vertebrae joint with one another (64). In posterior, they forms the facet joints. There is the superior articular process on upper side, and the inferior articular process on lower side where the pedicles and the lamina merged (65,66). The vertebral body and the vertebral arch create an opening by uniting named as vertebral foramen which is found in a typical vertebra. By overlapping of the vertebrae, these openings combine with each other. This structure, formed by the vertebral foramens and named as vertebral canal, contains the spinal nerves and associated meninges (63,64,66) (Figure 2.3).

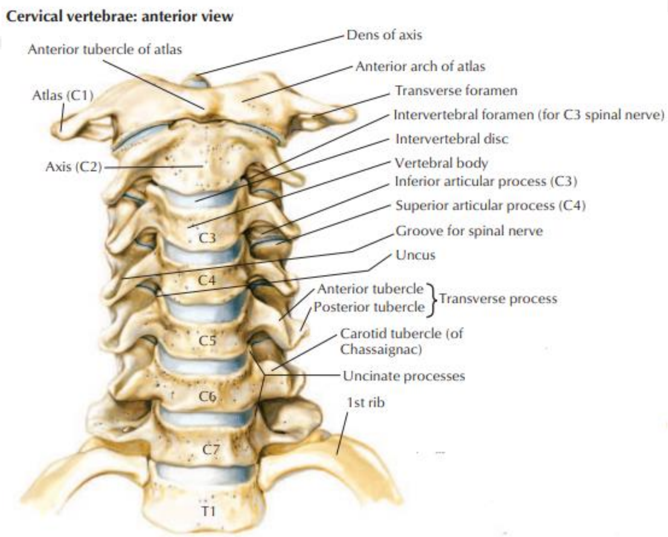

Figure 2.3. View of cervical vertebrae from anterior (63)

Atlas and axis are the first two vertebrae of the vertebral column, and both have atypical structures. Their morphology is specialized to orient, to support and to position the head (67).

Atlas, the first vertebra of the vertebral column, has been taken its name from Greek mythology because of that it carries a round sphere (68). The most important feature of the atlas is that it does not have a vertebral body and a spinous process, and since it does not have a body, there is no disc between it and the axis (67,68). It articulates with the occiput through the superior joint surfaces located on its both sides (68). Its transverse processes are large and protrude laterally more than those of other cervical vertebrae (63,67) (Figure 2.4).

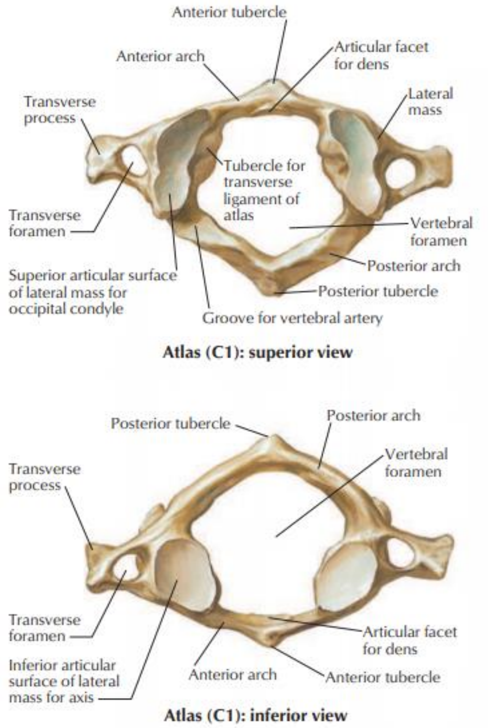

Figure 2.4. View of the atlas from superior and inferior (63)

The axis is the second vertebra of the vertebral column, and its most important anatomical features which distinguish it from a typical vertebrae are its odontoid process, its differences in the articular surface of superior facet joint, and its transverse process (63,69) (Figure 2.5).

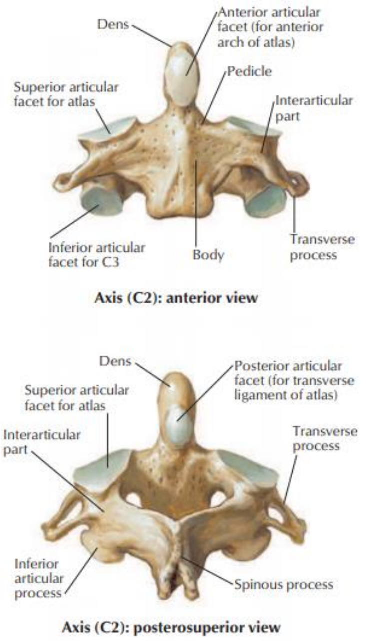

Figure 2.5. View of the axis from anterior and posterosuperior (63)

The seventh cervical vertebra (C7) is called as vertebra prominence because of that it is the one has the most prominent spinous process among all cervical vertebrae. In addition, its spinous process does not have a double-headed structure unlike the other cervical vertebrae, and because of this, it shows the characteristic of a thoracic vertebra. Furthermore, its transverse process is larger than that of a typical cervical vertebrae. Therefore, it may appear as if the beginning of a cervical rib (63,69,70) (Figure 2.6).

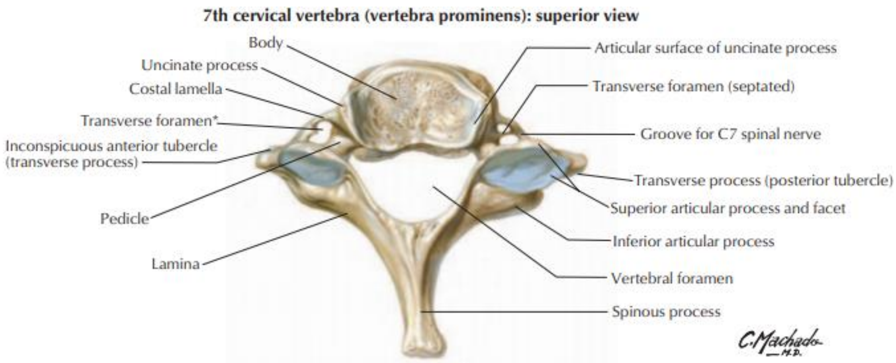

Figure 2.6. View of the 7th cervical vertebra from superior (63)

Even though the vertebrae from C3 to C6 are thought as typical vertebrae, they also have significant differences compared to the other vertebrae in other regions of the spine. Since the bodies of these vertebrae are smaller, and the widths of its vertebral bodies from one side to another are more than the widths of its vertebral bodies in anteroposterior plane, they appear triangular in shape. From C2 to C7, the difference between the anteroposterior diameters and the sideways diameters decreases. The spinous processes of these vertebrae are small, and their ends are bifurcate. Moreover, in this region, also the vertebral foramen is wider, and triangular in shape (68,69).

2.4.2. Functional Spinal Unit

The spine stands on three columns, one at the front and two at the back. The large column in anterior is made of the vertebral bodies, and of the intervertebral discs connecting them. The small columns at the back are made up of posterior intervertebral (facet) joints formed by articular processes. While the anterior column has a static role, the posterior column has a dynamic role (71).

The structures that lie between the horizontal plane passing through the middle of the adjacent vertebra are called as functional spinal unit or spinal motion segment. The functional spinal unit is divided into passive and active segments. While the passive segment includes the adjacent vertebrae, the active segment consists of the intervertebral disc, intervertebral foramen, articular processes, ligamentum flavum, and interspinous ligament. Mobility of the active segment forms the basis of spinal movement (71).

2.4.3. Intervertebral Disc

The total number of intervertebral discs is 23 (72). Discs make up 33% of the entire vertebral column height. There is no disc between the atlantooccipital and atlantoaxial joint (73).

Discs are one of the most important parts of the spine movement system in terms of its function and its mechanical properties. They are responsible for distributing and transporting loads on the spine, and preventing excessive movements (72). The viscoelastic structure of discs allows them to change shape and to harden depends on the load on the vertebrae. The discs function as a cushion by spreading pressure between the vertebrae with these features. They also contribute to increase flexibility during spine movements (64). The discs consist of the nucleus pulposus inside, and the anulus fibrosis outside (73).

The nucleus pulposus, a gelatinous structure located in the center of the disc, is rich in glycosaminoglycans. 88% of it consists of water. It is a translucent, yellowish-colored structure with no nerves or blood vessels. The nucleus pulposus, which makes up 40% of the disc, acts as a shock absorber against axial compressions while dissipates compressive stresses. Due to its high content of liquid, it has high resistance to pressure (64, 73-75).

The anulus fibrosus is the outer part that surrounds the nucleus pulposus, and creates the shape of disc. It is fibrocartilaginous in structure, and consists of bundles of Type I collagen fibers. The collagen tissue gives the disc the required flexibility. Since the number of fibrous fibers it contains increases with age, its elasticity decreases in time (73,76).

The spinal part where the intervertebral discs are thinnest is the cervical region (64). The intervertebral discs in the cervical region are smaller in diameter and height than those in the thoracic and lumbal regions. In addition, because the upper parts of the body of cervical vertebrae are concave, and the lower parts are convex, they stand embedded within the vertebral body (77). The anterior parts of its discs are about 3 times thicker than the posterior parts. This structural characteristic provides to form of natural cervical lordosis (68) (Figure 2.7).

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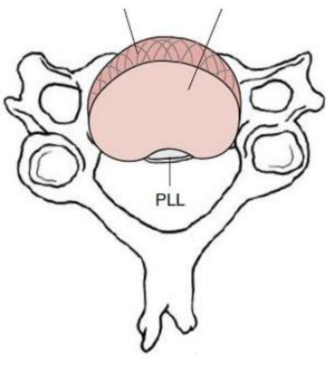


Figure 2.7. View of intervertebral disc and a typical cervical vertebra from superior (68)

2.4.4. Ligaments of Spine

Due to its structure, the cervical region has a high range of motion in 3 planes. Therefore, it is necessary to prevent injuries by avoiding the excessive movements. The ligaments of cervical region help to limit cervical movements, to maintain cervical lordosis and to protect the spinal cord (70).

The joints between the vertebrae are strengthened by ligaments (78). In order to provide stabilization of the spine, the ligaments put up resistance in stretch conditions. The anterior ligaments are stronger than the posterior ligaments. The posterior ligaments put up resistance to flexion while the anterior ligaments to extension. While the ligaments that put up resistance most to flexion movement are the interspinous ligaments, the ligaments that put up resistance most to extension are the anterior longitudinal ligaments (79).

Ligaments of the cervical vertebrae are divided into three groups as external and internal craniocervical, and vertebral ligaments (77) (Figure 2.8):

External Craniocervical Ligaments: External craniocervical ligaments, which are very loosely attached to make the movements of the skull easier, are the structures that connect the cranium to atlas and axis. These ligaments are (78):

1. Anterior atlantooccipital membrane
2. Posterior atlantooccipital membrane
3. Joint capsule (Lateral atlantooccipital joint)
4. Anterior longitudinal ligament
5. Ligamentum nucha
6. Ligamentum flavum

Internal Craniocervical Ligaments: Internal craniocervical ligaments, located on the posterior surface of vertebral body, play a role in strengthening of craniocervical region, and prevention of excessive movements. These ligaments are (78):

1. Tectorial membrane
2. Atlas transverse ligament
3. Apical ligament
4. Alar ligament
5. Ligamentum accesorium

<u>Vertebral Ligaments:</u> These ligaments are (79):

1. Anterior longitudinal ligament
2. Posterior longitudinal ligament
3. Ligamentum flavum
4. Supraspinal ligament
5. Interspinous ligament
6. Intertransverse ligament

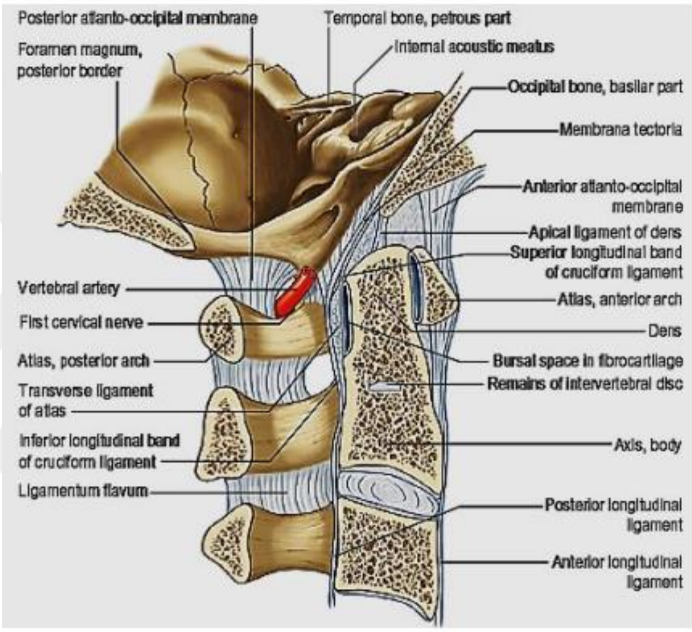


Figure 2.8. Ligaments of cervical region (77)

2.4.5. Muscles of Spine

Spinal muscles are examined in 5 groups according to their functions. These groups are as follows (80):

1. Flexor muscles: Rectus abdominis, internal and external abdominal obliques, psoas, sternocleidomastoideus, longus colli, and scalenes
2. Extensor muscles: Latissimus dorsi, erector spinae, spinalis, interspinalis, levator scapula, and splenius
3. Lateral flexor muscles: Sacrospinalis, quadratus lumborum, transversus thoracis, levator scapula, scalenes, and semispinalis

4. Ipsilateral rotatory muscles: Latissimus dorsi, splenius, longus colli, and internal abdominal obliques
5. Contralateral rotatory muscles: Transversospinalis, multifidus, longus colli, and external abdominal obliques

2.4.6. Muscles of Cervical Region

Because most of the muscles of neck region are deeply located and very small, it is impossible to palpate them separately (81).

Sternocleidomastoid Muscle: The sternocleidomastoid muscle is one of the largest and most superficial muscle in the neck. It has two heads and connects the mastoid process of temporal bone to the manubrium sterni and the medial clavicle. When contracted bilaterally, it extends the head, and flexes the neck. Besides, when contracted unilaterally, contralateral neck rotation and ipsilateral neck flexion movements occur. It is innervated by the ventral branch of accessory nerve which is XI. cranial nerve, and the direct branches of cervical plexus (C1-C2) (82).

Levator Scapula Muscle: While it originates at the transverse processes of the atlas and axis, as well as the posterior tubercles of the 3rd and 4th cervical vertebrae, it inserts on the superior angle and medial border of scapula. If the scapula is fixed, it causes lateral flexion in the head and neck when contracted unilaterally, and extension when contracted bilaterally. It is supplied by the dorsal scapular nerve (82).

Scalene Muscles: These are the anterior, middle, and posterior scalene muscles. The anterior scalene muscle originates from the anterior tubercle of C3-C6 transverse processes, and attaches to the first rib. The middle scalene muscle has its origin at the posterior tubercle of C3-C7 transverse processes, and inserts on the first rib, posteriorly to anterior scalene muscle. The posterior scalene muscle runs from the posterior tubercle of C5-C7 transverse processes to the second rib. Three main functions of the scalene muscles are elevating the ribs and thorax, laterally flexing the neck when contracted unilaterally, and flexing the neck when contracted bilaterally. They are also considered as an accessory muscles of inspiration. The anterior scalene muscle is innervated by the anterior branches of C4-C6 spinal nerves. The middle is innervated by the anterior branches of C3-C8 spinal nerves, and the posterior is innervated by the anterior branches of C6-C8 spinal nerves (79).

Trapezius Muscle: It is the most superficial muscles on the back dividing into three parts as upper, middle and lower. This muscle originates from the medial third of superior nuchal line, the external occipital protuberance, the nuchal ligament, and the spinous processes of C7-T12 vertebrae. It inserts on the lateral third of clavicle, the acromion, and the spine of scapula. The lateral flexion movement of the neck occurs when this muscle unilaterally contracted. Besides, when bilaterally contracted, it extends the neck. It is innervated by the accessory nerve (82,83) (Figure 2.9).

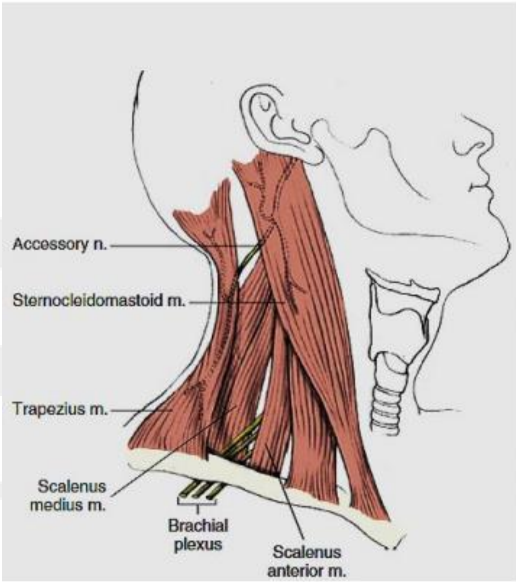


Figure 2.9. View of muscles of the cervical region from lateral (83)

Multifidus Muscle: It originates from the sacrum, the superior posterior iliac spine, the transverse process of T1-T12, and the articular process of C4-C7, while it attaches to the spinous process of vertebrae except C1. When contracted bilaterally, the extension movement occurs in vertebral column. Also, when contracted unilaterally, the lateral flexion and the contralaterally rotation movements of vertebral column occurs. It is innervated by the medial branch of the posterior ramus of spinal nerve at each level (82).

Platysma Muscle: It functions primarily in facial expressions, and helps to the head and neck flexion when contracted bilaterally. It is innervated by the facial nerve (79,82,84).

Splenius Capitis and Cervicis Muscles: Splenius capitis is deep to trapezius muscle, and has a broad origin on the nuchal ligament and the spinous processes of C7-T3 vertebrae. It attaches to the temporal bone, the mastoid process, the occiput and the lateral portion of superior nuchal line. Splenius cervicis is originates from the spinous processes of T3-T6 vertebrae, and inserts on the transvers processes of C2-C3. While they are working bilaterally, extends the head and neck. They also laterally flexes and ipsilaterally rotates the head and neck while they are working unilaterally. They are innervated by the posterior branches of cervical spinal nerves (79,82,85) (Figure 2.10).

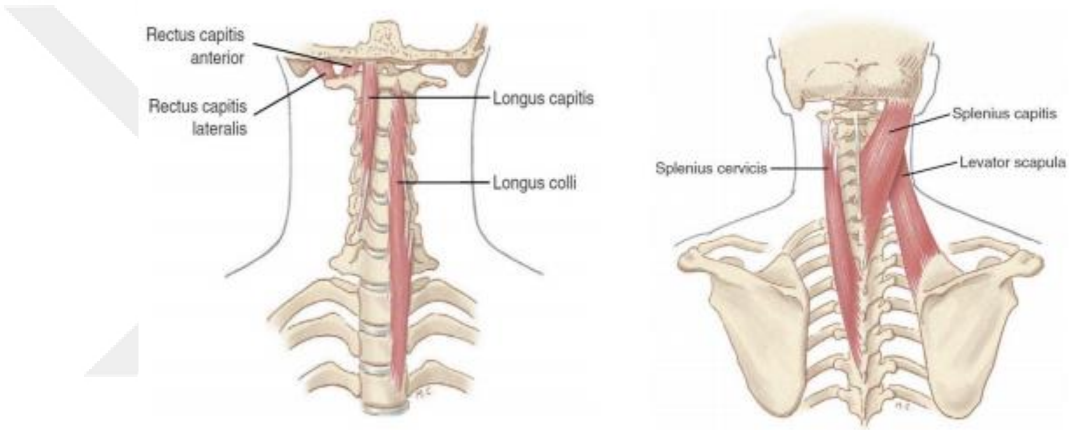


Figure 2.10. Muscles of cervical region in posterior (85)

Semispinalis Muscle: The semispinalis, which consists of three parts as capitis, cervicis and thoracis depending on the attachment site, lies deep to trapezius and just superficial to suboccipitalis muscles. Its origins are the articular processes of C5-C8 as well as the transverse processes of T1-T6. It attaches onto the occiput between the superior and inferior nuchal lines and the spinous processes of C2-T4 vertebrae. When contracted unilaterally, lateral flexion and contralaterally rotation movements of the head and neck occurs. When contracted bilaterally, it extends them. It is innervated by the posterior branches of the cervical and thoracic spinal nerves (79,82).

Longus Colli Muscle: Longus colli is the deepest muscle of anterior neck muscles. It provides a connection between cervical and upper thoracic vertebrae anteriorly. It runs the entire length of the neck between C1 and T3. Longus colli is responsible for the flexion and lateral flexion movements of the neck, as well as ipsilaterally rotation of the neck. It is innervated by the anterior branches of C2-C7 spinal nerves (69,79,82) (Figure 2.11).

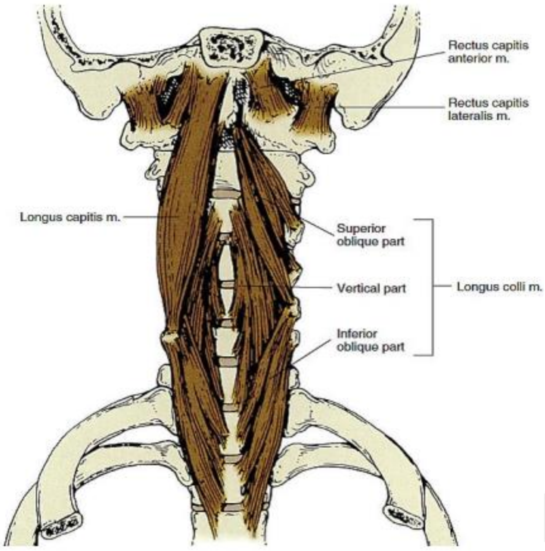


Figure 2.11. Deep layer muscles of the cervical region in anterior (69)

Suboccipital Muscles: It consists of the rectus capitis posterior minor and major muscles and the obliquus capitis superior and inferior muscles. They extends the head when contracted bilaterally, and ipsilaterally rotates the head when contracted unilaterally. They are innervated by the suboccipital nerve (79).

2.4.7. Movements of Spine

Movement of each vertebra occurs with the participation of the disc, the neural arc at the anterior and posterior of the vertebra, and the facet joints. The resulting movement is limited by the tendons, fascia, and joint capsule.

The rotation and translation movements of the vertebrae occur in the longitudinal, transverse, and sagittal axes.

The flexion, extension, axial rotation and lateral flexion movements of vertebrae are formed by the combination of rotation and translation movements. The flexion and extension movements of spine occur in sagittal plane, lateral flexion movement occurs in frontal plane (62).

2.4.7.1. Functional Anatomy and Biomechanics of Cervical Region

Because of its structure providing the head to move freely in all directions, cervical spine is the most mobile and complex part of the spine (62).

The cervical spine consists of two parts as the upper (occiput-C1-C2) and the lower (C3-T1) cervical region (86). The total motion of the neck is the sum of the movements of segments. All segments move simultaneously, but the direction and degree of the movement are different in all vertebrae moving in that direction (75). The cervical spine performs protraction, retraction, flexion and extension in sagittal plane, lateral flexion in both directions in coronal plane, and rotation in both directions in transverse plane. Approximate joint range of motion of the cervical spine consists of 50° flexion, 60° extension, 20-45° lateral flexion, and to both sides 90° rotation (87).

The head and neck flexion movement includes combined flexion of the atlantoccipital, atlantoaxial, and lower cervical segments, and the head and neck extension movement includes combined extension movements of the atlantooccipital, atlantoaxial, and lower cervical segments (62,86) (Figure 2.12).

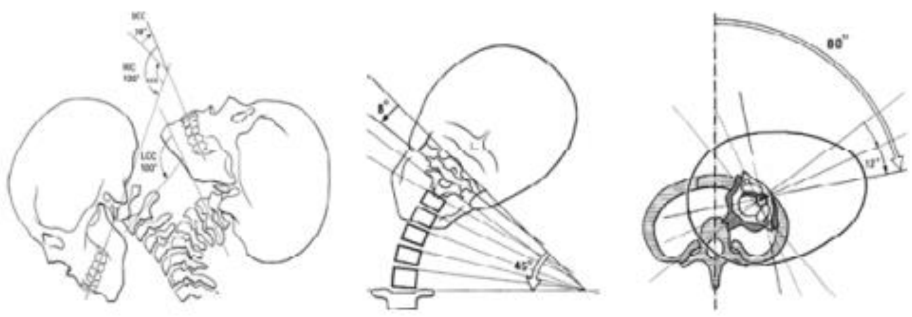


Figure 2.12. Joint movements of cervical spine (62)

<u>Atlantooccipital Joint:</u> It is the joint between the convex condyles of occiput and the deep concave superior articular facets of the atlas. The concave structure of atlas allows rotation movement while blocking translational movement. The movements of flexion and extension occur in this joint thanks to the rolling and gliding movements of condyls of occiput. In all movements, except flexion and extension, atlas and occiput act as a whole. Rotation and lateral flexion movements between occiput and atlas are neglected because they occur in very small amounts due to the depth of atlantal sockets where the occiput condyles are located (67,68,70). Flexion of atlantooccipital joint is 15°, and its extension is 20° (62,68) (Figure 2.13).

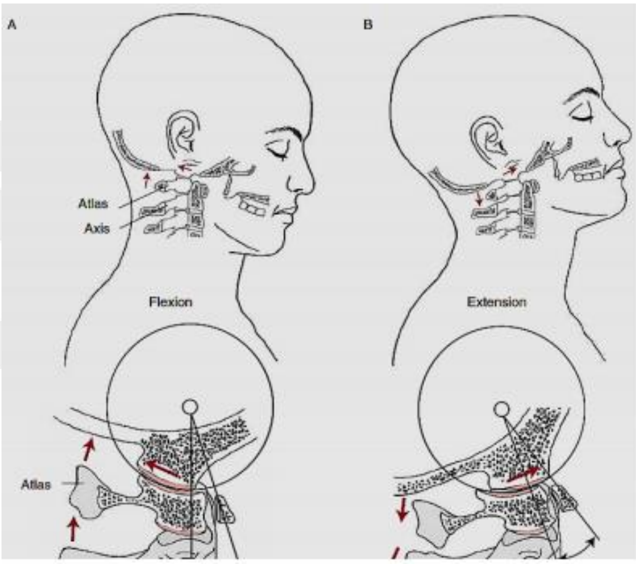


Figure 2.13. Flexion-extension movements of the atlantooccipital joint (68)

<u>Atlantoaxial Joint Complex:</u> The joint complex consists of a total of two different joints, which are those, at sides, between the facet joints of the atlas and axis, and in the middle, between the odontoid process of axis and the atlas. The weight of head is transferred to cervical spine by lateral atlantoaxial joints. Apart from carrying the weight of the atlas and occiput, the most important task of the joint is to provide rotation of the head. More than 50% of total cervical rotation occurs in the atlantoaxial joint, and the normal rotation movement of the atlas on the axis has been reported as 45-50° in both directions. Rotational movement is limited by the alar ligament and joint capsule. While the atlantoaxial joint rotation is 50°, its flexion and extension are 10° (62,88-90).

C2-C7 Cervical Joints: Starting at the joint between C2 and C3, rest of the cervical spine is more typical. The axis separates the upper cervical spine from the rest of the cervical column (91). During flexion and extension movements, gliding movement occurs between the upper and lower vertebra, in the C2-C7 vertebrae. The middle and lower parts of the cervical spine allow rotation and flexion movements, while they are resistant to lateral flexion (92). Total flexion-extension movement of lower cervical spine is 100-110°. While its lateral flexion is 35-37°, its rotation is 45° (62).

2.5. Anatomy of Shoulder Complex

The shoulder complex consisting of the glenohumeral joint, the acromioclavicular joint, the sternoclavicular joint, and the scapulothoracic joint is the most complex joint region of the body that connects the upper extremity to the trunk. The normal shoulder movements are performed by means of the simultaneous movement of these four separate joints, called the shoulder complex (93).

The scapula, humerus and clavicle are the bone structures that make up the shoulder joint which is also supported by the thorax and the sternum. The connection of the shoulder to axial skeleton is provided by muscular structures and sternoclavicular joint (94) (Figure 2.14).

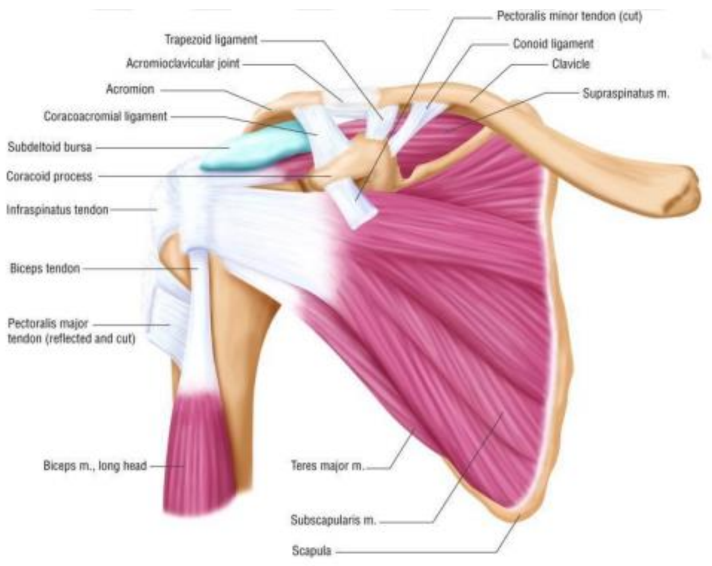


Figure 2.14. Shoulder complex (94)

2.5.1. Bones and Ligaments of Shoulder Complex

Clavicle: The clavicle is a long, S-shaped bone with a convex surface along its 2/3 sternal end, and a concave surface along its 1/3 acromial end. In medial, the clavicle articulates with manubrium sterni and first rib, and it forms the sternoclavicular joint. In lateral, it articulates with the acromion, and it forms the acromioclavicular joint. It is also an attachment site for many muscles such as deltoid, pectoralis major and sternohyoid muscles. The coracoclavicular ligament, composed of the conoid and trapezoid ligaments, attaches to the lateral, and the costoclavicular ligament attaches to the medial of the clavicle (95).

Scapula: It is a triangular shaped flat bone, which is located in the upper thoracic region posteriorly between the 2nd and 7th thoracic vertebrae. Its main structures are the body, the spine of scapula, the acromion, the glenoid cavity, and the coracoid process. The concave surface of the body, facing the ribs, is called the subscapular fossa. The convex surface on the posterior is divided by spine of scapula as supraspinous fossa and infraspinous fossa. The acromion, extending laterally and hooking over anteriorly, is a continuation of the spine of scapula. It also forms the acromioclavicular joint together with the clavicle. Like acromion, the coracoid process also is a hook-like bony protrusion of the scapula. It is the continuation of the scapular neck anterolaterally. The ligaments attaches to coracoid process are coracohumeral, coracoclavicular, and coracoacromial ligaments. Glenoid cavity is the region that scapula articulates with the head of humerus (96,97).

Humerus: It is the largest and the longest bone of the upper extremity, and connects the scapula to the radius and ulna. The proximal end of humerus consists of a rounded head, a narrow anatomical neck, and greater and lesser tubercles. The hemispheroidal shaped head and the glenoid fossa of the scapula, articulating with each other, form the glenohumeral joint (98,99).

2.5.2. Muscles of Shoulder Complex

Rotator Cuff Muscles: They are four muscles, which are supraspinatus, infraspinatus, teres minor, and subscapularis, all originates from the scapula, and inserts on the tubercles of the humerus. This complex has a significant role both in the motion and stabilization of shoulder joint, together with biceps muscle, labral complex, and glenohumeral ligament (100,101) (Figure 2.15).

Supraspinatus, which is the crucial muscle of the rotator cuff, locates in the superior part of the scapula. It originates from the supraspinous fossa, passes under the coracoacromial arch, and inserts in the greater tubercle. This muscle abducts the shoulder, and contracts maximally in the 30° elevation. It is innervated by the suprascapular nerve (102).

Infraspinatus, which is one of the most important external rotators of shoulder joints, fulfills the 60-90% of the external rotation of shoulder. It originates from the infraspinous fossa, and inserts in the greater tubercle. The primary function of the infraspinatus muscle is to depress the head of humerus. It is innervated by the suprascapular nerve (103,104).

Teres minor originates from the middle of the lateral side of scapula, and it inserts in the posteroinferior of tuberculum majus. In its inferior, the posterior joint capsule, in its superior, the deltoid muscle is located. It is one of the shoulder external rotators, and innervated by the posterior branch of axillary nerve.

Subscapularis originates from the subscapular fossa, passes from anterior of the shoulder joint, and inserts in the lesser tubercle. It is the single shoulder internal rotator among all rotator cuff muscles, and innervated by the subscapular nerve (105).

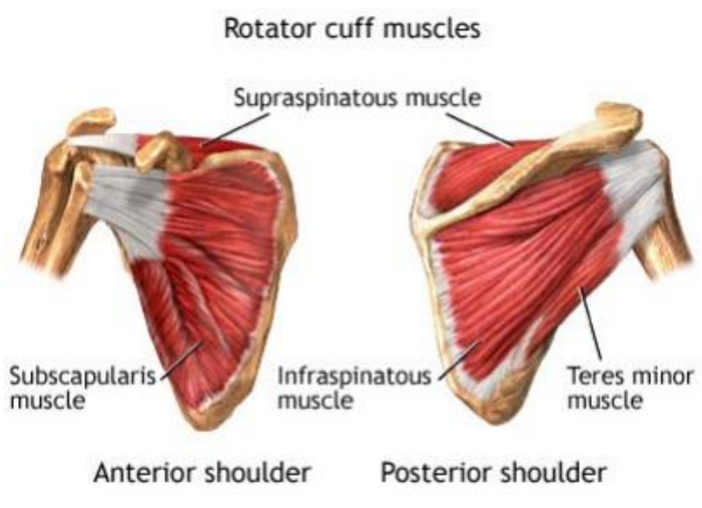


Figure 2.15. Rotator cuff muscles (101)

Deltoid Muscle: Its origins are that the 1/3 lateral of the clavicle, the acromion, and the spine of scapula, while its insertion is the deltoid tuberosity. It is divided into three functional parts as the anterior, middle, and posterior. The middle deltoid, which is the most powerful part, is responsible for the shoulder abduction. The anterior deltoid is a shoulder flexor, and it is also participate in the horizontal adduction and internal rotation of the shoulder joint. The posterior deltoid, besides, provides the extension and horizontal abduction of the shoulder joint, while helping to the external rotation movement also. Deltoid muscle is innervated by the axillary nerve (106,107).

Teres Major Muscle: It originates from the posteroinferior angle of the scapula, and attaches to the medial lip of the intertubercular sulcus of humerus. It extends and adducts the arm, and is innervated by the subscapular nerve (106).

Trapezius Muscle: It is the largest and the most superficial one among all scapulothoracic muscles. It originates from the medial third of superior nuchal line, the external occipital protuberance, the nuchal ligament, and the spinous processes of C7-T12 vertebrae, and inserts on the lateral third of clavicle, the acromion, and the spine of scapula. While its upper fibers is responsible for elevating the scapula, its middle fibers retract, and the lower fibers depress the scapula. When its upper and lower parts working together, they rotate the scapula upwardly. It is innervated by the accessory nerve (82).

Levator Scapula Muscle: It originates from the transverse processes of the atlas and axis, as well as the posterior tubercles of the 3rd and 4th cervical vertebrae, and inserts on the superior angle and medial border of the scapula. It elevates the scapula, and also pulls the scapula medially. If the scapula is fixed, it causes lateral flexion in the head and neck when contracted unilaterally, and extension when contracted bilaterally. It is supplied by the dorsal scapular nerve (82).

Rhomboid Muscles: Rhomboid minor muscle originates from the spinous processes of C7-T1 vertebrae, and attaches to the medial side of scapula, while the rhomboid major muscle originates from the spinous processes of T2-T5 vertebrae, and attaches to the medial side of scapula, just under where the rhomboid minor inserts in. Its main function is the scapular retraction. It also participates in the scapular elevation. It is innervated by the dorsal scapular nerve (82).

Serratus Anterior Muscle: This muscle originates from the anterior of first eight ribs, and attaches to the costal surface of scapula. It protracts and upwardly rotates the scapula. It is innervated by the long thoracic nerve (82).

Pectoralis Minor Muscle: While its origin sites are second to fifth ribs, the insertion site is the medial border and upper surface of coracoid process of scapula. It acts as a depressor and protractor of the scapula. It is innervated by the medial pectoral nerve (102).

Latissimus Dorsi Muscle: Its origins are that the spinous processes of T7-T12 vertebrae, the thoracolumbar fascia, the iliac crest of the sacrum, the ninth to twelfth ribs, and the inferior angle of the scapula, while its insertion is the intertubercular sulcus of humerus. It downwardly rotates the scapula, and is innervated by the thoracodorsal nerve (82).

Biceps Muscle: It is a muscle which has two origins. While the short head originates from the apex of coracoid process of scapula, the long head originates from the supraglenoid tubercle of scapula, and they both attach to the radial tuberosity, and aponeurosis of biceps brachii. It is innervated by the musculocutaneous nerve. It acts as a depressor of humeral head especially when the shoulder is in external rotation (82).

Pectoralis Major Muscle: Its clavicular head originates from the anterior surface of the medial half of clavicle, its sternocostal head originates from the anterior surface of sternum, the first six costal cartilage, and the aponeurosis of external oblique muscle. The attachment site of this muscle is the lateral lip of intertubercular sulcus of humerus. The function of its clavicular head is flexing the humerus, while the function of sternoclavicular head is adducting it. When its origin is fixed, the muscle adducts and medially rotates the humerus. It also pulls the scapula both anteriorly and inferiorly. It is innervated by the lateral and medial pectoral nerves (85,106) (Figure 2.16).

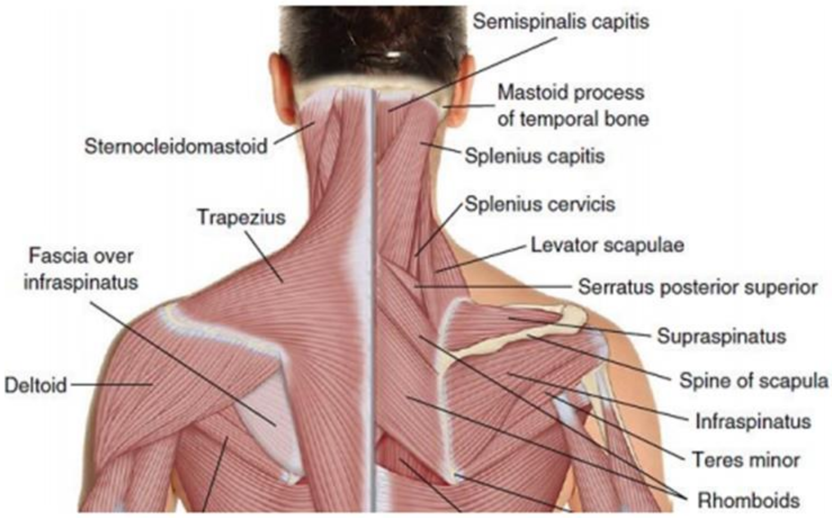


Figure 2.16. Muscles of shoulder region from posterior (85)

2.5.3. Functional Anatomy and Biomechanics of Shoulder Complex

Glenohumeral Joint: It is a ball and socket type joint between the head of humerus and the glenoid fossa of scapula. These two joint surfaces are not completely compatible with each other. Only 35% of the head of humerus comes into contact with the glenoid fossa. The stability of the joint is ensured by the ligaments and muscles. The stabilizers of the joint are divided into two groups as static and dynamic stabilizers. Joint capsule, labrum, and glenohumeral and coracohumeral ligaments are the static stabilizers, while the rotator cuff muscles are the dynamic stabilizers. In addition to these, although the glenoid cavity is not depth enough, the glenoid labrum, which is a fibrocartilaginous formation in the glenoid cavity, acts role to make it deeper (108). The movements of the shoulder joints are flexion, extension, abduction, adduction, internal and external rotation, and horizontal abduction and adduction. The nine muscles that cross to shoulder joint and move to humerus, which are pectoralis major, latissimus dorsi, deltoid, supraspinatus, infraspinatus, teres minor, subscapularis, coracobrachialis, and teres major, are the primary movers of shoulder joint (109). Since the deltoid muscle has the biggest moment among the whole muscles of shoulder complex during shoulder flexion, and also it has the largest cross-sectional area, it is considered as the primary flexor muscle of shoulder joint. The flexion movement of shoulder joint is produced by the anterior and middle parts of deltoid, together with the participation of its posterior part, in movements over 90° (110). While the flexion movement occurs, the deltoid and supraspinatus create a vertical shear force by contracting. This coordinated motion of the muscles provides to hold the head of humerus in glenoid cavity, and minimizes the humeral head translation. The initiation and the first 15° of abduction movement are performed by the supraspinatus muscle. After then, deltoid becomes more active (111).

Acromioclavicular Joint: It is a diarthrodial joint between the acromial end of clavicle and the acromion. There is a fibrocartilaginous intraarticular disc between these two bones (111). This joint has a weak and loose capsule, and three planes of movement. These movements are minimal but significant to maintain the normal shoulder motion (109). Three types of movement are defined for the acromioclavicular joint. The first one is the anterior and posterior glide of scapula on the clavicle, the second one is the hinge-like adduction and abduction of scapula on the clavicle, and the last one is the rotation of scapula about the long axis of clavicle (110).

Sternoclavicular Joint: It is the only joint between the upper extremity and the axial skeleton. It connects the sternal end of clavicle to the upper lateral part of the manubrium sterni, and the first rib. Three main ligaments, which are interclavicular, sternoclavicular and costoclavicular ligaments, support the sternoclavicular joint. The sternoclavicular ligament has two parts are called anterior and posterior sternoclavicular ligaments. The anterior and posterior movements of the sternal end of clavicle is limited by these two parts of sternoclavicular ligament. The anterior sternoclavicular ligament limits the movement of sternal end of clavicle to posterior, while the posterior sternoclavicular ligament limits its movement to anterior. The interclavicular ligament connects the superior of sternal ends of two clavicles over the sternum, and limits the clavicular depression. Conversely, while the primary function of the costoclavicular ligament is to limit the clavicular elevation, at the same time, the anterior costoclavicular ligament limits the movement of clavicle to lateral, while the posterior costoclavicular ligament limits its movement to medial (109). During shoulder motions, the clavicle circumducts around the sternoclavicular joint. While the elevation and depression movements occur between the clavicula and the disc, the anteroposterior and rotation movements occur between the disc and the sternum. The movement in the anteroposterior direction is approximately 35°, and the rotation movement is 45°. The elevation, on the other hand, of the sternoclavicular joint is 30-35° (111).

Scapulothoracic Joint: It is not a real synovial joint but is considered as a functional joint. The serratus anterior and subscapularis muscles separate these two bone structures. An important part of the scapulothoracic movement occurs between the fascia of subscapularis muscle and the fascia of thorax. In order to ensure and maintain the mobility and stability of upper extremity, the scapulothoracic joint must have normal function. The glenohumeral/scapulothoracic joint ratio after the first 20° of shoulder abduction is 2/1. In each 15 degree movement, in the glenohumeral joint 10° movement, and in the scapulothoracic joint 5° movement occurs. This coordinated motion of the glenohumeral and scapulothoracic joints is called as the scapulohumeral or scapulothoracic rhythm. Without the motion of the scapula, the shoulder joint makes abduction movement 90° actively, and 120° passively. Also the clavicle contributes to the stability between the scapula and the thorax (110,112) (Figure 2.17).

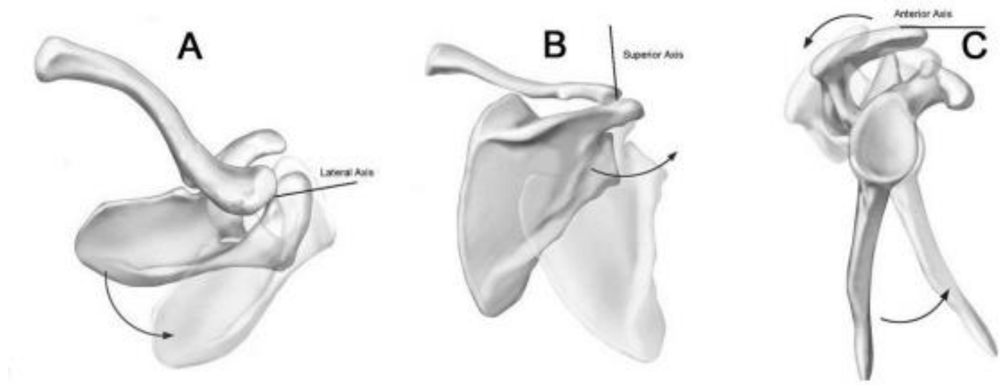


Figure 2.17. Scapular movements (A. External and internal rotation, B. Upward and downward rotation, C. Anterior and posterior tilt) (112)

2.6. Posture

Posture is the position and alignment of the body points relative to each other. It can be both active or inactive. Inactive posture is the posture while resting or sleeping. Active posture is divided into two types as static and dynamic. Although, the static posture is the posture where no movement occurs, in this posture, muscles contract isometrically to maintain the stabilization of the joints against gravity. Dynamic posture, on the other hand, is the alignment of body while moving (113).

The good posture is defined as, the straight and balanced alignment of the musculoskeletal system structures to protect other body structures from any injury and progressive deformation, by The American Academy of Orthopaedic Surgeons in 1947 (114). From a physiological and biomechanical point of view, it is the posture in which maximum efficacy is achieved with minimum effort in the body (115). Faulty posture is poor posture which causes muscles to contract more than necessary. In bad posture, the loads on the muscles and ligaments increases. Muscle weakness, muscle imbalance, pain, fatigue, stress, bad working position, familial or hereditary kyphosis, structural disorders that develop later or are congenital, and wrong habits may cause to the development of faulty posture (116). While in the good posture, muscles work most efficiently, and the optimum positions are provided for the chest and the abdominal organs, in the faulty posture, disorders in the alignment of some parts of the body cause stress in supporting structures, and this situation increase the energy required to keep balance. Good posture can be achieved and maintained, if the necessary mechanisms in the body are healthy and strong (117).

The posture is in constant interaction with the physical and mental state. Bones, ligaments, fascia, tendon tension, muscle tone, joint position, joint mobility, and also neurological features are the musculoskeletal factors which can affect the posture (116). Besides, the posture can be affected by personal habits, familial and environmental factors, race, body type, and job (117).

Nowadays, faulty posture is very common due to the body being in the wrong position for a long time, and inactivity. The body segments form compensatory mechanisms to restore balance, which is impaired by faulty posture, and this can cause pain and disability, in the end. Deviations in the cervical spine posture can cause severe pain in the neck (118,119).

2.6.1. Assessment of Posture

During the evaluation of the posture, various methods are used based on some reference points in the body. In this way, deviations and differences are determined by comparing the relationship between body parts with each other and gravity with normal anatomical features. Especially in evaluation of the posture of the head, neck, and shoulder girdle, observational methods, lateral posture analysis with plumb, symmetrigraf, photograping in sagittal plane, lateral radiography, goniometric measurements, and distance measurements at different positions are used. Moreover, New York Posture Analysis and Bragg Posture Table contain sections about head-neck, shoulder girdle (120-122).

The points where the plumb line passes in the correct standing posture are the slightly anterior of lateral malleolus, the slightly anterior of midline of knee joint, the slightly anterior of sacroiliac joint, the midline of the abdomen and back, the acromion process, and the ear lobe (117).

2.6.2. Postural Disorders of Spine and Shoulder Region

The adult human spine is characterized by the cervical and lumbal lordosis, and the thoracic and sacral kyphosis, in the lateral posture. These four alignments, which are fundamental, provide a functional posture, and are closely interrelated. Since spinal health is a whole, an angular deviation in one curvature results in another curvature to compansate the first one (123).

Postural disorders of the spine are that the forward head, thoracic kyphosis, scoliosis, increased lumbal lordosis, kypholordosis, sway back and flat back postures (119).

The position of the head relative to the rest of the body is called the head posture. The head and neck are in the ideal position in the posture where the head is in balance, and minimal effort is achieved in muscles. In the ideal head posture, the external auditory meatus and the acromioclavicular joint are in the same vertical plane, and there is normal anterior concavity in the neck.

In sagittal plane, the position of head in front of the reference line is called FHP which is the most common posture disorder of the head. This posture occurs by the flexion of lower cervical spine and the extension of upper cervical spine or displacement of the head towards anteriorly (124-126).

Among cervical muscles, longus colli, sternocleidomastoid, semispinalis capitis, rectus capitis posterior, and obliquus capitis superior muscles have an important place in the posture of the head and neck (127). Biomechanical changes in the FHP cause increased flexor torque, and permanent contraction of the dorsal cervical muscles (128). The head should be in upright position to minimize the loads on the neck muscles (117,119,129).

In ideal shoulder posture, the external auditory meatus and the acromioclavicular joint are in the same vertical plane, and there is normal scapula position. Conversely, the rounded shoulder posture is the forward deviation of the shoulders and the protraction of the scapula arising from the muscle imbalance between the shortened pectoralis minor and the lengthened middle trapezius. Rounded shoulder posture also causes to shortened serratus anterior and lengthened lower trapezius which is considered to affect the scapular tilt negatively (130).

2.7. Pain

Pain is defined by the International Association for the Study of Pain as the sensorially and emotionally disturbing experiences that occurs when the signals, reaching medulla spinalis from the receptors and the peripheral nerves, are transmitted to brain, in any tissue damage or risk of damage. It can be classified according to some factors such as its duration, location, intensity, etiology or type (131).

2.7.1. Neck and Shoulder Pain

Neck pain, which is defined as the pain or ache felt in the area between the inferior margin of occiput and the T1, is the second most common musculoskeletal disease after low back pain (10). Studies have shown that 30-50% of adult individuals suffer from neck pain over a period of one year (132). The main reason for this is that the cervical region is one of the most load bearing and the most mobile part of the body. Epidural venous structures, dura mater, vertebral bodies, neural arches, muscular structures, facet joints, ligaments, and discs are pain-sensitive structures. Any problem in neck mechanics can cause pain in these structures (133).

Although the lifetime prevalence of neck pain is around 70%, it is not easy to determine the etiology of neck pain in most patients. According to the studies, neck pain is more common in people with FHP from young ages (134-136). Besides, approximately 60-85% of the patients with neck pain have FHP (137). Therefore, the distinction between forward and normal head posture is important, and evaluating the head and neck postures of patients with neck pain is recommended (138,139).

Not only the head and neck postures, but also the scapulothoracic structures are the factors affecting neck pain. Craniovertebral angle is a reliable indicator to identify the posture of the head and neck. Anterior tilt of the head increases as the craniovertebral angle decreases. In a study, it was revealed that the neck pain is associated with the decreased craniovertebral angle, and the increased thoracic angle (140). The position of scapula is also important in neck pain. Studies have shown that the changes in the posture and the mechanics of shoulder girdle affect cervical spine biomechanics, and are effective in the development of cervical pain (141). Deviations in the position of scapula may increase the stresses on the neck region, and affect the neck functions, by changing the tension of cervicoscapular muscles (142). Repetitive and excessive stress in the neck can cause injury and pain in the tissues of the cervical region, and limited neck rotation (142,143). Taking into account all of these, it can be said that the neck pain may be seen together with the occipital pain, and the shoulder and upper toracic region pain (144).

Only 6% of people who feel pain in the neck, back, and the shoulder girdle experience pain once, while 39% have constant pain, and 55% have recurrent pain (145). This condition is seen as a major cause of disability in many countries that affects daily life, quality of life, and work life. The disability and pain, experienced by this situation, also affect the structures that make up the basic parts of social life, such as individuals, families, workplaces, and healthcare facilities (146).

3. MATERIALS AND METHODS

3.1. SUBJECTS

The sample of the study consists of university students from Yeditepe University Faculty of Health Sciences and Istanbul Gedik University Faculty of Health Sciences.

A total of 106 students (84F, 22M; 19,67±1,32 years) who met inclusion criteria were included in the study. According to the scores they got from the Smartphone Addiction Scale-Short Version (SAS-SV), all students were divided into two groups as Excessive Smartphone Use Group (ESUG) and Non-excessive Smartphone Use Group (NSUG), both consisting of 53 participants. To calculate the sample size, power analysis was done by using PS Power and Sample Size Calculation program.

3.1.1. Inclusion Criteria

- To be willing and volunteer to participate in the study
- To be between 18 and 25 years old
- To have been using smartphone for more than 1 year

3.1.2. Exclusion Criteria

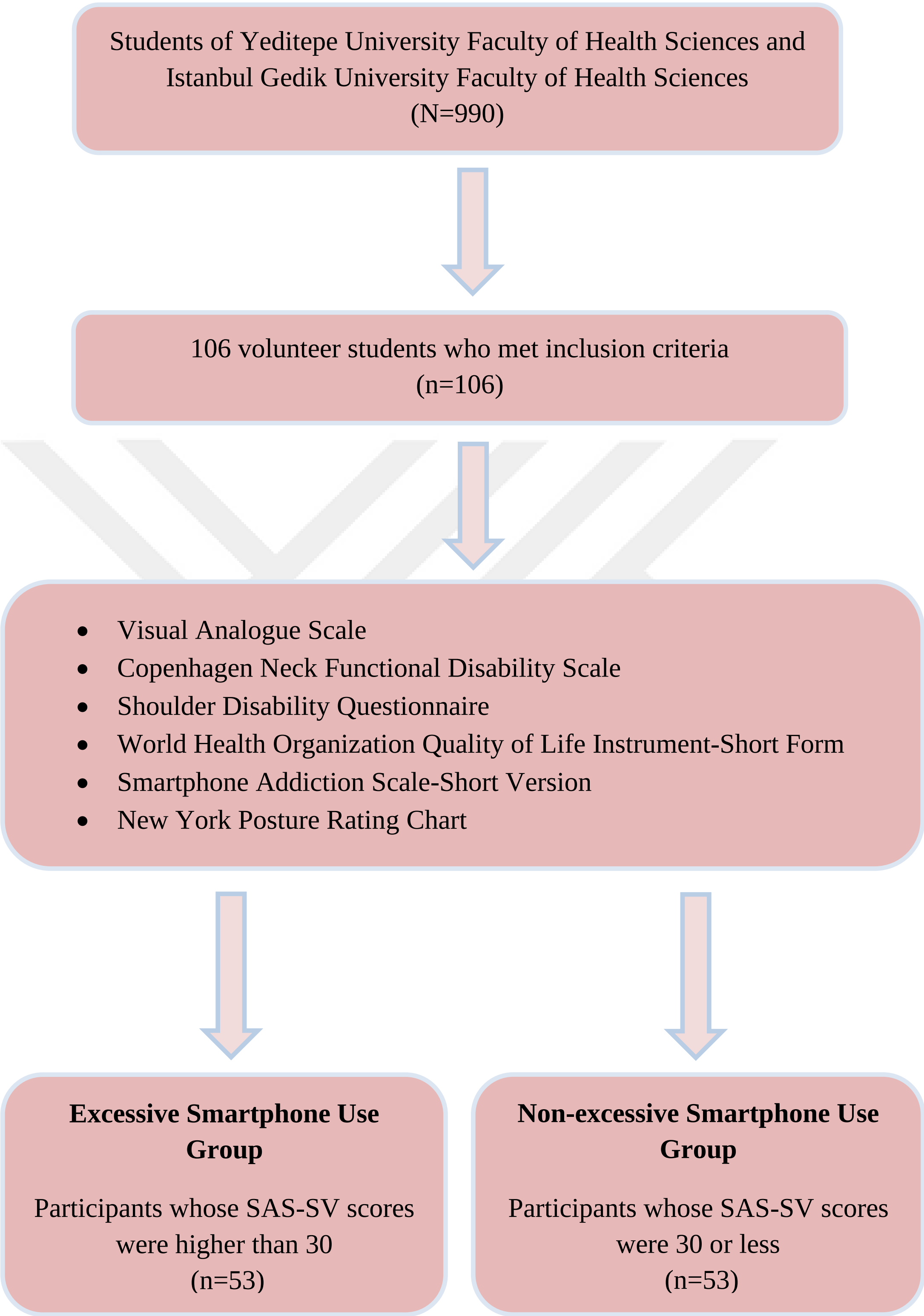
- To have any health problem history or diagnosed pathology related with the neck or shoulder regions
- To have any history of trauma or surgery related to neck or shoulder regions
- To have received any medical attention or treatment in the last six months because of a health problem related to neck or shoulder
- To have any diagnosed neurological problem

The study protocol was approved by the Yeditepe University Ethical Committe at the date of 30.05.2019, and issue number was 1682 (APPENDIX 1). Participants got involved in the study on a voluntary basis. The aim and plan were explained, and informed written consent was obtained from each participant (APPENDIX 2). The study was conducted according to Declaration of Helsinki.

3.1.3. Flow Chart: Study Process

The sample of the study consists of totally 990 university students from Yeditepe University Faculty of Health Sciences and Istanbul Gedik University Faculty of Health Sciences. We asked the students whether they were willing to be volunteer in our study. 106 students who met inclusion criteria were involved our study. According to the scores they got from the SAS-SV, all students were divided into two groups as Excessive Smartphone Use Group (ESUG) (n=53) and Non-excessive Smartphone Use Group (NSUG) (n=53). Participants whose scores were higher than 30 were included to the ESUG, and whose scores were 30 or less were included to the NSUG (6,147).

Figure 3.1. Flow Chart of Study



3.1.4. Study Protocol

First, the structured questionnaire, and then, Visual Analogue Scale (VAS), Copenhagen Neck Functional Disability Scale (CNFDS), Shoulder Disability Questionnaire (SDQ), World Health Organization Quality of Life Instrument-Short Form (WHOQOL-Bref), and Smartphone Addiction Scale-Short Version (SAS-SV) were applied to all participants respectively. Lastly, posture analysis was performed to all participants by using the New York Posture Rating Chart (NYPRC).

3.2. Evaluation

3.2.1. Structured Questionnaire

The structured questionnaire prepared by researchers applied face to face interviews. The questionnaire included informations about sociodemographic features, smoking behaviors, drinking habits, existing chronic diseases, history of medical intervention, injuries, surgical conditions, exercise behaviors, history of posture training, daily sitting and standing hours, daily smartphone use hours, and smartphone use year (APPENDIX 3).

3.2.2. Pain Assessment

In the assessment of pain level the VAS was used. This scale is 10 cm long, and has two ends on a vertical or horizontal line. One of these two ends is called as “0”, while one is named as “10”. “0” point defines no pain, and “10” points describe the most severe pain. Participants were asked to mark the pain area on a body chart first, and then the point on the VAS line corresponding to the pain intensity they feel. The distance between the marked point and the lowest end of the line (0 = no pain) was measured by the millimetric ruler, and the numerical value which was found and noted indicated the pain level of each participant (148-150) (APPENDIX 4).

3.2.3. Copenhagen Neck Functional Disability Scale

Functional level of the neck was evaluated with the CNFDS. The CNFDS is a valid and reliable tool for self-assessment of cervical pain and related disabilities, which is developed by Jordan el al. in 1998. This scale, consists of 15 items, questiones how much the neck pain affects functional level of the neck. In CNFDS, questions 1 and 5 measure the severity of pain, questions from 2 to 10 measure the disability in daily life activities, questions 6-9-11-13-14 focus on the social interactions and recreational activities, and question 15 measures the person's perception of the future effect of neck pain (151). The minimum score of the scale is 0, while the maximum score is 30. Disability level increases as the total score increases. This scale has been shown to be valid and reliable in Turkish (152,153) (APPENDIX 5).

3.2.4. Shoulder Disability Questionnaire

Functional level of the shoulder was evaluated with the SDQ. It is a 16-items disability questionnaire related to shoulder pain. The person answers each item by marking one of the options, yes, no, not applicable, depending on the situation in the last 24 hours. If the activity has been performed and the pain has occurred, the "Yes" option, if the activity has been performed but the pain has not occurred, the "No" option, if the activity has not been performed in the last 24 hours, the "Not applicable" option is marked. The result is calculated with a special formula, and evaluated out of 100. Disability level increases as the total score increases (154) (APPENDIX 6).

3.2.5. World Health Organization Quality of Life Instrument–Short Form

WHOQOL-Bref was utilized to assess the quality of life of participants. This questionnaire has been developed by World Health Organization, and has been validated in 1999 by Eser et al. in Turkish population. The scale measures physical, psychological, social and environmental health, and consists of 26 questions. Although the scale does not have a total score, each field of the scale is evaluated independently in itself and is scored out of 20 or 100 points. The higher the score shows the higher the quality of life level (155) (APPENDIX 7).

3.2.6. Smartphone Addiction Scale-Short Version

In determining the smartphone addiction levels of the participants, SAS-SV was utilized. SAS-SV is a self-assessment tool questioning smartphone usage, constituted by Kwon et al in 2013 (28). The validity and reliability study of its Turkish version was made by Noyan et al. in 2015. It is a convenient tool to assess smartphone addiction in young adults (22,28). It is composed of 10 items rated on a 6-point Likert-type scale from 1 to 6. The lowest score of the scale is 10, while the highest score is 60. As the score obtained from the scale increases, the severity of smartphone addiction increases (28). Since the cut-off score for Turkish population was detected as 29,5 both for male and female students in 2017 by Şata and Karip, in our study the scores which are obtained from the participants was used to classify them, as follows: those whose score is > 30 was considered as excessive smartphone users, and those whose score is ≤ 30 was considered as non-excessive smartphone users (6,147) (APPENDIX 8).

3.2.7. New York Posture Rating Chart

The NYPRC uses a quantitative approach to assess the alignment of various body parts. Postures of the participants have been examined with this chart from posterior and lateral. The NYPRC evaluates overall postural alignment with 13 drawings for each of 13 different body segments, and grade them in 3 level. This body segments are the head, shoulders, spine, hip, feet, and arches for posterior view, and the neck, chest, shoulders, upper back, trunk, abdomen, and lower back for lateral view from left side. Each segment is given points according to its grade. 5 points represent ideal posture, while 3 points shows slight deviation, and 1 point is for pronounced deviation (156). The total score calculated after the evaluation is at most 65, and at least 13. The low score indicates impairments of posture (87,157).

Instructions for use of the NYPRC were provided from the New York State Physical Fitness Test for Boys and Girls Handbook. A distance of 3 meters was left to evaluate the participant standing in front of a plain background. While assessing, participants took off their thick clothes, and they were evaluated with their t-shirts on, but to eliminate the misleadings, the participants were palpated from the region which is observed by. Participants were asked to stand in a comfortable and natural position, releasing their feet as much as possible. First, the participant was positioned as facing back the observer while standing. The relevant images, in this position, were marked by the observer. Then the participant was rotated 90°. Lateral evaluation from left side was performed, and the relevant visuals were marked (156) (APPENDIX 9).

Data Analysis

Statistical Package Analyze for Social Sciences (SPSS) version 25.0 was used for data analyzes. Descriptive statistics was utilized to define the features of study groups. The Kolmogorov-Smirnov test was preferred to test the numerical variables for normality. The Student t-test and Mann Whitney U-test analyzes were used to compare two independent groups. The summary of numerical data was showed as mean ± standard deviation and ratio was used for categorical data. The correlation analyzes were performed with Spearman Correlation test. The correlation coefficient r is interpreted as very weak for 0.00-0.25 interval, weak for 0.26-0.49 interval, moderate for 0.50-0.69 interval, strong for 0.70-0.89 interval, and very strong for 0.90-1.00 interval. The significance level was accepted as 0,05.

4. RESULTS

The study included 106 university students from Yeditepe University Faculty of Health Sciences and Istanbul Gedik University Faculty of Health Sciences.

The physical features (age, weight, height, and body mass index (BMI)) of ESUG and NSUG are presented in Table 4.1. There were no statistically significant differences in terms of age, weight, height, and BMI scores between the groups (Table 4.1).

Table 4.1. Physical Features of Participants

	ESUG (n=53) **Mean ± SD**	**NSUG (n=53)** **Mean ± SD**	**t** **p value**
Age (year)	19,85±1,39	19,49±1,23	-1,40 0,16 ns
Weight (kg)	60,57±12,01	61,31±11,36	0,32 0,74 ns
Height (cm)	168,51±8,47	161,25±33,25	-1,53 0,27 ns
BMI (kg/m²)	21,24±3,41	21,74±3,16	0,78 0,43 ns

Data expressed as mean±standard deviation, ns: non-significant. BMI: Body Mass Index. ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group.

The dominant side, and the smoking, alcohol and exercise habits of ESUG and NSUG were given in Table 4.2. There were no statistically significant differences in terms of the dominant side, and the smoking, alcohol and exercise habits between two groups (Table 4.2.).

Table 4.2. Descriptive Characteristics of Participants

		ESUG (n=53) % (n)	NSUG (n=53) % (n)	λ² p value
Dominant Side	Right	94,3 (50)	88,7 (47)	1,09 0,29 ns
	Left	5,7 (3)	11,3 (6)	
Smoking Habits	Yes	17,0 (9)	15,1 (8)	5,71 0,58 ns
	No	62,3 (33)	79,2 (42)	
	Cessation	20,8 (11)	5,7 (3)	
Alcohol Habits	Yes	32,1 (17)	26,4 (14)	0,41 0,52 ns
	No	67,9 (36)	73,6 (39)	
Exercise Habits	Yes	24,50 (13)	32,1 (17)	0,74 0,38 ns
	No	75,5 (40)	67,9 (36)	

Data expressed as % (n), ns: non-significant. ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group.

Daily sitting and standing hours of ESUG and NSUG were given in Table 4.3. There were no statistically significant differences between ESUG and NSUG in terms of daily sitting and standing hours (Table 4.3).

Table 4.3. Comparison of Daily Sitting and Standing Hours between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	t p value
Daily Sitting Hours	7,94±2,57	7,56±2,25	-0,80 0,42 ns
Daily Standing Hours	4,90±2,46	5,30±2,84	0,76 0,44 ns

Data expressed as mean±standard deviation, ns: non-significant. ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group.

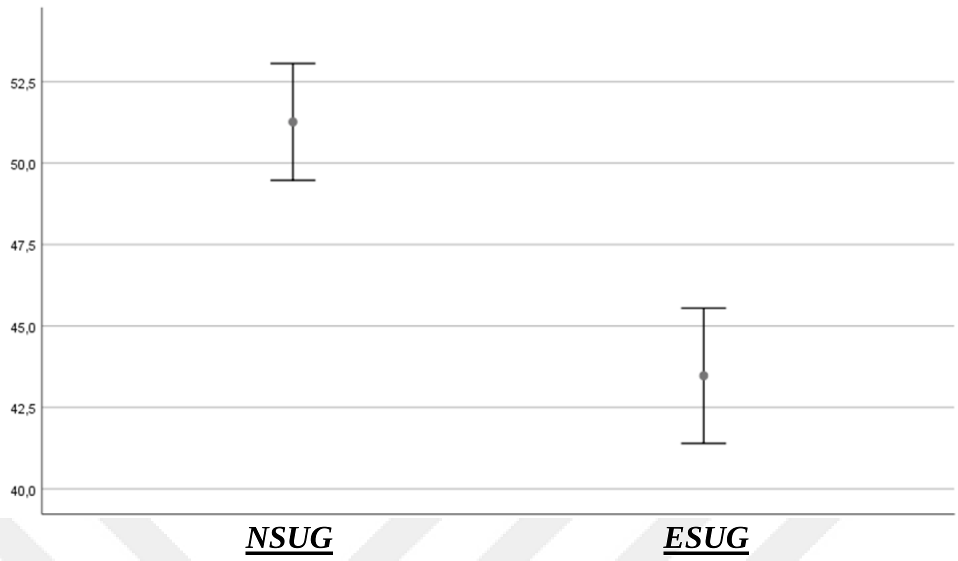
The Student t-test was used to compare the NYPRC total scores between ESUG and NSUG. The results showed that there was a statistically significant difference between the scores of both groups (p<0,01). The mean value of NYPRC total score was lower in the ESUG compared with the NSUG (43,47±7,53, 51,26±6,50 respectively) (Table 4.4, Figure 4.1).

Table 4.4. Comparison of NYPRC Total Scores between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	t p value
NYPRC Total Score	43,47±7,53	51,26±6,50	5,70 **,000****

Data expressed as mean±standard deviation. NYPRC: New York Posture Rating Chart, ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. **p<0,01.

Figure 4.1. NYPRC Total Scores of Groups



While comparing the neck and shoulder posture scores between ESUG and NSUG, the Mann Whitney U-test was used. Both neck and shoulder postures were found statistically significantly different between two groups ($p<0,01$ for both). The mean scores of the neck and shoulder postures were both lower in the ESUG when compared with the NSUG (3,00±1,17, 3,72±1,11 respectively for neck) (3,11±1,06, 3,87±1,07 respectively for shoulder) (Table 4.5).

Table 4.5. Comparison of Neck and Shoulder Postures Evaluated Laterally with NYPRC between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	Z p value
Neck Posture	3,00±1,17	3,72±1,11	-3,05 **,002****
Shoulder Posture	3,11±1,06	3,87±1,07	-3,42 **,001****

Data expressed as mean±standard deviation. ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. **p<0,01.

While the head pain levels were comparing with the Student t-test, the neck, shoulder, upper back, and lower back pain levels were compared with the Mann Whitney U-test. Only the neck and shoulder VAS scores were found statistically significantly different between two groups (p<0,01 for both). The mean values of the VAS scores of neck and shoulders were both higher in the ESUG when compared with the NSUG (2,81±3,01, 1,03±1,86 respectively for neck) (2,23±2,50, 0,46±1,35 respectively for shoulder) (Table 4.6).

Table 4.6. Comparison of Head, Neck, Shoulder, Upper and Lower Back Pain Levels according to VAS Scores between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	t/Z p value
VAS Head	0,61±0,30	0,50±0,23	t: -0,27 0,78
VAS Neck	2,81±3,01	1,03±1,86	Z: -3,48 **,000****
VAS Shoulder	2,23±2,50	0,46±1,35	Z: -4,45 **,000****
VAS Upper Back	1,0±2,04	0,82±1,93	Z: -,64 0,52
VAS Lower Back	1,54±2,42	1,27±2,42	Z: -,64 0,52

Data expressed as mean±standard deviation. VAS: Visual Analogue Scale, ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. **p<0,01.

The comparison of the neck and shoulder functions between ESUG and NSUG have analyzed by the Mann Whitney U-test. The mean scores of both CNFDS and SDQ were higher in the ESUG compared with the NSUG (5,38±4,23, 2,87±3,44 respectively for CNFDS) (24,05±28,55, 7,58±14,82 respectively for SDQ). According to the results, both scores were statistically different between the groups significantly (p<0,01 for both) (Table 4.7).

Table 4.7. Comparison of Neck and Shoulder Functions according to CNFDS and SDQ Scores between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	Z p value
CNFDS	5,38±4,23	2,87±3,44	-3,29 **,001****
SDQ	24,05±28,55	7,58±14,82	-4,03 **,000****

Data expressed as mean±standard deviation. CNFDS: Copenhagen Neck Functional Disability Scale, SDQ: Shoulder Disability Questionnaire, ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. **p<0,01.

Comparing all WHOQOL-Bref parameters with Mann Whitney U-test between ESUG and NSUG showed that only the psychological health was statistically significantly different between two groups (p<0,05). The mean score of psychological health item was lower in the ESUG compared with the NSUG (62,81±14,40, 69,73±11,94 respectively) (Table 4.8).

Table 4.8. Comparison of WHOQOL-Bref Parameters between ESUG and NSUG

	ESUG (n=53) Mean ± SD	NSUG (n=53) Mean ± SD	Z p value
WHOQOL-Bref General Health	60,61±15,38	66,98±14,72	-1,52 0,12
WHOQOL-Bref Physical Health	74,32±11,80	78,42±12,00	-1,55 0,12
WHOQOL-Bref Psychological Health	62,81±14,40	69,73±11,94	-2,31 **0,02***
WHOQOL-Bref Social Relationships	68,24±15,82	71,21±13,92	0,58 0,55
WHOQOL-Bref Environment	65,14±12,15	67,42±9,78	0,72 0,47

Data expressed as mean±standard deviation. WHOQOL-Bref: World Health Organization Quality of Life Instrument-Short Form, ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. *p<0,05.

The distribution of the pain regions within the groups were analyzed by the Chi Square test. While the neck (50,9%) and shoulders (22,6%) were the areas that seen pain most in the ESUG, the upper back (13,2%) and lower back (13,2%) were the most common areas of pain in the NSUG. In the NSUG, while the percentage of the neck pain was 9,4%, the percentage of the shoulder pain was 7,5%. The percentage of participants who have no pain was higher in the NSUG compared with the ESUG (35,8%, 17,0% respectively). The pain regions were seen to be statistically significantly different according to the groups (p<0,01) (Table 4.9).

Table 4.9. Comparison of Pain Regions between ESUG and NSUG

	ESUG (n=53) % (n)	**NSUG (n=53) % (n)**	**λ^2 p value**
Head	1,9 (1)	5.7 (3)	37,30 **,000****
Neck	50,9 (27)	9,4 (5)	
Shoulder	22,6 (12)	7,5 (4)	
Upper Back	3,8 (2)	13,2 (7)	
Lower Back	1,9 (1)	13,2 (7)	
Arm	1,9 (1)	3,8 (2)	
Hand	0,0 (0)	1,9 (1)	
Thigh	0,0 (0)	1,9 (1)	
Leg	0,0 (0)	3,8 (2)	
Foot	0,0 (0)	3,8 (2)	
No pain	17,0 (9)	35,8 (19)	
Total	**100,0 (53)**	**100,0 (53)**	

Data expressed as % (n). ESUG: Excessive Smartphone Use Group, NSUG: Non-excessive Smartphone Use Group. **p<0,01.

Relationship among neck, shoulder, upper back, and lower back posture scores were analyzed by the Spearman Correlation test. Results of the test showed that there was a statistically significant ($p<0,05$) and positively very weak ($r = ,210$) correlation between the neck and shoulder postures, that there was a statistically significant ($p<0,01$) and positively weak ($r = ,436$) correlation between the neck and upper back postures, and that there was a statistically significant ($p<0,01$) and positively moderate ($r = ,520$) correlation between the shoulder and upper back postures. However, according to the analyze, there was no correlation between the neck and lower back, the shoulder and lower back, and the upper back and lower back postures (Table 4.10).

Table 4.10. Relationship among Neck, Shoulder, Upper and Lower Back Postures Evaluated Laterally with NYPRC

	R	**p**
Neck-Shoulder Posture	**,210***	**,031***
Neck-Upper Back Posture	**,436****	**,000****
Neck-Lower Back Posture	,131	,181
Shoulder-Upper Back Posture	**,520****	**,000****
Shoulder-Lower Back Posture	,094	,338
Upper Back-Lower Back Posture	,185	,058

*p<0,05, **p<0,01.

The Spearman Correlation test was used to analyze the relationship between the neck, shoulder, upper back, and lower back posture scores and the head, neck, shoulder, upper back, and lower back pain levels. It was indicated that while the neck posture and neck pain (p<0,01) (r = -,334), the neck posture and shoulder pain (p<0,01) (r = -,303), and the upper back posture and shoulder pain (p<0,01) (r = -,317) were weakly correlated with each other, the shoulder posture and neck pain (p<0,05) (r = -,193), and the upper back posture and neck pain (p<0,05) (r = -,249) were very weakly correlated with each other statistically significantly and negatively (Table 4.11).

Table 4.11. Relationship between the Neck, Shoulder, Upper and Lower Back Postures Evaluated Laterally with NYPRC, and the Head, Neck, Shoulder, Upper and Lower Back Pain Levels according to VAS Score

		VAS Head	**VAS Neck**	**VAS Shoulder**	**VAS Upper Back**	**VAS Lower Back**
Neck Posture	**r**	-,001	**-,334****	**-,303****	-,075	-,139
	p	,996	**,000****	**,002****	,447	,154
Shoulder Posture	**r**	-,042	**-,193***	-,078	-,022	,028
	p	,671	**,048***	,424	,821	,779
Upper Back Posture	**r**	-,059	**-,249***	**-,317****	-,106	-,032
	p	,546	**,010***	**,001****	,277	,746
Lower Back Posture	**r**	,091	-,054	-,072	,000	,026
	p	,352	,579	,464	,997	,794

*p<0,05, **p<0,01. VAS: Visual Analogue Scale.

According to the Spearman Correlation test, which used to analyze the relations of the neck, shoulder, upper back, and lower back posture scores, and the CNFDS and SDQ scores, there were negatively weak (r = -,299) correlation between the neck posture and its function (p<0,01), negatively very weak (r = -,202) correlation between the shoulder posture and its function (p<0,05), negatively very weak (r = -,192) correlation between the neck posture and shoulder function (p<0,05), and negatively very weak (r = -,214) correlation between the upper back posture and neck function (p<0,05) (Table 4.12).

Table 4.12. Relationship between the Neck, Shoulder, Upper and Lower Back Postures Evaluated Laterally with NYPRC, and the Neck and Shoulder Functions according to CNFDS and SDQ Scores

		CNFDS	**SDQ**
Neck Posture	**r**	**-,299****	**-,192***
	p	**,002****	**,048***
Shoulder Posture	**r**	-,178	**-,202***
	p	,068	**,037***
Upper Back Posture	**r**	**-,214***	-,169
	p	**,028***	,084
Lower Back Posture	**r**	-,109	-,152
	p	,267	,120

*p<0,05, **p<0,01. CNFDS: Copenhagen Neck Functional Disability Scale, SDQ: Shoulder Disability Questionnaire.

The relationship between the neck, shoulder, upper back, and lower back posture scores and the WHOQOL-Bref parameters was evaluated with the Spearman Correlation test. Statistical interpretation of test results showed that shoulder posture was very weakly correlated with both psychological health (p<0,05) (r = ,211) and social relationship (p<0,05) (r = ,228) statistically significantly and positively, while upper back posture was weakly correlated (r = ,270) with the psychological health only, statistically significantly and positively (p<0,01) (Table 4.13).

Table 4.13. Relationship between the Neck, Shoulder, Upper and Lower Back Postures Evaluated Laterally with NYPRC, and the WHOQOL-Bref Parameters

		WHOQOL-Bref General Health	WHOQOL-Bref Physical Health	WHOQOL-Bref Psychological Health	WHOQOL-Bref Social Relationships	WHOQOL-Bref Environment
Neck Posture	**r**	-,116	-,014	,090	-,075	-,035
	p	,235	,891	,358	,444	,724
Shoulder Posture	**r**	,101	,084	**,211***	**,228***	,111
	p	,301	,391	**,030***	**,019***	,258
Upper Back Posture	**r**	,120	,078	**,270****	,033	,170
	p	,219	,429	**,005****	,738	,082
Lower Back Posture	**r**	,083	,022	,047	,074	-,083
	p	,398	,820	,629	,454	,397

*p<0,05, **p<0,01. WHOQOL-Bref: World Health Organization Quality of Life Instrument-Short Form.

When the relationship of the head, neck, shoulder, upper back, and lower back pain levels and the CNFDS and SDQ scores were examined with the Spearman Correlation test, the moderate correlation (r = ,540) of the neck pain and its function (p<0,01), the weak correlation (r = ,365) of the shoulder pain and its function (p<0,01), the weak correlation (r = ,338) of the neck pain and shoulder function (p<0,01), the weak correlation (r = ,296) of the shoulder pain and neck function (p<0,01), the weak correlation (r = ,291) of the lower back pain and neck function (p<0,01), and the very weak correlation (r = ,191) of the lower back pain and shoulder function (p<0,05) were found statistically significant and positively (Table 4.14).

Table 4.14. Relationship between the Head, Neck, Shoulder, Upper and Lower Back Pain Levels according to VAS Scores, and the Neck and Shoulder Functions according to CNFDS and SDQ Scores

		CNFDS	SDQ
VAS Head	**r**	,076	,064
	p	,438	,512
VAS Neck	**r**	**,540****	**,338****
	p	**,000****	**,000****
VAS Shoulder	**r**	**,296****	**,365****
	p	**,002****	**,000****
VAS Upper Back	**r**	,162	,054
	p	,097	,585
VAS Lower Back	**r**	**,291****	**,191***
	p	**,002****	**,049***

*p<0,05, **p<0,01. VAS: Visual Analogue Scale, CNFDS: Copenhagen Neck Functional Disability Scale, SDQ: Shoulder Disability Questionnaire.

Evaluation of the relationship between the head, neck, shoulder, upper back, and lower back pain levels and all WHOQOL-Bref parameters with the Spearman Correlation test showed that only the lower back pain had weakly correlations with general health (r = -,252), physical health (r = -,311), and psychological health (r = -,286), negatively and statistically significantly (p<0,01 for all) (Table 4.15).

Table 4.15. Relationship between the Head, Neck, Shoulder, Upper and Lower Back Pain Levels according to VAS Scores, and the WHOQOL-Bref Parameters

		WHOQOL-Bref General Health	WHOQOL-Bref Physical Health	WHOQOL-Bref Psychological Health	WHOQOL-Bref Social Relationships	WHOQOL-Bref Environment
VAS Head	**r**	,079	-,024	-,073	-,021	-,099
	p	,419	,809	,459	,829	,312
VAS Neck	**r**	-,111	-,138	-,061	-,046	,018
	p	,257	,159	,534	,643	,855
VAS Shoulder	**r**	-,029	-,077	-,165	,037	,013
	p	,771	,434	,091	,703	,894
VAS Upper Back	**r**	,072	-,090	-,043	-,188	,041
	p	,466	,359	,665	,053	,675
VAS Lower Back	**r**	**-,252****	**-,311****	**-,286****	-,011	-,002
	p	**,009****	**,001****	**,003****	,911	,984

**p<0,01. VAS: Visual Analogue Scale, WHOQOL-Bref: World Health Organization Quality of Life Instrument-Short Form.

The results of Spearman Correlation test showed that the CNFDS score was statistically significantly, negatively, and very weakly correlated with the general health parameter ($p<0,05$) ($r = -,226$) and weakly correlated with the physical health parameter ($p<0,01$) ($r = -,380$) of the WHOQOL-Bref. Likewise, the SDQ score was statistically significantly, negatively, and very weakly correlated with the general ($p<0,05$) ($r = -,212$) and the physical health ($p<0,05$) ($r = -,231$) items (Table 4.16).

Table 4.16. Relationship between the Neck and Shoulder Functions according to CNFDS and SDQ Scores, and the WHOQOL-Bref Parameters

		WHOQOL-Bref General Health	**WHOQOL-Bref Physical Health**	**WHOQOL-Bref Psychological Health**	**WHOQOL-Bref Social Relationships**	**WHOQOL-Bref Environment**
CNFDS	**r**	**-,226***	**-,380****	-,031	,032	,033
	p	**,020***	**,000****	,749	,746	,740
SDQ	**r**	**-,212***	**-,231***	-,140	,010	-,147
	p	**,029***	**,017***	,151	,919	,133

*p<0,05, **p<0,01. CNFDS: Copenhagen Neck Functional Disability Scale, SDQ: Shoulder Disability Questionnaire, WHOQOL-Bref: World Health Organization Quality of Life Instrument-Short Form.

5. DISCUSSION

According to the statistical analyzes, consistent with the hypothesis, the main results of this study showed that, the use of smartphone affects both neck and shoulder posture negatively, causes both neck and shoulder pain, and has negative effects on both neck and shoulder functions in young adults. Additionally, it was concluded that, in young adults, the use of smartphone affects overall posture and psychological health, and that the regions where pain complaints seen in the body change according to the use of smartphone. Other outcome of this study was that the neck posture, neck pain and function are interrelated. In the same way, the results of this study showed that there is also a relationship among the neck posture, shoulder pain and function. Likewise, according to the results, the upper back posture, neck pain and function are related with each other also.

Statistical analyzes showed us that the physical features and the descriptive characteristics of the participants of two groups were similar with each other. Besides, both daily sitting and standing hours of participants were similar between the groups. Because some factors like age, weight, dominant side, smoking behaviors, exercise habits, and prolonged sitting or standing hours have effects on the posture, the similarity of these factors between the groups indicates that they cannot have influence on the results.

While in the study they conducted in university students in 2015, Park et al. could not found any relation between the craniovertebral angle, which is an indicator of FHP, and the use of smartphone, in next studies, which have been conducted by Jung et al. and Akodu et al. in university students, it has been revealed that the craniovertebral angle decreases as smartphone usage time increases. Since the decreasing in the craniovertebral angle is a sign of FHP, they have been concluded that there is an association between the use of smartphone and FHP in young adults (3,6,7). In our study, the mean score of neck posture was significantly lower in the participants who use smartphone excessively. Because of that the decreasing in the score of NYPRC, which is the tool we used in our study, shows the disorders in postural alignment, we also interpreted these results as the postural alignment may be impaired as the use of smartphone increase.

Only one study was found in the literature examining the relationship between the use of smartphone and the shoulder posture. In that study, conducted by Jung et al. in 2016 in university students, participants have been divided into two groups depends on the time they spent on the smartphone daily. The rounded shoulder posture has been evaluated with scapular index. The results have been showed that participants who use smartphone more than 4 hours in a day had lesser scapular index than those who use smartphone less than 4 hours in a day. These results have been interpreted by them as that the use of smartphone could cause the rounded shoulders (3). Similarly, in our study, the mean score of shoulder posture was significantly lower in the participants who use smartphone excessively. Because of that the decreasing in the score of NYPRC, which is the tool we used in our study, shows the disorders in postural alignment, we also interpreted these results as young adults who use smartphone excessively may be more likely to have rounded shoulders.

In addition to these, there is not any study in the current literature that using the New York Posture Rating Chart to evaluate the total posture, and comparing its results between the people who use smartphone excessively and the people who use smartphone non-excessively. Our results showed that the young adults who use smartphone excessively had lower NYPRC total scores than those the young adults who use smartphone non-excessively. According this outcome, we were concluded that also overall posture is affected by the use of smartphone in young adults.

There are several studies in the current literature which stated that the neck pain is a common musculoskeletal symptom seen in the young adults and adolescents who use smartphone excessively, and is a comorbid factor of the text-neck syndrome, which is the repetitive stress injury or overuse syndrome occurs due to the use of smartphone sustained period of time, and causes neck pain and damage to structures around the neck area (15,16,158). Most of these are the researches that questioning the symptoms of participants with a self-assessment questionnaire. However, there are very few studies evaluating the severity of pain. Lee et al., in 2016, examined the pain in university students with Short Form McGill Pain Questionnaire and according to its scores they divided participants into two groups. They found that in the neck pain group the smartphone use time was higher (1). In another study, in 2018, Vijayakumar et al. found in their research that the mean value of neck VAS score was higher in the young adults who have text-neck syndrome (15). Accordingly, it was concluded that the young adults who use smartphone more, have higher risk of suffering from neck pain. We also used the VAS to detect the severity of pain in the present study, and compared the results of it between two groups. Statistical analysis indicated that the mean VAS score of neck, accordingly the neck pain level, was higher in the group whose participants use smartphone excessively. Thus, consistent with literature, our results showed that neck pain is more frequent among the young adults using smartphone extended period of time.

Some of the researches that examining the musculoskeletal symptoms of the smartphone users who are young adults and adolescents have reported that the shoulder pain is also one of the complaints of these people (15,16,158). However, there is only a few studies evaluated the relationship of the shoulder pain level and the use of smartphone. In our study that we questioned this relation, the results showed us that the severity of shoulder pain is much more in the young adults who use smartphone excessively than those who use smartphone non-excessively. Consistently, in 2018, Vijayakumar et al. found in their research that the mean value of shoulder VAS score, accordingly the shoulder pain level, was higher in the young adults who have text-neck syndrome (15). According to results of both studies, it can be concluded that the shoulder pain is more frequent among the young adults using smartphone extended period of time.

In addition, some studies have reported that the use of smartphone is associated with headache and upper back pain in young adults (15,16). In 2018, Vijayakumar et al. found in their research that the mean values of the head and upper back VAS scores, accordingly the head and upper back pain levels, were higher in the young adults who have text-neck syndrome (15). In contrast to the outcomes of these studies, we could not find any relation between those.

Limited number of studies have evaluated the relationship between the use of smartphone and the functional level. In the study conducted by Yılmaz et al. in 2017, relationship between smartphone addiction and the upper extremity functional levels of nursing students has been investigated using the SAS-SV and The Disabilities of the Arm, Shoulder and Hand Score. In result of that study, a relation has been found between the smartphone addiction level and the upper extremity functional levels of nursing students (24). In our study, we evaluated the shoulder function with the SDQ and the neck function with the CNFDS. The higher scores obtained from these tools shows the greater level of disability, and in our study, the mean values of both the CNFDS and SDQ scores of the ESUG were significantly higher than the NSUG. It means, the results of the statistical analysis presented the fact that using smartphone causes decline in the both neck and shoulder functional levels, consistent with the previous study.

As with other studies in literature showing us that the use of smartphone excessively is associated with neck, shoulder and upper back pain complaints, in the result of our study it was revealed that the neck and shoulder pains are more common in young adults who use smartphones excessively (15,16).

Although the use of smartphone affects our lives both physically and psychologically, most of the research investigating the effects of smartphone use on quality of life, in the current literature, are the studies in the field of psychology. These studies have shown that the smartphone use has a psychological impact on young adults significantly (18,42,44-46,50,51). In our study, the quality of life was evaluated with the WHOQOL-Bref which has different parameters to examine the general health, physical health, psychological health, social relationships, and environment. The higher scores obtained from each part of the scale, shows the higher quality of life. In the present study, the results showed that the NSUG got higher score from the psychological health part of WHOQOL-Bref than the ESUG. If the statistical analysis is interpreted, it can be said that the use of smartphone affects the psychological health of young adults, consistent with the results of previous studies. However, no relationship was found between the other parameters of WHOQOL-Bref and the use of smartphone. According to the results of our study, not only the smartphone use, but also the shoulder posture and upper back posture were found associated with the psychological health. Moreover, it was also revealed that the shoulder posture has an effect on social relationships. Consequently, it can be said that both smartphone use and posture have several effects on the psychological health and social relationships, accordingly on the quality of life of young adults.

The results of the research conducted by Raine and Twomey have indicated that the FHP is related with the kyphosis, and the rounded shoulders is related with the upper cervical spine extension. However, again according to the results of that study, FHP was not associated with the rounded shoulders and the upper cervical spine extension (159). Unfortunately, there is not enough studies in the literature that have examined this subject. In our study, with the statistical analysis, the neck, shoulder, and upper back postures were shown to be correlated with each other. It means, when a postural problem occurs in one of them, this condition may affect the other one, and cause an other postural misalignment in that segment also. The discrepancy between the results of these two studies can be explained by the differences in measurement methods and the age range of participants of two studies (159). In addition to this, the definition of FHP in different sources is not the same. While some sources stated that the upper cervical spine extension is a part of the FHP, other sources do not agree with it. Hence, this situation might have been contributed to that the outcomes of both studies were different.

In the present study, it was indicated that the neck posture, pain, and function are correlated with each other. Consistent with these results, in some previous researches it has been revealed that people with a smaller craniovertebral angle more likely to have neck pain (160). Put it differently, because the decreasing in the craniovertebral angle is a sign of FHP, it can be said that people with FHP suffer from neck pain more frequently. Besides, when our results taking into consideration, decreasing in the neck functions of ESUG can be explained with that the postural misalignments and pain can cause to functional disabilities.

According to the results of another previous study, increase of the upper thoracic angle was associated with the higher neck pain severity and disability (160). Likewise, in our study, the correlation among the upper back posture, neck pain and neck function was indicated.

Unlike other studies, we have also revealed that the neck posture, shoulder pain, and shoulder function are interralated.

Besides, according to the results of the present study, it is one of the fact exhibited that the shoulder posture, neck pain, and shoulder functions are correlated. However, in a previous research conducted by Nejati et al. in 2014, the result that has been reached were that the shoulder posture was not associated with neck pain (10). That study has been conducted in Iranian office workers, in contrast to our study. So, the difference in the samples in terms of culture and vocation may have caused that the results of these two studies have been different.

To sum up briefly, these are the known facts that smartphone is today's addiction, and that its use is fairly common in young adults. It has long been thought that this condition, in young adults, may cause various musculoskeletal deformities. Although it has also been revealed that the neck and shoulders are the primary regions that can be affected by the use of smartphone, there is no studies evaluated these two regions in terms of both posture, pain, and function, and compared their results. Considering this opinion, we questioned the effects of the use of smartphone on the neck and shoulder posture, pain, and functions, and the quality of life. The results of the study showed that the use of smartphone is associated with the postural misalignments in both neck and shoulder regions, the pain seen in both neck and shoulder areas, and the decreased level of both neck and shoulder functions, to the same degree. Consistent with that the postural disorders, pain, and functional disabilities may decrease the quality of life, our results revealed that the quality of life is also decreased when the use of smartphone increase. In conclusion, according to results of this study, the use of smartphone affects the posture, pain, function, and quality of life in young adults.

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7. APPENDICES

7.1. APPENDIX 1. Ethical Committee Approval

T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15- 1682 **30/05/2019**
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

İlgili Makama (Sıla Yılmaz)

Yeditepe Üniversitesi Sağlık Bilimleri Fakültesi Fizyoterapi ve Rehabilitasyon Bölümü Doç.Dr. Rasmi Muammer'in sorumlu araştırmacı olduğu **"Genç Erişkinlerde Akıllı Telefon Kullanımının Postür, Ağrı, Fonksiyonel Durum Ve Yaşam Kalitesi Üzerine Etkilerinin İncelenmesi"** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası **(1660)** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **29.05.2019** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 1032**).

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

7.2. APPENDIX 2. Informed Written Consent

Bilgilendirilmiş Gönüllü Olur Formu

Değerli katılımcı;

Davet edildiğiniz akademik araştırma Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Fizyoterapi ve Rehabilitasyon Yüksek Lisans Programı tarafından yürütülen ve "Genç Erişkinlerde Akıllı Telefon Kullanımının Postür, Ağrı, Fonksiyonel Durum ve Yaşam Kalitesi Üzerine Etkilerinin İncelenmesi" konulu yüksek lisans tez çalışmasıdır.

Çalışmanın amacı akıllı telefon kullanımının genç erişkinlerde; boyun ve omuz postürü ve ağrısı, boyun ve omuz eklemleri fonksiyonel durumu ve yaşam kalitesi üzerine etkilerinin belirlenmesidir.

Bu araştırma için sizden hiçbir ücret talep edilmeyecek ve size herhangi bir ödeme yapılmayacaktır.

Araştırmaya katılmama, katıldığınız takdirde ise dilediğiniz zaman araştırmadan ayrılma hakkınız bulunmaktadır.

Araştırmaya katılmayı kabul ettiğiniz takdirde, araştırma verileri; Sosyodemografik Bilgi Formu, Vizüel Analog Skala, Kopenhag Boyun Fonksiyonel Özürlülük Skalası, Omuz Özürlülük Sorgulaması, Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu, Akıllı Telefon Bağımlılığı Ölçeği-Kısa Form ve New York Postür Değerlendirme Testi kullanılarak toplanacak olup, bu değerlendirme yaklaşık 30 dakika sürecektir.

Görüşme sırasında vereceğiniz yanıtların doğruluğu araştırmanın geçerlilik ve güvenilirliği açısından önem taşımakta olup yanıtlarınız ve kişisel bilgileriniz gizli tutularak yalnızca bilimsel amaçla kullanılacaktır.

Onayınız ve katılımınız için teşekkür ederiz.

<u>**Sorumlu Araştırmacı**</u>	<u>**Yardımcı Araştırmacı**</u>
Prof. Dr. Rasmi MUAMMER Yeditepe Üniversitesi Sağlık Bilimleri Fakültesi Fizyoterapi ve Rehabilitasyon Bölümü Tel: 0216 578 0000	**Sıla YILMAZ** Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Fizyoterapi ve Rehabilitasyon Yüksek Lisans Programı Tel:

GÖNÜLLÜ BEYANI

Bilgilendirme formundaki tüm açıklamaları okudum. Bana yukarıda konusu ve amacı belirtilen araştırma ile ilgili yazılı ve sözlü açıklama araştırmacılar tarafından yapıldı. Araştırmaya katılmaya gönüllü olduğumu, istediğim zaman gerekçeli veya gerekçesiz olarak araştırmadan ayrılabileceğimi biliyorum. Söz konusu araştırmaya, hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı kabul ediyorum.

Gönüllü;

Ad-Soyad: İmza:

Tel:

Adres:

Tarih:

7.3. APPENDIX 3. Structured Questionnaire

SOSYODEMOGRAFİK BİLGİ FORMU

1) Ad Soyad:

2) Yaş: 3) Boy: 4) Kilo:

5) Cinsiyet: Kadın ( ) Erkek ( )

6) Dominant El: Sağ ( ) Sol ( )

7) Medeni Durum: Bekar ( ) Evli ( )

8) Sigara kullanıyor musunuz? Hiç içmedim ( ) Bıraktım ( ) Halen içiyorum ( )

9) Alkol kullanıyor musunuz? Evet ( ) Hayır ( )

10) Herhangi bir sürekli hastalığınız var mı?

Sürekli bir hastalığım yok ( )

Romatizma ( ) (Lütfen belirtiniz ………………..)

Ortopedik hastalık ( ) (Lütfen belirtiniz ………………..)

Nörolojik problem ( ) (Lütfen belirtiniz ………………..)

Diğer ( ) (Lütfen belirtiniz ………………..)

11) Daha önce boyun veya omuz bölgesi ile ilgili bir travma veya cerrahi operasyon geçirdiniz mi?

Evet ( ) (Lütfen belirtiniz ………………..) Hayır ( )

12) Son 6 ay içinde boyun veya omuz bölgesini ilgilendiren sağlık problemi sebebiyle bir tıbbi müdahale veya tedavi gördünüz mü?

Evet ( ) (Lütfen belirtiniz ………………..) Hayır ( )

13) Egzersiz/spor yapıyor musunuz?

Evet ( ) (Haftada ….. gün, …… dakika) Hayır ( )

14) Ne kadar zamandır egzersiz/spor yapıyorsunuz? ………………………

15) Hangi tür egzersizleri/sporları yaparsınız? ………………………….

16) Daha önce postür eğitimi aldınız mı? Evet ( ) Hayır ( )

17) Günde kaç saati oturarak geçiriyorsunuz? …………….

18) Günde kaç saati ayakta geçiriyorsunuz? ………………

19) Günde kaç saat akıllı telefon kullanıyorsunuz? …………………

20) Ne kadar zamandır akıllı telefon kullanıyorsunuz? …………………

7.4. APPENDIX 4. Visual Analogue Scale

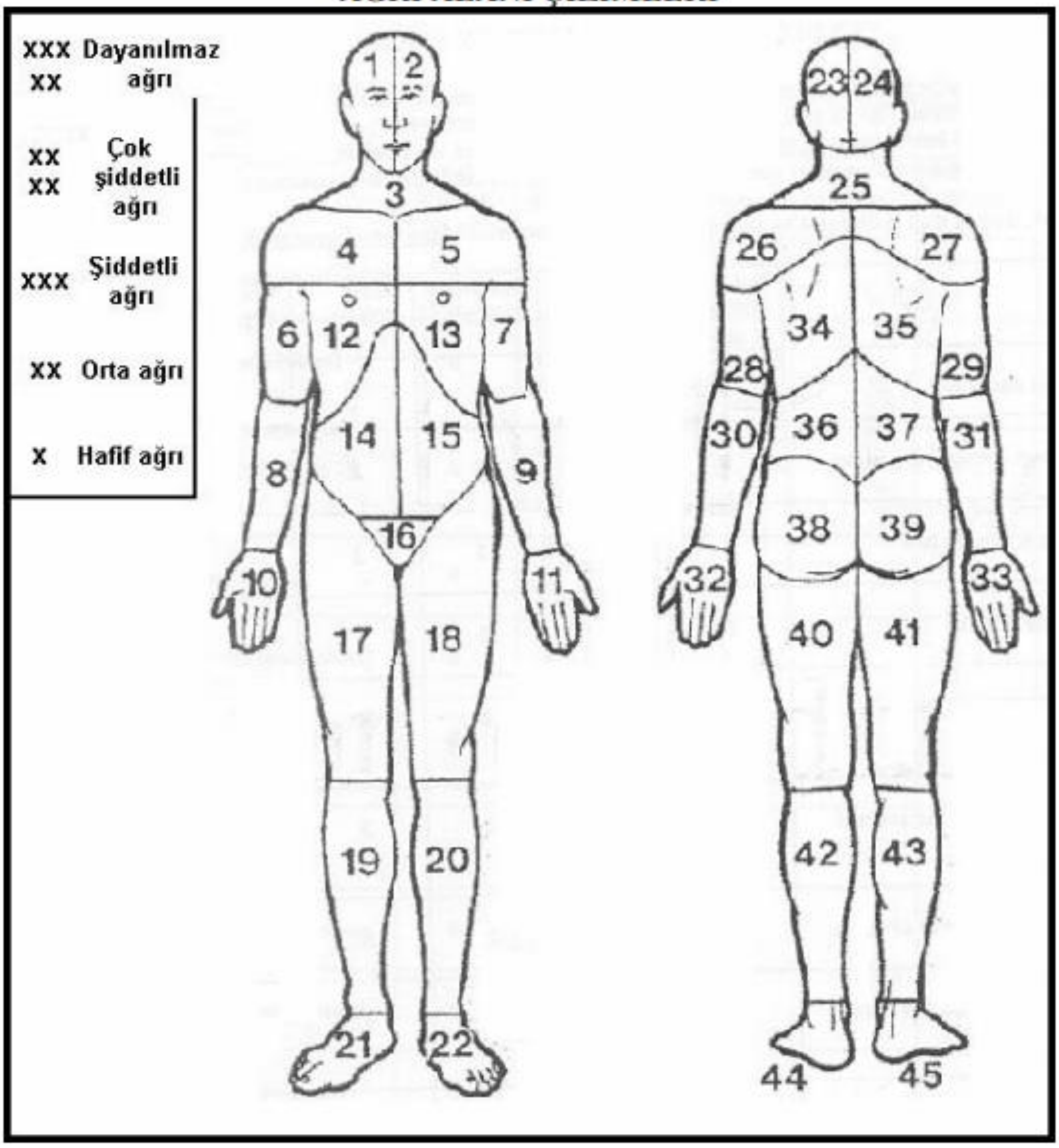
Vizüel Analog Skala

Tarih:

Vücudunuzun herhangi bir bölgesinde ağrı hissi yaşıyorsanız lütfen aşağıdaki şekil üzerinde ağrınız olan bölgeyi/bölgeleri şeklin solunda gösterildiği gibi işaretleyin.

Vücudunuzun herhangi bir bölgesinde ağrı hissi yaşamıyorsanız bir sonraki sayfaya geçin.

AĞRI ALANI ÇİZİMLERİ



Aşağıdaki, soldan sağa doğru gittikçe artan ağrı şiddetini ifade eden ve sol ucu "Hiç ağrı olmaması", sağ ucu "En dayanılmaz ağrı" durumunu belirten 10 cm'lik ölçek üzerinde ağrınızın şiddetini gösteren noktayı/noktaları bir önceki sayfadaki şekil üzerinde işaretlediğiniz bölgenin/bölgelerin numaraları ile birlikte işaretleyin.

Vücudunuzun herhangi bir bölgesinde ağrı hissi yaşamıyorsanız ölçeğin "Hiç ağrı olmaması" kısmını işaretleyin.

7.5. APPENDIX 5. Copenhagen Neck Functional Disability Scale

Kopenhag Boyun Fonksiyonel Özürlülük Skalası

Lütfen aşağıda boyun fonksiyonel durumunuzun yaşamınızı ne kadar etkilediğini ölçmek için hazırlanmış soruları cevaplarken, soruda bahsedilen durum size tamamen uyuyorsa "Evet", kısmen uyuyorsa "Ara sıra", uymuyorsa "Hayır" şıkkını seçecek şekilde sizin için uygun olan seçeneği işaretleyin.

1. Geceleri boyun ağrınız olmaksızın rahat uyuyabiliyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

2. Boyun ağrısı çekmeden günlük aktivitelerinizi eksiksiz yapabiliyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

3. Günlük işlerinizi başkalarının yardımı olmadan yapabiliyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

4. Sabahları normalden çok fazla zaman harcamadan giyinebiliyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

5. Boyun ağrısı olmadan lavaboya eğilip dişlerinizi fırçalayabiliyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

6. Boyun ağrısından dolayı daha çok evde zaman geçiriyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

7. Boyun ağrısından dolayı 2-4 kg'lık eşyaları kaldırmaktan çekiniyor musunuz?
   ☐ Evet ☐ Ara sıra ☐ Hayır

8. Boyun ağrısından dolayı okuma alışkanlığınız azaldı mı?
   ☐ Evet ☐ Ara sıra ☐ Hayır

9. Boynunuz ağrıdığında başınız da ağrıyor mu?
   ☐ Evet ☐ Ara sıra ☐ Hayır

10. Boyun ağrısından dolayı konsantrasyonunuzun azaldığını hissediyor musunuz?
    ☐ Evet ☐ Ara sıra ☐ Hayır

11. Boyun ağrısı boş zamanlarınızı değerlendirmenizi engelliyor mu?
    ☐ Evet ☐ Ara sıra ☐ Hayır

12. Boyun ağrısından dolayı yatakta daha uzun süre mi kalıyorsunuz?
    ☐ Evet ☐ Ara sıra ☐ Hayır

13. Boyun ağrısının ailenizle olan duygusal ilişkinizi etkilediğini düşünüyor musunuz?
    ☐ Evet ☐ Ara sıra ☐ Hayır

14. Geçtiğimiz iki hafta boyunca boyun ağrısından dolayı diğer insanlarla olan sosyal ilişkilerinizi bitirmek zorunda kaldınız mı?
    ☐ Evet ☐ Ara sıra ☐ Hayır

15. Boyun ağrınızın geleceğinizi etkileyeceğini düşünüyor musunuz?
    ☐ Evet ☐ Ara sıra ☐ Hayır

7.6. APPENDIX 6. Shoulder Disability Questionnaire

Omuz Özürlülük Sorgulaması

Lütfen aşağıda omuz fonksiyonel durumunuzun yaşamınızı ne kadar etkilediğini ölçmek için hazırlanmış soruları cevaplarken, soruda bahsedilen aktiviteyi 24 saat içinde ağrı hissederek gerçekleştirdiyseniz "Evet", ağrı hissetmeden gerçekleştirdiyseniz "Hayır", soruda bahsedilen aktiviteyi 24 saat içinde gerçekleştirmediyseniz "Uygulanamaz" şıkkını seçecek şekilde sizin için uygun olan seçeneği işaretleyin.

1. Gece omuz ağrısı yüzünden uyanıyorum.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
2. Üzerine yattığımda omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
3. Omuzumdaki ağrıdan dolayı ceket ya da kazak giymekte zorluk çekiyorum.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
4. Her zaman yaptığım günlük işleri yaparken omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
5. Dirseğimin veya elimin üzerine yattığımda omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
6. Kolumu hareket ettirdiğimde omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
7. Kalemle ya da daktiloyla yazı yazdığımda omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
8. Araba ya da elektrik süpürgesi kullanırken omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
9. Bir şeyi kaldırıp taşıdığımda omuzum ağrıyor.
   ☐ Evet ☐ Hayır ☐ Uygulanamaz
10. Omuz seviyesinin üstündeki bir şeye uzanırken ya da yakalarken omuzum ağrıyor.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
11. Bir kapıyı açarken ya da kapatırken omuzum ağrıyor.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
12. Elimi başımın arkasına getirirken omuzum ağrıyor.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
13. Elimi kalçama getirdiğimde omuzum ağrıyor.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
14. Elimi belime getirdiğimde omuzum ağrıyor.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
15. Ağrılı omuzumu bir gün boyunca birden fazla sayıda ovuyorum.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz
16. Omuzumdaki ağrıdan dolayı insanlarla ilişkilerim normalden daha kötü ve huzursuzum.
    ☐ Evet ☐ Hayır ☐ Uygulanamaz

7.7. APPENDIX 7. World Health Organization Quality of Life Instrument-Short Form

Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği-Kısa Formu

Bu anket sizin yaşamınızın kalitesi, sağlığınız ve yaşamınızın öteki yönleri hakkında neler düşündüğünüzü sorgulamaktadır. Lütfen bütün soruları son 2 haftayı göz önünde bulundurarak ve size en uygun olanı seçerek cevaplayınız.

1- Yaşam kalitenizi nasıl buluyorsunuz?
a) Çok kötü b) Biraz kötü c) Ne iyi, ne kötü d) Oldukça iyi e) Çok iyi

2- Sağlığınızdan ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d)Epeyce hoşnut e) Çok hoşnut

3- Ağrılarınızın yapmanız gerekenleri ne derece engellediğini düşünüyorsunuz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Aşırı derecede

4- Günlük uğraşlarınızı yürütebilmek için herhangi bir tıbbi tedaviye ne kadar ihtiyaç duyuyorsunuz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Aşırı derecede

5- Yaşamaktan ne kadar keyif alırsınız?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Aşırı derecede

6- Yaşamınızı ne ölçüde anlamlı buluyorsunuz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Aşırı derecede

7- Dikkatinizi toplamada ne kadar başarılısınız?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Son derecede

8- Günlük yaşamınızda kendinizi ne kadar güvende hissediyorsunuz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Son derecede

9- Fiziksel çevreniz ne ölçüde sağlıklıdır?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Son derecede

10- Günlük yaşamı sürdürmek için yeterli gücünüz kuvvetiniz var mı?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Tamamen

11- Bedensel görünüşünüzü kabullenir misiniz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Tamamen

12- İhtiyaçlarınızı karşılamaya yeterli paranız var mı?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Tamamen

13- Günlük yaşantınızda size gerekli bilgi ve haberlere ne ölçüde ulaşabiliyorsunuz?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Tamamen

14- Boş zamanları değerlendirme uğraşları için ne ölçüde fırsatınız olur?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Tamamen

15- Bedensel hareketlilik (etrafta dolaşabilme, bir yerlere gidebilme) beceriniz nasıldır?
a) Çok kötü b) Biraz kötü c) Ne iyi, ne kötü d) Oldukça iyi e) Çok iyi

16- Uykunuzdan ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

17- Günlük uğraşlarınızı yürütebilme becerinizden ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

18- İş görme kapasitenizden ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

19- Kendinizden ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

20- Aile dışı kişilerde ilişkilerinizden ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

21- Cinsel yaşamınızdan ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

22- Arkadaşlarınızın desteğinden ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

23- Yaşadığınız evin koşullarından ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

24- Sağlık hizmetlerine ulaşma koşullarınızdan ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

25- Ulaşım olanaklarınızdan ne kadar hoşnutsunuz?
a) Hiç hoşnut değil b) Çok az hoşnut c) Ne hoşnut, ne de değil d) Epey hoşnut e) Çok hoşnut

26- Ne sıklıkta hüzün, ümitsizlik, bunaltı, çökkünlük gibi duygulara kapılırsınız?
a) Hiçbir zaman b) Nadiren c) Ara sıra d) Çoğunlukla e) Her zaman

27- Yaşamınızda size yakın kişilerle (eş, iş arkadaşı, akraba) ilişkilerinizde baskı ve kontrolle ilgili zorluklarınız ne ölçüdedir?
a) Hiç b) Çok az c) Orta derecede d) Çokça e) Aşırı derecede

7.8. APPENDIX 8. Smartphone Addiction Scale-Short Version

Akıllı Telefon Bağımlılığı Ölçeği-Kısa Form

Aşağıda akıllı telefon kullanımı ile ilgili çeşitli duygu ve düşünceleri içeren anlatımlar verilmiştir.

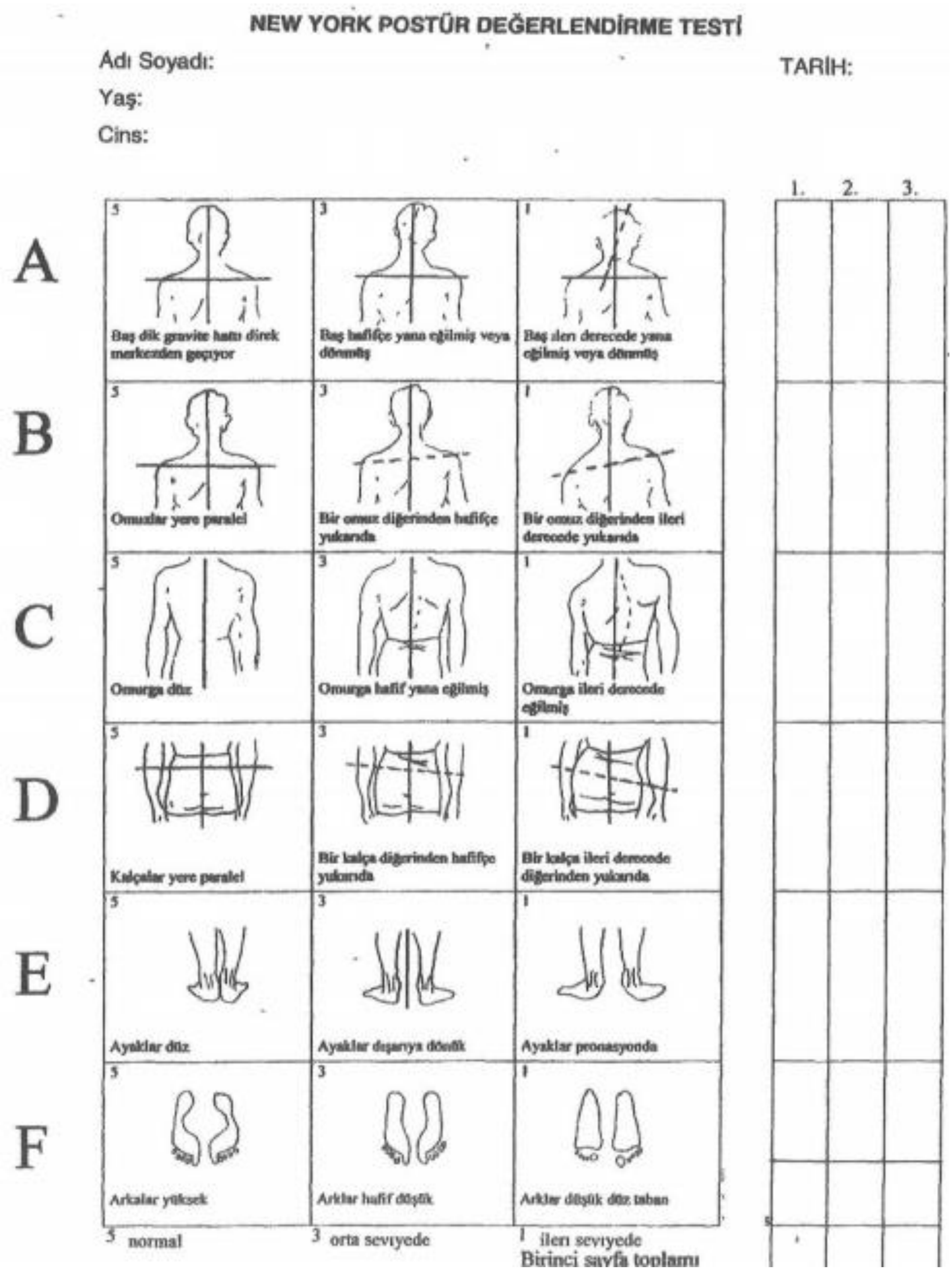
Her anlatımın karşısında 1'den 6'ya kadar o anlatıma ne ölçüde katıldığınızı ifade eden rakamlar bulunmaktadır.

1-Kesinlikle katılmıyorum, 2-Katılmıyorum, 3-Kısmen katılmıyorum, 4-Kısmen katılıyorum, 5-Katılıyorum, 6-Kesinlikle katılıyorum anlamına gelmektedir.

Lütfen her anlatımın size ne kadar uyduğunu değerlendirerek en uygun seçeneği yuvarlak içine alınız.

Akıllı telefon kullanmaktan dolayı planladığım işleri aksatırım.	1	2	3	4	5	6
Akıllı telefonu kullanmaktan dolayı derslerime odaklanmakta, ödevlerimi yapmakta ve işlerimi tamamlamakta güçlük çekerim.	1	2	3	4	5	6
Akıllı telefon kullanmaktan dolayı el bileğimde veya ensemde ağrı hissederim.	1	2	3	4	5	6
Akıllı telefonumun yanımda olmamasına tahammül edemem.	1	2	3	4	5	6
Akıllı telefonum yanımda olmadığında sabırsız ve sinirli olurum.	1	2	3	4	5	6
Kullanmasam da, akıllı telefonum aklımdadır.	1	2	3	4	5	6
Günlük yaşamımı aksatmasına rağmen akıllı telefonumu kullanmaktan vazgeçemem.	1	2	3	4	5	6
İnsanların twitter veya facebook üzerindeki konuşmalarını kaçırmamak için sürekli akıllı telefonumu kontrol ederim.	1	2	3	4	5	6
Akıllı telefonumu hedeflediğimden daha uzun süre kullanırım.	1	2	3	4	5	6
Çevremdeki insanlar akıllı telefonumu çok fazla kullandığımı söylerler.	1	2	3	4	5	6

7.9. APPENDIX 9. New York Posture Rating Chart



NEW YORK POSTÜR DEĞERLENDİRME TESTİ

Adı Soyadı: TARİH:

Yaş:

Cins:

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

5 normal 3 orta seviyede 1 ileri seviyede

Birinci sayfa toplamı

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

1.Eğer sol kolondakı açıklamaya uygun ise 5 puan
2.Eğer orta kolondakı açıklamaya uygun ise 3 puan
3.Eğer sağ kolondaki açıklamaya uygun ise 1 puan ekleyin.

7.10. APPENDIX 10. Curriculum Vitae

Özgeçmiş

Kişisel Bilgiler

Adı	Sıla	**Soyadı**	Yılmaz
Uyruğu	T.C.	**Doğum Yeri**	İstanbul

Öğrenim Durumu

Derece	Alan	Mezun Olduğu Kurumun Adı	Mezuniyet Yılı
Lisans	Fizyoterapi ve Rehabilitasyon	Yeditepe Üniversitesi	2017
Lise	Sayısal	İzzet Baysal Anadolu Lisesi	2011

Bildiği Yabancı Dilleri	Yabancı Dil Sınav Notu
İngilizce	88,75 (YDS)

İş Deneyimi

Görevi	Kurum	Süre (Yıl - Yıl)
Araştırma Görevlisi	İstanbul Gedik Üniversitesi	2018 -

Bilgisayar Bilgisi

Program	Kullanma becerisi
Microsoft Office Programları	İyi
SPSS	Orta