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EFFECT OF SCAPULAR RETRACTION EXERCISE 2022

EFFECT OF SCAPULAR RETRACTION EXERCISE ON FORWARD HEAD POSTURE AMONG UNIVERSITY STUDENTS

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By

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ABSTRACT

Background and Objective: Forward head posture (FHP), an abnormal alignment of the neck that is developed the muscle imbalance on the agonist and antagonist muscle of the shoulder which might further result in pain and deterioration of quality of life. Moreover, several studies show a high prevalence of forward head posture problem in university students. Despite this, the number of studies is limited and difference in methodology, study populations and study settings. Therefore, this study is conducted to investigate the effects of scapular retraction exercise intervention to determine the effects if it is significant although there are different methodology, population, and settings. The objective of this study is to determine the effects of scapular retraction exercises on forward head posture among university students.

Methods: This study was a single subject (AB design), randomized, experimental study. The sampling method was convenience sampling, with sample size calculated to be at 60. The targeted participant were university students. Participants were randomized into 2 groups, the intervention group, and the control group. Postural alignment assessment was used to assess baseline characteristics and inclusion criteria. All participants in the intervention group underwent a 4-week scapular retraction exercise consisting of 5 different exercises plus ergonomic advice. On the other hand, all participants in the control group were only given ergonomic advice. There were 2 post-treatment postural assessment using the postural alignment assessment tool, at the end of second week and fourth week. The difference between the craniovertebral angle during pre-treatment and post-treatment was calculated.

Results: The total participants were only 52 university students; thus, their result data is processed. Firstly, the prevalence of forward head posture among university student was 48% after screening of 130 recruited participants. Moving to the effects of scapular retraction exercise, week 2 and week 4 post-treatment CVA was assessed. Significant effect on forward head posture was found within group of intervention group (scapular retraction exercise plus ergonomic advice) at week 2 and week 4. Gender differences and BMI category was also tested in between groups with the week 4 post-treatment CVA, no significant difference was found. Ultimately,

between groups result also proved to have significant difference between intervention and control group with the week 4 post-treatment CVA. All in all, this study proved that there was a significant effect of scapular retraction exercise on forward head posture among university students.

Conclusion: This current study concluded that a 4-week scapular retraction exercise was effective on treating forward head posture among university students. A simple, effective, and convenient set of scapular retraction exercise intervention was proven, as it aims to contribute to the physiotherapy field and the knowledge of intervention in treating forward head posture.

Keywords: Scapular Retraction Exercise, Forward Head Posture, University Students

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APPROVAL SHEET

This Research project entitled "**EFFECT OF SCAPULAR RETRACTION EXERCISE ON FORWARD HEAD POSTURE AMONG UNIVERSITY STUDENTS"** was prepared by TAY KAI WEI and submitted as partial fulfilment of the requirements for the degree of Bachelor of Physiotherapy (HONOURS) at Universiti Tunku Abdul Rahman.

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Date: 23 December 2022

PERMISSION SHEET

It is hereby certified that **Tay Kai Wei** (ID No: **20UMB033554**) has completed this Research project entitled "EFFECT OF SCAPULAR RETRACTION EXERCISE ON FORWARD HEAD POSTURE AMONG UNIVERSITY STUDENTS" under the supervision of MAHADEVI A/P MUTHURETHINA BARATHI (Supervisor) from the Department of Physiotherapy, Faculty of Medicine and Health sciences.

Yours truly,

(TAY KAI WEI)

DECLARATION

I hereby declare that the Research project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Name: TAY KAI WEI

Date: 23 December 2022

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PA	Physical activity
CVA	Craniovertebral Angle
UTAR	Universiti Tunku Abdul Rahman
IPAQ	International Physical Activity Questionnaire
BMI	Body Mass Index
TOS	Thoracic Outlet Syndrome
FVC	Forced Vital Capacity
FEV1	Forced Expiratory Volume in 1 second
IT	Information Technology
SERC	Scientific and Ethical Review Committee
PAS	Postural Analysis System
EHPI	Electronic Head Posture Instrument
CA	Cervical Angle
BSRSER	Bilateral Shoulder Retraction and Shoulder External Rotation
EMG	Electromyography
FHP	Forward Head Posture

CHAPTER 1

INTRODUCTION

1.1 Chapter overview

This chapter comprises the background of the study, mainly to provide a framework for the context of my research project before proceeding to the importance and relevance, research objectives as well as hypotheses and operational definition of terms for the research study.

1.2 Background of study

1.2.1 Posture

Posture, defined as the orientation of body parts and it is the way we position our body in a manner which is perceived as “appropriate” by oneself. Akbari & Gannad (2006) have argued that posture was a description of positioning of body segments that can be measured by vertical angle, and it is relative to the gravitational vector. Control of posture includes interpretation of consciousness about body movement, sensory motor integration and execution of proper orientation (Akbari & Gannad, 2006). A proper posture is beneficial for our body to be oriented in proper allignment biomechanically which results in healthy execution of movement and prevention of injuries and deformites of body structure (Akbari & Gannad, 2006).

1.2.2 Forward Head Posture

Forward head posture is also one of the most common erroneous habitual neck postures, also regarded as text neck syndrome or turtle-neck syndrome. As suggested by Singla & Veqar (2017), the occurrence of forward head posture is the exaggeration of the protraction movement of the head, which is weighted 6% of the total body weight, for an extended duration. In the anatomical aspect, our cervical part of the spine is a lordotic curve, there are also retraction and protraction movement in the neck other than flexion and extension of the head. In long period of usage of electronical devices, tensing the neck in a protracted position for a long time will shift our centre of gravity of head forward, leading to increased load of the neck (T. W. Kim et al., 2016). After that, degree of flexion of the neck and the protraction angle increases, causing the cervical joints around to be straightened to compensate to the inclination to maintain upfront gaze direction, then posterior head, neck muscle will be shortened and possibly causes protraction of shoulder with compensatory rounding of the back (T. W. Kim et al., 2016). As such, a forward head posture is detrimental to one's posture and general health as our muscular system, joints and body structure's position act as a closed chain and compensates each other when confronting pathological condition.

1.2.3 Scapular Retraction Exercise

The scapular retraction exercise includes the rolling back movements of the shoulder, more specifically, it is the retraction motion of the scapula. Scapular retraction exercise is generally considered as exercises that works on the movement as follow: external rotation, upward rotation, posterior tilt movement of the scapula and the retraction and depression movement of the clavicle (Myers et al., 2010). Given its

wide variety of muscle activation and targeted movement at the scapula and clavicle, it is widely used among clinician to treat shoulder pathologies by training scapular retractor muscle group to hypertrophy and restore normal function, range of movement of shoulder.

1.2.4 Home exercise programme

In this study, the most focused part, which is the intervention that will be carried out includes exercises at home as home exercise program. As home exercise program plays a big part in physiotherapy management of any disease, it is a common type of administration of exercise program. A study looking into the home exercise programs and patient with knee osteoarthritis concluded that home exercise programs improved pain symptoms and functions at the knee joint. Researcher also states that variety of closed-chain and open-chain kinematic exercises are recommended as it is proven effective in a large amount of literature (Anwer et al., 2016).

1.2.5 Ergonomic Advice

In my study, ergonomic advice is used for control group and intervention group as a baseline program for both. Moreover, ergonomic programs are used in several trials in previous study which is included as treatment for work-related complaints which comprises of keyboard adjustment, desk equipment adjustments and bodily ergonomic advice (Verhagen et al., 2009). In terms of forward head posture among university students, ergonomic advice will mainly be focusing on the ergonomics of computer users as majority of university students spend a lot of their time sitting in front of the computer to complete their assignments and academic learning process.

1.2.6 Craniovertebral angle

The craniovertebral angle is one of the common measures to examine the posture of the head. According to evidence of measurement of craniovertebral angle, it is the angle which forms when horizontal imaginary lines crossing from the spinous proves of the seventh cervical (C7) vertebra and another slanted line from the tragus of the ear (Lau et al., 2010). Not only that, individuals with shoulder pathologies, cervical discomfort or neck pain might have further decrease in the craniovertebral angle resulting in smaller angle than normal individual that indicates a forward head posture. Thus, the smaller the craniovertebral angle, the greater the degree of forward head posture.

1.2.7 Photogrammetry

There are a lot of methods to evaluate the forward head posture, through observation, manual measurement by using angle measurement tools like the goniometer. Ultimately, to assess a more accurate craniovertebral angle, an upgraded and reliable method of assessment is needed to further determine the therapeutic intervention clinically, that is the photogrammetry method (Salahzadeh et al., 2014). Photogrammetry method is nothing but using photography method to measure the head posture by measuring the posture of different part of the body using anatomical references (Salahzadeh et al., 2014). In this study, photogrammetry is used to measure the degree of forward head posture. More specifically, the craniovertebral angle is measured by the photogrammetry method by using electronic imaging instruments like the camera or the camera feature in the mobile smartphone (Salahzadeh et al., 2014).

1.2.8 The Prevalence of Forward Head Posture

Prevalence is defined by the proportion of a population who is holding a particular attribute in a specific duration of time. To calculate prevalence as an estimation, researcher choose a sample of smaller group at random from the overall population of interest to determine prevalence. Using random selection techniques, enhances the likelihood that the sample's characteristics resemble those of the population. Prevalence for a representative sample is calculated as the proportion of the sample's overall population that has the characteristic of interest (What Is Prevalence?, n.d.).

Among young adults, majority of them are from the population of student, which is still pursuing undergraduate studies at their current age. With the advancement of technology and smart gadgets and devices, student population especially university students are already long immersed in the environment of smart devices and gadgets. As such, majority of the school related activities, such as assignments, lectures video and tutorials are completed via laptops, smart tablet, or smartphone. From this, university student is considered to have the tendency to spend most hours in a day, locking their eyes on the screen. Not to mention, there is also leisure activities and entertainment such as electronic games, tv series, and movie which is mainly enjoyed by the population of university students. This adds to the total time of electronic device usage. Therefore, it is a hypothesized that the prevalence of forward head posture is high among university students.

In short, postural problems are getting more widespread which are independent of age. Even university students nowadays are getting postural problems

related to erroneous forward head posture and at a young age which they are unaware of (Naz et al., 2018). Hence, an easily accessible and applicable exercise intervention should be investigated and introduced to the public to reduce this worryingly high statistical number of people with this postural problem. All in all, the forward head posture is proved to be prevalent in many groups of populations by the overwhelming statistical value, hence the effects of scapular retraction exercise should be studied to reduce the large amount of forward head posture cases.

1.2.9 Health effects of forward head posture

Knowing the prevalence of forward head posture, it is no longer a trivial matter that can be overlooked as this abnormal posture brings various detrimental long-term health effects to individual. The forward head posture can cause problems that stimulate abnormal changes on the musculoskeletal system such as changes following with age, or to a certain part of body, pain, and the respiratory function (Singh et al., 2020). Furthermore, the chain of reaction of abnormal posture further affects nerve, vessels. Such disturbances will surely affect a student either on their physical and mental well-being, therefore forward head posture must be reduced to prevent this pathological condition from happening.

1.2.10 Cause of forward head posture

Among all the factors that might cause forward head posture, there are environmental factors, body structural factors and habitual factors. Majority of these problems are ultimately caused by the lifestyle and habits that are cultivated by technologies. Nowadays, people cannot live without electronic gadgets in this big environment as electronic gadgets have successfully taken over the world, and every

city citizen living in it by storm, especially the university students. University students tend to spend a lot of time on electronic gadgets for academic purposes, as well as entertainment and communication between friends. Moreover, habitual factors which also plays a major role in development of forward head posture such as the use of mouth breathing. Therefore, the cause of forward head posture should be eradicated to reduce the prevalence of forward head posture individual.

1.2.11 BMI

BMI, in the long form, represents body mass index, the metric that is currently in use for measuring anthropometric height and weight features and for categorizing them into groups. Nowadays, it is frequently understood as an indicator of an individual fatness (Nuttall, 2015).. To add on, it is also globally used as a risk factor for the emergence of or the prevalence of a few health issues. Furthermore, it is frequently employed in formulating public health strategies. BMI's widespread acceptability is expressed in classifying specific categories of body mass as a health concern, it has proved helpful in population-based investigations (Nuttall, 2015).

The limitation of BMI is that it has become more and more worse as a predictor of body fat percentage as BMI also does not record details on the amount of fat in various body parts (Nuttall, 2015). It is also shown that BMI portrays detrimental effect on the cervical health in several past literature (KILINÇ & KARADUMAN, 2021). The stress and strain on and the muscle and joints around the head and neck can cause structural derangements, leading to forward displacement of the head, causing forward head posture.

1.2.12 Physical Activity

Physical activity has a huge impact on an individual health, fitness, and well-being. A physical inactive individual might expose him or herself to various public health problem and thus improving physical activity levels is utmost imperial. Physical activity is defined as the bodily movements that escalate energy expenditure which originates from skeletal muscle contractions (US Department of Health and Human Services, 1996). Physical activity stands as a big part of energy expenditure, and energy balance and body composition in the physical aspect; physical activity can also effectively reduce the risk mental illness such as clinical depression, anxiety, improve self-esteem and elevate the mood (Miles, 2007). Therefore, physical activity such as exercises of retracting the shoulder works to improve bodily posture and ignites the bodily fuel and increases energy expenditure that is crucial to keep individual at bay from majority of the types of illness, physically or mentally.

1.2.13 Rationale of study

As future professionals who are giving care and services to the public and society, the well-being of university students should be sought after as a start of our professionalism and as a part of our responsibility as health care students. With that much of literatures that showed large prevalence of forward head posture in university students, the imperiality of conducting this study to assess the effectiveness of the simple, convenience, easy scapular retraction exercise that is achievable by everyone is not well-known (Naz et al., 2018; Ramalingam & Subramaniam, 2019; Singh et al.,

2020). Also, it is crucial to identify the prevalence of forward head posture in the population of university student, to effectively assess and modify the intervention to be given to treat this pathological condition in the future. As we know that forward head posture brings various detrimental effect to our bodily posture and internal system, the implementation of this study is to reduce the prevalence of forward head posture and hopefully restoring the head and neck posture to a normal alignment with the scapular retraction exercise. Through this study, I wish to study the feasibility of scapular retraction exercises that can be performed easily by everyone anytime, anywhere with minimal equipment. This is to bring up awareness of the forward head problem with this simple exercise intervention. With an effective exercise, this problem can be reduced and improve quality of life. Thus, it is a contribution to future clinical intervention for treating patients with forward head posture. Therefore, the scapular retraction exercise should be experimented to determine the effects on the forward head posture.

1.2.14 Problem Statement

Although studies show large prevalence of people with forward head posture especially in university students, studies were distinctive in study methodology in reviewing the effects of Scapular Retraction Exercise. What's more, studies of scapular retraction exercise which specifically target scapular retractors group on forward head posture is yet to be discovered in Malaysia or other country. If there were a simple, effective, and universal exercise that can be done by anyone, the public will be more aware of this problem thus reducing their pain while contributing to the future clinical intervention of the same problem. Therefore, a study on effect of scapular retraction exercise on forward head posture should be implemented.

1.2.15 Research Question

Can the scapular retraction exercise produce effect on forward head posture among university students?

1.2.16 Concluding Remarks

In a nutshell, this study was conducted to assess the effects of scapular retraction exercise on forward head posture among university students, as well as to find out the prevalence of forward head posture among university students. The forward head posture was assessed through the outcome measures before, during and after the scapular retraction exercises are given to see if there are any effects on the forward head posture. As we know that forward head posture comes with a lot of adverse effects on health and posture, thus it is worthy and crucial to formulate a simple, convenient, and easy exercise intervention to treat this problem. It is seen as more imperial to conduct this study to investigate the effect of scapular retraction exercise on forward head posture to see if exercise intervention might reduce the abnormal alignment of head. This is especially true on the university students, which will in turn breed into greater amount and higher severity of forward head posture in future workplace in a few years' time if awareness and exercise intervention were absent.

1.3 Research Objectives

1. To determine the prevalence of forward head posture among university students.
2. To determine the effect of scapular retraction exercises on forward head posture among university students.

1.4 Hypotheses

$H0_I$: There is no significant effect of scapular retraction exercises on forward head posture among university students.

$HA_{I:}$ There is significant effect of scapular retraction exercises on forward head posture among university students.

1.4.1 Secondary Hypothesis

$H0_{II}$: There is no significant difference between the effects of scapular retraction exercise on forward head posture between male and female university students.

$HA_{II:}$ There is significant difference between the effects of scapular retraction exercise on forward head posture between male and female university students.

1.5 Operational Definition

1. Scapular Retraction Exercise:

Scapular retraction exercises encompass a wide variety of exercises that involves retraction movement and strengthening of the retractor muscles which can be either with or without resistance. Retractors muscle displace shoulder blades medially thus making your shoulders back to upright position (Kirupa et al., 2020).

2. Forward Head Posture:

Forward head posture is the abnormal extended alignment of atlanto-occipital joint and upper cervical spine and the abnormal flexed lower cervical and upper thoracic spine (Mosaad et al., 2020).

3. University Students

Individuals who enrol in a university are classified as university students, age ranging between 17-30 years old (Singh et al., 2020).

1.6 Structure of Research Project

In this research paper, Chapter 1 comprises the background of the study which include all the related backgrounds of the study, research questions, research objectives, importance, and relevance of the study. Subsequently, Chapter 2 follows with the literature review section which is studies that has been done in the past on relevant themes. Then, Chapter 3 highlights the methodology of this research which consist of the research design, ethical approval, sampling design, research instrument, procedure for data collection and data analysis. Chapter 4 exhibits the results of the analyzed data after descriptive and inferential analysis as well as the hypothesis testing. Chapter 5 will be the concluding chapter, encompasses discussion from the findings from the study in accordance with the study objectives, limitation of the study and suggestion for future study.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter overview

This chapter outlines the reviews and surveys of scholarly article, past literature that includes sources such as articles, journals, books, and other sources. Also, critical review of literatures that are related to the topic of my study will be carried out to further derive and develop the problem statements and research questions of my study. The literature review section acts as a foundation for the experimental or analytical section of my study, also to further exhibit an overview of past studies and literatures of topics related to my study.

2.2 The health impacts of forward head posture on university students

Along with the most associated symptoms, which is neck pain, forward head posture also influences cardiovascular system, musculoskeletal systems, and neurological aspects of body (Singh et al., 2020). Breathing problems, occurrence of palpitation, sleep disorders, and numbness in limbs can be present following the posture problem (Singh et al., 2020). Other than that, there is risk of predisposing individuals towards conditions that decreases quality of life including headaches, neck pain, temporomandibular disorders; pathological conditions such as vertebral bodies disorders, alteration of soft-tissue length and strength, disruption of the scapula and shoulder rhythm, dyskinesis of the scapula and shoulder, which may also restrict the activity of daily living (Singh et al., 2020).

2.2.1 Pain

On the topic of pain, a study conducted to evaluate the effects of forward head posture on activity of daily living among students has shown that activity of daily living of the students is affected to some extend with the occurrence of neck pain throughout the day (Singh et al., 2020). According to Im et al. (2016), 60% of individuals with neck pain have the complaints of forward head posture problem. An untreated forward head posture in the long-term loads the posterior cervical structures such as bones, and soft tissue such as ligaments, capsules, and muscles (Im et al., 2016). However, majority of the study portrays the association of forward head posture with neck pain only (Kim. & Kim., 2016; Nejati et al., 2014). A recent study looking into neck pain and rounded shoulder posture clarifies that although rounded shoulder posture may disrupt the neuromuscular balance in the neck, shoulder extensors, which leads to neck pain, but the effect of forward head posture with neck pain will be greater (Ertekin & Günaydın, 2021). If the pain does not subside, university students will fail to concentrate on their academic matters, poor results will affect one's mood, motivation, and mental health. In addition to the constant pain at the cervical region, the mental health of university students also gets affected.

2.2.2 Degenerative changes

In a neglected and severe forward head posture individual, the musculoskeletal condition that might be seen there might be early signs of degenerative changes in the cervical spine, especially around the zygoapophyseal joint that serves as the weight bearing joint (Darnell, 1983). This is the result of reduced disc space when the upper cervical spine bend posteriorly and eventually might compress each other, the occipital nerves might be encroached as well (Darnell, 1983)..

2.2.3 Musculoskeletal and Neurovascular condition

In addition, there are possibilities of manifesting the thoracic outlet syndrome (TOS) symptoms due to elevated tension in the anterior and lateral part of the cervical muscles, causing position changes at the first and second ribs, hence compressing the neurovascular components in the space between collarbone and the first rib (Darnell, 1983). In fact, numbness and hypoesthesia might occur along the lateral aspect of neck and radiates down to the arm. As compression of nervous tissue are concerned, there also may be chances of entrapment neuropathy that will weaken the rhomboids and levator scapulae muscle due to overactivation of the scalene muscles that irritates the dorsal scapula nerve which runs through the scalene muscles (Darnell, 1983).

Consequently, combination of weakened rhomboids and levator scapulae muscle might lead to even severe protraction of shoulder girdle and the scapula (Darnell, 1983). In other words, the formation of rounded shoulder posture is imminent if the shoulder girdle protraction problem is not attended to, resulting in tightness of pectoralis muscles, compressing the neurovascular component nearby, increasing the risk of developing thoracic outlet syndrome again as mentioned above (Darnell, 1983). The neck flexors, levator scapula, sternocleidomastoid, splenius muscle, suboccipitalis, and the erector spinae muscles at the upper thoracic region are maintained in a stretched position, further causing the scapula to be elevated (Darnell, 1983). Not only that, but shoulder girdle protraction might also be constantly maintaining the underlying nervous structure to be in a stretched position such as the suprascapular nerve, exposing it to manifestation of neuropathy (Darnell, 1983).

2.2.4 Mandibular Dysfunction

The forward head posture also affects the mandibular structures. According to a study of forward head posture and mandibular posture, the forward head posture will cause the mandibular position to be in an elevated and retruded position due to the muscle activity of several neck muscle stemming from abnormal extension of occiput at the craniocervical junction (Gonzalez & Manns, 1996). As a result, the previously mentioned elevation and retrusion force acting on the mandible also reduces the physiological freeway space, also known as the space between both surface of tooth between the maxillary and mandibular at resting position of mandible (Johnson et al., 2002). In a forward head position, connective tissues such as tendons are elongated and increased tension of transversal neck muscle such as suprahyoid muscle, further adding to the abnormal elevated, retruded position of mandible (Gonzalez & Manns, 1996). Therefore, it might obstruct the movement and the range of motion of the mandible and causing discomfort.

2.2.5 Respiratory function and thoracic shape

Apart from the above effects, forward head posture can impair the respiratory function. This is due to the exerting tension and weakening of the respiratory muscles, mainly the accessory respiratory muscles such as sternocleidomastoid muscle, scalene muscles, upper trapezius, pectoralis major and thoracolumbar erector spinae muscle (Han et al., 2016; M. S. Kim et al., 2017; Koseki et al., 2019). In a study conducted to test forward head posture and respiratory function, researcher measured the forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1), results show reduced FVC and FEV1 levels in individuals with forward head posture than the individual with normal head posture (Han et al., 2016). The same study also studied

muscle activity of those upper thoracic muscle group stated above and maximal inspiratory and expiratory pressure, which shows decreased for the latter variable due to the reduced activation of the former variable resulting from weakened muscle activity (Han et al., 2016). The decrease in FVC and FEV1 might be the result of exaggerated kyphosis at the upper thoracic region, caused by decreased of thoracic cage volume (Han et al., 2016).

Other than that, there is also another study stating the reduction of respiratory functions and thoracic shape caused by the forward head posture due to the change of expansion and contraction of upper thorax and lower thorax respectively. Subsequently, the decrement to respiratory activity is due to the restricted motion of thoracic during respiration, causing the FEV1 to drop in the previous study (Koseki et al., 2019). Additionally, forward head posture was found to hinder the lower thorax mobility due to the shortening of abdominal muscle, this instead restricts the lower thoracic expansion (Koseki et al., 2019). Therefore, the forward head posture can affect thoracic mobility and thoracic cage volume, thus detrimental effects on respiratory functions.

2.2.7 Brief Conclusion

All in all, on the musculoskeletal aspect, maintaining a prolonged forward head posture can eventually cause muscular imbalance leading to shortening of adjacent muscle and associated elongation of the cervical spine muscles. Moreover, the pain can reduce the quality of life of one without him/her realising its cause and whether he is having any improper posture. There are also studies that are stating that abnormal postures may fasten the process of degenerative changes in the bone and

joint structures later in life (Verma et al., 2018). On the other hand, cardiorespiratory system is disrupted as well by the formation of forward head posture, leading to various abnormal alterations to the thorax and lungs.

2.3 Cause of Forward Head Posture

To delve deeper into the topic of Forward head posture, according to studies that proposed the aetiology of forward head posture, researcher proposed that muscular and soft tissue imbalances is the predominant cause of forward head posture which is ascribable to muscle length-tension relationship changes, weaknesses, and range of motion of surrounding joints (Darnell, 1983). There are 3 main points that will be elaborated in detail regarding the cause of forward head posture, the points are as follow: genetic and environmental factor, mouth breathing, structural compromise in cervical spine (Darnell, 1983).

2.3.1 Genetic and environmental factor

Firstly, the pathological condition of forward head posture is hugely due to musculoskeletal imbalances and postural deformity, and it is believed to have a strong relation to our innate genetic make-up and external environment that we live in (Darnell, 1983). As an example, one can be born with extra vulnerable musculoskeletal system that the body experience changes even faster than normal individual even with stimulations from external environment of a small degree or of a short duration. Moreover, environmental factor comprises occupational work field and daily activities that we do. For instance, jobs that require one to position the head more anterior than the trunk and for a prolonged period and activities and exercises

that majorly focuses on anterior placing of the upper extremities in front of the trunk in the gym. This is said to be even accurate on university students based on an establishment that was formed associating the large number of usages of computer and smart gadgets with the high prevalence of postural problem (Kim et al., 2019). Additionally, a study conducted on work related risk factors of neck, shoulder and upper extremities claimed that neck and shoulder complaints are more prevailing than other parts of the body and these complaints are positively related to faulty head posture and body position associated with work demands (Eltayeb et al., 2009). As we can see, major of the forward head posture is formed due to the pronounced effect of environment, therefore these effects of exercise intervention should be studied to see if there is any reverse on forward head posture.

This anterior placing of head and upper extremities is detrimental to our bodily posture as it places stress on the cervical musculoskeletal structures and further alters its muscle length-tension relationship among the relatively neglected posterior, lateral and the anterior aspect of musculoskeletal structures at the vicinity (Darnell, 1983). Therefore, it is utmost true that the genetic composition and the environment we live in majorly regulates our bodily posture and musculoskeletal composition.

2.3.2 Mouth breathing

Next, researcher also stated that mouth breathing effects largely on upper cervical and thoracic posture, as according to (Darnell, 1983), breathing through mouth causes changes of head and neck posture to meet respiratory needs, at the same time affecting other structures such as lowering position of mandibular, lowering and

placing the tongue more anteriorly than normal individual and exaggerate activation of accessory muscles of breathing such as the scalene muscle. As a result, the origin of scalene muscle gets pulled forward at the upper and middle cervical region resulting in an anteriorly placed head position than the trunk.

2.3.3 Structural compromise of cervical spine

From the previous cause of forward head posture, it all contributes to the structural compromise in cervical spine. When the cervical spine is displaced more anterior than the trunk, the head droops anteriorly and slightly inferiorly, the body will compromise its normal structure to ensure the body's functionality to have the ability to carry out daily life functions (Darnell, 1983). With that, one's face and visual gaze will not be in the optimal position to see the surroundings normally. As a matter of fact, a chain of compensation of musculoskeletal structures occurs starting from the strong posterior cervical muscles contracts by pulling the occiput bone back in upright position, followed by the compensatory action of the upper thoracic and lower cervical vertebra which bend forward, creating a hump or exaggerated kyphosis at the cervicothoracic portion of the spine (Darnell, 1983).

2.4 Effects of Scapular Retraction Exercises on Forward Head Posture

Researchers conduct studies with varying scapular retraction exercises and shows significant improvement on forward head posture (Kim et al., 2016, Kirupa et al., 2020). Scapular Retraction Exercises encompasses a wide variety of exercises that involves retraction movement of the back and shoulder muscles which can be either with or without resistance. However, the literature in examining the effectiveness of

scapular retraction exercise in treating forward head posture are still scarce, there are only 2 of the articles that test the effectiveness of the exercise. In both of those studies in the past, there are difference in study methodology, which includes different study populations, exercise intensity and study settings. (Kim et al., 2016, Kirupa et al., 2020). There are several latest articles that are related to forward head posture and scapular retraction which will be brought into discussion that addresses the differences stated above. (Kim et al., 2016, Kirupa et al., 2020).

Firstly, there are two studies that uses scapular retraction exercise which solely focuses on forward head posture. From one of the studies, according to Kim et al. (2016), the intervention utilizes elastic band in performing all shoulder planes exercise which includes scapular external rotation exercises, also considered as a scapular retraction exercise. This study shows significant improvement in craniovertebral angle which shows reduction in forward head posture (Kim et al., 2016). However, the outcome might vary if the exercises is done for a long period instead of only done once as it has been done in this study before assessing the data. In addition, the significant increase in craniovertebral angle (CVA) that indicates improvement of forward head posture is inaccurate in this study which consists of a mixture of exercise of all planes of shoulder instead of just retraction exercise. Thus, the exercises in this study which comprises elements of scapular retraction exercise can be simulated in the intended study to examine whether the result will be same with altered exercise duration while solely uses scapular retraction-specific exercises in addressing forward head posture and pain.

Moving on to the second study from Kirupa et al., (2020), it also uses scapular

retraction exercise in addressing the forward head posture as well and obtained great outcome in improving the forward head posture. Comparing to the intended study, the outcome of study might vary due to the group or populations of study and the location of study. In this study, researcher specifically picked population of IT workers to conduct their study, whereas all the study subject populations are locally from India. Due to fact that is stated previously, IT workers works for longer hours, thus they tend to maintain in static posture of the neck and shoulder longer than university students. IT workers are also seen to be holding their head in forward position longer than university students due to the job nature for them to better see the data on the computer screen. Next, the IT workers which are from India might be having a different working ethics, work hours or muscle strengthening capacity, this might lead to more rapid or greater extend of postural change in study subject in different country. Therefore, this study is decent in producing results but there are several points that might affect the outcome if it is done here in Malaysia, also by using the population of university students.

Overall, it is convinced of scapular retraction exercises is valid in producing improvements mostly in forward head posture. However, evidence related to the efficacy of scapular retraction exercises on forward head posture were still limited except for only 2 of those reviewed articles. Not only that, number of studies of scapular retraction exercise in addressing this forward head problem is not saturated. Therefore, since previous studies both showed significant effects on forward head posture, it is also important to look at the changes or effects in the forward head posture by following a study including exercise intervention of different methodology. All in all, scapular retraction exercises must be experimented on both

forward head and to determine its effects and whether this simple and convenient exercise are applicable in this pathological condition.

2.5 Duration of exercise intervention on forward head posture

There are mounting evidence showing that 4 weeks exercise intervention that created a significant effect in forward head posture, although some of their study utilizes different exercises, like scapular stabilization exercise, which is like scapular retraction exercise (Im et al., 2016; Kang et al., 2018). Also, another exercise, which is the elastic band exercise intervention, also showed significant effect on treating forward head posture in 4 weeks duration (T. W. Kim et al., 2016; Nitayarak & Charntaraviroj, 2021).

Other than that, there are also limited study proving that 2 week of exercise intervention make significant difference on outcome measure. A study of using chest exercise on posture, another study with 2 weeks Kendall exercise program on postural problems shows some significance in correcting the posture (Diab & Moustafa, 2012; DiVeta et al., 1990).

All in all, 4 weeks of exercise intervention has significant effects in forward head posture has been shown other study, therefore, it is also interesting to investigate the effects of scapular retraction exercise as an exercise intervention in this study to produces similar significant results in 2 weeks duration.

2.6 Muscle activity and intervention exercise on forward head posture

Forward head posture is formed due to imbalance of the length tension relationship of muscles (Im et al., 2016). Simple retraction exercise can strengthen muscles that are week and regulate the unbalanced muscle tension and strength. As

suggested by Im et al. (2016), weak and lengthened muscles in forward head are the deep neck flexors and scapular stabilizers and retractors which includes rhomboids, infraspinatus, middle and lower trapezius whereas the tight and shortened muscles are the deep upper cervical extensors, upper trapezius, pectoralis major, pectoralis minor and levator scapula. Not only that, the shortening of the posterior neck extensors, tightening of the anterior neck and shoulder muscles also included in the whole chain of abnormal muscle activation. As such, an effective scapular retraction exercise should focus on the weak middle and lower trapezius but not the already tight upper trapezius.

2.6.1 The 0° resistive band bilateral external rotation exercise

In addition, studies reporting that performing scapular retraction exercises in different angle in the shoulder abducted position will greatly affects the trapezius muscle activation levels (Fennell et al., 2016; Kara et al., 2019). Subsequently, evidence has clarified that only activating middle and lower trapezius in scapular retraction exercises but not activating upper trapezius is achievable by performing retraction at 0° shoulder abduction which satisfy the statement above by only selectively strengthening the weak muscles (Kara et al., 2019). However, there are two of the studies that proves that scapular retraction exercises performed in 90° shoulder abduction also provide more activation of trapezius muscle but not specified to which part of trapezius muscle (Fennell et al., 2016). As such, to prevent the activation of upper trapezius muscle activation, the 90° shoulder abducted scapular retraction exercise cannot be included in the study as one of the interventions. On the other hand, one study that uses the 0° resistive band bilateral external rotation exercise also stated that this exercise is mainly focusing on the middle trapezius and

rhomboids muscle (Nitayarak & Charntaraviroj, 2021)

As a continuation to the statement above, according to Ronai (2018), bilateral scapular exercise of 0° shoulder abduction is beneficial in improving upper body posture, especially with resisted instruments. As such, the bilateral external rotation exercise should be done with resisted band at 0° shoulder abduction angle. This series of exercises is repeatable as several studies used this exercise as their intervention method in their study to treat postural problem (M.-K. Kim et al., 2018; Wang et al., 1999)

2.6.2 Elastic Band exercise on Forward Head Posture

Among all the scapular retraction exercise, there are instrument resisted and non-instrument resisted exercise. The instrument resisted scapular resisted exercise that utilize elastic band is considered as more effective in increasing muscle strength, muscle function and provide lower risk of injury than bare body resistance exercise (Ha & Sung, 2021). In addition, muscle strength, muscle flexibility, and balance can be enhanced by the elastic band scapular strengthening resisted exercise as it is an effective exercise intervention for more easy strength and resistance control (Liao et al., 2018).

The elastic band resisted scapular strengthening exercises has been implemented in the past studies by several researchers, with different population and outcome measures. In both studies, the outcome measures and study population were very specific in their own respective aspects. In the study of (Ha & Sung, 2021), the outcome measure of the conducted study was the scapular strengthening exercise on balance and quality of life, whereas the study population was conducted among the

elderly population. Next, a study conducted by Liao et al. (2018), focuses on lean mass and physical capacity with a specific obesity with a very specific population, which is older women with sarcopenic obesity. Moving to their study results, both studies show significant beneficial effect on their respective outcome measures, which comprises muscle mass, muscle quality, physical function, and improvement in balance and quality of life in their own respective population.

As mentioned earlier, both studies have some similarity in using the scapular retraction exercise with the elastic band, but only with different targeted population. In both studies, both researchers exhibit the tendency to conduct their studies in elderly population, especially one specific population with high risk of sarcopenia and decreased properties of muscle fibers. If the exercise capacity and frequency of the elder person is low, it is obviously harder to maintain the gradually decreasing muscle properties of elderly population. As one ages, loss of muscle mass, muscle strength and function is imminent which signifies changes in the properties of muscle fibers (D'Antona et al., 2007). On the contrary, as past studies has not cover contents relating to university students which age ranges form 17-30 years old, it is my scope of study to determine the effects of scapular retraction exercise using elastic band in university student which is not classified into the age group of elderly population.

2.6.3 Retraction Overhead exercise

On the other hand, shrugging exercises that are proved to be effective in activating the medial scapular muscles to elevate the drooping shoulder. The choice of exercise is the 'Retraction Overhead' exercise because it is the most effective exercise among other 2 shrugging exercises conducted by researcher in activating medial

scapular muscles especially the rhomboid muscle, middle trapezius, and lower trapezius (Castelein et al., 2016). However, it is contradicted in another study which states that strengthening exercise of scapular retractors selectively activates middle trapezius but less of rhomboid muscle, as they claim that inferior rotation of rhomboid muscle aggravates symptoms in patient with existing shoulder impingement (Fennell et al., 2016). However, this afore mentioned study can be heeded when performing scapular retraction exercise on shoulder impingement patient in the future, but it does not affect this study which exclusion criteria includes participant with shoulder impingement, therefore the safety of this exercise is presumed.

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2.6.4 Elbow push back exercise

The elbow push back exercise, also called as the reverse elbow push up exercise, is only used by a single study to assess the forward head posture. According to Kirupa et al. (2020), it is administered to participants of their study in turn to investigate the effectiveness towards treating postural problem.

2.6.5 Pectoralis wall stretch exercise

The pectoralis wall stretch exercise, is an easily and convenient stretching exercise that can be done anywhere if there is a wall at the corner. Based on an experimental study related to effect of exercise on scapular kinematics and functions, the pectoralis wall stretch is used in the study (Camargo et al., 2015; Moezy et al., 2014; Wang et al., 1999) According to the author, the stretches are picked based on evidence of increasing activation of the upper trapezius, pectoralis minor muscle in the form of stretching(Camargo et al., 2015).

2.6.6 Scapular retraction activation exercise

The scapular retraction activation exercise is a scapular retractor strengthening exercise that aims at certain groups of back muscle that are related to the muscles connecting to the scapula and the shoulder complex (Myers et al., 2010). This exercise is modified based on various article using this strengthening exercise during its training program to explore scapular muscle activity and solve shoulder posture problems as a mean of intervention (Kirupa et al., 2020; Myers et al., 2010). According to (Ruivo et al., 2017), the middle trapezius, lower trapezius and serratus anterior is also activated respectively when the scapulae is retracted when the arms abducted to 90°.

2.7 Brief conclusion

As discussed above, there are still some confusions among scapular retraction exercises that are both safe and effective to be performed clinically and as a long-term exercise. All previously mentioned study only accounted for the activation of certain muscles and their activity and pointed out the most effective shoulder retraction exercises. There is no indication or any relation of these effective exercise with improvement on forward head posture. Therefore, shoulder retraction exercises with these specific suggestions provided from these articles are to be implemented to evaluate the effects on people with forward head posture. Therefore, after presented with literature, the scapular retraction exercises are as follow: the retraction overhead exercise, 0° resistive band bilateral external rotation exercise, elbow push out exercise, scapular retractor activation, the pectoralis wall stretches.

CHAPTER 3

METHODS

3.1 Chapter overview

This chapter will outline the research methodology used, highlighting the research design, sampling design, ethical approval, research instrument and procedure in detail.

3.2 Research Design

The research design for this study was an experimental study design, with an AB design, comparing both groups. This study design consists of 2 groups, an intervention group, and a control group.

3.2.1 Sampling Method

Sampling method was randomization method, participant was allocated into these 2 groups using application in mobile power at a 1:1 allocation ratio. As such, the sampling method was convenience sampling method. This method is a non-probability method which selection of participant is according to the accessible population with advantages like timesaving, convenient, quick, and cost-effective (Elfil & Negida, 2019).The researcher and participants are not blinded due to limited

time and resources during data collection, but the statistical analysis was carried out with blinding of researcher.

3.2.2 Study settings

The study settings, including the recruitment sites were at KA block and KB block of University of Tunku Abdul Rahman, Sungai Long Campus in Selangor, Malaysia. In addition, the study population was university students of all faculties enrolled at University of Tunku Abdul Rahman, Sungai Long Campus, and all other universities in Malaysia.

3.2.3 Subjects

This study also requires 60 participants which is derived from the sampling size calculation. Individuals who are either male or female students, age ranging from 17-30 years old, enrolled in any certified course in UTAR Sungai Long campus or other universities in Malaysia, are all participants of interest. In addition, participant must also be determined of the forward head posture by photogrammetry to be counted in the study. At the time of actual study, 63 participants were recruited, 3 participants rejected, but there were 6 dropouts cumulated at the end of study.

3.3 Ethical Approval

At the time of recruitment, participants were required to read through the consent form and give their consent. After that, their demographic data were provided

after explanation of the study details. This study was performed after obtaining the ethical approval from the Scientific and Ethical Review Committees (SERC) of UTAR (refer to Appendix A). Confidentiality of participants was ensured.

3.4 Sampling Design

In this study, the participant of interest were university students in Malaysia. By using G*Power version 3.1.9.2, ‘t tests’ has been selected in test family with statistical test types as follow: ‘Means: Difference between two independent means (two groups)’. The paired t test and unpaired t test or the independent t-test are included to see difference within group and difference between group. Next, the input parameters settings include two tails with ‘effect size dz’ of 0.6, alpha error problem of 0.05 and power of 0.7. The allocation ratio N2/N1 is 1. The total sample size of group 1 after calculation shows minimum of 27 participants, while sample size of group 2 after calculation shows minimum of 27 participants. The final sample size will be adding 10% of 27 participants, becoming 30 participants in both group 1 and group 2. Therefore, the finalized sample size is 60 participants.

3.4.1 Inclusion Criteria

1. Male or female students enrolled in a certified course of UTAR Sungai Long Campus.
2. Participant of age ranging between 17-30 years old. (Singh et al., 2020)
3. Individuals with Forward Head Posture determined by photogrammetry (Ertekin & Günaydın, 2021)

3.4.2 Exclusion Criteria

1. Individuals with history of spine injury in the past 6 months.
2. Individuals with history of traumatic shoulder injury in the past 6 months (Fennell et al., 2016).
3. Pregnant women.

Individuals that had history of spine injury and traumatic shoulder injury should be exempted due to the nature of shoulder retraction exercises which will aggravate their symptoms as this exercise lead to hypertrophy of the muscles. Pregnancy, cognitive disabilities, and metal implants are absolutely contraindicated and should be excluded in this study because the risk of occurrence of any unwanted consequences will deal massive damage to the body and brings severe impact to the individual.

3.5 Research Instruments

The instruments used in this study is included in the section below. The apparatus and instruments used includes the photogrammetry and all of its included apparatus.

3.5.1 Photogrammetry

The research instrument that is used in the study is the photogrammetry method. The photogrammetry is a type of assessment which utilizes linear distances and angles between plotted points on a participant body to assess any posture deviation. Lines are connected by body markers which will be plotted by the assessor and a digital photograph will be taken. Then, the photograph will then undergo

analysis by a postural analysis system (PAS). The photogrammetry method is a convenient, simple assessment method which is non-invasive and does not require hard-copy printed photographs to generate analysis.

Regarding the reliability and validity of the instruments, the photogrammetry method is considered as one of the Electronic Head Posture Instrument (EHPI) in measuring the craniovertebral angle (CV) angle. According to a cross-sectional reliability study, the intra-rater (intra-class correlation coefficient (ICC = 0.86 -0.94) and inter-rater (ICC = 0.85-0.91) reliability of the EHPI in assessing the CV angle was considered as high. (Cheung Lau et al., 2009).

Moving on to the measurement, the postural angles such as the craniovertebral angle (CVA) or cervical angle (CA) are reviewed to be suitable in measuring forward head posture (Singla et al., 2017). The digital photograph comprises the photo of the individual's head posture taken by the photogrammetry method is used generate analysis and interpretation of the postural angles. Subsequently, the posture analysis system (PAS) that is going to be used in the photogrammetry method to produce result is the Kinovea software.

With that. the Kinovea software is a completely free computer software designed for sport analysis. A study has been conducted mainly about the Kinovea software and shows high intrarater and interrater reliability (ICC = 0.985-0.997) (Elwardany et al., 2015).

3.5.2 Mobile phone camera

A mobile phone camera is being used to capture pre-test, post-treatment data. The Redmi Note 11 Pro plus 5g Camera (108MP camera) is used to take lateral photographs of participant in the pre-treatment as well as the post-treatment to assess posture as previous study demonstrated (Nitayarak & Charntaraviroj, 2021; Singh et al., 2020).

3.5.3 Camera tripod stand

Next, a camera tripod stand is being used to standardize the camera position. Camera tripod stand is used support the Camera and to place camera at the appropriate position for taking photographs.

3.5.4 Masking Tapes

Masking tapes are used as a vertical line for participant to position their standing place to fit in the frame of the camera appropriately.

3.5.5 Color Stickers

Round shaped, colored, small size stickers were used to label the anatomical landmarks on participant before taking the head posture photo.

3.5.6 Resistant elastic band

During the intervention, a resistant elastic band are used to perform the scapular Retraction Exercises or to provide progression for the exercises to increase resistance.

3.5.7 Yoga mat

Yoga mats are used for exercises that requires lying position to protect participants from foreign object of the floor and keeping the hygiene of the floor for participant that wishes to complete the exercise in physio center.

3.5.8 Appendix

Ethical Approval form (Appendix A), Informed consent form (Appendix B), Personal Data Protection notice (Appendix C), and followed in the second section which required the participants to indicate their will to participate in the study. The third section pertains to the demographic data (Appendix D), which was collected such as Age, Gender, Race/Ethnicity. The fourth section comprises of visual infographics of scapular retraction exercise (Appendix E). The fifth section comprises of ergonomic advice infographic for control group (Appendix F). The sixth section comprises of IPAQ questionnaire and electronic device usage time questionnaire (APPENDIX G**).** The seventh section comprises of Turnitin report (Appendix H).

3.6 Procedure

After the ethical approval by the UTAR Scientific and Ethical Review Committee was received, researcher proceeded to approach as many students as possible around the university campus to ask for participation in the research study. Subjects were recruited from every faculty possible in UTAR Sungai Long through online publicization, physical request and word of mouth. Students that were considered as exclusion criteria were that of with history of spine injury and history of traumatic shoulder injury in the past 6 months, pregnant females. Through convenience sampling, participants are recruited in UTAR Sungai Long Campus and other universities through face-to-face method, social media publicization, such as

WhatsApp, Instagram, Facebook. After being notified about the nature and details of study, informed consent was obtained from each participant and were given a form to leave their names and contact numbers for future communication purpose and calculation of prevalence of forward head posture as one of the secondary objectives.

The study utilized social media platforms such as WhatsApp, Facebook, Instagram to recruit participants for data collection via meeting participant physically to do the pre-test. The participants of interest were majority of UTAR students that were still pursuing their studies in their field of interest at the time of recruitment. The recruitment of participant lasted for 1 week via face-to-face method. The experiment was done in a duration of 4 weeks after recruitment as home-based exercise.

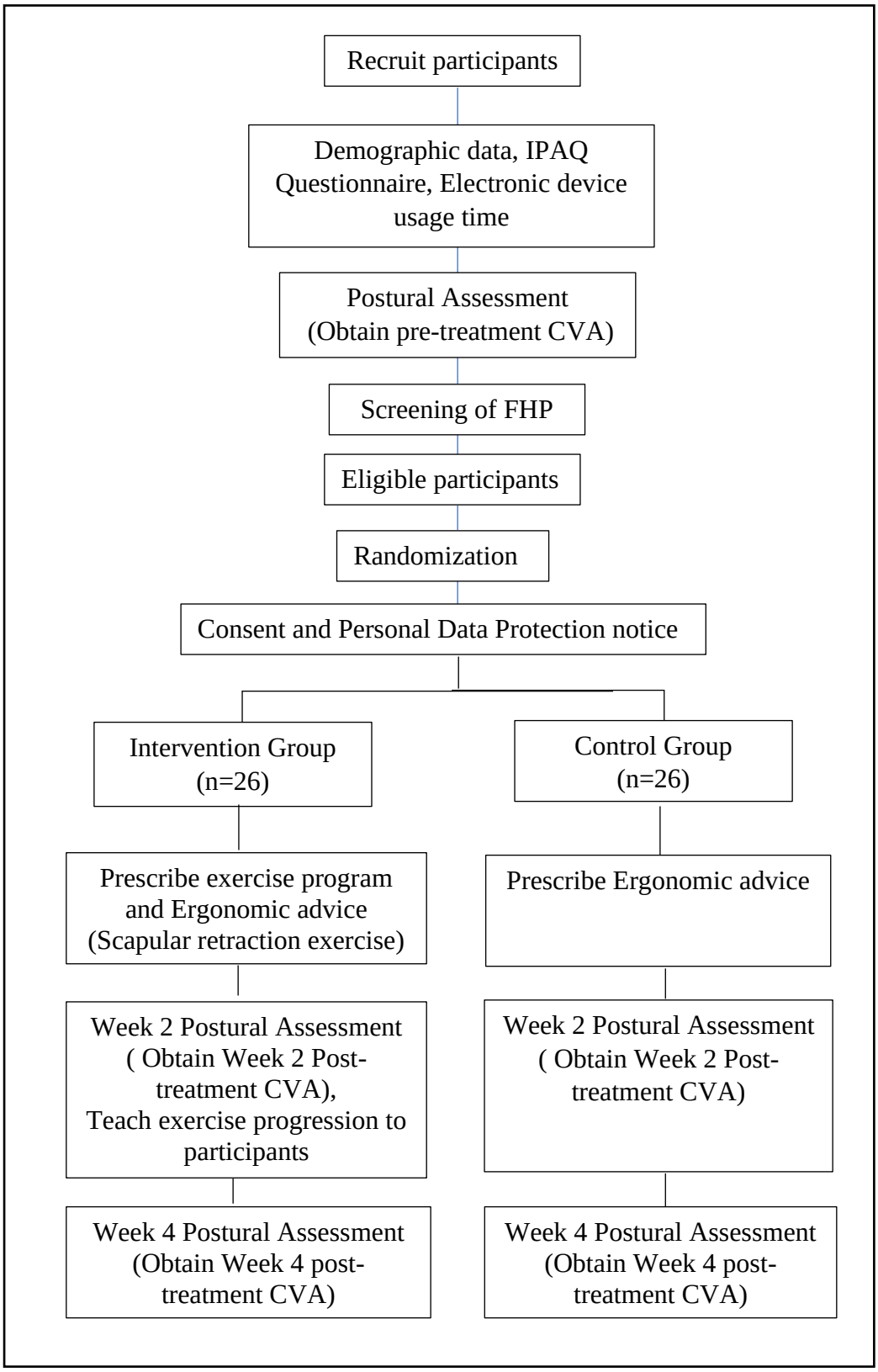

Figure 3.1: Study procedure

3.6.1 Initial assessment

At the first approach, the participants are met physically to obtain their pre-treatment data with the photogrammetry techniques as a mean of screening for forward head posture. All these photos taken with the photogrammetry method are taken back to be assessed with the postural analysis system (PAS). The Postural alignment assessment will be used to identify individuals to determine their qualification for the requirements of inclusion criteria. Participants that fulfilled the inclusion criteria for forward head posture are recruited. Then, participants who qualified were given questionnaires to fill in. The questionnaire are as follows

I. Demographic data (Appendix D)

II. Informed consent form (Appendix B)

III. Personal data protection form (Appendix C)

Participants are required to fill up both section and to go through the information in the inform consent form in detail and give their consent.

3.6.2 Postural Assessment

In the pre-treatment of postural alignment assessment, the cervical angle (CA) or the craniovertebral angle will be assessed. The mobile phone camera will be used to take lateral view photographs (Nitayarak & Charntaraviroj, 2021). The digital imaging instrument, the mobile phone camera was placed at 150 cm on a tripod stand. The height was adjusted according to the level of the subject's shoulder(Nitin Worlikar & Rajesh Shah, 2019). Therefore, the level of camera is not fixed, it depends on the height of the participant. Then, the camera is always placed 300cm from a foot marker, which is the standing point of participant. The subject was asked to stand in

front of camera, to stand facing straight and lateral to camera. The foot marker will be placed in front of a wall with 25 cm apart. A 20 cm long masking tape segment will be pasted on the wall which serves as the reference line of participants when they are taking side-view photographs

Subjects were asked to look up and down at their head and neck into flexion and extension to the full range and gradually reduce the motion, then maintained the head and neck in the participant's natural position. Next, they were then instructed to assume their natural standing position. Participants will be asked to stand on the foot marker with both of their arms placed beside their body and place their feet according to their shoulder width. Next, a 20 cm long masking tape segment served as the reference line of participants when they are taking side-view photographs. The importance of standing in natural posture during the photo-taking session was explained by the researcher.

Investigator will place a colored sticker as a marker at the tragus of the ear, C7 Spinous process once the participant had adjusted optimal position to be photographed. The landmarks were palpated by researcher by locating the C7 spinous process by asking the subject to move the cervical spine into flexion and extension. As such, the C7 spinous process is more prominent in palpation, while another less prominent landmark is the C6 spinous process will disappear when subjects put the head back into extension to the normal position of head. At the same time, subject was asked to look in front at a distance point.

3.6.3 Screening for Forward head posture

By using the Kinovea software, forward head posture will be tested positive if the craniovertebral angle, also known as the cervical angle, is less than 53º (Singh et al., 2020). The CA is formed between the line drawn horizontally through the C7 spinous process and the line formed between the tragus of the ear and the C7 spinous process (Ruivo et al., 2014).

3.6.4 Exercise Intervention

After identification of forward head posture sample as participants of this study, randomized allocation of 1:1 ratio into 2 groups were carried out, mainly the intervention and control group. Within the control and intervention group, subjects in the control group consists of giving participants simple ergonomic advice by showing a visual poster of correct and recommended posture (Appendix F).

On the other hand, same as the control group, the intervention group consists of giving participants simple ergonomic advice on the desk front through a visual poster of standard recommended posture for good ergonomics with visual handout, plus giving the scapular retraction exercises. Thus, these 2 groups will be compared. Researchers proceed to teach participant in the intervention group about the correct way to perform the exercises as the intervention. Each exercise intervention was formulated in a list with given description and illustrations. Participants were required to demonstrate the exercise once more after teaching to ensure they had the ability to carry out all the exercises at home correctly.

The intervention group participants were asked to perform scapular retraction

exercise which consists of 5 different exercises. Firstly, participant will go through a series of shoulder dynamic warm-up exercises adapted from Summit Orthopedics (n.d.), which comprises:

1. Circular arm swing in clockwise and anti-clockwise direction in standing position.
2. Shoulder rolls forward and backward.
3. Overhead motion, to the front and to the side.

There was a 1-minute interval or rest time for participants in between each of the 5 scapular retraction exercises. Dosage with home program exercise with scapular retraction exercise are as follow:

1. All the 5 exercises must be done for 3 days per week, for the whole 4 weeks duration,
2. All the 5 exercises must be done for 2 sets per 1 day of 10 repetitions per set.
3. Next, 1 rest day in alternate is allowed, therefore a minimum of 6 sessions should be done in every week (Kirupa et al., 2019).

There will be progression to the scapular retraction exercise at the middle of the whole study period, at the end of week 2. The progression of exercise is as follow:

1. Five more repetitions were added for the last 2 weeks as progression for all 4 scapular retraction exercise excluding the pectoralis wall stretch exercise.

2. The hold interval is increased to 5 seconds with the increment in repetitions as progression for all 4 scapular retraction exercise excluding the pectoralis wall stretch exercise.
3. One more extra set for the pectoralis wall stretch exercise is added.
4. Decrease of rest interval from 1 minutes to 30 seconds between each repetition.

In addition, there was an exercise log given in a calendar format for participant to document and jot down the day that they had done the exercises, a total of 3 'ticks' should be recorded in every week. Also, after 2 weeks, they are required to return for follow-up to check the exercise techniques and update participants about exercise progression, if appropriate.

3.6.5 Control Program

Subjects that were in the control group did not participate in the exercise program that comprises all the scapular retraction exercise. However, same as the intervention group, they were given simple ergonomic advice on the desk front through a visual poster of standard recommended posture for good ergonomics and were instructed to continue with their daily routines (Appendix F).

3.6.6 Other assessment measures at baseline

The IPAQ Questionnaire (short form) was given to find out the participants physical activity by categorical score. Next, 3 questions about electronic device usage time were included to assess participants usage time on electronic devices (Appendix G).

3.6.8 Exercise Compliance

The compliance rate was calculated from the exercise logs. Verbal assurance was also done to participants to check whether they are properly following the exercise program. From the words of participants, some of them complaint about their busy schedule and would miss some of the days to perform the exercises, but they will certainly replace the exercises on another day to sum up to a total of 3 session of exercise done per week (Appendix E).

3.6.9 Exercise program

Firstly, the prone scapular retraction activation exercise from Kirupa et al., (2019). Participant be in the prone lying position. First, participant is required to slightly extend the head and tuck in the chin to touch the chest, both arms can be abducted maintaining elbow straight. In this position, raise the shoulder from the floor and hold for 3 seconds (Refer to Appendix E for illustrations). For progression, the hold can be extended to 5 seconds or an increase in repetitions.

After that, the first exercise is the Retraction Overhead Exercise adapted from a study in 2016 (Castelein et al., 2016). Participant will first measure their distance with the wall by standing in front of it. The distance is appropriate when the tips of fingers are in contact with the wall with both arms placed neutrally beside the body with elbow flexed in 90º, wrist and fingers in neutral position. Participants are instructed to lift their arm above the head placing their arm against the wall. Participant are instructed to retract their shoulder and hold that position for 3 seconds and return to normal position for 3 seconds, repeat the cycle according to the dosage stated above (refer Appendix E for illustrations). Progression of this exercise is to

wrap a resistance band around the arm while performing arm lift.

Then, the elbow push back exercise adapted from Kirupa et.al., (2019). Participant is required to be in crook lying position while keeping the shoulder in 90-degree abduction, arm in external rotation. Participant is required to push back against the floor with elbow and raise the head. Make sure to keep knees bent and feet flat on the floor and push only through your elbows. The shoulder is retracted in this position and maintain this movement for 3 seconds and relaxed (Refer to Appendix E for illustrations). Alternately, this exercise can be done at a surface of the wall by keeping elbow at both sides of wall and contract to bring the upper body forward while shortening distance between 2 elbows by retracting the scapular. Progression can be given for a hold of 5 seconds or an increase in repetitions.

Next, participant will be required to perform the bilateral scapular external rotation exercise with resistive band in 0º shoulder abduction which is adapted from Ronai (2018) as the bilateral shoulder retraction and shoulder external rotation (BSRSER) exercise. For the 0º shoulder abduction scapular external rotation exercise, the starting position is in upright standing position, chin slightly tucked in, participants are required to relax their shoulder and place their arms beside their body neutrally with elbow flexed at 90º, forearm in mid prone position while grasping a resistance band (Refer to Appendix E for illustrations). Position of arm beside of body so elbows pressing gently against mid axillary line of thorax and maintained at same angle of elbow flexion throughout the exercise. Participants should hold the outward maximal contracted external rotation position for 3 seconds and slowly return to the starting position with eccentric contractions for 3 seconds. According to Ronai

(2018), lower, middle trapezius, rhomboids, teres minor, infraspinatus are all activated with these set of exercises.

Lastly, the pectoralis stretch is also adapted from Wang et al. (1999) which acts as a concluding exercise which mainly targets to stretch the tight pectoralis muscle. Participants are instructed to perform 90º shoulder abduction with 90º elbow flexion in this exercise at any corner or any door frame for 10 seconds with 5 repetition, 5 more repetitions are added for the last intervention week (Refer to Appendix E for illustrations). Subjects were instructed to place their hands above their head on the adjacent comer walls, lean forward into the comer, and hold the stretch for 10 seconds for each of 5 repetitions. Five more repetitions were added every 2 weeks.

This set of scapular retraction exercises which comprises of 4 separate exercises will be performed by participants for an intervention duration of 4 weeks. The concluding exercise will be the pectoralis stretch. The total exercise duration will take about 15 minutes. After every 1 week of intervention, all participants are required to perform a post-treatment which includes the photogrammetry for assessing the forward head posture respectively. The post-treatment procedure is the same as the pre-test. All the data will be recorded in a tabulated form and the comparison of pre-treatment and post-treatment data can be made to determine whether if there is any reduction of forward head posture problem.

3.7 Data analysis

Demographic data such as age, gender, year of study and body mass index (BMI); baseline characteristics of participants such as the pre-treatment craniovertebral angle, level of physical activity and electronic device usage time were included into the calculation of descriptive statistic to generate standard deviation (SD) and mean (M). The collected data was tabulated and analyzed using IBM Statistical Package for the Social Science (SPSS) software of version 26.0 and Microsoft Excel to produce outcome results. The Shapiro-Wilk test is used to test for normality of result data. The paired t-test is used to assess the pre-treatment and post-treatment result generated among the participants in the single treatment group. The independent t-test is used to assess the differences of mean score of post-treatment result data in between two groups, such as gender.

CHAPTER 4

RESULTS

4.1 Chapter overview

This chapter will mainly showcase the findings and results obtained and derived from the data collection process in this research project. Firstly, prevalence of forward head posture in university students will be exhibited. Then, the demographic information of participants was illustrated. Next, the results of the inferential tests are discussed, consisting of the paired t-test and independent t-test, thereafter the hypothesis testing is discussed. In the sections that are displaying the findings, all relevant graphs are provided in order, followed by a brief explanation of the illustration of data and finally a concluding tabulation of data that sums up the section. All data were presented in comparison of both groups including the table and graphs.

There were 60 collected data from participants which all of them were already given their consent to run the analysis of data from the start of study. Unfortunately, there were 8 dropouts from this study, 4 from control group and another 4 from the intervention group, resulting in 26 and 26 of final participants respectively. Among all the dropout participant, 6 participants discontinued, 2 of them could not make it to the post-treatment period due to Covid-19 infection; another one went back to his hometown during the period due to emergency matters.

4.2 Prevalence of forward head posture in university students

Table 4.1 Prevalence of forward head posture

	Prevalence			
	Amount of sample with characteristic of interest	**Total number of samples**	**Prevalence**	**Percentage Prevalence (%)**
University Student with FHP	**63**	**130**	**0.48**	**48%**

*FHP = Forward Head Posture

The prevalence of forward head posture was intended to be determined as one of the objectives. The data collected were all only university students in UTAR. There was a total of approximately 22000 students in UTAR and only 130 university students among them were recruited to test for presence of forward head posture using the photogrammetry method. 63 university students were found positive for forward head posture (Table 4.9). The formula of calculation for prevalence is shown in Figure 4.1. The prevalence equals to the amount of people with the characteristic in sample, divided by the sum amount of people in sample of interest (What Is Prevalence? n.d.). In conclusion, the prevalence of forward head posture in university students of UTAR is 48%.

$$\text{Prevalence} = \frac{\text{\# of people in sample with characteristic}}{\text{Total \# of people in sample}}$$

Figure 4.1 Formula of Prevalence

4.3 Demographic of population

This section comprises of demographic information of the participants in the form of graphs, descriptions, and table form to wrap up the section.

4.3.1 Age

Figure 4.1 illustrates the distribution of age of participants in the intervention group in this study, while figure 4.2 illustrate the distribution of age of participant in the control group in this study. The age group range is 17-23 years old for all participants including the intervention group and the control group.

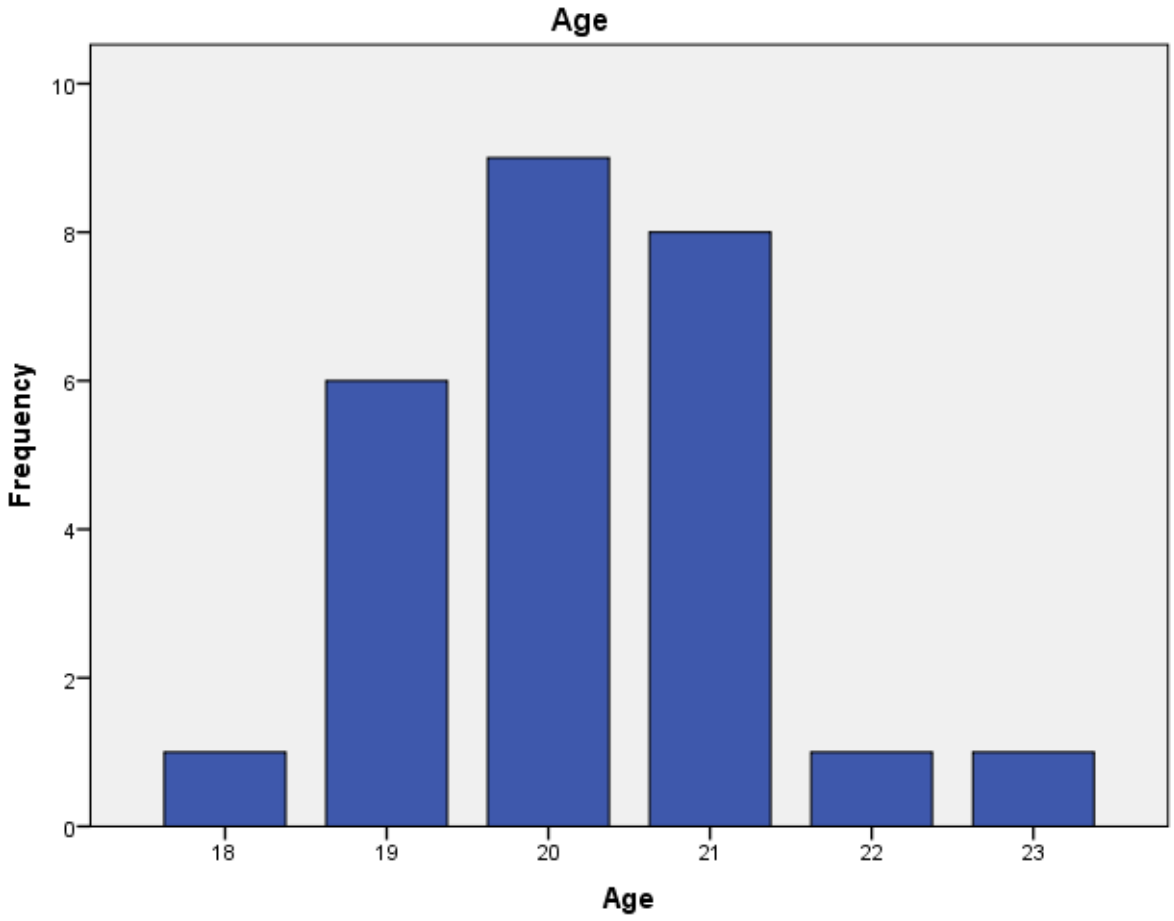

Figure 4.2 Age of participants in intervention group

In the calculation of age in intervention group participant shown in figure 4.1, results showed a mean of 20.19 (SD = 1.10) years, respectively (Table 4.1). The youngest participant is 18 years old, which only consists of 1 of them in this study, accounting for 3.8% among all participants. On the other hand, the oldest participant age is 23 years old, a percentage of 3.8 % was jotted down which shows 1 participant. Next, there were 6 of 19 years old participants, 9 of 20 years old participants, which covers 23.1% and 34.6% respectively of total participant. Subsequently, the 20 years old participant is represented as 34.6% in total population recorded at 9 participants. Then, 8 of 21 years old participants and 1 of 22 years old participants were noted, which constitute the final 30.8% and 3.8% of the participant. Majority of participants in the control group is 20 years old and minority of participants is 18, 22 and 23 years old (Table 4.1).

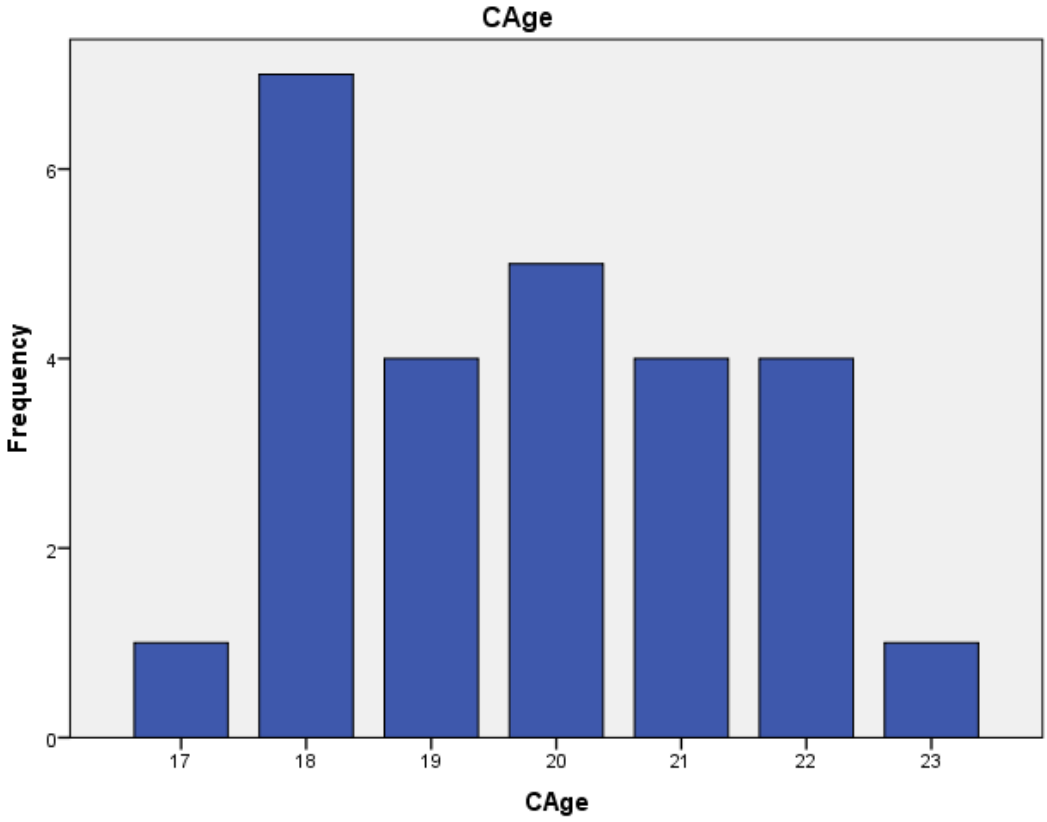

Figure 4.3 Age of participants in control group. (CAge = Age in control group)

In the calculation of age in control group participant shown in figure 4.2, results showed a mean of 19.77 (SD = 1.66) years (Table 4.1). In control group, the youngest participant is 17 years old, which only consists of 1 of them in this study, accounting for 3.8% among the control group participants. On the other hand, the oldest participant age is 23 years old, a percentage of 3.8% was jotted down which shows 1 participant among all 26 control group participants. Next, there were 7 of 18 years old participants, 4 of 19 years old participants, which covers 26.9% and 15.4 % respectively of total control group participant. Subsequently, the 20 years old participant is represented as 19.2% in total population recorded at 5 participants. Then, 4 of 21 years old participant and 4 of 22 years old participant were noted, which constitute the final 15.4% of the total control group participant. Majority of participants in the control group is 18 years old and minority of participants is 17 and 23 years old (Table 4.1).

At the last part, an independent t-test was carried out to test the similarities of demographic characteristics of participant in between both groups at baseline of study. With a mean of 20.25 (SD = 1.11) years in intervention group, and a mean of 19.77 (SD = 1.66) years in the control group, test result shows p value = 0.220 with negative assumption of equal variances at 95% confidence level. As a result, there was no significant differences in age groups with both control and intervention group.

4.3.2 Gender

The distribution of gender of the current study is depicted in table form in Table 4.1. In the intervention group, there are 15 males and 13 females, accounting

for 53.6% and 46.6% of the whole intervention group participant. In the control group, there were 16 male students recruited, which represent 61.5% of total population. On the contrary, there were 10 female students recruited, which represent 38.5% of control group participant pool, which made up a total of 26 control group participants (Table 4.1).

4.3.3 Race

Table 4.1 shows the racial distribution of the participant pool, the participants that were recruited were all from the Chinese ethnicity. There were 26 out of 26 of the participants in control group are Chinese; and 28 out of 28 of the participants in intervention group also originated from Chinese ethnicity (Table 4.1). A total of 55 participant is Chinese, constituting for 100% of total participant.

4.3.4 BMI

Table 4.1 depicts the BMI category of participants in this study. Figure 4.3 shows the BMI of participant in intervention group, while figure 4.4 depicts the BMI of participant in control group.

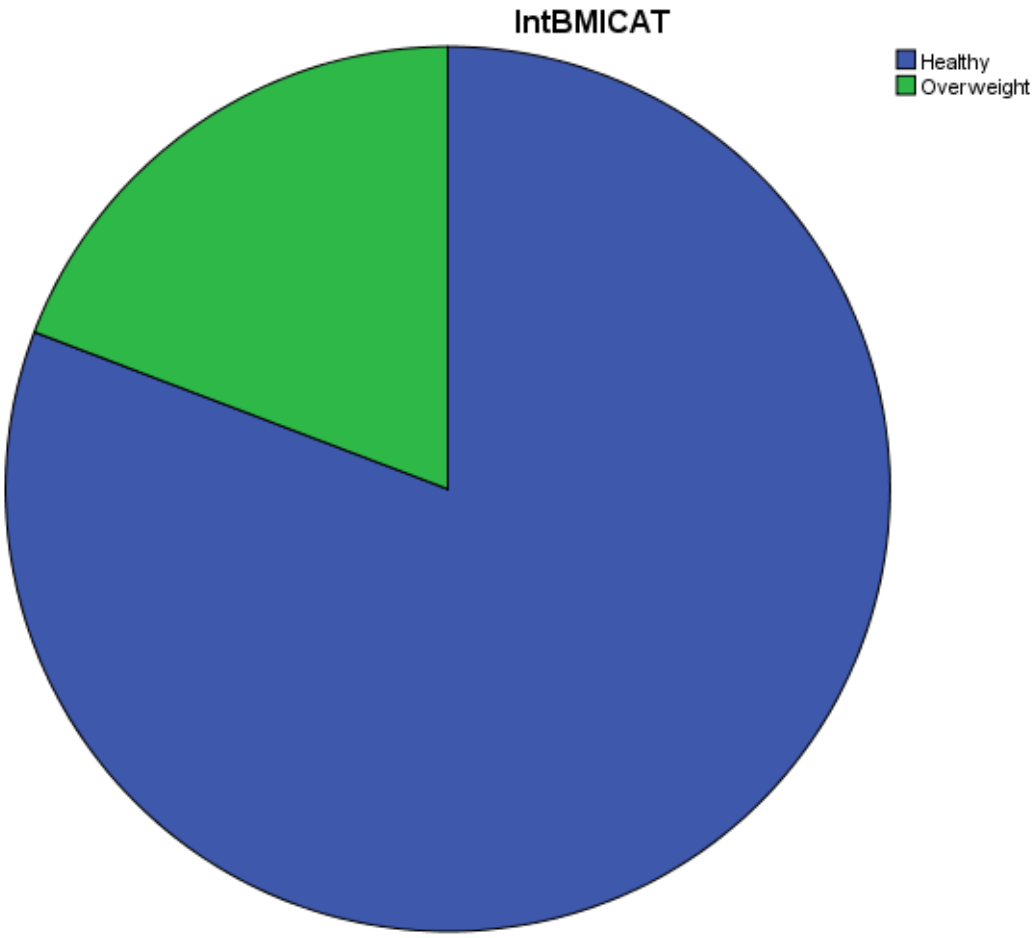

Figure 4.4 BMI of participant in intervention group. (IntBMICAT = Intervention group BMI category)

In the calculation of BMI in intervention group participant shown in figure 4.3, results showed a mean of 21.77 (SD = 2.86) as shown in Table 4.1. Majority of the participant, 21 of them, are categorized under ‘healthy’ category, constituting 80.8% of total participant in intervention group. Not only that, 5 ‘Overweight’ participants were noted, accounting for 19.2% of intervention group participant.

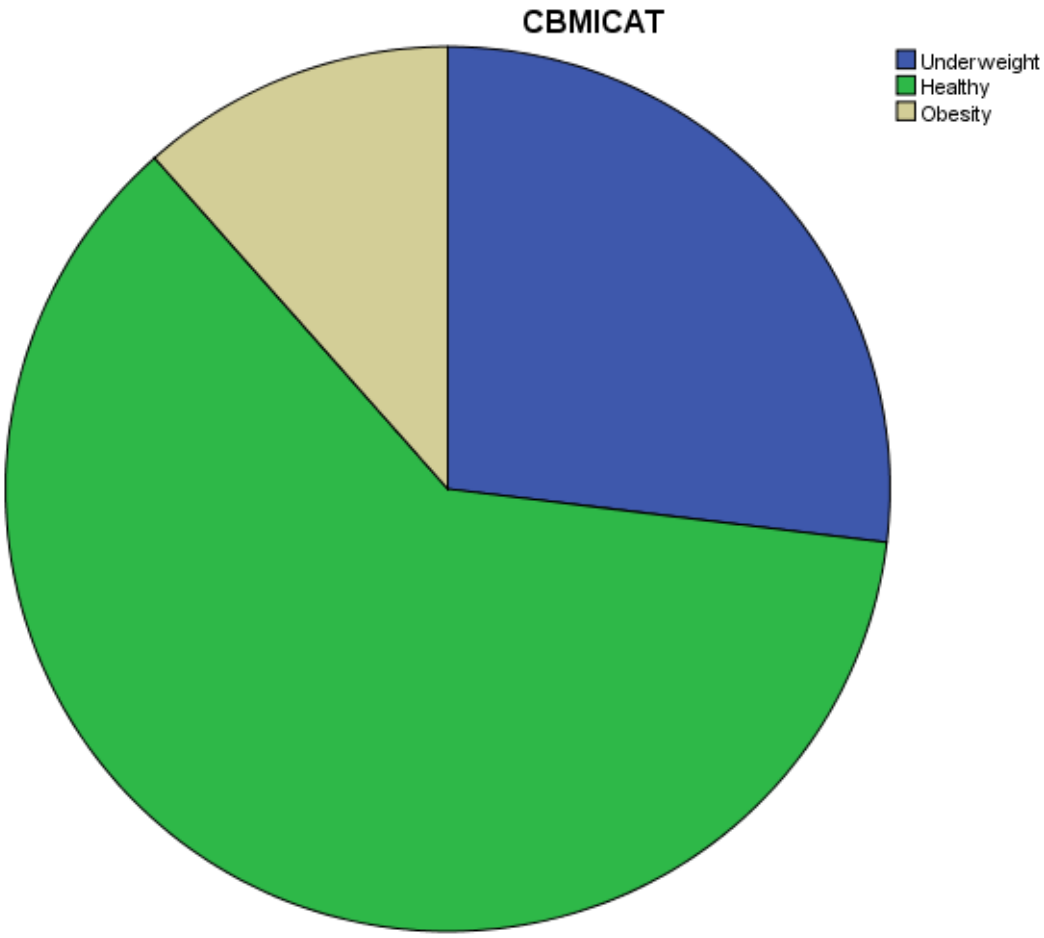

Figure 4.5 BMI of participant in control group (CBMICAT = Control group BMI category)

In the calculation of BMI in control group participant shown in figure 4.4, results showed a mean of 21.58 (SD = 4.97) as depicted in Table 4.1. Majority of the participant, 16 of them, are categorized under ‘healthy’ category, constituting 61.5% of total participant in intervention group. Not only that, 3 ‘Obesity’ participants were noted, accounting for 11.5% of intervention group participant; 7 ‘Underweight’ participants were recorded, accounting for 26.9% of total control group participant. In addition, no ‘Overweight’ category participant was found in data.

An independent t-test was carried out to test the similarities of demographic characteristics of participant in between both groups at baseline of study. With a mean of 22.395 (SD = 3.57) in intervention group, and a mean of 21.58 (SD = 4.97) in the control group, test result shows p value = 0.494 with positive assumption of equal variances at 95% confidence level. As a result, the BMI was not significantly different between the two groups of control and intervention groups.

4.3.5 Year of study

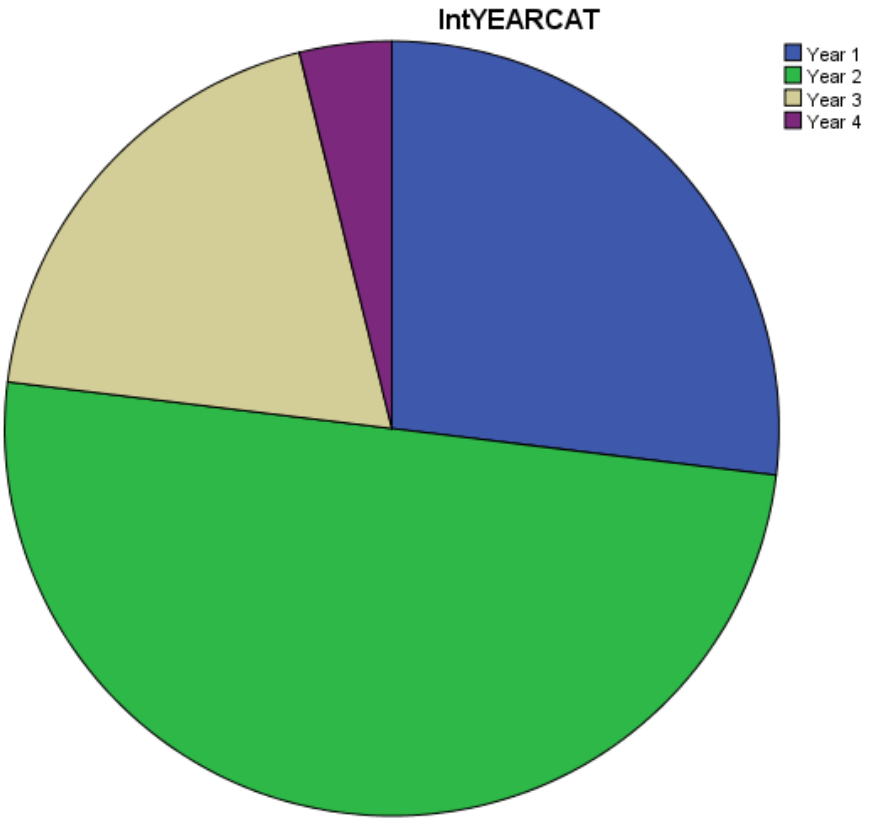

Figure 4.6 Year of study of participant in intervention group. (IntYEARCAT= Intervention group year of study category)

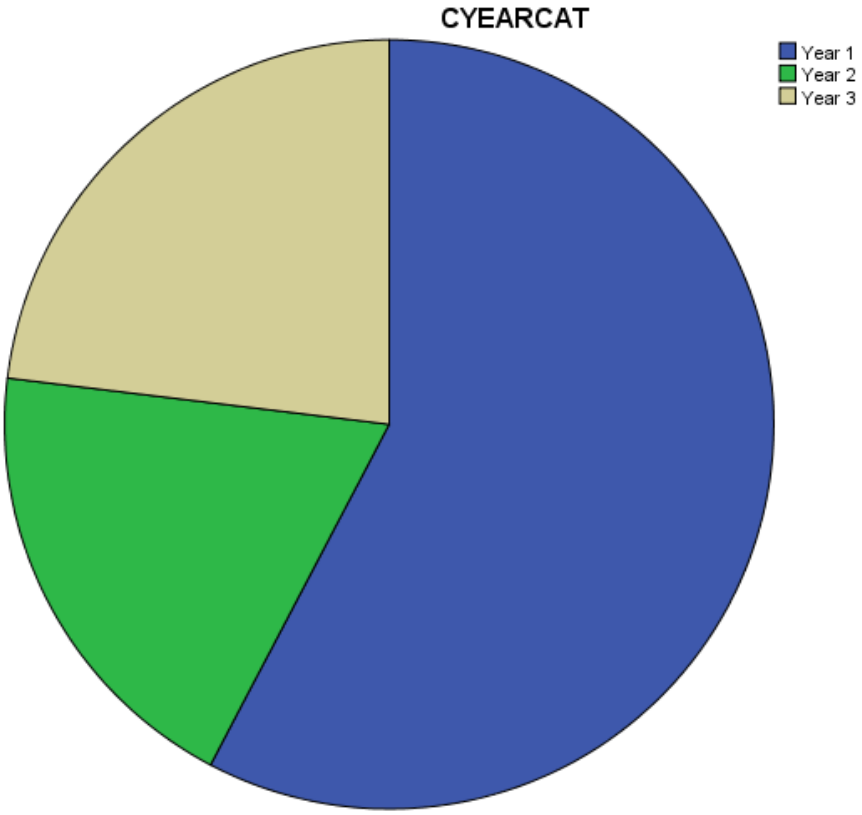

Figure 4.7 Year of study of participant in control group. (CYEARCAT = Control group year of study category)

Table 4.1 depicts the year of study category of participants in this study. Figure 4.5 shows the year of study of participant in intervention group, while figure 4.6 depicts the BMI of participant in control group.

In year of study of intervention group participant shown in figure 4.5, results showed median at year 2 (Table 4.1). There were a majority of the participant, 13 of them, are currently in the second year of study, constituting 50% of total participant in intervention group. Not only that, 5 or 19.2% of participants were in year 3; while 7 or 26.9% of participant were in year 1. The minority of participants were studying in

year 4, result shows that only 1 or 3.8% of them are recruited.

In year of study of control group participant shown in figure 4.6, results showed a median of 1.00, the median value is at year 1 (Table 4.1). There were a majority of the participant, 15 of them, are currently in the first year of study, constituting 57.7% of total control participant in intervention group. Not only that, 6 or 23.1% of participants were in year 3. The minority of participants were while 5 or 19.2% of participant were in the second year.

4.3.6 The Craniovertebral angle during pre-treatment

Firstly, the pre-treatment result data of both intervention and control group is analyzed. According to table 4.5, the pre-treatment craniovertebral angle obtained from both intervention and control group at the start of study is tested against the group of study. The mean score of intervention group was noted to have 49.69 (SD=2.38) whereas the intervention group mean score was jot down to have 48.72 (SD= 2.88). p value of 0.188 is obtained with 95% CI with the assumption of the variances were equal. This shows that there is no significant difference between the control group and intervention group in the craniovertebral angle during pre-treatment at the start of study.

4.3.7 Physical Activity

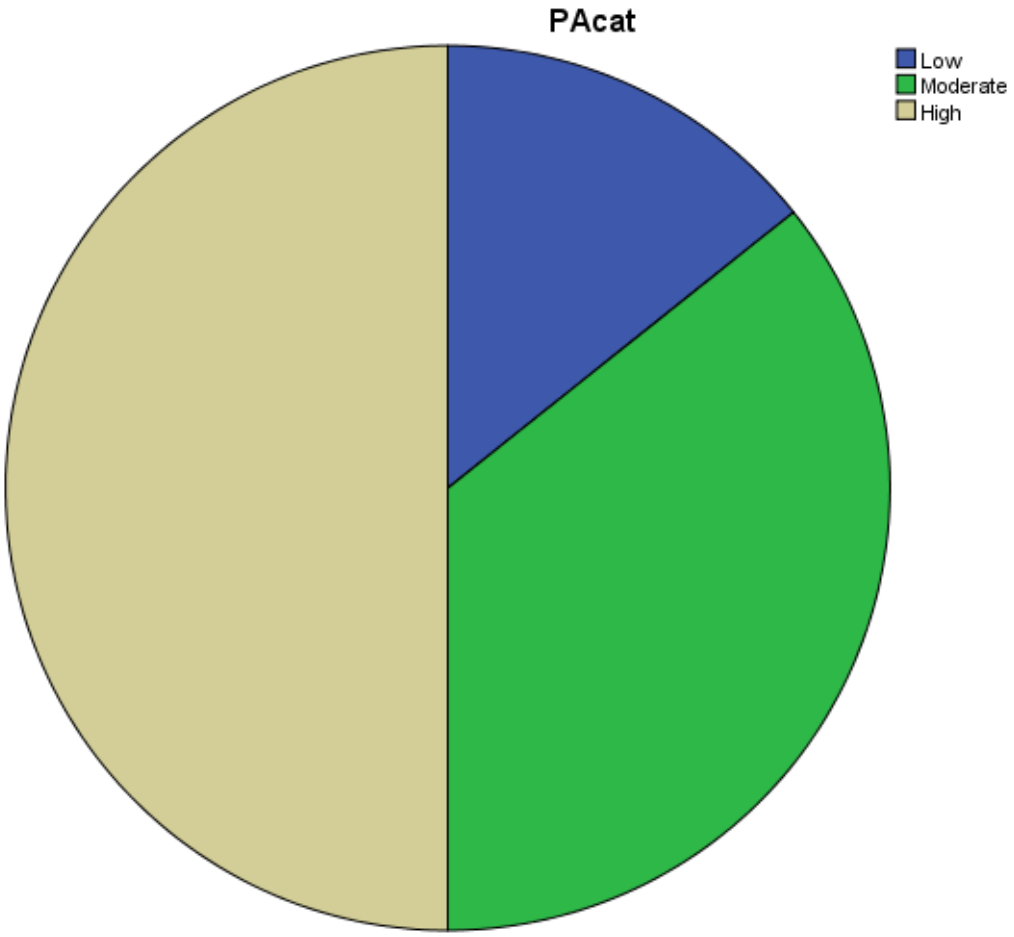

Figure 4.8 Physical Activity in intervention group

(PAcat = Physical activity category)

In the intervention group, the median is 2.5, which ‘1’ is represent as low, ‘2’ is represent as moderate, ‘3’ is represent as high. There is 4 or 14.3% individual in low category, 10 or 35.7% individual in moderate category, 14 or 50% individual in high category. Majority of the participant in intervention group is recorded in high in categorical score of IPAQ Questionnaire, minority of them are in the ow category.

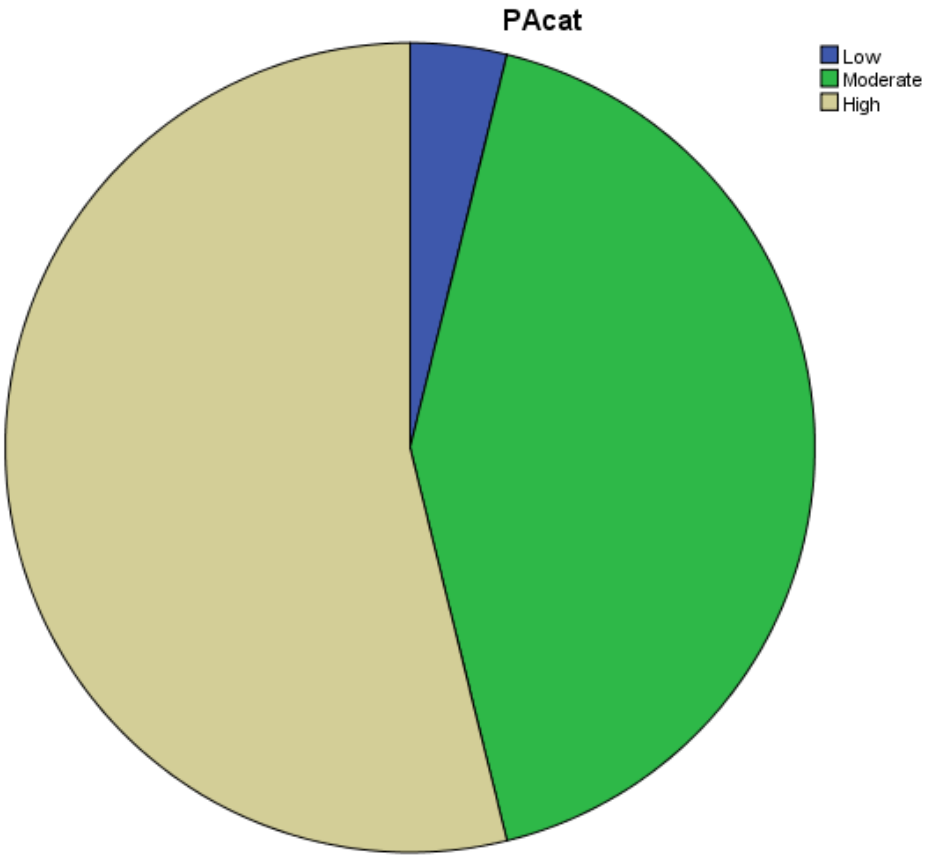

Figure 4.9 Physical activity in control group

In the control group, the median is 3.0, which ‘1’ is represent as low, ‘2’ is represent as moderate, ‘3’ is represent as high. There is 1 or 3.8% individual in low category, 11 or 42.3% individual in moderate category, 14 or 53.8% individual in high category. Majority of the participant in intervention group is recorded in high in categorical score of IPAQ Questionnaire, minority of them are in the low category.

4.3.8 Electronic Device Usage Time

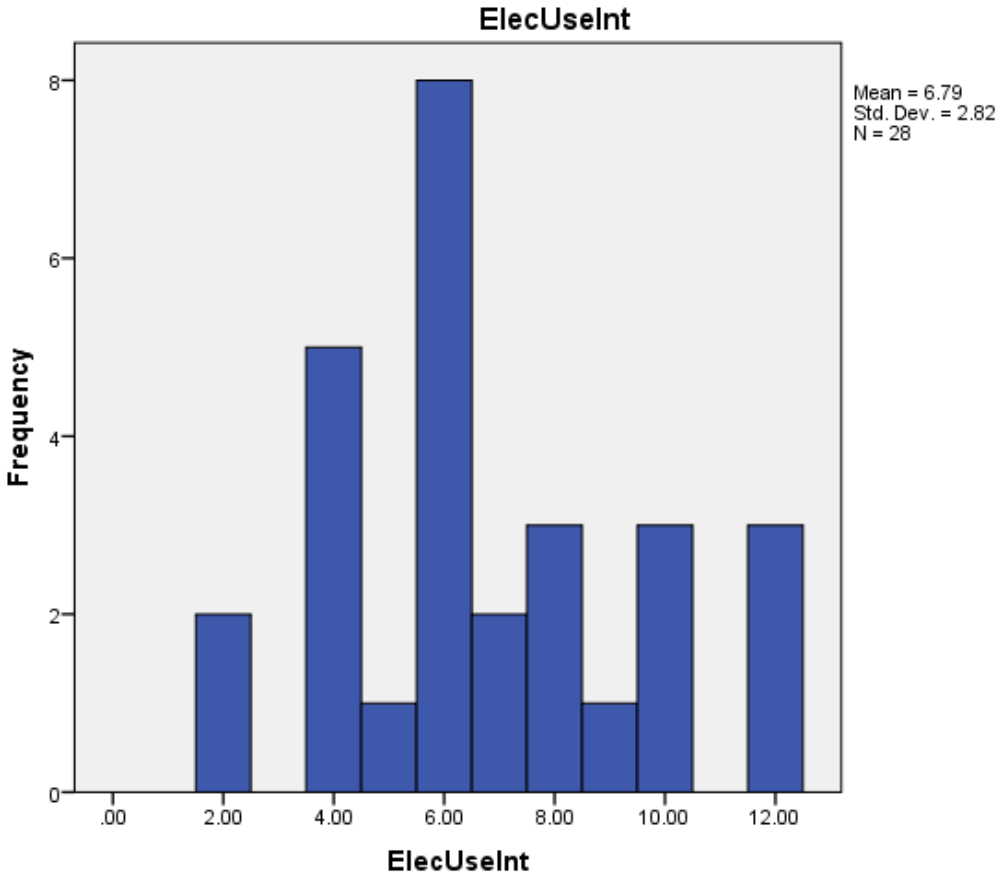

Figure 4.10 Electronic device usage time in intervention group. (ElecUseInt = Electronic device usage time in intervention group)

In the intervention group, the mean score of electronic device usage time is 6.79 (SD = 2.82). The electronic device usage time distribution is as follow: 2 hours is 2 participants or 7.1%; 4 hours is 5 participants or 17.9%; 5 hours is 1 participant or 3.6%; 6 hours is 8 participants or 28.6%; 7 hours is 2 participants or 7.1%; 8 hours is 3 participants or 10.7%; 9 hours is 1 participant or 3.6%. The longest time spend in electronic device is 12 hours and least time is 2 hours. Majority of the participants (8 participants) has 6 hours of electronic device usage time; minority of the participants (1 participants) has 9 hours of electronic device usage time.

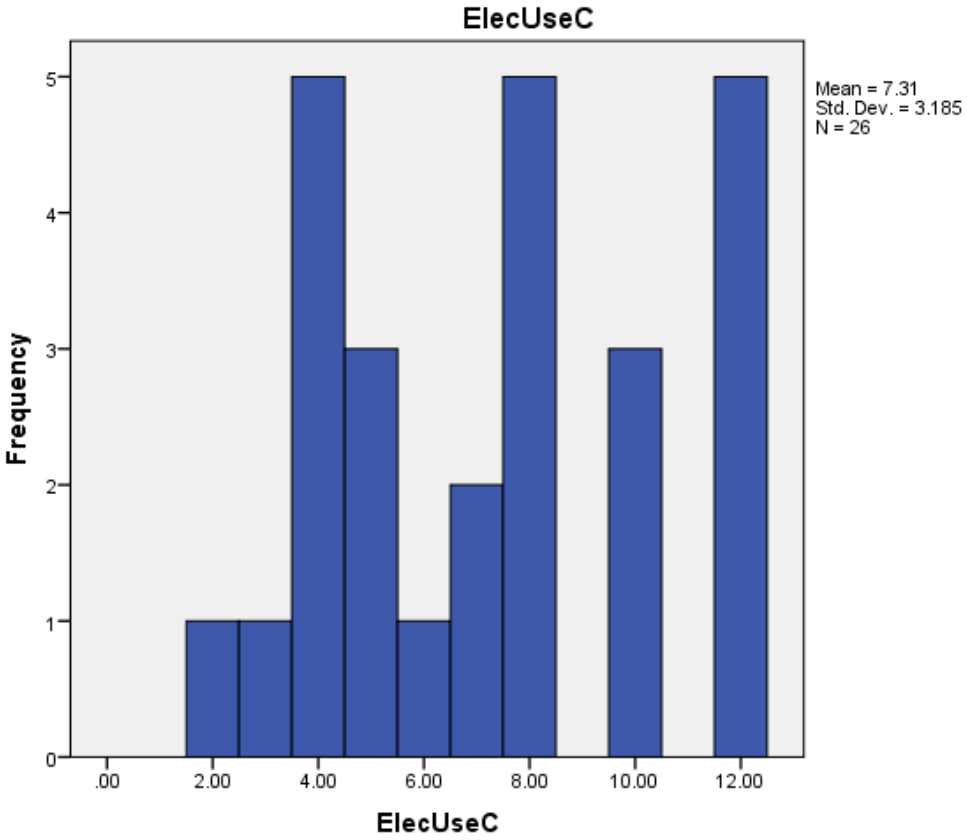

Figure 4.11 Electronic device usage time in control group. (ElecUseC = Electronic device usage time in control group)

In the control group, the mean score of electronic device usage time in is 7.31 (SD = 3.18). The electronic device usage time distribution is as follow: 2 hours is 1 participant or 3.8%, 3 hours is 1 subject or 3.8%, 4 hours is 5 participants or 19.2%; 5 hours is 3 participants is 11.5%; 6 hours is 1 participant or 3.8%; 7 hours is 2 participants or 7.7%; 8 hours is 5 participants or 19.2%; 10 hours is 3 participants or 11.5%; 12 hours is 5 participants is 19.2%. The longest time spend in electronic device is 12 hours and least time is 2 hours. Majority of the participants (5 participants) has 4 hours, 8 hours, and 12 hours of electronic device usage time, minority of the participants (1 participants) has 2 hours, 3 hours, 6 hours of electronic device usage time.

Table 4.2 Demographic data of participant at baseline of study (N=52)

Demographic data	**Intervention Group**		**Control Group**		**p-value**
	Mean (Std Dev)	**Frequency (%)**	**Mean (Std Dev)**	**Frequency (%)**	
Age	20.19 (1.10)		19.77 (1.66)		0.283
17		0 (0.0)		1 (3.8)	
18		1 (3.8)		7 (26.9)	
19		6 (23.1)		4 (15.4)	
20		9 (34.6)		5 (19.2)	
21		8 (30.8)		4 (15.4)	
22		1 (3.8)		4 (15.4)	
23		1 (3.8)		1 (3.8)	
Gender					
Male		13 (50)		16 (61.5)	
Female		13 (50)		10 (38.5)	
Race					
Chinese		26 (100)		26 (100)	
BMI	21.77 (2.86)		21.58 (4.97)		0.863
Underweight		0 (0.0)		7 (26.9)	
Healthy		21 (80.8)		16(61.5)	
Overweight		5 (19.2)		0 (0.0)	
Obesity		0 (0)		3 (11.5)	
Year of study	Median = Year 2		Median = Year 1		
Year 1		7 (26.9)		15 (57.7)	
Year 2		13 (50)		5 (19.2)	
Year 3		5 (19.2)		6 (23.1)	
Year 4		1 (3.8)		0 (0.0)	
CV angle (°)	49.69 (2.38)		48.72 (2.89)		0.188

Physical activity (Categorical Score)	Median = Moderate		Median = High	
Low		4 (15.4)	1 (3.8)	
Moderate		10 (38.5)	11 (42.3)	
High		12 (46.2)	14 (53.8)	
Electronic device usage time (hours)	7.08 (2.70)		7.31 (3.18)	0.779
1		0 (0.0)	0 (0.0)	
2		1 (3.8)	1 (3.8)	
3		0 (0.0)	1 (3.8)	
4		4 (15.4)	5 (19.2)	
5		1 (3.8)	3 (11.5)	
6		8 (30.8)	1 (3.8)	
7		2 (7.7)	2 (7.6)	
8		3 (11.5)	5 (11.5)	
9		1 (3.8)	0 (0.0)	
10		3 (11.5)	3 (11.5)	
11		0 (0.0)	0 (0.0)	
12		3 (11.5)	5 (11.5)	

*CV angle: Craniovertebral angle

4.4 Inferential analysis

In this section, inferential analysis was carried out, comprising the Paired sample t-test and independent t-test to evaluate the objectives and test the hypothesis. The paired sample t-test were used to compare the pre-treatment and post-treatment data, while the independent t-test is used to compare differences in mean scores of craniovertebral angle (CVA) between two independent groups which considered as categorical data. In this subsection, a brief explanation of the test carried out will be included, followed by the findings and result of the test. Thus, all the results were tabulated below the explanation for clarity purposes. For this section, IBM SPSS Statistics version 20 was used.

4.4.1 Test for Normality

Symmetrical data and normally distributed data were tested. Data that showed p value larger than 0.05 at 95% confidence level were considered as normally distributed.

Firstly, the Shapiro-Wilk Tests of Normality was used as the sample size is smaller than 50 individuals. All the craniovertebral angle (CVA) data in all pre-treatment and post-treatment in control group and intervention group were recorded. In the intervention group, pre-treatment CVA (p=0.068), week 2 post-treatment CVA (p=0.834), week 4 post-treatment CVA data (0.903) were all normally distributed.

In the control group, pre-treatment CVA (p=0.131), week 2 post-treatment CVA (p=0.332), week 4 post-treatment CVA data (0.474) were all normally distributed. As a result, the data is normally distributed in all pre-treatment and post-treatment for the craniovertebral angle (CVA) data in both intervention and control group. Therefore, paired t-test can be utilized to carried out to determine the difference in mean score of the data obtained from the pre-treatment and post-treatment for all groups of participants.

Then, age of both intervention and control group is also tested using the Shapiro-Wilk Tests of Normality. Analysis showed that age in intervention group is normally distributed. Although p value was almost normal (p=0.046), the skewness value of graph is 0.378, which is within the range of symmetrical data distribution of the range -0.5 and 0.5, therefore the age of intervention group is considered as normally distributed. Age in control group is also normally distributed (p=0.071).

4.4.2 Paired sample t-test

In this subsection, 2 pairs of paired t-test were generated including the comparison of pre-treatment and post-treatment during week 2 and week 4 of both control group and intervention group.

Table 4.3 Results of Paired sample t-test between Pre-treatment and Week 2 Post-treatment CVA in both groups

Week 2	**Craniovertebral angle (°)**				
	Pre-treatment CVA	**Post-treatment CVA**	**Diff (pre-treatment–post-test)**	**t**	**Sig (p-value)**
	M (SD)	**M (SD)**			
Control Group	48.71 (2.88)	50.79 (3.82)	-2.07	-3.31	0.003
Intervention Group	49.69 (2.38)	52.13 (3.32)	-2.43	-3.49	0.002

*M (SD) = Mean (Standard Deviation)

According to table 4.3, there is a comparison table between the pre-treatment and the week 2 post-treatment craniovertebral angle. The mean pre-treatment craniovertebral angle in control group was 48.71° (SD = 2.88) and the mean post-treatment craniovertebral angle is 50.79° (SD = 3.82) with a mean difference of -2.07 °. The p value is 0.003 at 95% interval. Therefore, this difference is statistically significant between pre-treatment and post-treatment craniovertebral angle result in the control group ($p<0.05$).

On the other hand, the mean pre-treatment craniovertebral angle in intervention group was 49.69° (SD = 2.38), while the mean post-treatment craniovertebral angle is 52.13 (SD = 3.32) with a mean difference of -2.43 °. The p value of 0.002 at 95% confidence interval. Therefore, this difference was statistically significant between pre-treatment and post-treatment craniovertebral angle result in the intervention group ($p<0.05$).

Table 4.4 Results of Paired sample t-test between Pre-treatment and Week 4 Post-treatment VA in both groups

Week 4	**Craniovertebral Angle (°)**				
	Pre-treatment CVA	**Post-treatment CVA**	**Diff (pre-treatment–post-test)**	**t**	**Sig (p value)**
	M (SD)	**M (SD)**			
Control Group	48.72 (2.88)	50.61 (4.43)	-1.89	-2.36	0.028
Intervention Group	49.69 (2.92)	53.78 (3.28)	-4.09	-6.41	0.0001

*M (SD) = Mean (Standard Deviation)

Table 4.4 mainly highlights the comparison between the pre-treatment and the week 4 post-treatment craniovertebral angle. The mean pre-treatment craniovertebral angle in control group is 48.72° (SD = 2.87) while the mean post-treatment craniovertebral angle in intervention group was 50.61 ° (SD = 4.43) with a mean

difference of -1.87 °. The p value was 0.028 at 95% confidence interval. Therefore, this showed statistically significant difference between pre and post-treatment craniovertebral angle in the control group ($p<0.05$).

On the other hand, the mean craniovertebral angle in intervention group during the pre-treatment is 49.69 ° (SD = 2.92) while the mean post-treatment craniovertebral angle was 53.78 ° (SD = 3.28) with a mean difference of -4.09 °. The p value was 0.0001 at 95% confidence interval. Therefore, this difference was statistically significant between pre- and post-treatment craniovertebral angle in the intervention group ($p<0.05$).

4.4.3 Independent t-test

In this subsection, the unpaired or independent t-test were carried out in both groups to compare the variables of gender (male and female), group of study (control and intervention group) which was the binary outcome independent variable with the post-treatment of week 4 of both control group and intervention group as the dependent variables. The independent t-test is conducted to examine if there were any inter-group differences with the obtained variables. Following the description, data will be tabulated following the description section, including a closing statement for the significancy obtained from the independent t-test.

4.4.3.1 Independent t-test with baseline demographic characteristics

Age, Pre-treatment CVA, BMI value, and electronic device usage time was analyzed to confirm that there is equal demographic characteristics at baseline

between both control and intervention group.

The mean score of age in intervention group is 20.25 while control group is 19.77, p=0.283, therefore there is no significant differences between control and intervention group with age.

The mean score of BMI in intervention group is 21.77 while control group is 21.58, p=0.863, therefore there is no significant differences between control and intervention group with BMI.

The mean score of pre-treatments CVA in intervention group is 49.69 while control group is 48.71, p=0.188, therefore there is no significant differences between control and intervention group with pre-treatment CVA. The mean score of electronic device usage time in intervention group is 7.08 while control group is 7.3, p=0.779, therefore there is no significant differences between control and intervention group with age.

In the control group, the mean score of electronic device usage time is 7.31 (SD = 3.18). In the intervention group, the mean score of electronic device usage time is 6.79 (SD = 2.82). The mean difference of this result is 0.522. The p value of 0.526 at 95% confidence interval with the assumption of the variances were equal. Thus, there was no significant difference between control group and intervention group with electronic device usage time.

4.4.3.2 Independent t-test with groups of study

According to table 4.5, the craniovertebral angle measured during post-treatment during week 4 from both intervention and control group is tested against the 2 groups of study (control and intervention group) to assess the improvement of head posture after between 2 groups.

Table 4.5 Result of independent sample t-test of control and intervention group

	Craniovertebral Angle (°)				
	Control Group **M (SD)**	Intervention Group **M (SD)**	**Diff (pre-treatment–post-test)**	**t**	**Sig (p value)**
Week 2 Post-treatment CVA	50.79 (3.83)	52.13 (3.32)	-1.35	-1.35	0.182
Week 4 Post-treatment CVA	50.61 (4.43)	53.78 (3.29)	-3.18	-2.94	0.005

*M (SD) = Mean (Standard deviation)

Consequently, table 4.5 illustrates the craniovertebral angle measured during post-treatment during week 2 from both intervention and control group is compared with the group of study (control and intervention group) to assess the improvement of head posture between 2 groups. The mean score of control group was recorded at 50.79 ° (SD= 3.83) whereas the intervention group mean score was noted to have 52.13 ° (SD= 3.32) with a mean difference of -1.35°. The p value was 0.182 with 95% confidence interval with the assumption of the variances were equal. Therefore, there was no significant difference between control group and intervention group in week 2

post-treatment craniovertebral angle.

The mean score of craniovertebral angle in control group was recorded to have 50.61° (SD=4.43) whereas the intervention group mean score was jot down to have 53.78° (SD= 3.29). The mean difference of this result is -3.18 °. The p value was 0.005 at 95% confidence interval with the assumption of the variances were equal. Consequently, there was a significant difference between control group and intervention group in the week 4 post-treatment craniovertebral angle.

4.4.3.3 Independent t-test with gender

In comparison with gender (male and female) in the intervention group, all the tabulated data were recorded in table 4.5 and table 4.6, illustrated the craniovertebral angle measured during post-treatment during week 2 and week 4 from both groups (control and intervention group) to assess the improvement of head posture between gender in a single group.

Table 4.6 Result of independent sample t-test of gender (male and female) in the intervention group

Craniovertebral Angle (°)					
Intervention Group	Male (n=13) **M (SD)**	Female (n=13) **M (SD)**	**Diff**	**t**	**Sig (p value)**
Week 2 Post-treatment CVA (°)	51.82 (2.85)	52.44 (3.83)	-0.623	-0.03	0.642
Week 4 Post-treatment CVA (°**)**	54.88 (3.57)	52.68 (2.66)	2.2	0.622	0.088

*M (SD) = Variable Mean (Standard deviation)

At week 2, the mean score of male gender in intervention group was recorded to have 51.82° (SD= 2.85) whereas the female gender in intervention group's mean score was noted to have 52.44 ° (SD= 3.83). The mean difference of this result is -0.623 °. The p value was 0.642 at 95% confidence interval with the assumption of the variances were equal. Thus, there was no significant difference between genders, male and female, in week 2 post-treatment craniovertebral angle in the intervention group.

At week 4, the mean score of male gender in intervention group was noted to have 54.88 ° (SD= 3.57) whereas the female gender in intervention group's mean score was noted to have 52.68 ° (SD= 2.66). The mean difference of this result is 2.2°. The p value was 0.088 at 95% confidence interval with the assumption of the variances were equal. This shows that there was no significant difference between genders, male and female, in week 4 post-treatment craniovertebral angle in the intervention group.

Table 4.7 Result of independent sample t-test of gender (male and female) in the control group

Craniovertebral Angle (°)					
Control Group	Male **M (SD)**	Female **M (SD)**	**Diff (pre-treatment–post-test)**	**t**	**Sig (p value)**
Week 2 Post-treatment CVA (°)	51.07(3.03)	50.34 (5.01)	0.73	0.465	0.646

Week 4 Post-treatment CVA (°)	50.98 (3.44)	50.01 (5.85)	0.97	0.536	0.597

*M (SD) = Variable Mean (Standard deviation)

At week 2, the mean score of male gender in control group was recorded to have 51.07° (SD= 3.02) whereas the female gender in control group's mean score was noted to have 50.34° (SD= 5.00). The mean difference of this result is 0.73°. The p value was 0.646 at 95% confidence interval with the assumption of the variances were equal. Therefore, there was no significant difference between genders, male and female, in week 2 post-treatment craniovertebral angle in the control group.

At week 4, the mean score of male gender in control group was noted to have 50.98 ° (SD= 3.43) whereas the female gender in control group's mean score was noted to have 50.01 ° (SD= 5.85). The mean difference of this result is 0.97 °. The p value of 0.597 at 95% confidence interval with the assumption of the variances were equal. Thus, there was no significant difference between genders, male and female, in week 4 post-treatment craniovertebral angle in the control group.

4.4.3.4 Independent t-test with BMI in intervention group

Table 4.8 Result of Independent t-test with Overweight and Obesity, Underweight and Healthy individual

	BMI	
	Overweight and Obesity group (n=5)	Underweight and Healthy group (n=21)

	M (SD)	M (SD)	Mean Diff	t	Sig (p value)
Week 4 Post-treatment CVA (°)	52.9 (3.55)	53.99 (3.27)	1.01	0.662	0.514

At week 4 post-treatment CVA, the mean score of Overweight and Obesity group was 52.9 (SD= 3.55) whereas the Underweight and Healthy group mean score was 53.99 (SD= 3.27). The mean difference of this result is 1.01. The p value of 0.514 at 95% confidence interval with the assumption of the variances were equal. Thus, there was no significant difference between Overweight and Obesity group and Underweight and Healthy group with week 4 post-treatment craniovertebral angle in the intervention group.

4.5 Hypothesis Testing

Null Hypothesis

$H0_I$: There is no significant effect of scapular retraction exercises on forward head posture among university students.

Alternate Hypothesis

HA_I: There is significant effect of scapular retraction exercises on forward head posture among university students.

To reject or accept this hypothesis, the paired sample t-test was utilized to examine the effects of the intervention in each group first. In control group (the ergonomic advice group), the p value in the results show 0.028. Thus, there is

significant difference in pre-treatment CVA and week 4 post-treatment CVA in control group. In the intervention group (the ergonomic advice + scapular retraction exercise group), the p value in the results show 0.001. Thus, there is significant difference in pre-treatment CVA and week 4 post-treatment CVA.

In my study, the independent t-test was carried out to compare means between the control group (the ergonomic advice group) and intervention group (the ergonomic advice + scapular retraction exercise group). In the Levene's Test for Equality of Variances, the equal variances were assumed. The results showed p value of 0.005 which is lesser than 0.05 ($p < 0.05$). Thus, there is a significant difference between the control group (the ergonomic advice group) and intervention group (the ergonomic advice + scapular retraction exercise group) with the week 4 post-treatment CVA.

At the final verdict, the significant effect of scapular retraction exercises on forward head posture among university student is tested by independent t-test. The level of confidence was at 95%, confidence level 'α' was set at 0.05 ($\alpha = 0.05$). If the p value is <0.05, the null hypothesis will be rejected. On the other hand, if the p value is >0.05, the null hypothesis would be accepted. In my study, the p value is 0.005, which the differences the control group (the ergonomic advice group) and intervention group (the ergonomic advice + scapular retraction exercise group) with the week 4 post-treatment CVA is highly significant. As decision, the null hypothesis is rejected, the alternate hypothesis is accepted. In conclusion, there is significant effect of scapular retraction exercises on forward head posture among university students.

CHAPTER 5

DISCUSSION

5.1 Chapter overview

In this section, an overview of the key results of the results data will be further discussed in accordance with the research objectives. It is then followed by the research limitations and recommendations for future study and end with conclusion of the study.

5.2 Discussion

5.2.1 Prevalence

In this study, the prevalence of forward head posture estimated in university students was 48%, It is calculated from 63 university students with forward head posture among 130 university students recruited as sample.

Among university student, according to a prevalence study of forward head posture by (Naz et al., 2018), they proved that there was 64% of forward head posture prevalence in male and female university students. Thus, they indicate that forward head posture is a common posture problem among university students (Naz et al., 2018) On the aspects of occupational settings, there was a study mentioning a high value of 86% and 69% of incidence of forward head posture in students and residents

of Tehran University (Vakili et al., 2016). Another study that is conducted on university students of age between 18-30 years old shows 73% of prevalence of forward head posture in students at Adesh University (Singh et al., 2020). According to Ramalingam & Subramaniam, 2019), there is a high prevalence of 67% of forward head posture among 188 university students whereas the same study also found out that 45.2% of forward head posture students came from the age group between 18-21 years old. All in all, all the above past evidence is certainly consistent with the findings of this study. However, the findings of prevalence of this study were certainly lesser than all of the past evidence above due to insufficient sample and a small sample size taken, it only can be inferred that 48 out of 100 people has the forward head posture in this study, but its value cannot be generalized to the level of all university students. In addition, there is also abundance of forward head posture in the population of physiotherapist. A study conducted in 2022 amongst physiotherapy students between age of 20-30 years old showing 70% of them with forward head posture and 30% of them with normal head posture (Goswami & Contractor, 2022).

5.2.2 Effect of four weeks duration Scapular retraction exercise on forward head posture

During the week 4 post-treatment of result data in paired t-test, on comparing the pre-treatment mean CVA with the post-treatment mean in within group (intervention group), shows highly significant difference (p value = 0.0001). Therefore, this difference was statistically significant between pre- and post-treatment craniovertebral angle in the intervention group ($p<0.05$). As such, this increment in craniovertebral angle signifies improvement in the forward head posture.

At week 4, with the same pre-treatment mean score of control group using independent t-test, the mean post-treatment craniovertebral angle in intervention group, shows highly significant difference (p value = 0.005). Consequently, there was a significant difference between control group and intervention group in the week 4 post-treatment craniovertebral angle. In short, that means that at week 4, control group and intervention group did make a difference, the intervention group is much more effective in creating an effect on forward head posture.

The findings of this study build up the same evidence as the study conducted by Kirupa et al. (2020) , which also shows significant difference in craniovertebral angle within the scapular retraction exercise group. They arrived at the conclusion at which that exercises to retract the scapula are more successful at treating the forward head posture (Kirupa et al., 2020). In their study, the inclusion criteria of participants such as the age group of participants are similar. Also, the duration of study was similar with just 1 week difference (Kirupa et al., 2020) . However, different populations, IT workers were targeted, and different geographical population, India and races were included in their study (Kirupa et al., 2020). With all that have been said, this study successfully produced significant effects on forward head posture on university student population in Malaysia. Further studies can be done in other populations and geographical location to add to the generalizability of this study regarding scapular retraction exercise on forward head posture.

Moreover, the result of this study is consistent with that of Im et al., (2016), which the forward head posture was much improved in terms of Neck Disability

Index score in performing the same 4 weeks duration, but similar intervention, the scapular stabilization exercises. Another study with scapular stabilization exercises also displays improvement in the CVA, neck alignment through increased muscle activity of lower trapezius and serratus anterior with a duration of 4 weeks intervention (Kang et al., 2018).

In addition, the most conspicuous factor that results in the significant improvement of forward head posture is because of the specific muscle activation that is taking place which all the exercises administered can provide complementary effects to respective muscles that requires strengthening, relaxing, or stretching. In this study, the retraction overhead exercise which is shown to mainly target the rhomboids muscle, middle trapezius, and lower trapezius (Castelein et al., 2016) ; the scapular retraction activation exercise which targets the middle and lower trapezius muscle and serratus anterior (Ruivo et al., 2017); the pectoralis wall stretch exercise that aims to stretch the tightened pectoralis major and minor muscles in forward head posture (Im et al., 2016) are exercises that produces complementary effects of strengthening and stretching to the targeted muscles without aggravating the muscles in pathological state. Lastly, the elbow push back exercise, which has not been widely used and explained by past literatures is considered as the scapular retraction movement itself. More future studies can be done on the elbow push back exercise to determine its targeted muscle activity and effectiveness in treating forward head posture.

Similarly, the elastic band exercise which was included in as one of the intervention exercises might be the major contributing factor to the huge improvement

of the forward head posture. The result of this study backs up the result from the study from (T. W. Kim et al., 2016) , which also generated significant effects on postural problem, since the 0 ° resisted band bilateral external rotation exercise for 4 weeks has shown significant effectiveness in treating forward head postural problems in past evidence(T. W. Kim et al., 2016; Nitayarak & Charntaraviroj, 2021). As stated by past studies, the 0 ° resisted band bilateral external rotation exercise also mainly targets the middle trapezius and rhomboids muscle which also plays a part in rolling the shoulder backward (Ruivo et al., 2017).

As discussed in the literature review above, forward head posture can cause spastic, tight and overactivated upper trapezius, deep upper cervical extensors muscle and levator scapula, causing it to become tense and irritated (Im et al., 2016). As such, effective exercise should evade this part of muscles that is already problematic. Evidence has shown that practising retraction at 0° shoulder abduction, which satisfies the premise above by just strengthening the weak muscles, such as the middle and lower trapezius during scapular retraction exercises but not the upper part muscles that are at the vicinity of neck and head. As a result, the intervention improves neck alignment by minimising compensatory movements of the muscles responsible for forward head position. Thus, it has been inferred that improvement in craniovertebral angle is stimulated when the exercise had been done at the correct angle.

5.2.3 Effect of two weeks duration of Scapular retraction exercise on forward head posture

During the week 2 post-treatment of result data in paired t-test, on comparing the pre-treatment mean craniovertebral angle, with the mean post-treatment

craniovertebral angle in within group (intervention group), shows a significant difference (p value = 0.002). Therefore, this difference was statistically significant between pre- and post-treatment craniovertebral angle in the intervention group ($p<0.05$). As such, it can be inferred that the scapular retraction exercise had successfully produces effect in improvement in the forward head posture in a short amount of time.

During the week 2 post-treatment CVA in independent t-test, on comparing between the scapular retraction exercise and ergonomic advice group, the p value was 0.182. Therefore, there was no significant difference between control group and intervention group with week 2 post-treatment CVA. This further implies that at week 2, control group and the intervention group did not make a difference, both ergonomic advice and scapular retraction exercise can make an impact on the forward head posture.

This can be due to the insufficient 2 weeks duration of intervention exercise in improving the forward head posture. Majority of the study suggests exercise intervention that is of 4 weeks duration or longer than 4 weeks duration, which those study illustrated high significant effects in improving the forward head posture in terms of CVA and other outcome measures (Harman et al., 2005; Im et al., 2016; Kang et al., 2018; Lee et al., 2017; Moezy et al., 2014). Also, a progression was given at the middle of the intervention duration at the end of week 2 after assessing the week 2 post-treatment result in this study. This might make a difference in the effect of the significance between intervention and control group as the study showed significant improvement similar with the result of this study, utilizing home-based

exercise with progression of repetition and resistance of elastic band.

In past evidence, there was only a study that found encouraging results on the CVA measurements through two weeks of chest exercises and predicted that the applied stretching intervention exercise will play a significant role in treating forward head posture in the clinical setting (DiVeta et al., 1990). In addition, there is another study that found significant changes on the craniovertebral angle by comparing treatment and control groups with administration of a shortened 2-week Kendall exercise program that were originally a 10-week program (Diab & Moustafa, 2012). Thus, this study produces similar significant effects of scapular retraction exercise in short duration of time of 2 weeks, but the intervention used were different. Nonetheless, the result of this study had instilled more information on acute 2 weeks effect of intervention exercise on improving forward head posture.

On the contrary, majority of studies encouraged long duration administration of intervention exercise which consist of 8 weeks, 6 weeks, and 10 weeks intervention period (Harman et al., 2005; Lee et al., 2017; Moezy et al., 2014). A 6-week intervention exercise centered on scapular stability was effective in improving pectoralis minor flexibility, decreasing forward head, shoulder postures and range of motion is had synced results with this study (Moezy et al., 2014). The result of this study was also in line with an 8-week intervention comprising self-stretch exercise, the McKenzie exercise, and the Kendall exercise, which portrayed increased CVA (Lee et al., 2017). In addition, this study also strikes the same results with a 10-week progressive home exercise program, which comprises the pectoralis stretches, deep neck flexor and shoulder retractor strengthening that improved the forward head

posture (Harman et al., 2005).

5.2.4 Effect of demographic characteristics on forward head posture

This part was to determine the effects of demographic characteristics that was obtained at baseline period of study with the post-treatment CVA. The effect of demographic characteristics was investigated in the intervention group only. The aim was to see if the demographic characteristics had any influence on the outcome measures. If there were significant differences in statistical testing between the demographic characteristics with the post-treatment CVA, this may be implying a confounding factor that is influencing the study result, which places doubt in the effects of scapular retraction exercise in this study.

5.2.4.1 Effect of Gender on forward head posture

At week 4, the mean score of male gender in intervention group, female gender in intervention group's mean score. The p value was 0.539. This shows that there was no significant difference between genders, male and female, in week 4 post-treatment craniovertebral angle in the intervention group. As a result, at week 4, there was no differences in the improvement of craniovertebral angle in male of the intervention group compared to female of intervention group.

In a study which investigates the gender differences on trapezius activity while performing high intensity eccentric shoulder exercise, they suggested that the shoulder muscles in men and women were activated in distinct ways. However, females have a better and notable ability to resist muscle fatigue, this phenomenon is

likely explained by the distinct activation pattern of shoulder muscle when employed in different gender (Nie et al., 2007). Despite of that, current study has almost equal male and female participants which different activation pattern of shoulder muscle were exerted by the scapular retraction exercise, therefore showing insignificant differences between gender with week 2 and week 4 post-treatment craniovertebral angle.

Despite of that, this result of this study is consistent with a study by Brink et al., (2014) , which also identified insignificant association between gender and posture when assessing the spinal posture of computer users among adolescents in a real-life setting. At week 2 and week 4 of post-treatment craniovertebral angle in this study, the insignificant result has been contradicted by a study, debating that males tend to stress the head and neck to flexion while females were associated with increased stress to lumbar lordosis in excess computer use (Straker et al., 2007). In short, male would have had more improvement in head posture due to the exercise intervention than female if there was more head and neck flexion in males than females (Straker et al., 2007). Several external factors can affect this as well, such as the duration of usage and the individual posture developed by each individual when using electronic devices.

As such, all studies that are discussed were intervention other than the scapular retraction exercise. If there were more studies done on this aspect to determine gender differences and postural improvement during exercise intervention, different exercise protocol can be appropriately administered for male and female respectively to stimulate more improvement in head posture as the effectiveness of

exercise has elevated.

5.2.4.2 Effect of Age on forward head posture

The effect of age on forward head posture was not assessed in this study as the result of week 4 post-treatment CVA of both group, intervention and control group, data is normally distributed. The age of intervention group is normally distributed while the age of control group is normally distributed. However, they also concluded a linear positive relationship between forward head posture and age, which the severity of forward head posture increases with age (Nemmers et al., 2009). However, in this study, the week 4 post-treatment angle and age of participants are both normally distributed. It can be inferred that age is excluded from being a confounding factor to forward head posture in this study.

5.2.4.3 Effect of BMI on forward head posture in intervention group

At week 4 post-treatment CVA, the mean score of Overweight and Obesity group and Underweight and Healthy group mean score difference of this result is 1.01. The p value of 0.514 at 95% confidence interval with the assumption of the variances were equal. Thus, there was no significant difference between Overweight and Obesity group and Underweight and Healthy group with week 4 post-treatment CVA in the intervention group. As a result, there was no differences in the improvement of craniovertebral angle in Overweight and Obesity group compared to Underweight and Healthy group.

In a study, it shows that Obesity categorized by BMI affects the posture adversely, involving the spine, which acts as the pillar of body support against the gravity force, causing increasing kyphosis of thoracic and anteversion of the head (Fabris De Souza et al., 2005). However, the mean BMI of obese participants in their study was at 49.4, while the mean BMI of this study was only at 27.65 (2.55), which the severe effects of obesity was not observed in the population of this study, in turn implying similarity with this study's result showing no added significant effect of scapular retraction exercise on obese and overweight forward head posture individual compared to underweight and healthy individuals.

This study's finding is consistent with a strong systematic review and meta-analysis study, from a study from Molina-Garcia et al., (2021) claiming that no association between the Overweight and Obesity (OW-O) individual with the occurrence or forward head posture. Furthermore, their study also present findings showing that Overweight and Obesity category according to BMI does not appear to be a further factor in the presence of a forward head posture. Instead, the strength of the deep neck stabilizer muscles and cervical mobility are factors linked with an ideal head position (Molina-Garcia et al., 2021).

On a contrary, result from a prevalence study from KILINÇ & KARADUMAN, (2021) depicted that an elevated value in BMI would adversely affects the head and neck posture as their study showed that increased BMI was significantly associated with a more severe forward head angle. This contradicting result might be due to different sampling population and different geographical location of study conducted, but with similar inclusion criteria such as age group with

this study.

Generally, obesity is the ultimately consequence of excess of fat and adipose tissue in the body, excess adipose tissue tends to overload the spinal column and alter its biomechanics as extra burden is placed on the joint in addition to the gravitational force (KILINÇ & KARADUMAN, 2021). The stress and strain on the joints and muscles around the head and neck region are higher due to poor weight distribution on their body due to shift of centre of gravity (KILINÇ & KARADUMAN, 2021). A study portrayed the spine structure is greatly impacted by a high BMI due to its supportive function against excessive loads that in turns cause functional overloads in the muscles and other soft tissues structure (Molina-Garcia et al., 2021). Due to the interrelated segmental structure of the vertebral column sagittal curvatures, a rise in thoracic kyphosis and cervical lordosis is also seen (KILINÇ & KARADUMAN, 2021). Consequently, the anterior tilt of the head likewise increases when thoracic kyphosis and cervical lordosis increase.

5.2.4.4 Effect of Physical activity on forward head posture

Among the intervention group and control group, majority of the participants in both groups are categorized as high in IPAQ Questionnaire categorical score, only minority of participants were in the low group. As a result, the participants recruited in both groups were all highly active according to categorical score in IPAQ Questionnaire.

Physical activity is the meaning of exercise and activity itself. According to recent studies, choosing the type of physical exercise wisely is considered as

beneficial to realign body posture back to normal (Calcaterra et al., 2022). Moreover, physical activity is always perceived as a mean of solution to posture problems, there was study emphasizing physical activity and sports, which are the two tools that can be used to prevent, treat, and even reverse deformities and pathological postures (Disler et al., 2019).

A study from Bergman et al., (2009) also utilize the same physical activity category scoring according to the IPAQ scoring protocol, which group physical activity level into 3 levels, which is low, moderate, and high. According to the study, they categorized physical activity to lessen the impact of known measurement mistakes and the impact of skewed data.

Among all the highly active participants in control group and intervention group, it is inferred that forward head posture in the highly active category in both intervention and control group hasten the correction process of the posture as physical activity and appropriate exercise is the key to revert abnormal posture. This inference is consistent with the results of which 2 weeks scapular retraction exercise produces significant changes in CVA in intervention group.

Physical activity category		Cut off levels
1	Low	- no activity is reported or - some activity is reported but not enough to meet categories 2 or 3.
2	Moderate	- 3 or more days of vigorous activity for at least 20 min. per day or - 5 or more days of moderate intensity activity or walking for at least 30 min. per day or - 5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum of 600 MET min·week^{-1}
3	High	- 3 or more days of vigorous activity accumulating at least 1500 MET min·week^{-1} or - 7 days of any combination of walking, moderate or vigorous intensity activities achieving a minimum of 3000 MET min·week^{-1}.

See: http://www.ipaq.ki.se

Figure 5.1 Cut-off levels and Physical activity categories based on the IPAQ scoring protocol (Bergman et al., 2009).

5.2.4.5 Effect of electronic device usage time on forward head posture

Electronic devices are inclusive of computers, laptops, mobile smartphones, smart tablets in this study, which in turn causes deterioration of the head posture anteriorly (Guan et al., 2016).

In the control group and the intervention group, the mean score of electronic device usage time is analyzed. The p value was 0.522. There is no significant difference between control and intervention group in electronic device usage time. As a result, this shows that both groups spend similar amount of time in usage time of electronic device. This can be further inferred that with both group spending the similar number of hours on electronic device, resulting in a baseline result which both groups are similarly affected by the electronic device usage time. Thus, electronic device usage time would not make a difference on forward head posture when it is said to influence the effects of scapular retraction exercise in both groups.

In a study conducted by (Guan et al., 2016), they illustrated that between the postural changes of head and neck and the varying frequency of mobile phone screen time in young adults, the findings that was reached by researchers were not significant, which was consistent with the results of this study. Another study found no relationship between posture and computer use but concludes that spinal postures changes with increased trunk flexion with increasing computer use in adolescents (Brink et al., 2014).

However, in this study, majority of the participants in the intervention were

using electronic devices for 6 hours and above, while the greatest number of participants in the control group recorded to have 4 hours, 8 hours, and 12 hours electronic devices usage time. On average, the electronic device usage time of university student is at least 6 hours or more per day, including school related activities and entertainment and leisure activities. Not to mention, over 90% of participants in both groups reported using mobile phone more than 2 hours per day, which implied heavy dependence on electronic device among university students. Therefore, it is imperative to understand the impact of high electronic device usage time on university student's development and health, thus it is worthy for investigation.

5.3 Limitations of study

Moreover, there were some limitations to this study that were pointed out throughout the whole study period. Firstly, in the photogrammetry method that was used to capture lateral portraits of participants, there was alterations to the standardized shooting spot during pre-testing or post-testing period. For instance, the location of photo taking venue was often forced to change as there were other parties that need to occupy that space to run other events. Perhaps, this is also due to the way of conducting the post-test, as my participants were allocated in timeslots to come by, therefore the testing always went on for several days because participants tend to come by at their preferred convenient time. Therefore, the post-treatment went on for several days and the position of photo-taking was no longer standardized.

Next, the scapular retraction exercises for the intervention group for 4 weeks duration was given as home-based exercise, which is to complete the exercise at

home. As such, administering home based exercise has its own benefits and shortcoming. The problem of compliance must also be addressed. According to (Harman et al., 2005), home exercises were carried out, but results were good, or compliance achieved. Although participants were given a clear handout of scapular retraction exercise and a simple schedule for them to tick on their day of choice to do the exercises in a calendar form, researcher can only maximize the compliance. At the same time, participants that were in the intervention group need to complete a total of 3 session of exercise in a week, ideally with an alternate day in between, following the proper procedure. However, participants reported that they were unable to strictly abide to this proper procedure due to their respective busy schedule within these 4 weeks.

In addition to the high specificity of targeted population, which is the university student, the recruited sample for this study is considered as smaller than the calculated sample size by 2 samples. In addition, the sample taken was all from University of Tunku Abdul Rahman, Sungai Long campus, therefore it is not a mixture of sample from different university campus in Malaysia due to the time and resources restrictions. Thus, this study is not readily generalizable to other university students at different universities in Malaysia.

Moreover, one of the limitations of this study is noticed during the pre- and post- testing of participant. The insufficiency of verbal instructions, stating to relax the head and neck, before taking photo is expressed by participants not following the instructions but still tensing the neck and placing their head and neck as posteriorly as possible to display an on-obvious forward head posture. Although proper instructions

have been given, the tensing action of participant's neck and head further contracts the muscle around the neck and head, making the initial photo-taking position to be less ideal as muscles need to be relaxed to exhibit the normal head posture of participant whether he has forward head posture or not.

Lastly, the control group program is given only as an advice but not as an alternate intervention, this might introduce to a major intervention bias. To add on, there is also no monitoring done to check on the intervention consistency for the control group, there is only checking on participants in control group via verbal communication. Next, the resistive band strength is not assessed earlier according to each participant individual strength, and it is given to all participants universally. This random assignment will also introduce bias to the study.

5.4 Recommendation of study

This subsection mainly outlines the recommendation and suggestion for future similar studies. Firstly, a longer duration of intervention week should be included in the next study. It is proven that longer duration of intervention week was more effective on treating and correcting the misalignment problem of the body, especially the postural problem of the head and neck (Harman et al., 2005; Moezy et al., 2014). The results obtained will be more convincing and accurate with longer duration of study utilizing exercise intervention as a mean to determine its effectiveness on abnormal postural problem.

Next, for the sampling size, a bigger sampling size can result in more accurate result. In such, researcher should recruit more participants in future study. Future

studies should expand the recruitment of participants to other universities in Malaysia to include more variety of university student.

Moreover, there are also better methods that can be introduced to assess the forward head posture condition with adding more related outcome measures to enhance the reliability and accuracy of the study. To add on, there also might be hidden factors that might influence the study result that might be detected by adding more outcome measures. For instance, the head position angle and head tilt angle can be added to future study along with the craniovertebral angle which scored high inter- and intra-rater reliability (ICC= 0.75-0.94) for the 3 outcome measures stated above.

Then, surface EMG electrode placement can be added to future studies, integrating into the photogrammetry method. This is to ensure participants to relax their muscles around the head and neck while undergoing the postural assessment while standing laterally. There is a study utilizing the surface EMG electrode placement to monitor muscle activity of the shoulder and back including upper, lower trapezius and muscles of the shoulder (Bressel et al., 2001). Furthermore, surface EMG electrode placement can also be used when participants are performing the scapular retraction exercise to accurately pinpoint the activated muscle, in turn to enhance the effectiveness of the exercise.

In future study, control group can be given the kinesio taping intervention as the control group program. The kinesio taping intervention applies tension to realign the head back to the proper alignment by applying inhibition to the tightened upper trapezius, deep cervical extensors, levator scapulae muscles (Im et al., 2016). Before

administering the resistive band, participants should be given a period to test out the strength and tension of resistive band and perform 1 repetitive maximum (RM) to identify their appropriate strength and suitable resistive band.

In a nutshell, this study was conducted to assess the effects of scapular retraction exercise on forward head posture among university students, as well as to find out the prevalence of forward head posture among university students. The forward head posture was assessed through the outcome measures before, during and after the scapular retraction exercises are given to see if there are any effects on the forward head posture. As we know that forward head posture comes with a lot of adverse effects on health and posture, thus it is worthy and crucial to formulate a simple, convenient, and easy exercise intervention to treat this problem. It is seen as more imperial to conduct this study to investigate the effect of scapular retraction exercise on forward head posture to see if exercise intervention might reduce the abnormal alignment of head. This is especially true on the university students, which will in turn breed into greater amount and higher severity of forward head posture in future workplace in a few years' time if awareness and exercise intervention were absent.

Conclusion

In conclusion, this study was established to find out the effects of scapular retraction exercise on forward head posture among university students. In the meantime, the prevalence of forward head posture was also sought among university students. Ultimately, the current study concluded that a 4-week scapular retraction

exercise program was significantly improving the forward head posture and was effective among university students. The combination of 5 exercises that is included in this scapular retraction exercise selectively activates the middle and lower trapezius, rhomboids muscle, serratus anterior and lengthening the pectoralis group of muscles, which adds to the improvement of forward head posture. With that, this study had proved that a simple, provenly effective, convenient exercise program that one can do anytime, anywhere. Still and all, wishes were to ease the treatment procedure in the physiotherapy setting for the forward head posture and contribute to intervention knowledge of physiotherapy field with this set of scapular retraction exercise.

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APPENDIX A – ETHICAL APPROVAL FORM

UNIVERSITI TUNKU ABDUL RAHMAN
Wholly Owned by UTAR Education Foundation (Company No. 578227-M)

Re: U/SERC/224/2022

4 November 2022

Mr Muhammad Noh Zulfikri Bin Mohd Jamali
Head, Department of Physiotherapy
M. Kandiah Faculty of Medicine and Health Sciences
Universiti Tunku Abdul Rahman
Jalan Sungai Long
Bandar Sungai Long
43000 Kajang, Selangor

Dear Mr Muhammad Noh,

Ethical Approval For Research Project/Protocol

We refer to your application for ethical approval for your students' research project from Bachelor of Physiotherapy (Honours) programme enrolled in course UMFD3026. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
31.	Association of Postural Awareness with Sedentary Behavior and Back Pain During the Hybrid Study Among Undergraduate Students	Low Xin Yuen	Mr Martin Ebenezer Chellappan	4 November 2022 – 3 November 2023
32.	Impact of Social Media Addiction on Physical Activity Among Undergraduate Students	Mak Kai Nan		
33.	Tibial Torsion and Leg Length Discrepancy in Idiopathic Scoliosis Among UTAR Students	Khoo Wan Qi	Pn Nadia Safirah Binti Rusli	
34.	Prevalence of Patellofemoral Pain Among University Students	Khoo Wen Han		
35.	Prevalence of Varicose Veins Among Fast Food Employees in Cheras, Selangor: A Cross Sectional Study	Ropheca Phuah Su Hui		
36.	The Effect of Unstable Modified Wall Squat on Dynamic Balance Among Recreational Athletes	Chu Sin Jiet	Mr Sathish Kumar Sadagobane	
37.	Knowledge, Perception, and Attitude Towards Breast Cancer and Breast Self-Examination (BSE) Among Non-medical Private University Students	Foo Jes Myun		
38.	Perception, Knowledge and Attitude Towards the Impact of Daytime Nap on the Risk of Stroke Among Non-Healthcare Undergraduate Students: A Cross-Sectional Study	Chan Chi Kuan	Mr Tarun Amalnerkar Co-Supervisor: Ms Swapneela Jacob	
39.	Awareness, Knowledge and Attitude Toward Orthostatic Hypotension Among Elderlies	Ch'ng Hui Kee		
40.	Effect of TikTok on Student Learning Among Physiotherapy Students	Tan Eng Jing	Mr Avaniamban Chakkarapani	
41.	Awareness Towards Tourette Syndrome Among Health Science and Non-health Science Students in A Private University, Malaysia	Tan Kai Xuan		
42.	Effect of Scapular Retraction Exercise on Forward Head Posture Among University Students	Tay Kai Wei	Ms Mahadevi A/P Muthurethina Barathi	
43.	Comparison Between Effect of Lower Limb Cyclic Stretching and Ballistic Stretching on Jumping Distance Among Undergraduate Students: A Comparative Study	Ng Zi Ru		
44.	Relationship of Physical Activity with Anxiety and Depression Among University Students	Ong Aiwei		
45.	Gender Discrepancy and Its Association with Shoulder Pain Among Malaysian Recreational Badminton Players	Khoo Je-Yique	Pn Nur Aqliliriana Binti Zainuddin	
46.	Obesity, Eating Habits and Physical Activity Before and During Covid-19 Pandemic Among University Lecturers	Khoo Tze Sean		

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 **Fax:** (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 **Fax:** (603) 9019 8868
Website: www.utar.edu.my

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,

Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, M. Kandiah Faculty of Medicine and Health Sciences
Director, Institute of Postgraduate Studies and Research

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APPENDIX B – INFORMED CONSENT FORM

Research Participant Information Sheet

Universiti Tunku Abdul Rahman
Faculty of Medicine and Health Sciences
Department of Physiotherapy
Bachelor of Physiotherapy (Honours)

EFFECT OF SCAPULAR RETRACTION EXERCISE ON FORWARD HEAD POSTURE AMONG UNIVERSITY STUDENTS.

Student Investigator: Tay Kai Wei
Department: Department of Medical and Health Sciences
Course Name and Course Code: UMFD3026 RESEARCH PROJECT
Year and Semester: Year 3 Semester 2
Course Coordinator: Mr. Avanianban Chakkarapani

You are being asked to volunteer for this research study that is being conducted as part of the requirement to complete the above-mentioned Course.

Please read this information sheet and contact me to ask any questions that you may have before agreeing to take part in this study.

Purpose of the Research Study
The purpose of this study is to find out the effects of scapular retraction exercise in forward head posture among university students. The findings of this study will contribute to the knowledge in the field of physiotherapy in effective exercise prescription for forward head posture patient and clients.

60 University students will participate in this study.

Procedures
If you agree to be in this study, you will be asked to be assessed on the presence of forward head posture. During the intervention, you will perform 5 different scapular retraction (rolling back shoulders) exercises, such as the retraction overhead (raise arm overhead and roll back shoulders) exercise, 0° resistive band bilateral external rotation (pulling band sideways) exercise, elbow push back (rolling back shoulder exercise), prone scapular retraction activation (squeezing back exercise), the pectoralis wall stretches (wall stretching). After every week of intervention, you will be assessed for post-test. Handouts consisting of exercise details and a mini calendar will be included to improve the compliance of participant.

Length of Participation
A total of maximum 15 minutes per session, 2 session per day, 3 days per week, for a total of 4 weeks.

Risks and Benefits
There are some risks in participating in this study, which includes muscle soreness and possible injury. There are some direct benefits in participating in this study, which includes increased shoulder retractor strength, correction of posture problem.

Confidentiality
No information that will make it possible to identify you, will be included in any reports to the University or in any publications. Research records will be stored securely, and only approved researchers will have access to the records.

Voluntary Nature of the Study
Participation in this study is voluntary. If you withdraw or decline participation, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.

Contacts and Questions
If you have any questions, clarifications, concerns, or complaints, about the research, the researcher conducting this study can be contacted at 016-4086022, or by email to kaiwei01@1utar.my.

The Course Coordinator Mr. Avanianban Chakkarapani, can be contacted at 016-374 9125, or by email with avanianban@utar.edu.my, if there are any inquiries, concerns or complaints about the research, or comment on other researcher on the research team.

Please keep this information sheet for your records.

Research Participant Consent Form

Universiti Tunku Abdul Rahman
Faculty of Medicine and Health Sciences
Department of Physiotherapy
Bachelor of Physiotherapy (Honours)

Consent Form to Participate in the Study

Student Investigator: Tay Kai Wei
Department: Department of Medical and Health Sciences
Course Name and Course Code: UMFD3026 RESEARCH PROJECT
Year and Semester: Year 3 Semester 2
Course Coordinator: Mr. Avanianban Chakkarapani

I have read the provided information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have, has been answered to my satisfaction. I understand that I will be given a copy of this form, and the researcher will keep another copy on file. I consent voluntarily to be a participant in this study.

Signature: _____ Signature: _____

Name of participant: _____ Name of Witness: _____

Date: _____ Date: _____

APPENDIX C – PERSONAL DATA PROTECTION NOTICE

PERSONAL DATA PROTECTION NOTICE

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:
a) Name
b) Identity card
c) Place of Birth
d) Address
e) Education History
f) Employment History
g) Medical History
h) Blood type
i) Race
j) Religion
k) Photo
l) Personal Information and Associated Research Data

2. The purposes for which your personal data may be used are inclusive but not limited to:
a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing the value of education
g) For educational and related purposes consequential to UTAR h) For replying any responds to complaints and enquiries
i) For the purpose of our corporate governance
j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent:

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at _____.

kaiweitay99@gmail.com Switch account

* Required

Email *

Your email

Acknowledgment of Notice *

- [ ] I have been notified and that I hereby understood, consented and agreed per UTAR above notice.
- [ ] I disagree, my personal data will not be processed.

Name (Tay Kai Wei) *

Your answer

Date (e.g. 23/11/22) *

Your answer

Electronic Signature (e.g. kaiwei) *

Your answer

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APPENDIX D – DEMOGRAPHIC DATA

DEMOGRAPHIC DATA

1. Name

   ---

2. Age

   _____

3. Gender

   ☐ Male ☐ Female

4. University

   ☐ UTAR

   ☐ Others: _____

5. Programme Course

   _____

6. Year and Semester of study

   _____

7. Do you have any previous history of injury to the spine within past 6 months?

   ☐ No ☐ if Yes, please state :_____

8. Do you have any prior traumatic injury to your shoulder within past 6 months?

   ☐ No ☐ if Yes, please state :_____

9. Are you pregnant?

   ☐ No ☐ Yes ☐ Not Applicable

APPENDIX E – VISUAL INFOGRAPHICS OF SCAPULAR RETRACTION EXERCISE

EFFECT OF SCAPULAR RETRACTION EXERCISE ON FORWARD HEAD POSTURE AMONG UNIVERSITY STUDENTS

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

<u>Shoulder Exercises (Scapular Retraction Exercises)</u> = 3 days per week, 2 sets per day

1. **Overhead Retraction**
   (Note: body to wall distance is 1 forearm length, 1 set = 10 repetition with 3 seconds hold)

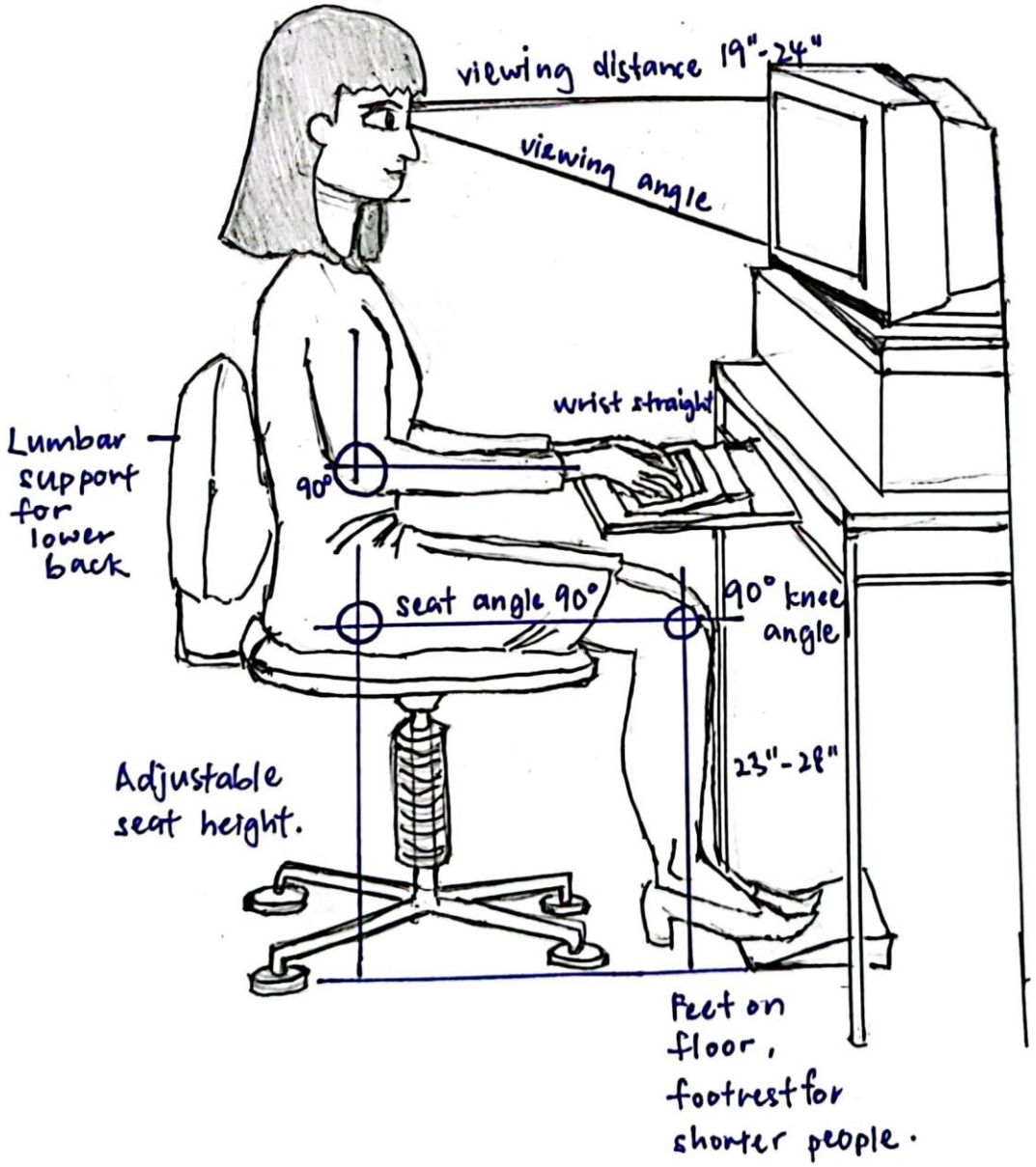
1. **Elbow Push Back Exercise** (Note: shoulder position at 90°, 1 set = 10 repetitions)

2. **Prone Scapular Retraction Exercise** (Note: lift hand up and squeeze shoulder inwards, 1 set = 10 repetitions)

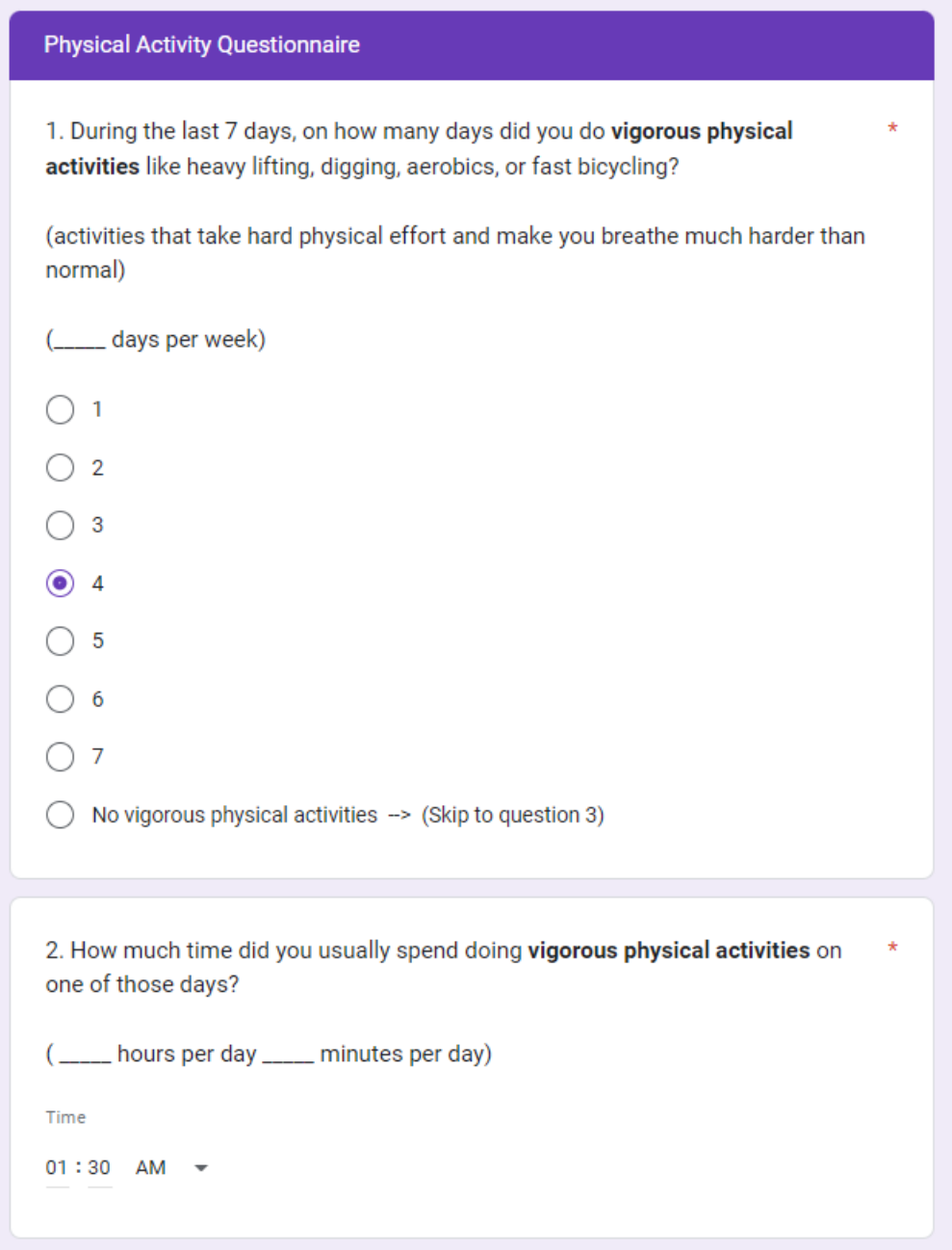
3. **0° resistive band bilateral external rotation exercise** (Note: stick elbow to trunk, squeeze shoulder inward, 1 set = 10 repetition with 3 seconds hold)

4. **Pectoral Wall Stretch** (Note: Shoulder position at 90**°** at corner of wall,
1 set = 3 repetition with 15 seconds hold)

APPENDIX F – ERGONOMIC ADVICE INFOGRAPHIC FOR CONTROL GROUP



APPENDIX G – IPAQ QUESTIONNAIRE AND ELECTRONIC DEVICE USAGE TIME QUESTIONNAIRE



Physical Activity Questionnaire

1. During the last 7 days, on how many days did you do **vigorous physical activities** like heavy lifting, digging, aerobics, or fast bicycling? *

(activities that take hard physical effort and make you breathe much harder than normal)

(_____ days per week)

- ○ 1
- ○ 2
- ○ 3
- ◉ 4
- ○ 5
- ○ 6
- ○ 7
- ○ No vigorous physical activities --> (Skip to question 3)

2. How much time did you usually spend doing **vigorous physical activities** on one of those days? *

(_____ hours per day _____ minutes per day)

Time

01 : 30 AM

3. During the last 7 days, on how many days did you do **moderate physical activities** like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking. *

(activities that take moderate physical effort and make you breathe somewhat harder than normal)

(_____ days per week)

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ◉ No moderate physical activities --> (Skip to question 5)

4. How much time did you usually spend doing **moderate physical activities** on one of those days? *

(_____ hours per day _____ minutes per day)

Time

__ : __ AM ▾

5. During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time? *

(includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure)

(_____ days per week)

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ No walking --> (Skip to question 7)

6. How much time did you usually spend **walking** on one of those days? *

(_____ hours per day _____ minutes per day)

Time

: AM

7. During the last 7 days, how much time did you spend **sitting** on a week day? *

(_____ hours per day _____ minutes per day)

Time

: AM

Total Screen Time of Electronic Device

Electronic devices include all devices listed (e.g., television, MP3 player, cellular phone, smartphone, tablet, video game console, computer, and other devices).

1. In 1 week, on average, how many days do you spend using electronic devices? *

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ None at all --> Skip to the last question

2. On average, how many hours per day do you spend using electronic devices? *

(_____ hours per day _____ minutes per day)

Time

__ : __ AM

3. On average, how many hours of electronic device usage per day are dedicated to work/school-related activities? *

(_____ hours per day _____ minutes per day)

Time

__ : __ AM

4. On average, how many hours of electronic device usage per day are spent on entertainment/leisure (e.g., movies, T.V., reading on a tablet, social media)? *

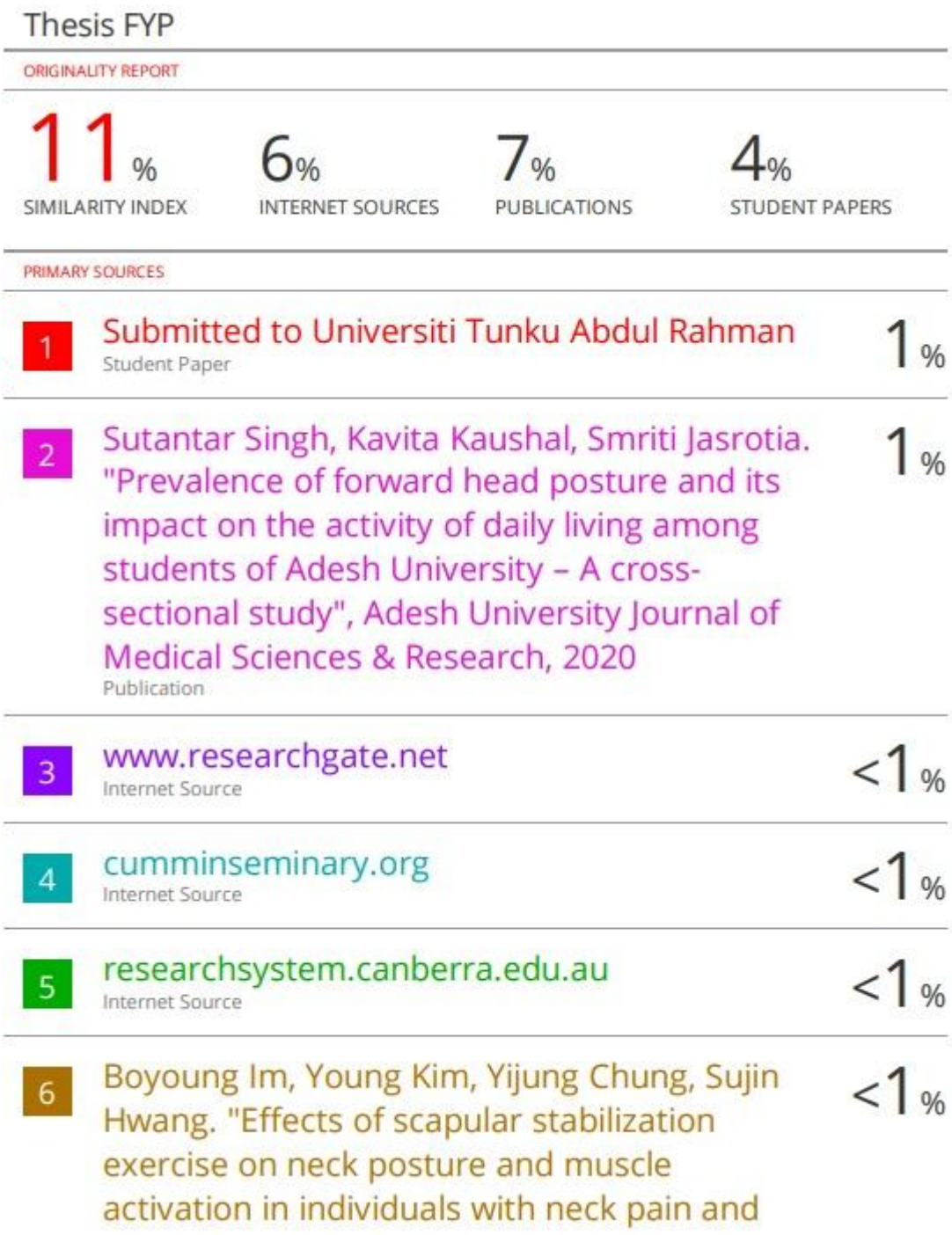
(_____ hours per day _____ minutes per day)

Time

__ : __ AM

Back Submit Page 3 of 3 Clear form

APPENDIX H – TURNITIN REPORT



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