EXPERIMENTAL INVESTIGATION ON MOBILE GAMERS PHYSICAL FATIGUE USING ELECTROMYOGRAPHY DURING MOBILE GAMING

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STUDENT'S DECLARATION

I declare that this project entitled "Experimental Investigation on Mobile Gamers Physical Fatigue Using Electromyography During Mobile Gaming" is the result of my own work except as cited in the references.

Signature :.....

Name : Muhamad Hirzi Bin Mohd Hatta

Date :.....

SUPERVISOR'S DECLARATION

I have checked this report and the report can now be submitted to JK-PSM to be delivered back to the supervisor and to the second examiner.

Signature :.....

Name of Supervisor : Dr. Juffrizal Bin Karjanto

Date :.....

DEDICATION

To Mother and Father

To Siblings

To Family

And to Myself

ABSTRACT

This study aimed to identify the change in the muscle activity and fatigue of sternocleidomastoid, upper trapezius and latissimus dorsi muscles, which are the crucial muscle parts under the three postures usually used by mobile gamer during the gaming session. The subjects of this experiment were six (6) college students in their 20 years old of ages. They have been classified into two different groups which are avid gamer and non-gamer based on their daily gaming time. The subject needs to perform three different postures which are middle bending, maximum bending and neutral posture. While the subjects maintained the postures, the muscle activity and fatigue were recorded by using surface electromyography device. Comparison of the muscle fatigue by each posture showed a statistically significant difference for sternocleidomastoid, upper trapezius and latissimus dorsi. Moreover, maintaining the maximum bending posture during mobile gaming resulted in a higher level of muscle activity and fatigue in sternocleidomastoid, upper trapezius and latissimus dorsi muscle compare to middle bending posture and neutral posture. Therefore, this study recommends that the mobile gamer to apply neutral posture to reduce muscle fatigue.

ABSTRAK

Kajian ini bertujuan untuk mengenal pasti perubahan aktiviti otot dan keletihan otot sternocleidomastoid, trapezius atas dan latissimus dorsi, yang merupakan bahagian otot penting di bawah tiga postur yang biasanya digunakan oleh gamer bergerak semasa sesi permainan. Subjek eksperimen ini adalah enam (6) pelajar kolej berusia dalam lingkungan 20 tahun. Mereka telah diklasifikasikan ke dalam dua kumpulan yang berbeza iaitu peminat permainan dan bukan pemain berdasarkan masa permainan harian mereka. Subjek perlu melakukan tiga postur berbeza iaitu lenturan tengah, lenturan maksimum dan postur neutral. Walaupun subjek mengekalkan postur, aktiviti otot dan keletihan dicatat dengan menggunakan alat elektromiografi. Perbandingan keletihan otot dengan setiap postur menunjukkan perbezaan yang signifikan secara statistik untuk sternocleidomastoid, trapezius atas dan latissimus dorsi. Tambahan pula, mengekalkan postur lenturan maksimum semasa permainan mudah alih menghasilkan tahap aktiviti otot dan keletihan yang lebih tinggi pada otot sternocleidomastoid, trapezius atas dan latissimus dorsi berbanding dengan postur lenturan tengah dan postur neutral. Oleh itu, kajian ini mengesyorkan agar pemain permainan video telefon pintar untuk menggunakan postur neutral untuk mengurangkan keletihan otot.

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LIST OF ABBREVIATIONS

PSM	Projek Sarjana Muda
SMS	Short Message Service
EMG	Electromyography
PES	Pro Evolution Soccer
LCD	Liquid Crystal Display
OLED	Organic Light-emitting Diode
PIM	Personal Information Manager
PDA	Personal Digital Assistant
PC	Personal Computer
sEMG	Surface Electromyography
ECG	Electrocardiogram
P1	Middle Bending Posture
P2	Maximum Bending Posture
P3	Neutral Posture

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CHAPTER 1

INTRODUCTION

1.1 Background

Mobile gaming is getting popular since smartphones took its place in 2009 due to the rapid development of world technology (Falaki et al., 2010). It is because smartphones play an important role in users' daily lives to make the users everyday lives more efficient. It has paved the way to short message service (SMS), text messaging, call, video chat, and applications that instantly allow people to communicate with everyone across the globe. The smartphones are also convenient for people to surf the web for education and entertainment (Al-Showarah et al., 2014). Research reveals that adults are the significant users of the smartphone because they tend to use the smartphone for their daily lives either for working or studies (Marko Milijic, 2019). The simple reason is because of the convenience of the smartphone for today millennial generation.

However, this smartphone's convenience is also involved in the electronic games industry because of the existence of mobile games. Since then, mobile games have become a favourite of most people because it is nothing compared to console games and it has the advantage that it is portable and can be played at any time. It is why teenagers and adults are more likely to play mobile games than have an outdoor activity to reduce the stresses they face throughout the day (Barnett et al., 2011). Moreover, some people tend to make mobile gaming as a hobby for free time (Torrente, 2009). The mobile games are believed to offer engagement and enjoyment (Okazaki, 2008). It will lead the users to keep frequently playing, without immediate personal consequences, and to embed behaviour change procedures needed to make only positive health changes. These mobile games are divided into several levels based on suitable ages where children can play, and some can only be performed by

teenagers and adults (Baranowski et al., 2015). Various levels have led to the growth of the mobile gaming industry and also the now famous, e-sport. E-sport is a video game competition that is digitally played and facilitated by an electronic system and meditate by human-computer interfaces (Hamari & Sjöblom, 2017). It is a phenomenon that is growing and gaining popularity over the years (Hutchins, 2008). Besides, e-sport causes the mobile gaming industry to become more advance and create today's generation, especially young ages, to spend their time enjoying mobile gaming.

1.2 Problem Statement

Having a heavy gaming behaviour might cause a negative effect on human mental and physical health (Quwaider et al., 2019). It might cause internalising and externalising behaviour problem such as depression, anxiety, and aggressive or uncontrolled behaviour. Having an addiction to gaming will also increase the risk of computer eye syndrome, such as eye discomfort, inability to focus accurately, and experiencing headaches (East West Eye Institute, 2015). Moreover, having an excess of gaming also might produce muscular problems such as muscular disorder at fingers, arms, and other related upper body parts (Berolo et al., 2011). However, having a long gaming period also needed an appropriate posture to ensure the gaming session will not affect the user's physical health. A previous study also stated that if the smartphone user is applying an inappropriate posture, it also will affect the muscles and joints, especially upper body muscles such as back, neck, and shoulder muscle group (Lee et al., 2015).

Applying a good posture for a long period of a gaming session is needed in order to care for the muscle from muscular disorder. The neck muscle group is the most crucial part because the user tends to bend down their neck during mobile gaming instead of applying an appropriate posture. This might cause a muscular disorder on the neck muscles group. This scenario might also affect other muscle groups, such as back and shoulder muscles

because they are highly related (Szeto & Sham, 2008). It is important to take full attention to these muscle parts because they are connected to the spine. The user needs to care about the spine because it is an important part of physical health care. In order to care of the spine, the user needs to apply an appropriate posture to reduce the bending angle of the spine during playing smartphone or mobile gaming session (Hansraj, 2014)

1.3 Hypothesis

It is hypothesised that the human body prefers a neutral position to prevent or reduce any strong effect during mobile gaming. On the other hand, the less the usage of a muscle, the less the effect will occur. Furthermore, avid gamers will experience less muscle fatigue compared to non-gamer due to training-related neural adaptations on muscles and higher muscle activity.

1.4 Objective

1. By the end of this project, the different postures of the body that are crucial during mobile gaming will be recognised by using a self-rating questionnaire.
2. By the end of this project, sets of electromyography (EMG) will be developed and the human body area for the best placement for the EMG sensor will be identified to get the maximum reading of the related groups of muscles.
3. By the end of this project, the suitable postures for playing mobile games that generate less muscle fatigue will be concluded by using EMG as a measurement tool.

1.5 Scope

This scope of this study is only to analyse the physical fatigue of avid mobile gamers and non-gamer. The avid gamer was defined as the individual with 2 hours and more gaming session per day, and non-gamer was defined as the individual who has gaming session less than 1 hour per day. The participants are between 18 to 24 years old and did not experience any muscle injury for at least the in past six months. EMG device was used as the equipment for the experiment, which can record the muscle activity and fatigue at dominant muscle groups related to the sitting position while playing a smartphone. Only the following sitting postures were used as the gaming position:

- Maximum bending posture
- Middle bending posture
- Neutral posture

Sports games were used as a gaming session such as football games (Pro Evolution Soccer (PES) 2020) because gaming duration can be fixed, which is 5 minutes. The smartphone with a screen size of 5.0 inches was used as a gaming device within this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Handheld Devices

The handheld device is a computer small enough to be hold and operated in hand (Cummings et al., 2010). Generally, any handheld devices will have Liquid Crystal Display (LCD) or Organic Light-emitting Diode (OLED) flat screen interface, providing a touch screen interface with digital or physical buttons and keyboard along with internet connection. The handheld devices are commonly used for personal information manager (PIM) types of applications such as maintaining schedules, keeping contact information, doing simple calculations, taking notes, and any daily life business (Rouse, 2015). There two types of handheld devices, which are a wireless connection and wired connection. For the wireless connection handheld devices, it is genuinely convenient when it comes to making people more efficient throughout the day because of its accessibility, whether at home, vehicle, working place, schools, business, and other public places (Martin et al., 2010). Its portability advantage makes ease to daily usage and faster to access the daily task. There are various handheld devices that have been invented throughout the years, such as Personal Digital Assistant (PDA), Pocket PC, tablet computer, smartwatch, and the most favoured by the present-day user, a smartphone (Bhih et al., 2016).

2.1.1 Smartphone

Smartphones are classified as mobile phone and multi-purpose mobile devices (Rouse, 2019). There are many features of a smartphone, such as the capability of extensive mobile operating systems, which facilitate more comprehensive software, internet connection, and multimedia functionality alongside basis phone functions such as voice call and text messaging. Smartphones are also provided with online-based communication,

business, education, entertainment media, and even clinical applications suitable for all ages (Mok et al., 2014). Most people owned a smartphone for their daily usage, whether adults or children (Kuntsche et al., 2009). Because of the advancement of the internet and online platform, people nowadays, especially kids and teenagers, tend to entertain themselves by playing games using smartphones because it is convenient and easy to use (Baranowski et al., 2015).

2.1.2 Gaming in the Smartphone

Online social network applications such as social media and games have engaged most mobile application market shares, whether in Appstore or Playstore, due to an increase in the number of downloads of mobile games (Cai et al., 2013). Gaming in a smartphone or mobile gaming is genuinely similar to desktop games and consoles game, which is provided almost with the same features and same gaming experience, whether online or offline (Cai et al., 2013). Since mobile gaming is getting popular during the last decades, people have risen concerning how gaming and game-like simulations can provide benefits to learning experiences besides entertaining (Aldrich et al., 2018). This will motivate young people, such as teenagers, and children to play mobile gaming frequently during their leisure time (Torrente, 2009). However, besides being beneficial, mobile gaming also has some disadvantages to user's health (Baranowski et al., 2015). Most of the user's common health problem is neck muscle pain because of its related neck flexion posture (Andersen et al., 2003; Bababekova et al., 2011; Jensen et al., 1993). Furthermore, users have to follow the appropriate posture while playing smartphone or mobile gaming to avoid muscular disorder.