T.C.

YEDİTEPE UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

THE PREVALENCE OF TEXT NECK SYNDROME AMONG INTERNATIONAL STUDENTS

MASTER THESIS

AYESHA FAROOQI, PT

ISTANBUL 2023

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APPROVAL

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

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DECLARATION

I hereby declare that this thesis is my work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person or material that has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

AYESHA FAROOQI

DEDICATION

I proudly dedicated my work to my family, who have always encouraged and supported me in every step of my life. I'm very appreciative of my supportive parents, Pervaiz Iqbal Qureshi and Amber Pervaiz, who gave up so much for me to have a brighter future. I will always be grateful for what they have done for me. I want to express my gratitude to my spouse, Mian Wasiq Adnan, for his support throughout the writing of my dissertation.

I want to dedicate this work to my cherished late (nonbiological) mother, Musarrat Zurqarnain, who always supported me and believed in my ability to do anything. Even though she is no longer with me, I am grateful for her influence on my life and her unwavering love for me.

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With all the effort and attention paid, this thesis work has been such a devotion to my dedicated supervisor, Prof. Dr. Feryal SUBASI, and me. She has been sincerely giving and always there whenever I needed her. For the most part, it is a great honour to be her master's student, and I am willing to take our scientific relationship forward.

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LIST OF SYMBOLS AND ABBREVIATIONS

SPA	Smartphone addiction
FHP	Forward head posture
CES	Cervical Erector Spinae
UT	Upper Trapezius
FC	Facet capsule
ATL	Atlas Transverse Ligament
TM	Tectorial Membrane
CVA	Craniovertebral Angle
FHD	Forward Head Distance
SA	Shoulder Angle
SHA	Sagittal Head Angle
SAS	Smartphone addiction scale
NDI	Neck disability index
SAS, SV	Smartphone addiction scale, short version
CT	Computerized Tomography
MRI	Magnetic Resonance Imaging
CROM	Cervical Range of motion
NSAIDs	Nonsteroidal anti-inflammatory drugs
SPSS	Statistical Package for Social Sciences

ABSTRACT

Farooqi,A(2023). The Prevalence of Text Neck Syndrome among International Students in Istanbul. Yeditepe University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, M.Sc. thesis, Istanbul.

This research aims to identify the frequency of text neck syndrome among international students residing in Istanbul. The study employed a cross-sectional research design. The research group was made up of international students. A total of 396 international students participated voluntarily in this online survey. Out of 396 participants, 193 were male, and 198 were female. Participants' demographic characteristics were documented using a structured questionnaire. The smartphone addiction scale, shortened version, measured smartphone addition. The neck disability index was utilized to evaluate neck discomfort. The mean value of the smartphone addiction scale was 3.74, which showed a high level of addiction, and the mean score of the neck disability index was 2.78 showing a moderate level of disability. An independent t-test was used for calculating the comparisons among groups. There was a significant difference between gender groups. Females have a high level of smartphone addiction than males. The association between the neck disability index and the smartphone addiction scale was examined using the Pearson coefficient correlation test. The significant value of .425 showed a moderate positive relationship between the smartphone addiction scale and the neck disability index. As the scores on the smartphone addiction scale increase, there is a tendency for the scores on the neck disability index to increase as well and vice versa. The p-value is reported as 0.000, meaning the correlation is statistically significant at 5% and 1% significance levels. The results showed that the international students had neck disability, which showed a substantial relationship between text neck syndrome and smartphone addiction. Hence, it is imperative to prioritize promoting awareness regarding maintaining appropriate sitting posture and reducing mobile device usage duration.

Keywords

Cervical spine, pain, body posture, mobile phone, Text Neck Syndrome

ÖZET

Farooqi,A(2023). İstanbul'daki Uluslararası Öğrenciler Arasında Metin Boyun Sendromu Yaygınlığı. Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı, M.Sc. Tez, İstanbul.

Bu araştırma, İstanbul'da ikamet eden uluslararası öğrenciler arasında metin boynu sendromu sıklığını belirlemeyi amaçlamaktadır. Çalışmada kesitsel araştırma deseni kullanılmıştır. Araştırma grubu uluslararası öğrencilerden oluşturulmuştur. Bu çevrimiçi ankete toplam 396 uluslararası öğrenci gönüllü olarak katılmıştır. 396 katılımcıdan 193'ü erkek, 198'si kadındı. Katılımcıların demografik özellikleri, yapılandırılmış bir anket kullanılarak belgelenmiştir. Akıllı telefon bağımlılığı ölçeği, kısaltılmış versiyon, ölçülen akıllı telefon ilavesi. Boyun rahatsızlığını değerlendirmek için boyun sakatlık indeksi kullanıldı. Akıllı telefon bağımlılığı ölçeğinin ortalama değeri 3,74 olup, bu yüksek düzeyde bir bağımlılık gösterirken, boyun özürlülük indeksinin ortalama puanı 2,78 olup orta düzeyde bir engeli göstermektedir. Gruplar arası karşılaştırmaları hesaplamak için bağımsız bir t-testi kullanıldı. Cinsiyet grupları arasında anlamlı bir fark vardı. Kadınların erkeklere göre daha yüksek düzeyde akıllı telefon bağımlılığı vardır. Boyun sakatlığı indeksi ile akıllı telefon bağımlılığı ölçeği arasındaki ilişki Pearson katsayısı korelasyon testi kullanılarak incelenmiştir. .425'lik anlamlı değer, akıllı telefon bağımlılık ölçeği ile boyun özürlülük indeksi arasında orta düzeyde pozitif bir ilişki olduğunu gösterdi. Akıllı telefon bağımlılığı ölçeğinden alınan puanlar arttıkça boyun engeli indeksinden alınan puanların da artma eğilimi vardır ve bunun tersi de geçerlidir. p-değeri 0.000 olarak bildirilir, yani korelasyon istatistiksel olarak %5 ve %1 anlamlılık seviyelerinde anlamlıdır. Sonuçlar, uluslararası öğrencilerin, metin boyun sendromu ile akıllı telefon bağımlılığı arasında önemli bir ilişki olduğunu gösteren boyun engeline sahip olduğunu gösterdi. Bu nedenle, uygun oturma pozisyonunun korunması ve mobil cihaz kullanım süresinin azaltılması konusunda farkındalığın artırılmasına öncelik verilmesi zorunludur.

Anahtar kelimeler

Servikal omurga, ağrı, vücut duruşu, cep telefonu, Metin Boyun Sendromu

1 INTRODUCTION AND PURPOSE

The neck connects the skull and the remaining parts of the body. It connects the head directly to the body and is situated between the mandible and the collarbone. It includes several crucial parts. It comprises several organs and tissues essential to proper physiology and houses some of the body's most intricate and complicated structures. In addition to supporting and connecting the brain and cervical spine, these structures also regulate metabolism and the flow of blood and lymph fluid flow into and out of the head. The neck also regulates speech, swallowing, and breathing. [1]. The uppermost vertebral column segment, or backbone, is known as cervical spinal column. It is made up of seven vertebrae (C1-C7) that are divided by intervertebral discs. When moving, these serve as shock absorbers, allowing the spine to move easily. The neck's bones, ligaments, and muscles provide the head's mobility and stability. Neck stiffness or discomfort might result from abnormality, inflammation, or injury. This spine region is prone to numerous conditions, such as neck pain, arthritis, degenerative bone and disc disease, and stenosis [1].

Pain in the neck is a frequent complaint that has a high prevalence worldwide. It is generally agreed upon that neck discomfort constitutes a substantial threat to public health and is associated with considerable degrees of impairment. When an individual experiences pain between the superior nuchal border and a portion of the first thoracic vertebra known as the spinous process, they are diagnosed with neck pain. [2].

Since the world became a global village, the internet has played a major role. The internet has recently become a significant aspect of people's lives due to its rising popularity and increasing speed. In the meantime, the smartphone, a new type of portable gadget, has ushered in a new era of mobile internet. As a result, a growing number of people are becoming overly dependent on smartphones for a variety of daily tasks, including talking to friends online, browsing the internet, making financial transactions, watching television, searching the web, keeping up with the news, attending conferences, enjoying music, interacting with others, and finding entertainment. [3]. Researchers have proposed that the behaviour of excessive use of smartphones can be characterised as smartphone addiction (SPA) because smartphones have the potential to induce addictive behaviours in users due to their portability, lightweight, simplicity, and efficient information processing capabilities [4]. Smartphone users typically grasp the device with one hand while contacting the screen with the other, whether seated or standing. Smartphone users often adopt the typical yet unfavourable forward head posture (FHP). This is because most smartphone-related activities require the user to bend their neck and extend their arms to reach and interact with the screen. Forward head posture (FHP) causes a change in the curvature of the cervical and thoracic spines. The alterations may be recognized by the presence of an exaggerated anterior curve in the lower cervical spine and an extreme posterior angle in the region of the upper thoracic spine. The adoption of this postural positioning is done to preserve muscular equilibrium [5].

One of the most prevalent risk factors for musculoskeletal diseases, decreased range of motion, and muscle flexibility of the neck and shoulder area is using a smartphone while doing repetitive activities and maintaining a static posture [6]. The head projects forward concerning the shoulders and vertebrae; instead of being aligned with the shoulders, the head is positioned in front of the body's centre of gravity. This faulty posture is known as forward head posture or text neck. The incidence is high regardless of age and comparable to low back pain. In recent reports, as of 2022, the global count of mobile network smartphone subscriptions has nearly reached 6.6 billion, which is expected to exceed 7.8 billion by 2028. The top three countries for smartphone mobile network subscriptions are China, India, and the United States [7]. According to a recent study, a significant proportion of individuals aged 18-44, specifically 79%, always carry their mobile devices. Furthermore, these individuals reportedly spend barely two hours daily without their mobile devices in hand [8]. Indeed, the inevitable dependence on computers and mobile phones for communication has led to a rise in musculoskeletal disorders such as neck pain, cervical spondylosis, disc degeneration, etc.

The term "TEXT NECK" was first invented by an American chiropractor, Dr Dean L. Fishman. This term is used to define the pain in the area of neck and back muscle injury caused by bending the neck at different angles while staring at the screen of a smartphone. This may alter the normal curvature of the cervical spine. The forward pull of the head places unnecessary stress on the lower neck vertebrae, which leads to disc degeneration and other neck disorders. The word "text neck" is widely used to characterize injuries associated with repetitive strain caused mostly by excessive usage of mobile phones and texting. However, it is important to note that "text neck" is not a formal medical diagnosis. Furthermore, this posture requires the upper back muscles to work constantly to counteract the impact of gravity on the forward head [9]. The weight supported by the neck rises by 27 pounds when the head is tilted forward and downward at an angle of 15 degrees. At angles of 30, 45, and 60 degrees, the corresponding weights are 40, 49, and 60 pounds, respectively. [10]. The condition known as "text neck" has the potential to cause inflammation of the ligaments, muscle tissue, and nerves in the neck, as well as irreversible arthritic damage. If left untreated, it may also increase the curve of the spine [8].

This research aims to investigate the prevalence of text neck syndrome among international students’ The research question was, "Are international students having text neck syndrome, and do they know the consequences that lead them to this state?"

Two hypotheses were identified in the study:

H0: The excessive use of smartphones cannot cause text neck syndrome among international students.

H1: The excessive use of smartphones can cause text neck syndrome among international students.

2 THEORETICAL FRAMEWORK

2.1 Function of Cervical Spinal Column

The human spinal column comprises a complicated structure that serves several different purposes. It is a structure that encloses an important part of the human skeleton and permits significant multi-axial mobility while still supporting the upper body's weight [11]. It is a structure that encloses an important part of the human skeleton and permits significant multi-axial mobility while still supporting the upper body's weight. The spine is vulnerable to serious damage and chronic illness as a result of this fragile functional homeostasis.

2.2 Anatomy and Biomechanics of the Cervical Spinal Column

The basic building blocks of the spine are the flexible intervertebral discs and the hard, bony vertebrae. The twenty-four vertebrae that make up the flexible parts of the spine are further separated into the cervical (C1-C7), thoracic (T1-T12), and lumbar (L1-L5) regions (see Figure 2.1). The sacrococcygeal region is underlain by a rigid spinal segment consisting of nine fused vertebrae, namely the sacral and coccygeal vertebrae. Each segment has its own unique curvature in the sagittal plane. This curvature is called "kyphotic" when seen from the front, and "lordotic" when seen from the back. These curvatures are believed to increase the spine's longitudinal compressive strength, flexibility, and shock-absorbing capacity [12,13].

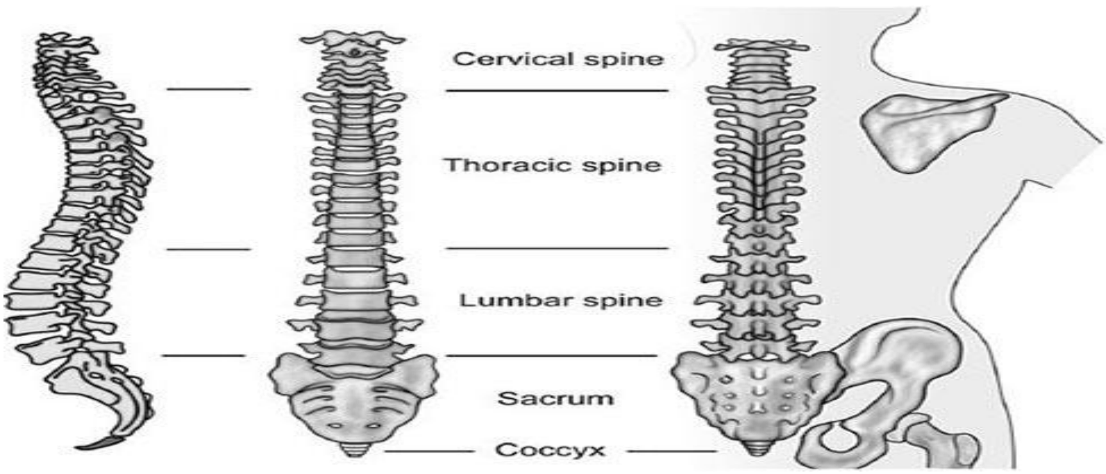

Figure 2-1 Vertebral column; the entire spinal column, with each region labelled [14].

The cervical spine is the uppermost portion of the spinal column, and it supports the head. It allows the movement of the head in several planes, such as nodding, tilting the head left and right, and looking up and down. They help with both portability and structural integrity. The cervical vertebral column and the other parts of the spine are supported by ligaments, tendons, and muscles, which are soft but powerful structures that limit excessive motion [11,15]. The flexion and extension axes, as well as the transverse axis, are the fundamental rotating components of the spine. which includes a range of movements from flexing forward to extending backwards; the lateral bending axis, which allows us to bend side-to-side while standing upright or walking; and axial rotation (or "twist"), which is essential for turning your head or torso [11]. The range of motion of the cervical spine is around 80–90 degrees of flexion, 70 degrees of extension, 20–45 degrees of lateral flexion, and rotation between these two extremes (see Figure 2-2) [16].

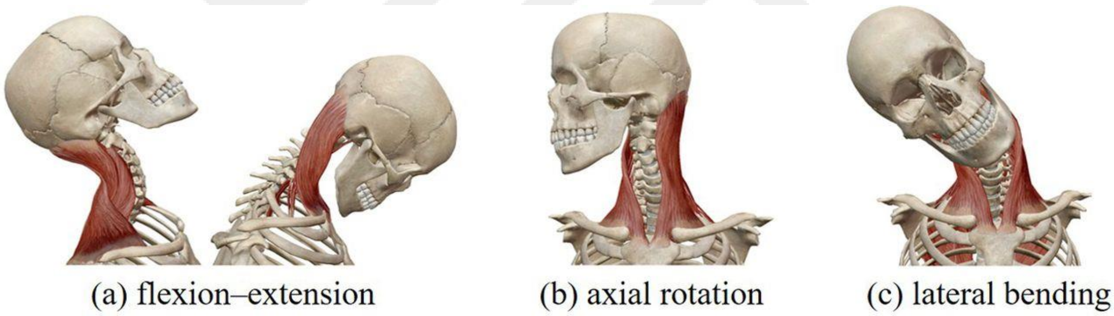

Figure 2-2 Demonstrated of cervical vertebrae twisting: (a) flexion and extension, (b) shows axial rotation, (c) represents lateral bending [17].

The cervical spine comprises two structures with unique mechanical properties: the upper (C1–C2) and the lower (C3–C7) cervical segments (see Figure 2-3) [18]. A vertebra comprises a posterior bony ring called the neural arch, and an anterior block of bone called the vertebral body that contains the articular transverse and spinous processes. The vertebral body is a cylinder-shaped mass of cancellous bone enclosed in a thin cortical shell. The concave endplates of the vertebrae may be seen on both the superior and inferior surfaces of the vertebrae. The neural arch is composed of a pair of pedicles and a pair of laminae, from which seven processes arise. While the fundamental structure of the vertebrae from C3 to L5 in various regions of the spine is similar, minor deviations in morphology may exist between the initial cervical and terminal lumbar vertebrae., the vertebrae's size, and mass increase.

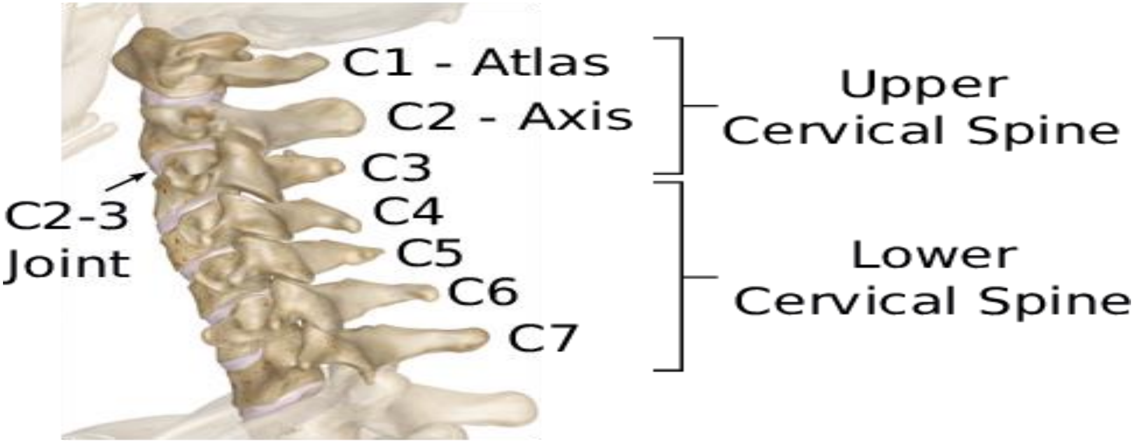

Figure 2-3 The Atlas (C1), Axis (C2), third cervical vertebra and its C2-3 joint, and the Lower Cervical Spine (C4–C7) are shown anatomically as the neck's four primary kinematic components. The cervical spine picture comes from [21].

The vertebra is placed on top of one another, with a cartilage cushion (intervertebral disc) between each vertebra [11]. Each vertebra has an oval-shaped vertebral bulk. The vertebral spinal canal is a large hole behind the vertebral body. The spinal canal houses the nerves and the spinal cord that go from the top of the brain to the bottom of the spine. These nerves transmit cerebral signals to the muscles and the remainder of the body. Pedicles are the thick portions of the vertebrae that comprise the sidewalls of the spinal canal.

The dense bone that forms the posterior portion of the spinal canal is known as the lamina. A spinous process is a bony point that extends from the lamina (the part you can feel when you contact your back) [19]. Each vertebra is joined to the one following it by an intervertebral disc and a pair of facet joints. The facet joints unite near the lamina on each side of the posterior side of the spine. The complex interaction between these three vertebral joints at each vertebral level allows for significant spinal flexibility and provides stability and injury resistance [20].

2.3 The Atlas (C1) and Axis (C2) Components of the Upper Cervical Spine

The superior portion of the cervical vertebrae encompasses the first and second vertebrae, commonly referred to as the atlas and axis, correspondingly. The atlas provides support and stabilization to the base of the occiput at the atlantooccipital articulation. As a result, several distinguishing features set the atlas apart from the other vertebrae. It is noteworthy that the atlas exhibits an absence of a vertebral body. The fusion of the anterior and posterior arches forms a sizable ring, which facilitates the accommodation of the spinal cord as it exits the foramen magnum by the C1 vertebra (refer to Figure 2-4). The atlas exhibits distinct concave articular facets oriented medially to accommodate the convex occipital condyles. The morphology mentioned above facilitates the articulation to actively participate in roughly fifty percent of the neck's flexion-extension movement while simultaneously limiting the lateral displacement of the occipital bone. These joints are also maintained by powerful soft-tissue ligaments that allow for tight adherence to the occiput. [22,23].

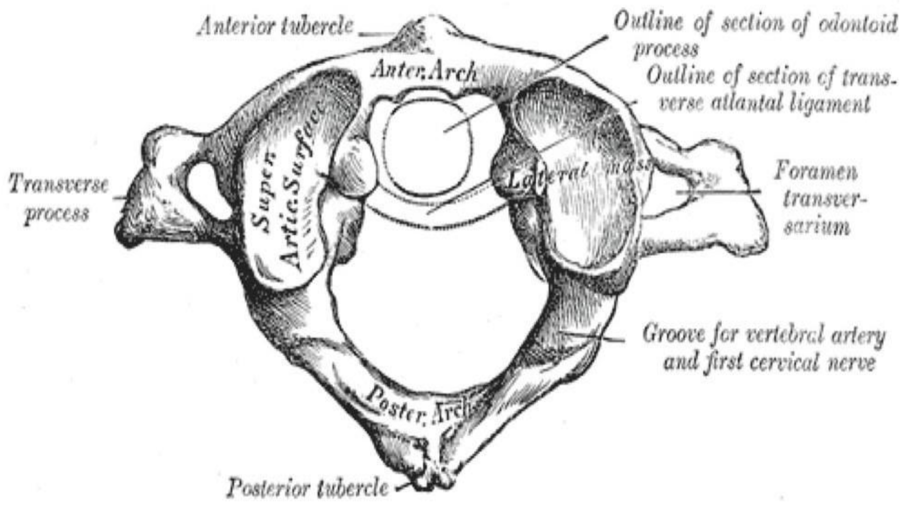

Figure 2-4 Superior axial view of the first cervical vertebra, or atlas (C1) [24].

Distinctive anatomical features can also be observed in the axis vertebra, commonly referred to as C2 (refer to Figure 2.5). The axis bone serves as the main weight-bearing structure in the upper cervical region, whereas the atlas bone is responsible for providing accommodation to the occipital bone. The anatomical structure referred to as the odontoid process, or dens, is an osseous protrusion that extends in a cranial direction from the vertebral body, as depicted in Figure 2-6. The structure in question originated from the atlas body and serves as the principal site of attachment for soft tissues that provide stability to the atlantoaxial junction. In contrast to the atlantooccipital joint, the atlantoaxial junction is accountable for roughly 50% of the rotational movement of the cervical spine. The intersection point is composed of three distinct articulations, namely an atlanto odontoid joint located in the midline and two atlantoaxial facet joints. The atlanto-odontoid joint facilitates the rotational movement of the proximal arch of the atlas around the odontoid process. The lateral facet joints are comprised of the inferior facets of the atlas and the superior facets of the axis and are relatively shallow to accommodate various movements. [22,23,25,26].

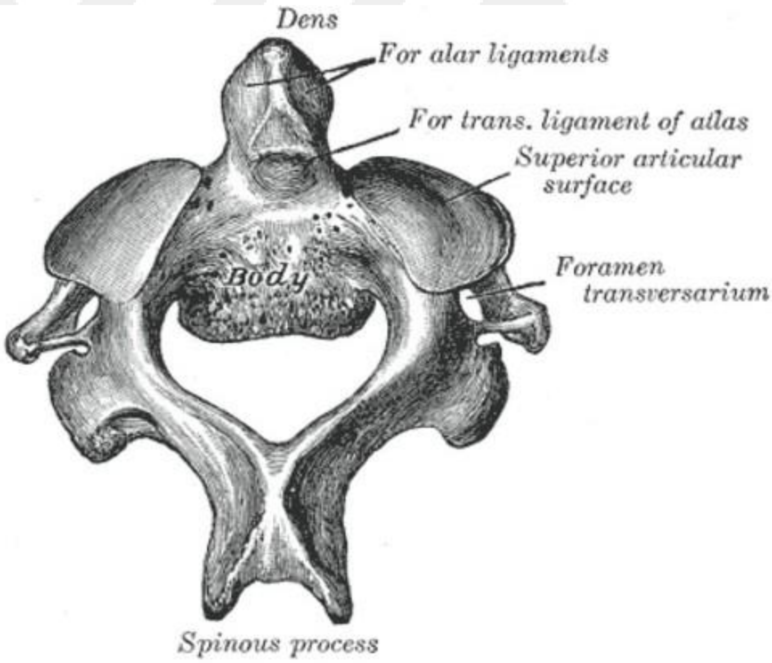

Figure 2-5 Superior oblique view of axis (C2) vertebra [27].

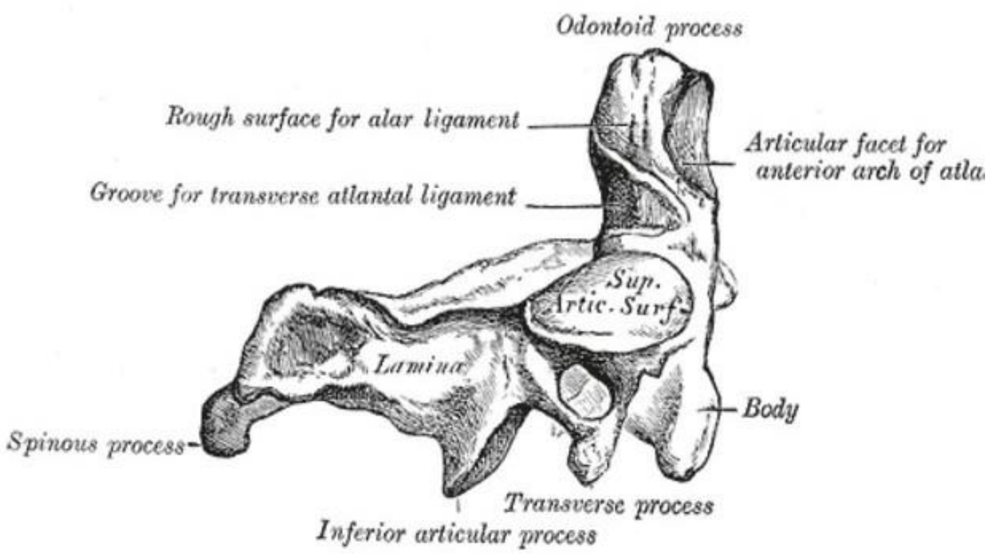

Figure 2-6 Lateral view of axis (C2) vertebra [27].

2.4 C3-C7 (lower cervical spine)

When compared to the upper cervical spine, all five vertebrae in this location exhibit identical morphological and functional characteristics, as well as vertebral structure. Uncinate processes are bony protrusions on the sides of the vertebral body that connect at Luschka joints to restrict the vertebrae from becoming loose. C7 is also separated from the rest of the sub-axial area by a few minor features (see Figure 2-7). C7 may be characterised as normal or uncommon, but it has two different features. The vertebral artery does not cross the transverse foramen in the first cervical vertebra, as it does in the other cervical vertebrae. Because C7's transverse foramen is smaller in diameter than the neighbouring vertebrae in the area, it is usually absent of vertebral arteries. The second distinguishing feature is a lengthy spinous process, often known as "vertebra prominens". C7 features a spinous process and inferior facets comparable to thoracic vertebrae as a transitional vertebra [28,29].

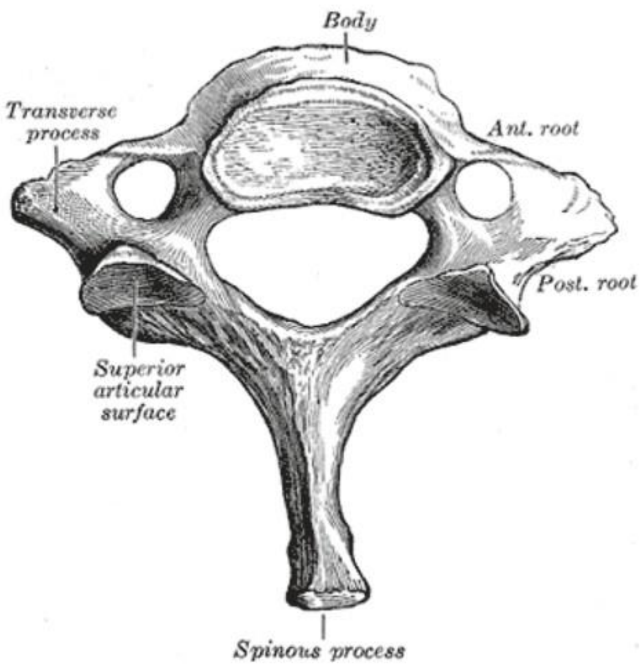

Figure 2-7 Gray's illustration of Vertebra prominens[30].

2.4.1 Joints of the cervical spine

Each adjacent cervical vertebra normally has three joints: one disc joint (intervertebral disc joint) and two paired (left and right) facet joints. The facet joints are located posterolaterally, but the disc joints are located anteriorly and are referred to as "Luschka joints" [31]. The atlantoaxial (x3) and atlantooccipital (x2) joints are unique to the cervical spine.

2.4.1.1 Atlanto-occipital joint

The atlanto-occipital joint is a synovial joint that connects the occipital bone and the first cervical vertebra. The C1 vertebra and the occipital bone are connected through elliptical or oval articular surfaces, which lack an intervertebral disc. The articular surfaces are entirely covered by hyaline cartilage, and the first cervical vertebra features inferior articular facets. The superior lateral masses of the vertebra exhibit facets. The observed objects exhibit an oval shape and concave curve and are positioned medially. The two long axes indicate an oblique orientation in the anteromedial direction and converge at the midline anterior to the atlas. The superior articular portions are situated on the occipital condyles. The pair of spherical protuberances exhibit an elliptical shape, a convex surface, and a notable extension. The condyles are located in the anteromedial and lateral regions of the anterior portion of the foramen magnum [32].

The primary movement of the atlantooccipital joint is flexion and extension. This behaviour allows for nodding one's head, as observed in instances where an indication of agreement is conveyed (i.e., the affirmative gesture). The two condyloid joints, which are ellipsoid in shape, operate in tandem and can be evaluated as a singular joint from a mechanical standpoint. The upper cervical spine is designed to execute diverse ranges of motion. However, its stability is compromised. The maintenance of joint peace in the craniocervical region is primarily attributed to the articular surfaces, ligaments, fibrous capsules, and surrounding musculature [33].

2.4.1.1.A Kinematics of atlanto-occipital joint

Flexing the head causes the occipital condyles to move towards the posterior direction on the lateral masses. Simultaneously, the occipital bone separates from the posterior arch of the atlas. The term utilized to describe this movement is flexion. Separating the rear arches of the atlas and axis results in a slight flexion at the atlanto-occipital joints. The range of motion in flexion is restricted by the tension produced in various anatomical structures such as the joint capsules, posterior atlanto-occipital membrane, ligamentum nuchae, and posterior suboccipital muscles [34].

During extension, the occipital condyles' anterior gliding on the atlas' lateral masses can be observed (refer to Figure 2-8). Consequently, the posterior arches of the atlas and axis are approximated, resulting in the occipital bone being brought close to the posterior arch of the atlas. This also tends to induce a slight extension of the atlantoaxial joints. The occipital bone, along with the atlas, axis, and posterior arches, has an influence that prevents extension. Being trapped between the other two bony segments during forceful extension, the posterior arch of the atlas is susceptible to fracture. Limitations on lateral flexion exist in the suboccipital area; the maximum angle to each side is 8 degrees. The axis moves in opposition to the third cervical vertebra by three degrees, while the skull moves five degrees against the atlas. The atlas rotates around the dens, which causes the limited amount of rotation allowed at the atlanto-occipital joints [34]. Researchers discovered that the possible degrees of flexion and extension at the A-O joint varied based on in vitro and in vivo examinations of the upper cervical spine. The observations taken together seem to indicate that the range of flexion is approximately in between the ranges of 3.5°–7.0° and that the range of extension is at some point in the range of 16.5°–21.0°. As a result, the overall range of motion in the sagittal plane at the C0–C1 segment is between 20°–28° [35,36,37].

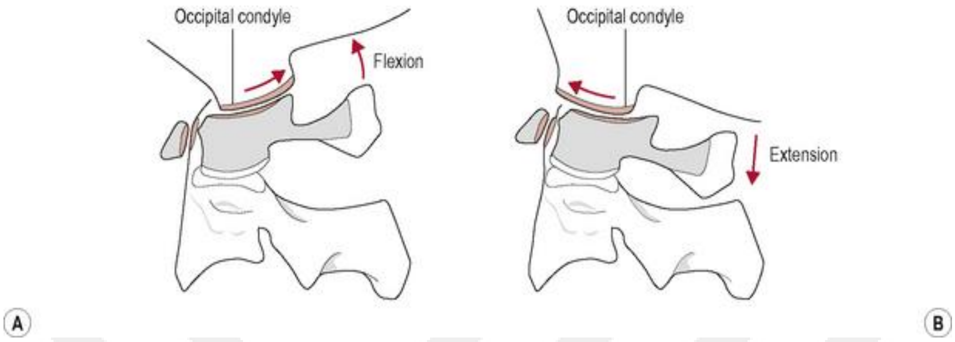

Figure 2-8 (A) Kinematics of the atlanto-occipital joint in flexion and (B) extension **[**34**].**

2.4.1.1.B Coupling of movements at the atlanto-occipital joint

The distinct planar movements of the A-O joint have each been investigated and handled. However, they may be more clinically relevant when evaluated in conjunction, as they occur during typical upper cervical movement patterns. Most upper cervical spine coupling patterns are contralateral, especially if rotation is the initial action. In contrast, the sub-axial cervical spine exhibits predictable ipsilateral side flexion and rotation coupling.

A-O joint flexion: the extension is followed by 2–3° of contralateral rotation and side flexion. These data imply that when the A-O joint is assessed using combined movements, the primary motions of flexion and extension should be coupled with rotation first and contralateral lateral flexion. To "lock" the A-O joint, the segmental position must be opposed to the linked motion, i.e., flexion, extension, rotation, and ipsilateral side-flexion [38].

2.4.1.2 Atlanto-axial Joints

The planar motions of the A-O joint have been addressed individually. However, they may be more clinically relevant when evaluated in conjunction, because they take place during normal upper second cervical vertebral fusion, the axis, bears and transmits the head and atlas' axial stress to the other parts of the spine below. It has three synovial joints: one medial and two lateral atlantoaxial. The dens of the C1 vertebrae and two anterior and posterior ligamentous structures form the median atlantoaxial joint. The atlas osteoligamentous rings and transverse ligament are these structures. Gliding joints are the bilateral atlantoaxial joints laterally. These facets transfer the atlas and head load inferiorly and anteriorly to the C2-3 intervertebral disc and inferiorly and posteriorly to the C2-3 zygapophysial joints. The atlas (C1) and axis (C2) are the cervical spine's highest sections, forming the atlantoaxial joint. [11,38] The arrangement of the three A-A joints primarily facilitates the movement of rotation, in which the head and atlas move as a unit while rotating around the axis. Small quantities of flexion, extension and lateral flexion also occur at this level because of the biconvex nature of the facet joints [23].

2.4.1.2.A Kinematics of atlanto-axial joint

The anatomical structure of the A-A joint allows a large range of segmental rotation. Due to the absence of an intervertebral disc among C1 and C2 and a loose joint capsule attachment (see Figure 2-9). These features allow a greater unilateral range of rotation than the other lower parts of the cervical spine. Studies showed that the unilateral range of A-A rotation is between 38 degrees to 56 degrees [39]. According to reports, unilateral neck movement from C0 to C7 is between 60° and 70°. This implies that approximately 60% of the cervical spine's total range of motion occurs at the A-A joint. As a result, degenerative changes happen much more often at this joint than at the A-O joints [40,39].

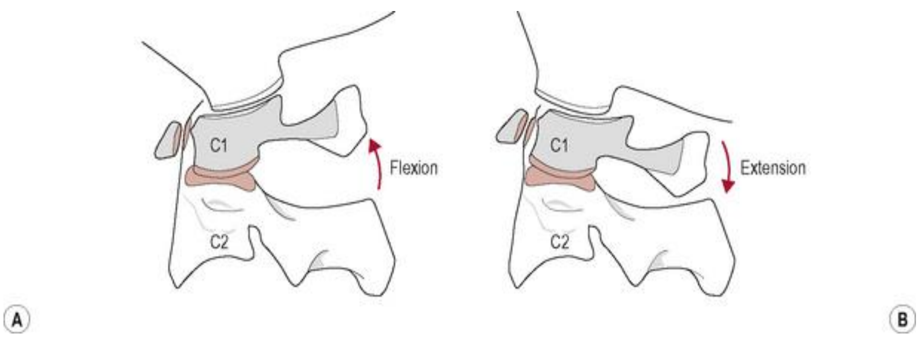

Figure 2-9 (A) Kinematics of the atlanto-axial joint in flexion and (B) extension [34]

Other research has examined A-A joint flexion and extension. These ROMs have mostly been measured in vitro. The range of sagittal plane movement is higher at the A-O segment than at the A-A segment. However, analysing the motions independently indicates that flexion is highest at the A-A joint, and extension is greatest at the A-O joint. In vivo, investigations usually record lesser ROMs for A-A flexion and extension, which range from 6°–12° and 5°–10°, respectively. Retraction and protraction of the upper levels of the cervical vertebra increase extension and flexion at the C1–2 joint [23,36,35].

2.4.1.2.B Coupling of movements at the atlanto-axial joint

The right inferior articular surface of C1 travels backwards on the right superior facet of C2 during the right rotation of the A-A joint. The left inferior articular surface of C1 slides forward on the left superior facet of C2. It lengthens the muscles and ligaments around the left and right facet joints.

The biconvex A-A joint surfaces make axial rotation at C1–C2 a convex on-convex movement. The A-A joint surfaces touch at the convexity in the neutral joint position. The right lateral mass of C1 moves backwards and medially down the posterior slope of its atlantial facet during right rotation, while the left lateral mass slides forward and medially down the anterior slope. The A-A joint drops vertically due to a double-threaded screw-like mechanism. This loosens the alar ligaments, delaying their rotation-limiting impact. This vertical translation is accompanied by a contralateral lateral bending of 2–3° and flexion or extension. The location of the upper part of the cervical vertebral column determines whether axial rotation results in flexion or extension of the C1-C2 vertebrae. The axial rotation will be linked with extension if the upper cervical spine is extended or prolonged. If it is flexed or retracted, it will be linked to flexion [36,40,11].

This important feature happens because C1 is inactive when the head applies axial stress. The atlas is not connected to the axis by tendons and is not directly affected by many muscles. Because of this, the atlas is often compared to an inactive "washer" between the occiput and C2. So, how the occiput sits on the atlas to the line of gravity affects some of the secondary movements at the A-A joint. These kinds of moves are called "paradoxical" moves. So, the head position has a big effect on how the upper cervical spine moves, and it should be considered when checking segmental movement or addressing joint limitations in this area [23].

2.4.2 The Intervertebral Disc

The intervertebral discs are located within the intervertebral space that exists between the vertebral bodies situated in the lower cervical spine. The intervertebral discs facilitate both rotational and translational movements between adjacent vertebral bodies, albeit to a minimal extent. The intervertebral discs are comprised of three distinct components, namely the central nucleus pulposus, the surrounding annulus fibrosus, and the cartilaginous endplates located at the superior and inferior aspects of the discs (refer to Figure 2-10). The nucleus pulposus in a state of good health is characterised by a fluid composition with a high degree of hydration, containing proteins such as proteoglycans and loosely arranged collagen. When observed in either the coronal or sagittal plane, the object appears to resemble a barrel. Upon transverse plane observation, the cervical disc constitutes approximately 25% of the total cross-sectional area [41].

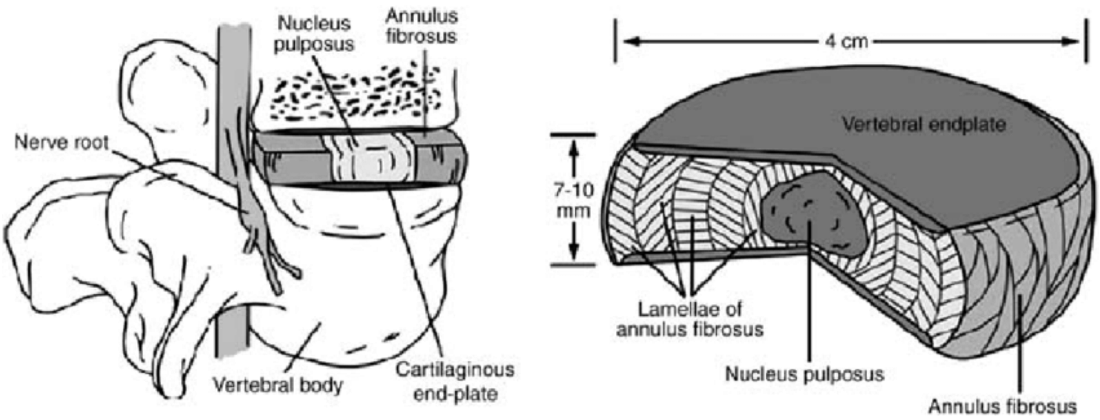

Figure 2-10 Anatomy of the intervertebral disc [42].

In contrast, the annulus fibrosus displays a configuration of approximately 20 aligned laminae that are strengthened by collagen fibres, resembling an angle-ply composite laminate. The fibres exhibit a radial orientation that ranges from 600 (relative to the axial direction) at the external laminae to 450 at the nucleus pulposus. These fibres pass via Sharpey's fibres and enter the cartilaginous endplates in the disc's middle to link to the vertebral body at the periphery. It is widely believed that the annulus serves the purpose of imparting rigidity in the axial, transverse shear, and torsional shear loading orientations, in addition to confining the nearly hydrostatic pressure that arises within the nucleus pulposus because of axial loading. The cartilaginous endplate serves as a non-articulating interface that separates the disc's internal constituents between the vertebrae and the vertebral bodies. The thickness of the cartilaginous endplate is approximately 0.6 mm at its centre and increases to about 1.2 mm towards the periphery. The permeability of the endplate is of utmost importance as a significant portion of the disc's nutritional and hydration supply is contingent upon its ability to traverse the endplate. The endplate is believed to have a protective function for the intervertebral disc, as it gradually reduces stiffness compared to the adjacent vertebral bodies, potentially mitigating mechanical damage [11,43,44].

2.4.3 The Articular Cartilage

The width of the facet cartilage varies substantially from one facet to the next across the cervical spine. It is uncommon for the thickness of the cartilage in the lower area to be greater than 0.5 millimetres. The cartilage measurements are consistent. In contrast, the current study's findings indicate that the upper cervical facets include cartilage with a thickness of more than 2 millimetres, with a variation of more than 1 millimetre over the articulating area. This increased thickness is likely required to make up for the loading and shock-absorbing capacity given by the lower spine's intervertebral disc [45,46].

2.4.4 Spine Canal

The cervical spine has a spacious spinal canal, unlike the thoracic and lumbar spines. The structure's shape is elliptical when viewed in the transverse plane, with a mean anteroposterior diameter of 17 mm. However, this dimension is subject to variation depending on the individual's movements, with flexion causing an increase and extension resulting in a decrease. During the extension process, there is a retrograde motion of the superior vertebra concerning the inferior vertebra, which is attributed to the angular orientation of the facet joints. However, there is a significant margin of safety because the spinal cords anteroposterior diameter at the mid-cervical level is only around 10 mm [47].

2.4.5 Intervertebral foramen

The spinal nerve emerges from the spinal canal via the intervertebral foramen situated amidst two adjacent pedicles. The foramen extends throughout the bifid transverse process and is positioned at an anterolateral angle of 45° and an Antero caudal angle of 15°. The uncinate process and vertebral body demarcate the anterior boundary, while the articular facet constitutes the posterior boundary. The combined movement of extension and ipsilateral rotation reduces the diameter of the foramen [48,49].

2.4.6 Neural Tissue

The neural tissue plays a crucial role in properly operating the nervous system and participates in a diverse array of physiological functions, such as sensory perception, motor regulation, and cognitive abilities. The cervical spine provides support for a complex network of neural structures. Researchers investigating the biomechanics of the spinal column exhibit particular interest in examining the tissues located within the vertebrae. The spinal cord, ganglia, and nerve roots are distinct tissue types. The spinal canal contains the spinal cord, which functions as the principal conduit for transmitting neural signals between the central and peripheral nervous systems. The transmission of information to different anatomical locations is facilitated by nerve roots emanating from the spinal cord at each cervical spine level. As mentioned above, the roots traverse bilaterally through the intervertebral foramina to reach their intended destination within the body. The spinal ganglia are enlarged regions situated near the confluence of the nerve roots and the spinal cord [28]. The ganglia are situated precisely in the regions of the eight intervertebral foramina that exhibit the narrowest dimensions, despite possessing the largest cross-sectional area among all the tissues involved in the constitution of the nerve root. Prior studies have demonstrated that in a healthy spine with a neutral posture, the spinal ganglia utilize approximately 72% (range: 61-95%) of the intervertebral foramina width across all levels from C2-C3 to C6-C7 during evaluation. As mentioned above, the percentage exhibits a range of variability spanning from 61% to 95%. When the height of structures is included as a variable in the study, the findings indicate that the ganglia occupy 68% (with a range of 58-80%) of the accessible space, as reported in reference [50,48]. The measurements of the spinal ganglia fail to account for the presence of fatty and vascular tissues, which also traverse the intervertebral foramina, constricting the available space for the neural tissue [28].

2.4.7 Muscles of Cervical Spine

The cervical musculature can be categorised into three distinct groups, namely the anterior, lateral, and posterior neck muscles. The classification of each group is based on its specific muscle function and anatomical placement. The neck muscles primarily facilitate head movements such as extension, flexion, lateral flexion extension, and rotation. However, the deeper muscles also play a role in more complex functions such as speaking and swallowing.

2.4.7.1 Anterior Neck Muscles

The superficial layer of neck muscles includes the platysma, sternocleidomastoid and subclavius. They are responsible for the downward movement of the mandible and the tightening of the skin in the neck area, the movements of neck flexion, extension, and rotation, and they act as an anchor for the clavicle, respectively. The scalene muscles are responsible for the lateral and anterior flexion of the neck. It is further divided into the following subdivisions: anterior scalene, medial scalene and posterior scalene muscle. The suprahyoid muscles are responsible for the elevation of the hyoid bone during swallowing. This set of muscular structures is involved in the physiological functions of mastication, deglutition, and speech production. In addition, in conjunction with the infrahyoid musculature, these muscles contribute to stabilising the hyoid bone, which lacks articulation with any other osseous structure. The suprahyoid musculature contributes to the enhancement of neck flexion. These are situated in the anatomical region between two distinct osseous structures: the mandibular base superiorly and the hyoid bone inferiorly. Each side of the neck has four pairs, known as follows. Digastric, mylohyoid, geniohyoid and stylohyoid [51]. The infrahyoid muscles are responsible for depressing the hyoid bone and aiding in the downward movement of the larynx following the act of swallowing. These are the following: sternohyoid, thyrohyoid, Omohyoid, and Sternothyroid.

2.4.7.2 Lateral Neck Muscles

The function includes bending of the neck in both the anterior and lateral directions, as well as the stability of the vertebral column in the cervical region. The longus capitis, the longus coli, the rectus capitis anterior, and the rectus capitis lateralis are the muscles that make up the lateral side of the neck.

2.4.7.3 Posterior Neck Muscles

The posterior neck muscles are subdivided into three subgroups according to their functions, such as the splenius group: the splenius capitis and splenius cervicis. These involve two types of muscular contractions observed in the neck region bilateral contraction, which involves the extension of the neck, and unilateral contraction, which involves lateral flexion and ipsilateral rotation. There are four muscles located in the back of the neck that are known as the suboccipital muscles. These muscles are situated below the occipital bone. The rectus capitis posterior major muscle, the rectus capitis posterior minor muscle, the obliquus capitis superior muscle, and the obliquus capitis inferior muscle are the muscles that make up the previously stated muscles [52]. The musculature of the head and neck area serves a critical function in maintaining postural stability and enabling different motions, such as extension and rotation of the neck. This musculature also plays a part in protecting the skull. The set of muscles that are placed at the rear of the spine and are responsible for the rotation and extension of the spine are called the semispinalis capitis, semispinalis cervicis, rotators cervicis, interspinalis cervicis, and intertransversarii [53]. The condition known as "text neck" exerts a direct influence on the cervical spine. The extent of flexion and the magnitude of gravitational force applied to the cervical structures are determining factors. The present study aimed to evaluate the levels of neck muscle activity and discomfort across different angles of neck flexion. An increase in the activity of the Cervical Erector Spinae (CES) muscle was observed, while a decrease in the activity of the Upper Trapezius (UT) muscle was noted with an increase in the neck flexion angles. Distinct variations in the activity of neck muscles were observed across different angles of neck flexion. At a neck flexion angle ranging from 0° to 15°, the level of activity exhibited by the cervical erector spinae (CES) and upper trapezius (UT) muscles was relatively low [10].

2.4.8 Ligaments of Cervical Spine

Ligaments play a critical role in the stabilisation of the human spine and the regulation of excessive movement. It is imperative to consider the six noteworthy ligaments of the cervical spine. Most of these ligaments are dispersed along the complete extent of the vertebral column. The vertebral column is enveloped by a pair of elongated ligaments, namely the anterior and posterior longitudinal ligaments, that traverse the vertebral bodies and intervertebral discs. As per the findings of the three-dimensional study, the anterior and posterior longitudinal ligaments exhibit specific patterns in terms of their origins, lengths, and orientations. The dimensions of the anterior and posterior longitudinal ligaments varied along the cervical spine. Specifically, at the levels between C3 and T1, their width was approximately 7.5 mm, and their length was around 12 mm. However, at the C1-C2 level, these ligaments were narrower, measuring 3.8 mm in width, but longer, with lengths of 23 mm and 31 mm for the anterior and posterior ligaments, respectively. This information is depicted (refers Figure 2-11) [54]. The ligamentum flavum serves as the vertebral canal's caudal limit and as a damping system to prevent excessive spinal column flexion. Being somewhat far from the intervertebral centre of rotation causes it to encounter large stresses during ordinary spinal movement. To prevent buckling into the spinal canal, which might harm the spinal cord, the LF must also maintain tension at low loads [55,11,56]. The ligamentum flavum's length increased from 5.2 mm at C2-C3 to 8.7 mm at C7-T1, but its breadth stayed constant at 5 mm [54]. The facet capsule ligaments (FC) entirely encircled the mating facet cartilage pairs. These ligaments hold the lubricating synovial fluid and stiffen the facet joints [57,58,59]. The capsular ligaments were always angled posteriorly at around 45 degrees to the transverse plane [54]. The interspinous ligament links the spinous processes of neighbouring vertebrae together. The interspinous ligament was 30-40 degrees anteriorly inclined, with the lowest length detected at the C2-C3 and C3-C4 levels [54]. The lower cervical spine has many ligaments that extend into the upper cervical area; however, their morphologies vary from tape-like to membranous. The membrane structure may include significant soft tissues like the spinal cord and allows for various mechanical qualities [55]. These ligaments often have less stiffness than their lower sections, allowing for a wider range of motion. [60,61].

The nuchal ligament, which runs along the back of the neck, is a continuation of the supraspinous ligament. Through its attachment to the ends of the spinous processes that extend from C1 to C7, it provides the proximal connection for the rhomboids and trapezius muscles. With a 15–20-degree inclination, the supraspinous ligament was positioned more vertically than the interspinous ligament [54]. The ligament connecting the lateral masses of the atlas and encircling the back of the dens for roughly 20 mm is known as the transverse ligament of the atlas. It maintains the dens in their right location consequently [62]. The ATL has a massive cross-section, measuring around 3 mm in thickness and 9 mm in height. Considering its role as an articulating component, the ATL is constructed from sturdy fibrocartilaginous tissue. In addition to its role in the atlantoaxial joint, the ATL features superior and inferior cruciform elements that link its main structure to the occiput and inferior section of the dens, respectively. These portions typically measure 5 mm in width and 1.3–1.4 mm in thickness, having smaller cross-sections than the main body of the ATL [63]. From C2 to C0, several ligaments run along the upper cervical spine. They are often concentrated along the spinal canal. The cervical spine has ligaments that are separated into external and internal types. All the outside ligaments are called the atlanto-occipital, anterior atlanto-occipital, and anterior longitudinal ligaments. The trough-shaped atlanto-occipital joint (C0-C1) has a range of motion in flexion and extension of around 20 degrees. However, as indicated in sources, it is substantially more constrained in other directions [64,65].

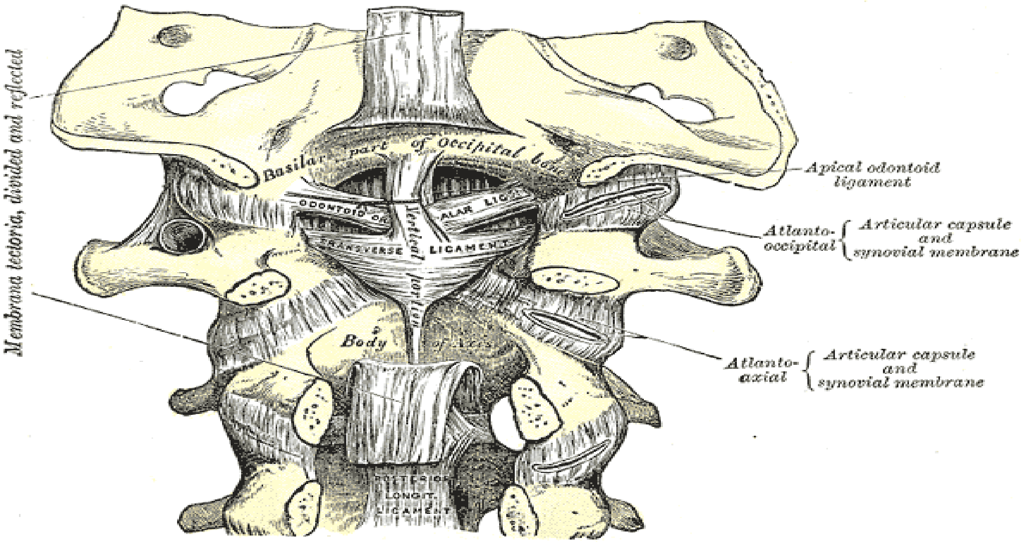

Figure 2-11 The upper spine ligaments articulation [66].

From the anterior arch of C1 to the foramen magnum, an opening at the base of the skull, the anterior atlanto-occipital membrane, a thin ligament, travels. This is mirrored in the coronal plane by the posterior atlanto-occipital membrane. Capsular ligaments that connect to the lateral foramen magnum borders and provide extra support are positioned around the occipital condyles. The cross-sections of these alar ligaments are larger than those of the atlantal alar ligaments. Internal ligaments include transverse ligaments, auxiliary ligaments, alar ligaments, accessory atlantoaxial ligaments, and the tectorial membrane. The apical ligament connects the foramen magnum's anterior border to the dens' tiny tip directly. This ligament, which prevents the head from being loaded upward, is only present in between 70 and 80 percent of the population [67,63]. The occipital portion of the alar ligaments inserts similarly on the dens and is attached to the lateral foramen magnum boundaries. Like the atlantal alar, but with a larger cross-section, are these alar ligaments. The spinal canal's anterior lining is made up of the tectorial membrane (TM). The front of the foramen magnum is joined to the base of the dens by this thick (1.0 mm), strong membrane. At the proximal end of the spine, the TM closes off the spinal canal. The TM offers the cervical spine stability, adheres firmly to the dura mater (outside sheath) of the spinal cord, and prevents the tip of the dens from protruding into the spinal canal [68]. The ATL cruciate sections are not far from this membrane.

2.4.9 Innervations

The predominant source of innervation for the atlantoaxial joint is the second cervical spinal nerve's branches. Typically, every cervical vertebra comprises nerve roots originating from the spinal cord and protruding bilaterally. The ventral portion of the vertebral column comprises the ventral root, while the dorsal portion comprises the dorsal root. The confluence of nerve roots within the spinal foramen is designated as spinal nerves. Although the human body has only seven cervical vertebrae, it possesses eight pairs of spinal nerves. Typically, the spinal nerves emerge superior to their corresponding vertebrae. The C8 nerve root emerges inferior to the C7 vertebra [69].

2.4.10 Craniocervical Angle

The craniocervical angle, also known as the craniovertebral angle, defines the angle between the cranium base (occiput) and the upper cervical spine (C1 vertebra, also known as the atlas). It indicates the position and relationship of the cranium and cervical spine. The craniovertebral angle (CVA) is the geometric angle created by the intersection of the horizontal line at the seventh cervical vertebra (C7) and the line that connects the tragus of the ear to C7. This measurement has been found to have a high level of reliability, with a correlation coefficient of 0.88, according to previous studies [70,71]. According to the study, there is an inverse relationship between CVA and FHP, where a higher CVA is associated with a lower FHP. The Shoulder Angle (SA) is the angle produced by the intersection of the line connecting the C7 vertebra to the acromion process and the horizontal line passing through the acromion process. A reduced surface area corresponded to an increased forward head posture and a more pronounced kyphotic posture, as reported in the reference. (See Figure 2.2-12). The inclination between the line between the canthus of the eye and the tragus of the ear is known as the sagittal head angle (SHA). According to earlier research, the amplitude of this angle decreased, and the FHP dropped as a result [73].

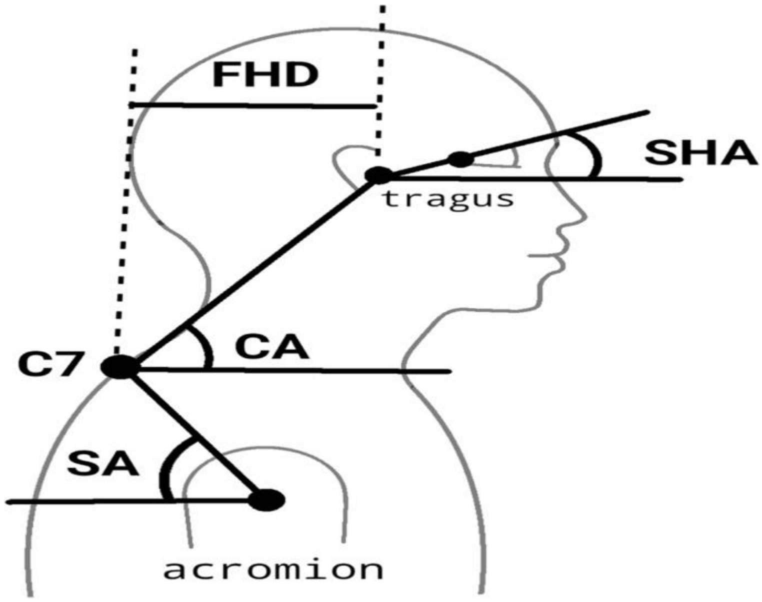

Figure 2-12 Analysed the skull and shoulder region parameters [72]

The measurement of the distance between the tragus and the C7 vertebra is known as the forward head distance (FHD). The findings showed a positive correlation between the distance and the FHP, where a greater distance was associated with a higher FHP value [74]. Photogrammetry measured the craniovertebral angle (CVA) on a sagittal plane to quantify forward head posture (FHP) precisely. A higher CVA measurement indicates a more optimal alignment between the head and neck, while a lower angle signifies a more severe degree of forward head posture [75]. The assessment of the craniocervical angle is a crucial metric for appraising the arrangement and firmness of the upper cervical spine. It can also present valuable information regarding any pathologies or irregularities impacting this anatomical region. Nonetheless, it is imperative to consider it in conjunction with other clinical findings and imaging assessments to acquire a comprehensive comprehension of the patient's state [76].

2.4.11 Common Musculoskeletal neck problems

Pain in the neck is quite prevalent. It can originate from any component of the neck, including the muscles, bones, joints, tendons, ligaments, or nerves. Pain in the neck is frequently caused by muscle strain or stress. The issue is typically caused by excessive or repetitive stress on the neck muscles. Approximately 66% of individuals will encounter neck pain at some point [77,78]. The incidence of this condition is most prominent among individuals in the middle age population, with a higher prevalence observed among females than males [79]. Different studies report widely varying rates of the condition's prevalence; some put the point prevalence at 7.6% (range: 5.9-38.7%), while others put it at 48.5% (range: 14.2-71.0%) [79]. In the United Kingdom, hospital-based physiotherapy cases are comprised approximately 15% of neck pain cases, while in Canada, 30% of chiropractic referrals are attributed to neck pain [80,81]. Neck pain constitutes a notable proportion of general practitioner consultations in the Netherlands, with a prevalence of up to 2%. Most patients who exhibit neck pain are diagnosed with "non-specific (simple) neck pain," which is characterised by postural or mechanical symptoms. The aetiology of this condition is currently not well comprehended and is typically characterised by multiple contributing factors, such as suboptimal posture, psychological distress, cervical muscle tension, and engagement in athletic or vocational pursuits. Neck pain that arises after a whiplash injury can be classified under this category, given the absence of any bony injury or neurological impairment. The prevalence of mechanical factors often leads to using the term "cervical spondylosis" to describe the condition. However, it is frequently utilised to denote any form of non-specific neck pain. Chronic neck pain is more likely associated with mechanical and degenerative factors [82].

Most cases of acute neck discomfort improve within a few days to a few weeks. However, for around 10% of people, the discomfort in their neck gradually becomes chronic. The issue of neck pain is a commonly observed health concern, with a significant proportion of adult patients reporting its occurrence. Recent data indicate that technological advancements are causing a shift in the prevalence of this significant issue from adulthood to all paediatric age groups. The premature and unsuitable utilisation of personal computers, particularly mobile phones, may be associated with the emergence of a multifaceted group of medical indications generally referred to as "text neck syndrome, " which is associated with forward head posture. This medical term describes the deterioration of the cervical spine brought on by the repeated stress of forward head flexion produced by "texting" and using mobile devices for extended periods of time [83].

Other cervical injury exhibits a higher incidence rate in the male population than females, with the age group of 15-30 and those above 65 years exhibiting the highest prevalence. Among individuals below the age of 15, the most frequently observed causative factors are motor vehicle collisions, incidents of falling, and injuries sustained during participation in sports activities. The cervical spine segments C2, C5, C6, and C7 are frequently affected by injury [84].

2.4.11.1 Pathomechanics

The development and persistence of chronic neck pain can be attributed to various pathomechanics. The pathomechanics encompass the following: Poor posture: Prolonged sitting or standing with poor posture can cause muscular imbalances in the neck and greater strain on the cervical spine, which can result in chronic discomfort. The effect and amount of weight are forcefully and progressively increased to varied degrees with a forward head, which significantly increases the head's weight on the spine [83]. On average, the cervical spine flexes between 37 and 47 degrees when texting on smartphones [85]. According to research findings, it has been observed that the head's weight increases to 18.14 kg at a 30-degree angle and 22.23 kg at a 45-degree angle [83]. This phenomenon can cause inflammation of the ligaments, muscles, and nerves in the neck, which may result in permanent arthritic damage and an augmented spine curvature.

Muscle imbalances can disrupt the normal balance and coordination of muscle activity in the neck region, resulting in abnormal cervical spine loading and persistent pain. This can occur due to weakness or tightness in specific neck muscles. Repetitive strain injuries: Repeated movements or activities that strain the neck, such as using a computer, lifting heavy objects, or repetitive sports motions, can lead to cumulative stress and persistent discomfort. The cervical spine may experience degenerative changes because of ageing, including but not limited to osteoarthritis, herniated discs, and spinal stenosis. Compression of the nerves, inflammation, and persistent pain are all consequences of these alterations. Whiplash injuries: These are caused by sudden, forceful movements, like those that happen in car crashes or sports-related events. The injuries have the potential to cause harm to the soft tissues, ligaments, and discs located in the cervical region, ultimately resulting in persistent discomfort. Psychological factors, such as emotional stress, depression, anxiety, and other factors, have been found to influence the perception and severity of chronic neck pain. It is significant to highlight that persistent neck pain is frequently complex, and specific instances may have a mix of various pathomechanics. The effective diagnosis, management, and treatment of chronic neck pain require the consideration of underlying causes and contributing factors.

2.4.11.2 Risk factors

Text neck syndrome may develop due to several risk factors. It is more likely to develop if someone uses electronic devices like computers, tablets, and smartphones for extended periods. When staring down at screens, the cervical spine is stressed when the neck is bent repeatedly and for an extended period. It can develop due to poor posture when using electronic devices, such as slouching or rounding the shoulders. The tension and burden on the neck muscles and tissues are increased when the head, neck, and spine are not properly aligned. It can be more likely to develop if electronic devices are used excessively and often, both at work and during leisure time. The tension on the neck and upper back increases the longer time is spent utilising electronics. It can also be exacerbated by not taking frequent breaks and not moving the neck and shoulders when using electronic gadgets. Extended periods of static postures without breaks for stretching and movement and inadequate ergonomic configurations of workstations, such as the placement of monitors or keyboards, can lead to muscle imbalances and stiffness. The cervical spine is subjected to increased strain due to improper device alignment and orientation; this may lead to extended neck flexion. Text neck might be more likely to occur if the neck and upper back muscles are weak because of inadequate physical fitness and muscular strength. Text neck syndrome may be more likely to develop in those with pre-existing diseases, including cervical disc degeneration, spinal arthritis, or prior neck traumas because of damaged neck structures and decreased stress tolerance. Text neck syndrome may be prevented by being aware of these risk factors, taking preventive action, and engaging in healthy habits, including excellent posture, regular breaks, and neck and shoulder exercises [8,86].

2.4.11.3 Symptoms

The condition known as text neck is frequently characterised by symptoms such as discomfort, rigidity, and tenderness in the neck region (see Figure 2.2-13). The main symptoms are neck discomfort and stiffness, especially when attempting to turn the head side to side after using a smartphone. Localized Text neck syndrome patients can report pain that feels stabbing or stinging. This form of pain commonly affects the lower parts of the neck. The neck and trapezius muscles are largely in one location or area of pain when there is general discomfort. Due to the forward head position, radiating pain may travel down a nerve from the neck into the shoulder and arms. Numbness and weakness; the trapezius, scalenus, rhomboids, and sternocleidomastoid muscles are the main targets for weakening in the shoulders. Sometimes neck discomfort that affects the head's muscles and nerves causes headaches. For example, tightening the neck muscles might cause a tension headache. Text neck, if left untreated, text neck may result in a range of indications and manifestations, including but not limited to cervical lordosis flattening, premature arthritis onset, spinal malalignment, intervertebral disc degeneration, disc herniation, discomfort, and paraesthesia in the upper extremities [8].

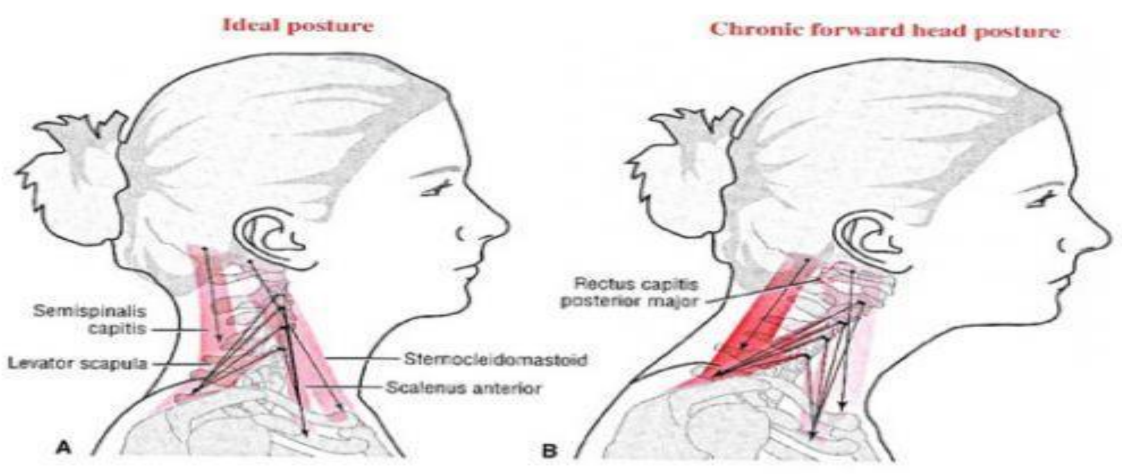

Figure 2.2 13 Presentation of forward head posture as compared with normal cervical posture [87]

2.5 Assessments

Before the physical examination, a thorough medical history must be taken, including the time spent using electronic devices and when symptoms first appeared.

Pain should be primarily evaluated for its type, frequency, severity, and propagation to the neck or lower back.

2.5.1 Physical evaluation

The neck is examined for any abnormal posture or abnormalities and is palpated to check for any potential muscular stiffness or soreness.

2.5.2 Other investigations

Following a physical examination and consideration of the patient's medical history, an X-ray may be advised. The X-ray of the neck reveals a backwards-curving curvature [88]. Other investigations can be recommended according to the patient's condition, such as a CT scan or MRI, to rule out the actual point of injury.

2.5.3 Electromyography (EMG)

This is a diagnostic technique that entails the insertion of a needle into a muscle to assess nerve signal velocity. This procedure aids in the identification of a pinched nerve. Additionally, nerve conduction studies are often conducted in conjunction with EMG.

2.5.4 Bedside techniques

The cervical range of motion will be assessed using bedside instruments to measure flexion, extension, lateral flexion, and rotation. Other tools for cervical range of motion (CROM) include a measuring tape, a compass, a goniometer, and an inclinometer. The cervical range of motion (CROM) device was used to measure the participants' cervical flexion angles while standing and sitting while typing on their smartphones to assess text neck [89]. The implementation of this approach has the potential to improve the accuracy and precision of objective measurement in clinical examinations aimed at evaluating the cervical range of motion [90].

2.5.5 Pain assessment

The visual analogue scale can determine the severity of discomfort after protracted smartphone use [91]. Other self-assessment scales, such as the neck disability index and smartphone addiction scale, can be used to determine the prevalence of text neck syndromes [92,93].

2.5.6 Evaluation of Neck muscular strength

The assessment was conducted utilising Pressure Biofeedback, and the resultant values were recorded. The patient assumed a hook-lying position on a therapy table, with their head and neck in a neutral alignment. The pressure biofeedback device was positioned beneath the occiput, utilising its pressure cuff. Participants were directed to perform a slight chin tuck resembling the affirmative gesture while refraining from engaging the neck muscles that could potentially replace the sternocleidomastoid muscle. The experimental protocol involved a pressure range of 20-30 mmHg, with each 2-mmHg increment being maintained for 10 seconds without any intervening periods of rest [94].

2.6 Treatments

The management of text neck syndrome generally requires a combination of self-care strategies, alterations to a patient's lifestyle, and skilled interventions. The following are several prevalent methods for addressing text neck syndrome:

2.6.1 Posture correction:

It is recommended to prioritize the enhancement of posture while using electronic devices and daily activities. Maintaining a neutral spine position is recommended, as aligning the head with the shoulders, and refraining from excessive forward bending of the neck. Making ergonomic modifications to workstations, such as altering the monitor's height or utilizing a laptop stand, may prove helpful [8].

2.6.2 Take regular breaks:

Taking regular breaks from the use of electronic devices can alleviate neck strain and facilitate improved posture. It is recommended to integrate brief rest intervals every half an hour or thereabouts to engage in physical stretching and mobility and provide respite to the cervical and scapular musculature.

2.6.3 Neck exercises and stretches:

Engage in physical activities and stretching routines that specifically focus on the musculature of the neck, upper back, and shoulders. Strengthening exercises that target the neck and upper back muscles, such as chin tucks, shoulder blade squeezes, and cervical range of motion exercises, has been shown to mitigate symptoms and enhance muscle equilibrium [95].

2.6.4 Pain management:

Nonsteroidal anti-inflammatory drugs (NSAIDs), which are available over the counter, have the potential to offer temporary relief from pain and inflammation that is commonly associated with text neck syndrome. It is imperative to seek advice from a healthcare practitioner before consuming any medication [8].

2.6.5 Physical therapy:

In instances where the condition is more severe or prolonged, the services of a physical therapist could be helpful. Physical therapists can conduct specific exercises, manual therapy methods, and recommendations for correcting posture to mitigate symptoms and enhance neck mobility and strength.

2.6.6 Heat or cold therapy:

Applying thermal modalities, such as heat or cold packs, has been shown to have analgesic and anti-inflammatory effects on the affected region. Thermal therapy, encompassing techniques such as applying warm compresses or exposure to hot showers, can induce relaxation and enhance blood circulation to the musculature. Applying cold therapy, using ice packs or cold compresses, effectively reduces swelling and induces numbness in the affected region.

2.6.7 Ergonomic modifications:

Assess and modify the ergonomic arrangement of the workstation, encompassing the elevation and placement of the desk, chair, monitor, and keyboard. The utilization of ergonomic accessories, such as a chair that provides support, an ergonomic keyboard, or a monitor stand that can be adjusted, has been shown to aid in the maintenance of appropriate alignment and the mitigation of strain on the neck and upper back.

2.6.8 Lifestyle modifications:

Incorporate health-promoting behaviors into an individual's daily routine, such as engaging in consistent physical activity, upholding a desirable body mass index, effectively coping with stress, and obtaining sufficient rest. These variables are influential in promoting musculoskeletal well-being and may aid in managing text-neck syndrome.

3 METHOD AND MATERIALS

3.1 Subjects

The study included 396 participants who took part in this study voluntarily. The study population was international students. The participants signed a consent form after reading about the purpose of the survey.

3.1.1 Inclusion criteria

The participants who fulfilled the following inclusion criteria participated in this study.

- Participants were international students from different universities/institutions.
- Participants were recruited voluntarily.
- Males or females were included.
- Participants with age 18 to 31 years old.
- Smartphones must be used daily for at least 3 hours.
- Participants who proved proficiency in the English language were included.
- Participants who had not any previous history of accidents and trauma participated.
- Students were included with no identifiable pathology, which has been found to account for discomfort in the cervical region or upper extremity. Furthermore, there is no evidence of neurological or cardiovascular dysfunction.

3.1.2 Exclusion criteria

These Participants who had the following problems were not eligible to participate in this study.

- Participants below the age of 18 and above 31 were excluded.
- Those who had any history of cervical spine trauma or accident.
- Participants who had any neurological and congenital diseases were excluded.
- Participants other than international students were excluded.

- Participants who did not comprehend the English language were excluded from the study.

3.1.3 Flow of research

The research methodology employed in this study is a cross-sectional survey design, applying a convenient sampling approach. A customised electronic questionnaire was created using Google Forms and distributed to students who used multiple social media platforms and spent over three hours per day on their mobile devices. The purpose of the study was clearly explained before acquiring the consent. A total of 450 participants were contacted through phone calls and social media websites. Only 396 people out of 450 were responding to the survey. One participant was excluded because of the disapproved consent form. Finally, 395 International students took part in this study. One participant was excluded because of the disapproved consent form (see Figure 3.1-1). The study was conducted within three months. Later, all collected data were completely analysed and interpreted.

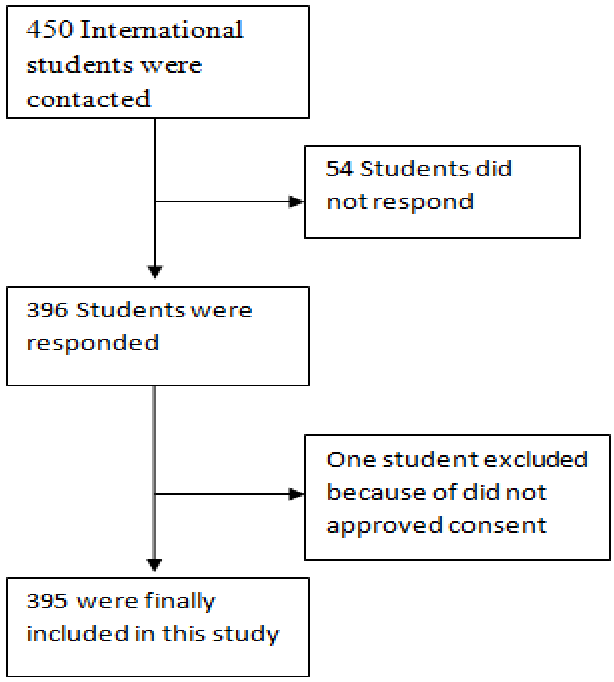

Figure 3-1 Flowchart Diagram

3.1.4 Study protocol

The ethical committee board of Yeditepe University approved the study protocol on 12.04.2022, with issue number 202203Y0229 (Appendix 1). Before proceeding, participants must provide their signatures on the consent form. Participants must meet the inclusion criteria to participate in this study. Google Forms was used to create a structured online questionnaire that was used for assessment. Four components make up the questionnaire (Appendix 2). The first section of the questionnaire consisted of a consent form, which the participants were required to sign before moving on to the next part of the questionnaire; the second section of the questionnaire included the socio-demographic questions. The third segment included a shorter version of the smartphone addiction scale, and the fourth section contained the neck disability index. The permission was obtained from the authors of the neck disability index (NDI) (Appendix 6) and the short version of the Smartphone addiction scale (SAS, SV) (Appendix 4).

3.2 Evaluation

3.2.1 The Structured Questionnaire

The researcher designed a structured questionnaire that collected the participants' demographic information. The questionnaire included the name, age, gender, and country. Participants filled out this questionnaire after they acquired consent voluntarily.

3.2.2 Smartphone Addiction Scale-Short Version (SAS):

The third section of the questionnaire consisted of the already published smartphone addiction scale (SAS) SAS-SV used as a screening tool for assessing and identifying smartphone addiction of participants (Appendix 3). The concurrent validity and internal consistency of SAS were confirmed (Cronbach's alpha=0.967). It serves as a trustworthy and accurate evaluation instrument for assessing smartphone addiction. There are ten questions in the SAS questionnaire, and the possible answers range from one to six, with one denoting significant disagreement and six indicating strong agreement. The cut-off value of this test is 31 [96].

3.2.3 The Neck Disability Index

The fourth section of the questionnaire contains the neck disability index to collect information from the participants about how they performed their daily activities if they suffered from neck pain The Neck Disability Index (NDI; Appendix 5) was created by Howard Vernon in 1989. Clinicians and academics now routinely use the NDI to quantify patients' reports of their handicaps due to neck discomfort. The 10 things are scored between 0 and 5. There is a cut-off of 50. A percentage score may be calculated by multiplying the resulting score by two. The means 15 – 24 out of 50 (the raw score) equates to moderate disability. The high percentage in numbers means that the participant has reported a greater disability [97].

3.2.4 The Statistical analysis

The statistical analysis was performed by applying version 22 of SPSS (Statistical Package for Social Sciences). For sociodemographic factors, including age, gender, and country, descriptive analysis was performed as a frequency analysis. It is represented as a table with standard deviation, mean medium, minimum, and maximum values. The statistical method employed to compare two independent groups with normal distribution was the Independent Samples t-test, using the t-table value. The SAS SA and NDI questionnaires were subjected to frequency analysis, and the Pearson correlation coefficient was utilised to establish their relationship. The Pearson correlation approach is mostly used for numerical variables. The correlation coefficient allocates a numerical value ranging from -1 to 1, with 0 indicating no correlation, 1 indicating a positive correlation, and -1 indicating a negative correlation. A correlation coefficient of 0.7 between the two variables denotes a statistically significant and positive relationship. In the event of an increase in variable A, there is a corresponding increase in variable B, whereas a decrease in variable A results in a decrease in variable B. [98]

4 RESULTS

The study involved the participation of 395 international students. One was excluded because of disapproved consent. A total number of 450 international students who were contacted via phone call and other social media platforms, 396 were responded. Data was collected with the help of Google Forms. Participation of students was completely voluntary. In this study, participants were divided into two groups based on the distribution of their ages. According to the mean value (25.68) 125 participants fall in the age group 18-24, representing 31.6% of total responses, whereas 270 participants aged 25-31 years account for 68.2% of the total responses (see Figure 4-1).

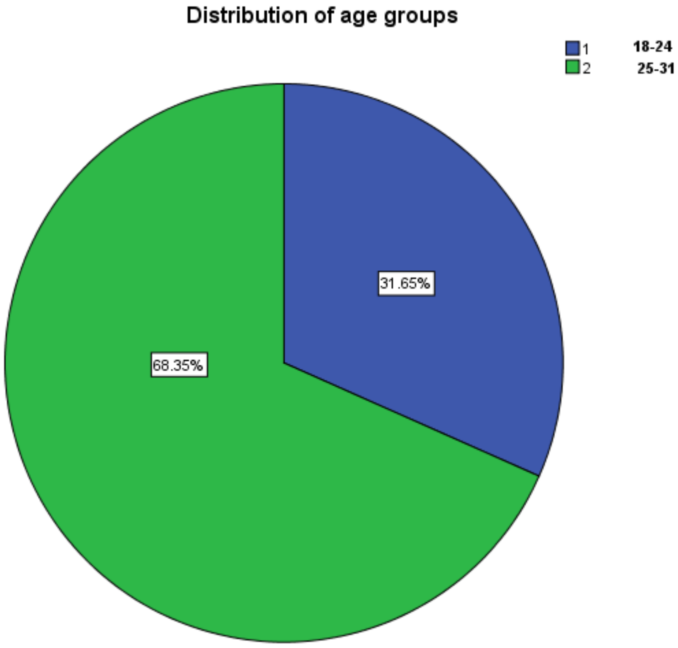

Figure 4-1 Distribution of age among the study group.

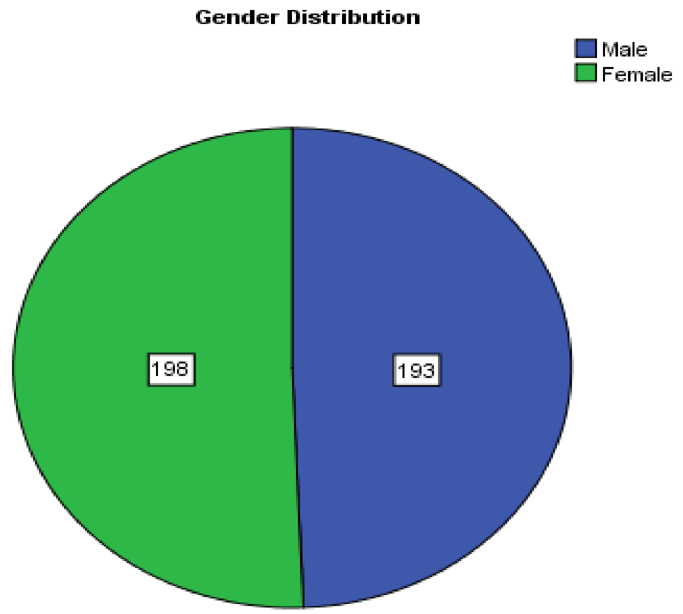

Figure 4-2 Distribution of participants according to their gender.

Both males and females took part in this study. Among the sample of 396 individuals, 5 respondents did not provide information regarding their gender, resulting in a final sample size of 391 participants who reported their gender. 193 (48.7%) were male and 198 (50%) were female students (see Figure 4-2).

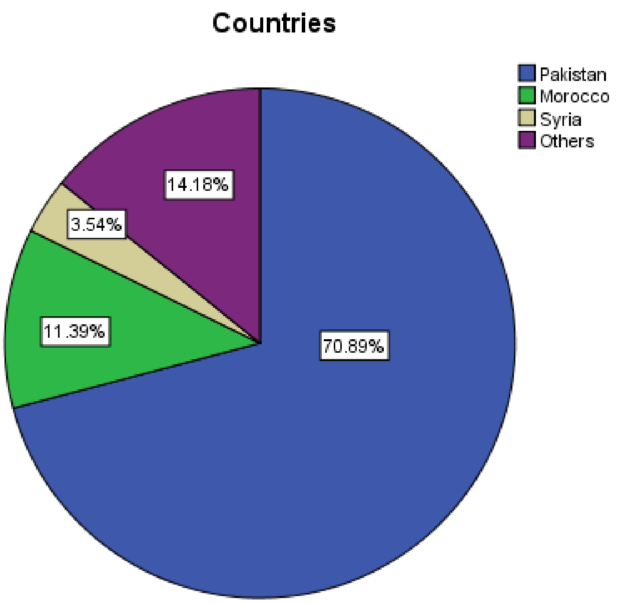

Figure 4-3 Distribution of participants according to their home countries.

The international students took part voluntarily in this study. International students from 32 countries were included. (See Figure 4-3) According to the analysis below, out of 396 participants, 70% were Pakistani students, 11.39% were Moroccan citizens, 3.54% were Syrian students, and 14.18% were other students from other countries such as America, Azerbaijan, Bangladesh, Canada, Dubai, the United Kingdom, India, Germany, Iran, Iraq, Japan, Palestine, Tunisia, Uzbekistan, Turkmenistan, Sweden, Sudden, Slovakia, Saudia, Russia, Ethiopia, Jordan, Kyrgyzstan, Libya, Lebanon, Lithuania, Qatar, Oman and Nigeria were included in this survey study.

Table 4.1 Descriptive analysis of neck disability index and smart phone addiction scale

	N	Minimum	Maximum	Mean	Std. Deviation
Neck Disability Index	394	1.00	6.00	2.7888	1.08992
Smart Phone Addiction Scale	395	1.00	5.00	3.7427	.64030

Data expressed as mean and standard deviation. Neck disability index used as a self-assessment tool for neck pain and smart phone addiction scale is used for the assessment of smart phone addiction.

This table reveals descriptive statistics of the variables under study: neck disability index and smartphone addiction. The mean value for the neck disability index is 2.79, with a standard deviation of 1.09, while for smartphone addiction, the mean is 3.7, with a standard deviation of 0.64 (See Table 4.1).

Table 4.2 Comparison of neck disability index scale between age groups

	Age (18-24) Mean±SD N= 124	Age (25-31) Mean±SD N= 270	t	p
Neck Disability Index	2.8±1.038	2.7±1.11	.286	.775

Data expressed as mean ± standard deviation between two age groups. Significance set as $p < 0.05$.

It is shown in the table that the p-value of 0.775, which is greater than the 0.05 significance level. The p values were greater than the typical significance level of 0.05, that means there was no significant difference between the mean of the two groups according to neck disability index.

Table 4.2 Comparison of smartphone addiction scale between age groups

	Age (18-24) Mean±SD N= 125	Age (25-31) Mean±SD N= 270	t	p
Smart Phone Addiction Scale	3.6±.667	3.7±.625	-1.735	.084

Data expressed as mean ± standard deviation between two age groups. Significance set as $p < 0.05$.

The smartphone addiction scale revealed that no statistically significant difference between the means of the two age groups, as shown by p value was higher than the standard significance threshold of 0.05 ($p < 0.05$).

Table 4.3 Comparison of neck disability index scores between gender groups.

	Gender		t	p
	Male N= 192	Female N= 198		
	Mean ± S. D.	Mean ± S. D.		
Neck Disability Index	2.7294 ± 1.16124	2.8426 ± 1.02372	-1.023	.307

Data expressed as mean ± standard deviation between two age groups. Significance set as $p < 0.05$.

The above table (Table 4.3) showed the mean and standard deviation statistics between the gender groups. The descriptive statistics of the neck disability index were shown. The mean value of the neck disability index in the male and female groups was 2.7 and 2.84, with 1.16 and 1.02 standard deviations, respectively. The neck disability index was analysed with an independent t-test. The p-value was .044 indicated that there was not enough evidence which showed that the variance was significantly different.

Table 4.4 Comparison of smartphone addiction scale scores between gender groups.

	Gender		t	p
	Male N= 193	Female N= 198		
	Mean ± S. D.	Mean ± S. D.		
Smart Phone Addiction Scale	3.8466± .60655	3.6469± .65989	3.112	.002

Data expressed as mean ± standard deviation between two age groups. Significance set as $p < 0.05$.

The table (table 4.4) showed the descriptive statistics according to the gender group. The mean value of the smartphone addiction scale in the male and female groups was 3.84 and 3.64, with .606 and .659 standard deviations, respectively. According to the independent samples t-test results, the smartphone addiction scale variable was calculated. Here is a summary of the results of the independent samples t-test. A p-value 0.002 showed that there is substantial evidence to support a significant difference between the means of the two groups. This is because the p-value is below the 0.05 standard of significance. which similarly pointed that there was a substantial difference between the means of the two groups.

Table 4.5 Correlation between smart phone addiction scale and neck disability index.

Correlations			
		Smart Phone Addiction Scale	**Neck Disability Index**
Smart Phone Addiction Scale	Pearson Correlation	1	.452**
	Sig. (2-tailed)		.000
	N	395	394
Neck Disability Index	Pearson Correlation	.452**	1
	Sig. (2-tailed)	.000	
	N	394	394

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient between the neck disability index and the smartphone addiction scale short version, which is 0.452 in this table's summary, indicates that there is a somewhat favourable association between the two. The scores on the neck disability index have a propensity to rise when the scores on the smartphone addiction scale rise, and vice versa. The association is statistically significant at both the 5% and 1% significance levels, as shown by the p-value, which is presented as 0.000.

5 DISCUSSION

The primary objective of this research was to determine the prevalence of text neck syndrome among international students. According to the results, the age of the participants was 18-31. Which is divided according to the mean (25.68) into two groups such as (18-24) and (25-31). 125 participants fall in the age group 18-24, representing 31.6% of total responses, whereas 270 participants aged 25-31 years account for 68.2% of the total responses. There were no significant differences found when statistically analysed on an independent t-test for the neck disability index and smartphone addiction scale among age groups.

193 (48.7%) male and 198 (50%) female students took part in this study. According to the neck disability index, there were no significant difference between gender groups, whereas the p value .002 showed a significant difference between gender groups on smartphone addiction scale. Which means that female students have more addiction to smartphones than male students. A researcher explained in his study mobile phone usage is typically higher among females (50.6%) than males (49.4%). Women are more prone than males to experience the most common forms of pain and suffer greater discomfort after invasive procedures [101]. For evaluation two scales were used. The smartphone addiction scale short version and neck disability index. The SAS-SV has shown great validity and reliability in the present study's evaluation of smartphone addiction. In research and community settings, the short form of the smartphone addiction scale that was developed and validated used to measure smartphone addiction [96]. The neck disability index was proposed as a potentially helpful tool in the evaluation of neck pain complaints [97]. After removing the missing data from each scale, 395 out of 396 respondents answered SAS and SV, with a mean score of 3.74 for the overall smartphone addiction scale. A mean score of 3.74 on the Smartphone Addiction Scale (SAS) short version indicates a relatively high level of smartphone addiction or dependence. 394 individuals answered overall after missing data were removed. A mean score of 2.78 on the Neck Disability Index (NDI) indicates a moderate level of neck disability among the respondents or participants. According to the findings of the connection between the neck disability index and the short form of the smartphone addiction scale, which is 0.452, there is a somewhat good association between the two. The findings revealed a substantial link between neck discomfort and

the use of smartphones. It would not be wrong to say that mobile phones have had a very bad effect on students' lives, but they do not even realise it. Another researcher discovered a link between the length of smartphone usage and the degree of neck discomfort. According to this comprehensive research, musculoskeletal complaints among mobile device users vary from 1.0% to 67.8%, with neck issues having the greatest prevalence [102]. It was anticipated that prolonged neck flexion caused by using a smartphone to text excessively would harm the cervical tissues. According to research, the cervical spine can modify its mechanical and neuromuscular behaviour after ten minutes of static flexion, which might result in the structures of the cervical spine losing some of its strength [1]. Another researcher found a strong correlation between the frequency and severity of neck discomfort and the amount of time spent using a mobile device [100].

There are many treatments to treat neck and shoulder pain, such as exercises, massage therapies, Anti-inflammatory drugs, and Pain killers such as opioids. In serious cases, acupuncture, manual manipulation therapy, trigger point injections, cervical spinal steroid injections, and cervical facet injections may be used [8]. If bad posture is the reason for neck pain, then making a few simple modifications might help. Modifying the workplace to enhance ergonomics involves optimising the placement of the chair, monitor, mobile phones, and keyboard to promote a more natural alignment of the body, head, and neck. The activities which lead to postural changes should be limited. If someone spends more hours a day hunched on smartphones for texting and checking updates, they need to take some rest intervals during that time to prevent their neck structures from overloading. The mobile phones should be held at eye level to keep the neck straight and upright. These kinds of minor lifestyle changes could save us from serious illnesses.

The presented investigation exhibits a limited scope. The population under investigation comprises solely individuals who are enrolled as international students. The questionnaire is exclusively intended for individuals who possess proficiency in the English language. The individuals participating in this study must fall within the age range of 18 to 31 years.

6 CONCLUSION

It is concluded that with the evolution of technology, smartphones become an essential part of our lives. They have made our life easier, but they also harm our health. We need to pay attention to the awareness of text neck syndrome. This phenomenon represents an increasing health concern on a global scale. In order to decrease the growing incidence of text-neck syndrome, preventative measures such as limiting smartphone use and preserving an ergonomically correct posture should be taken to reduce the risk factors for neck and shoulder discomfort.

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APPENDICES NO 1

T.C.
YEDİTEPE ÜNİVERSİTESİ REKTÖRLÜĞÜ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı : E.83321821-805.02.03-31
Konu : Non Interventional Clinical Research
Ethics Board Decision

Sayın Prof. Dr. Feryal Subaşı

Yeditepe University Non-Interventional Clinical Research Ethics Board has reviewed the research proposal placed upon ethical approval for the project as the research title, the researchers, the application number, the ethics board meeting details, and the provided documents have been outlined below. This research proposal has been evaluated by the members of the ethics board and full ethical **APPROVAL** has been granted.

Research Title:	**Text neck syndrome: perception and prevalence among international university students in Istanbul, Turkey**
Researchers:	**Fzt.Ayesha Farooqi, Prof. Dr. Feryal Subaşı**
Application Number:	**202204Y0229**

ETHICS BOARD MEETING DETAILS			
Meeting Date:	8 April 2022	**Meeting Place:**	Online (Google Meet)

PROVIDED DOCUMENTS
Wet signed application file, file uploaded to a CD or USB media, and electronic submission
Title of research and the names of the researchers
Letter of application
Application Form
Nature of the Research;
• Type
• Significance and distinctive value
• Aims and objectives
• Method
• Management of the research
• Widespread impact
• Pertinence of the budget and reason (if applicable)
• Timeframe and convenience
• References
Informed consent form (uniquely prepared for the research)
Letter of Undertaking-1 A commitment to undertake the responsibility of obtaining institutions permission from where the data collection will be made

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Adresi : http://belgedogrulama.yeditepe.edu.tr/bg.aspx?id=6CC6AF8C-30F9-40A3-ADA6-4CA4966C6879

Yeditepe Üniversitesi 26 Ağustos Yerleşimi, İnönü Mahallesi Kayışdağı Caddesi 34755
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Kep Adresi : yeditepeuniversitesi@hs03.kep.tr

Bilgi İçin: Sinem ARI
Unvan: Uzman Yardımcısı
Telefon No:

Letter of Undertaking-2 A commitment to read the latest version of the World Medical Association Declaration of Helsinki and all relevant guidelines of the Ministry of Health
Letter of Undertaking-3 A commitment on whether there are previous ethical board applications
Letter of Undertaking-4 A commitment that no action will be taken during the research that is not included in the research budget and that will bring additional burden to the volunteer or the Social Security Institution
Letter of Undertaking-5 A commitment to reading the circular on treatment approaches and scientific research in COVID-19 patients
Letter of Undertaking-6 A commitment to reading the document of Research Application Permissions that is published by Ministry of Education
'Resume Forms' filled separately by all the researchers and signed
Additional documents (Scale permissions used, if any, etc.)

Prof. Dr. Didem ÖZDEMİR ÖZENEN
Chair

Assoc. Prof. Dr. Gökhan ERTAŞ
Deputy Chair

Assoc. Prof. Dr. Elif SUNGURTEKİN EKÇİ
Reporter

Assoc. Prof. Dr. Mehmet Engin CELEP
Member

Assoc. Prof. Dr. Binnur OKAN BAKIR
Member

Assist. Prof. Dr. Elif Çiğdem KELEŞ
Member

Assist. Prof. Dr. Emine Nur ÖZDAMAR
Member

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Telefon No:

APPENDICES NO 2

T.C. YEDİTEPE ÜNİVERSİTESİ

Text Neck Syndrome: Perception and prevalence among international university students in Istanbul, Türkiye.

Informed Consent Form *

Yeditepe University, Faculty of Health Science, Physiotherapy and Rehabilitation Department, is going to conduct research on the prevalence and perception of text neck syndrome in international University students in Istanbul Türkiye. The aim of this research is to provide awareness regarding the repetitive injury of the neck or the adaptation of abnormal posture while using smartphone devices unconsciously. Participation in the study is on a voluntary basis. Before you decide whether to participate in the study or not, it is important that you understand why and how the research will be done, how you will use your information, and what the study entails. Please take the time to read the following information carefully. If you need more information regarding this you can see (Appendix no 1). Two physical assessment questionnaires Neck Disability Index and Smartphone addiction scale will be used to assess the symptoms of neck pain and the addictions to smartphones respectively.

CONSENT:

I have read and understand the provided information and have had the opportunity to ask questions. I understand the language of this questionnaire. I know that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I voluntarily agree to take part in this study.

- [ ] Approve
- [ ] Disapprove

Name:

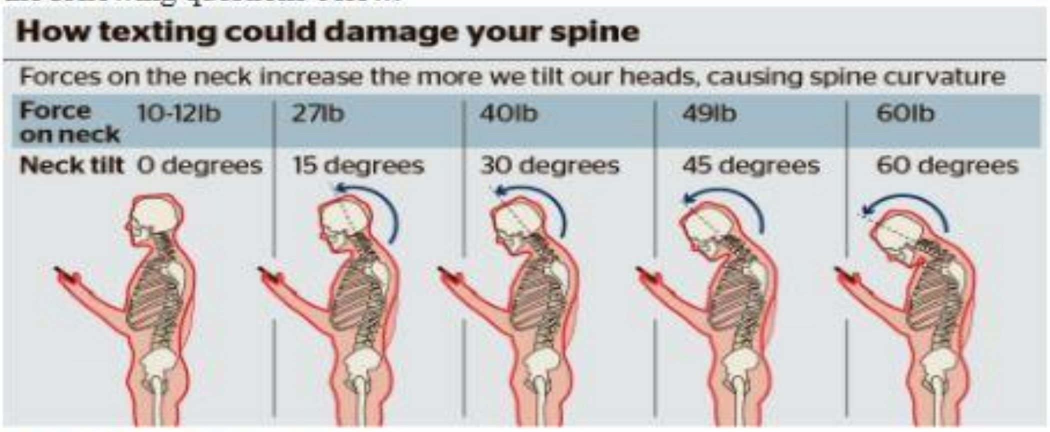
Age:

Gender:

- Male
- Female
- Prefer not to say

Country:

Text neck is defined as an overuse syndrome that typically results from excessive neck strain from looking down at any handheld mobile device. It can cause headaches, neck pain, shoulder pain, arm pain, and breathing problems. You can evaluate yourself with the help of the following questions below.



English Version of SAS-SV

The scores that can be obtained from the scale vary between 10 and 60, and high scores are considered to show an increased risk for addiction. **Males with a score of 31 or greater and females with a score of 33 or greater are interpreted as "smartphone addicts".**

Missing planned work due to smartphone use

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Feeling pain in the wrists or at the back of the neck while using a smartphone

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Won't be able to stand not having a smartphone

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Feeling impatient and fretful when I am not holding my smartphone

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Having my smartphone in my mind even when I am not using it

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

I will never give up using my smartphone even when my daily life is already greatly affected by it

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Using my smartphone longer than I had intended

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

The people around me tell me that I use my smartphone too much

1. Strongly disagree
2. Disagree

3. Neutral
4. Agree
5. Strongly Agree

Neck Disability Index: This questionnaire has been designed to give us information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the one box that applies to you. We realise you may consider that two or more statements in any one section relate to you, but please just mark the box that most closely describes your problem.

Section 1: Pain Intensity

1. I have no pain at the moment
2. The pain is very mild at the moment
3. The pain is moderate at the moment
4. The pain is fairly severe at the moment
5. The pain is very severe at the moment
6. The pain is the worst imaginable at the moment

Section 2: Personal Care (Washing, Dressing, etc.)

1. I can look after myself normally without causing extra pain
2. I can look after myself normally but it causes extra pain
3. It is painful to look after myself and I am slow and careful
4. I need some help but can manage most of my personal care
5. I need help every day in most aspects of self-care
6. I do not get dressed, I wash with difficulty and stay in bed

Section 3: Lifting

1. I can lift heavy weights without extra pain
2. I can lift heavy weights but it gives extra pain
3. Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table
4. Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned

5. I can only lift very light weights
6. I cannot lift or carry anything

Section 4: Reading

1. I can read as much as I want to with no pain in my neck
2. I can read as much as I want to with slight pain in my neck
3. I can read as much as I want with moderate pain in my neck
4. I can't read as much as I want because of moderate pain in my neck
5. I can hardly read at all because of severe pain in my neck
6. I cannot read at all

Section 5: Headaches

1. I have no headaches at all
2. I have slight headaches, which come infrequently
3. I have moderate headaches, which come infrequently
4. I have moderate headaches, which come frequently
5. I have severe headaches, which come frequently
6. I have headaches almost all the time

Section 6: Concentration

1. I can concentrate fully when I want to with no difficulty
2. I can concentrate fully when I want to with slight difficulty
3. I have a fair degree of difficulty in concentrating when I want to
4. I have a lot of difficulty in concentrating when I want to
5. I have a great deal of difficulty in concentrating when I want to
6. I cannot concentrate at all.

Section 7: Work

1. I can do as much work as I want to
2. I can only do my usual work, but no more
3. I can do most of my usual work, but no more
4. I cannot do my usual work

5. I can hardly do any work at all
6. I can't do any work at all

Section 8: Driving

1. I can drive my car without any neck pain
2. I can drive my car as long as I want with slight pain in my neck
3. I can drive my car as long as I want with moderate pain in my neck
4. I can't drive my car as long as I want because of moderate pain in my neck I can hardly drive at all because of severe pain in my neck
5. I can't drive my car at all

Section 9: Sleeping

1. I have no trouble sleeping
2. My sleep is slightly disturbed (less than 1 hr sleepless)
3. My sleep is mildly disturbed (1-2 hrs sleepless)
4. My sleep is moderately disturbed (2-3 hrs sleepless)
5. My sleep is greatly disturbed (3-5 hrs sleepless)
6. My sleep is completely disturbed (5-7 hrs sleepless)

Section 10: Recreation

1. I am able to engage in all my recreation activities with no neck pain at all I am able to engage in all my recreation activities, with some pain in my neck
2. I am able to engage in most, but not all of my usual recreation activities because of pain in my neck
3. I am able to engage in a few of my usual recreation activities because of pain in my neck
4. I can hardly do any recreation activities because of pain in my neck
5. I can't do any recreation activities at all

Appendix no 1

The term "text neck" was coined by a chiropractor in the United States. Text neck is defined as an overuse syndrome caused by excessive strain on the neck from looking down at any handheld mobile device, which can cause headaches, neck pain, shoulder and arm pain, and breathing difficulties. when a person has flexed their neck and sat down for extended periods of time to look at a smartphone or other electronic device. Muscle aches and text neck syndrome are brought on by this position. The most frequent musculoskeletal condition affecting adolescents is neck pain. The use of computers has increasingly become a major part of people's daily lives. However, frequent overuse of digital tasks on handheld smartphones appears to have a global health impact known as "Text Neck." According to reports, the total number of global smartphone users will reach 6.8 billion by 2023. With the global population expected to exceed 8 billion, 8 out of 10 people (85%) will own a smartphone. The aim of this study is to figure out the frequency of text neck syndrome in international university students in Istanbul, Türkiye and also educate them about the risk factors which will cause postural changes because of spending a lot of time on handheld smartphone devices. This will help them to know about their postural changes and enhance their quality of life by educating them about it. For this purpose, the above questionnaire was used as a tool. The above questionnaire consists of Four parts; Consent form, Demographic data, Smartphone addiction scale short version and Neck disability index. The consent form includes the information about my study as mentioned above and also the permission letter. It also provides information on possible risks and benefits. The participation of individuals is completely voluntary. The demographic information which includes name, age, gender, and the country will be completely confidential. The Smartphone addiction scale (SAS) is a scale for smartphone addiction that consisted of 6 factors and 33 items with a six-point Likert scale (1: "strongly disagree" and 6: "strongly agree") based on self-reporting. In this study short version of (SAS) is used. The SAS comprises ten items (e.g., "Having my smartphone in my mind even when I am not using it") concerning daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationships, overuse, and tolerance. Each item is rated on a six-point Likert-type scale from 1 (strongly disagree) to 6 (strongly agree). The other scale is the neck disability index; The NDI consists of ten questions in the following domains: Pain Intensity, Personal Care, Lifting, Reading, Headaches, Concentration, Work, Driving, Sleeping, and Recreation. Scoring: Each question contains six answer choices, scored from 0 (no disability) to 5 (complete disability). This study will add new information to the previous literature for future research. It will provide information about the globally growing problem such as "Text neck syndrome" in international university students in Istanbul. it will also provide effective information for future studies and also gives knowledge to international university students about their bad postures during the use of smartphone devices. This will help them to know about their bad posture. In that way they may change their bad habits and enhance their quality of life.

Thank you for participating in this survey.

APPENDICES NO 3

1

English Version of SAS

	Items	Strongly disagree	Disagree	Weakly disagree	Weakly agree	Agree	Strongly agree
1	Missing planned work due to smartphone use	1	2	3	4	5	6
2	Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	1	2	3	4	5	6
3	Experiencing lightheadedness or blurred vision due to excessive smartphone use	1	2	3	4	5	6
4	Feeling pain in the wrists or at the back of the neck while using a smartphone	1	2	3	4	5	6
5	Feeling tired and lacking adequate sleep due to excessive smartphone use	1	2	3	4	5	6
6	Feeling calm or cozy while using a smartphone	1	2	3	4	5	6
7	Feeling pleasant or excited while using a smartphone	1	2	3	4	5	6
8	Feeling confident while using a smartphone	1	2	3	4	5	6
9	Being able to get rid of stress with a smartphone	1	2	3	4	5	6
10	There is nothing more fun to do than using my smartphone.	1	2	3	4	5	6
11	My life would be empty without my smartphone.	1	2	3	4	5	6
12	Feeling most liberal while using a smartphone	1	2	3	4	5	6
13	Using a smartphone is the most fun thing to do.	1	2	3	4	5	6
14	Won't be able to stand not having a smartphone	1	2	3	4	5	6
15	Feeling impatient and fretful when I am not holding my smartphone	1	2	3	4	5	6
16	Having my smartphone in my mind even when I am not using it	1	2	3	4	5	6
17	I will never give up using my smartphone even when my daily life is already greatly affected by it.	1	2	3	4	5	6
18	Getting irritated when bothered while using my smartphone	1	2	3	4	5	6
19	Bringing my smartphone to the toilet even when I am in a hurry to get there	1	2	3	4	5	6
20	Feeling great meeting more people via smartphone use	1	2	3	4	5	6
21	Feeling that my relationships with my smartphone buddies are more intimate than my relationships with my real-life friends	1	2	3	4	5	6
22	Not being able to use my smartphone would be as painful as losing a friend.	1	2	3	4	5	6
23	Feeling that my smartphone buddies understand me better than my real-life friends	1	2	3	4	5	6
24	Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook	1	2	3	4	5	6
25	Checking SNS (Social Networking Service) sites like Twitter or Facebook right after waking up	1	2	3	4	5	6
26	Preferring talking with my smartphone buddies to hanging out with my real-life friends or with the other members of my family	1	2	3	4	5	6
27	Preferring searching from my smartphone to asking other people	1	2	3	4	5	6
28	My fully charged battery does not last for one whole day.	1	2	3	4	5	6
29	Using my smartphone longer than I had intended	1	2	3	4	5	6
30	Feeling the urge to use my smartphone again right after I stopped using it	1	2	3	4	5	6
31	Having tried time and again to shorten my smartphone use time, but failing all the time	1	2	3	4	5	6
32	Always thinking that I should shorten my smartphone use time	1	2	3	4	5	6
33	The people around me tell me that I use my smartphone too much.	1	2	3	4	5	6

English Version of SAS-SV

Items		Strongly disagree	Disagree	Weakly disagree	Weakly agree	Agree	Strongly agree
1	Missing planned work due to smartphone use	1	2	3	4	5	6
2	Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	1	2	3	4	5	6
3	Feeling pain in the wrists or at the back of the neck while using a smartphone	1	2	3	4	5	6
4	Won't be able to stand not having a smartphone	1	2	3	4	5	6
5	Feeling impatient and fretful when I am not holding my smartphone	1	2	3	4	5	6
6	Having my smartphone in my mind even when I am not using it	1	2	3	4	5	6
7	I will never give up using my smartphone even when my daily life is already greatly affected by it.	1	2	3	4	5	6
8	Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook	1	2	3	4	5	6
9	Using my smartphone longer than I had intended	1	2	3	4	5	6
10	The people around me tell me that I use my smartphone too much.	1	2	3	4	5	6

APPENDICES NO 4

RE: FW: Request for permission using SAS in my study External Inbox ×

Kwon Min <

to me

Apr 4, 2022, 4:58 AM

Dear,

I'm Min Kwon, first author of the SAS and SAS-SV.

Thank you for the interest in Smartphone Addiction Scale.

You can use my tools.

The SAS consists of 33 questions and is grouped into six subscales, all weighted equally on a 6-point scale.

The six subscales' scores are summed up to yield a total SAS score with a 33–198 range, where a higher score indicates more serious smartphone addiction.

Cut-off of the SAS has not been proven yet, and you can do the comparison on the smartphone addiction severity.

The SAS-SV consists of 10 questions without subscales, and all weighted equally on a 6-point scale. And the scale is cut-off value of 31 in boys and cut-off value of 33 in girls.

I attach the material you ask me and you can review this information through to attach paper.

Please let me know about the results of future studies.

Good luck for your study and keep me posted of your progress.

Best Regards,

MIN KWON, RN, PhD.

Assistant Professor

Department of Nursing, The University of Suwon

17 Wauan-gil, Bongdam-eup, Hwaseong-si, Gyeonggi-do, Korea

APPENDICES NO 5

Neck Disability Index

Office Use Only
Name ____________
Date ____________

This questionnaire has been designed to give us information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and **mark in each section only the one box that applies to you.** We realise you may consider that two or more statements in any one section relate to you, but please just mark the box that most closely describes your problem.

Section 1: Pain Intensity

☐ I have no pain at the moment
☐ The pain is very mild at the moment
☐ The pain is moderate at the moment
☐ The pain is fairly severe at the moment
☐ The pain is very severe at the moment
☐ The pain is the worst imaginable at the moment

Section 2: Personal Care (Washing, Dressing, etc.)

☐ I can look after myself normally without causing extra pain
☐ I can look after myself normally but it causes extra pain
☐ It is painful to look after myself and I am slow and careful
☐ I need some help but can manage most of my personal care
☐ I need help every day in most aspects of self care
☐ I do not get dressed, I wash with difficulty and stay in bed

Section 3: Lifting

☐ I can lift heavy weights without extra pain
☐ I can lift heavy weights but it gives extra pain
☐ Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table
☐ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned
☐ I can only lift very light weights
☐ I cannot lift or carry anything

Section 4: Reading

☐ I can read as much as I want to with no pain in my neck
☐ I can read as much as I want to with slight pain in my neck
☐ I can read as much as I want with moderate pain in my neck
☐ I can't read as much as I want because of moderate pain in my neck
☐ I can hardly read at all because of severe pain in my neck
☐ I cannot read at all

Section 5: Headaches

☐ I have no headaches at all
☐ I have slight headaches, which come infrequently
☐ I have moderate headaches, which come infrequently
☐ I have moderate headaches, which come frequently
☐ I have severe headaches, which come frequently
☐ I have headaches almost all the time

Section 6: Concentration

☐ I can concentrate fully when I want to with no difficulty
☐ I can concentrate fully when I want to with slight difficulty
☐ I have a fair degree of difficulty in concentrating when I want to
☐ I have a lot of difficulty in concentrating when I want to
☐ I have a great deal of difficulty in concentrating when I want to
☐ I cannot concentrate at all

Section 7: Work

☐ I can do as much work as I want to
☐ I can only do my usual work, but no more
☐ I can do most of my usual work, but no more
☐ I cannot do my usual work
☐ I can hardly do any work at all
☐ I can't do any work at all

Section 8: Driving

☐ I can drive my car without any neck pain
☐ I can drive my car as long as I want with slight pain in my neck
☐ I can drive my car as long as I want with moderate pain in my neck
☐ I can't drive my car as long as I want because of moderate pain in my neck
☐ I can hardly drive at all because of severe pain in my neck
☐ I can't drive my car at all

Section 9: Sleeping

☐ I have no trouble sleeping
☐ My sleep is slightly disturbed (less than 1 hr sleepless)
☐ My sleep is mildly disturbed (1-2 hrs sleepless)
☐ My sleep is moderately disturbed (2-3 hrs sleepless)
☐ My sleep is greatly disturbed (3-5 hrs sleepless)
☐ My sleep is completely disturbed (5-7 hrs sleepless)

Section 10: Recreation

☐ I am able to engage in all my recreation activities with no neck pain at all
☐ I am able to engage in all my recreation activities, with some pain in my neck
☐ I am able to engage in most, but not all of my usual recreation activities because of pain in my neck
☐ I am able to engage in a few of my usual recreation activities because of pain in my neck
☐ I can hardly do any recreation activities because of pain in my neck
☐ I can't do any recreation activities at all

Score: ___/50 Transform to percentage score x 100 = %points

Scoring: For each section the total possible score is 5: if the first statement is marked the section score = 0, if the last statement is marked it = 5. If all ten sections are completed the score is calculated as follows: Example: 16 (total scored)

50 (total possible score) x 100 = 32%

If one section is missed or not applicable the score is calculated: 16 (total scored)

45 (total possible score) x 100 = 35.5%

Minimum Detectable Change (90% confidence): 5 points or 10 %points

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NDI developed by: Vernon, H. & Mior, S. (1991). The Neck Disability Index: A study of reliability and validity. Journal of Manipulative and Physiological Therapeutics. 14, 409-415

APPENDICES NO 6

- Review copy
- Languages
- e-Versions
- Descriptive information
- Content validity documentation
- Measurement properties
- References and websites

Last update: November 2021

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- NDI in English for North America

APPENDICES NO 7

Ayesha Farooqi

Doctor of Physiotherapy at Jinnah burn and reconstructive surgery center

Work experience Providing physiotherapy assessment and treatment to both inpatient and outpatients by improving physical strength, cognition, mobility and quality of life in patients of all ages. Evaluating, planning and delivering bespoke physiotherapy plans to meet the needs of individual patients.

Contact Info

Mehvalana Mah
Istanbul, Turkey

Strengths & Skills

- Build patient rapport
- Good communication
- patient assessment
- Teamworking
- Critical thinking
- Good time management
- Patient care
- Tolerance and patience
- Encouraging and empathetic attitude
- Interpersonal Skills
- Patient education

Academics

Title	Institute	Date
Ms in general physiotherapy and rehabilitation	yeditepe university, Istanbul	
Doctor of physiotherapy	Superior Group of College, Lahore pakistan	

Certifications

Title	Authority	Date
Stepping into Professional World Series,		Starting March 2018
Lumbar Spine Management, LMDC		Starting January 2018
First Aid in Sports & Pediatrics, ANMC		Starting December 2017
International Workshop on ALS, Human Welfare Society		Starting December 2017
Workshop on Integrated Medicine, IMA		Starting February 2017

Experience 1 year

Company	Designation	Duration	
Jinnah Burn & reconstructive Surgery Centre/AIMC,Lahore Lah	Internship	Jan 2019 - Jan 2020	**1 year**
C.M.A Teaching and Research Hospital,Lahore	Internship	Jun 2016 - Jul 2016	**1 month**
Home Education System	English Teacher / English Language Trainer	Nov 2013 - Dec 2017	**4.1 years**

Work History

Jinnah Burn & reconstructive Surgery Centre/AIMC,Lahore Lah — **Jan 2019 - Jan 2020 (1 year)**

Internship — **Lahore, Pakistan**

C.M.A Teaching and Research Hospital,Lahore — **Jun 2016 - Jul 2016 (1 month)**

Internship — **Lahore, Pakistan**

Home Education System — **Nov 2013 - Dec 2017 (4.1 years)**

Projects

Physiotherapy Treatment Preferences for common Musculoskeletal Problems across Pakistan **May 2018 - Oct 2018 (5 months)**

Company: Hospital

Tools: Questionnaire (likert scale)

Industries

- Healthcare/Hospital/Medical

Functional Areas

- Health & Medicine
- hospitals
- rehabilitation centers
- home visits
- universities

Languages

- English - Native
- Urdu - Native
- Turkish - Beginner

Hobbies

- Traveling
- Book reading
- Sketching
- Adventurous task