CHAPTER I

INTRODUCTION

1.1. Background

Computer use is widespread in recent decades for both personal and work use. Over the past years, it is known that 92% companies in Indonesia have used computer for their business process with 71,84% computer used in micro scale company, 92,74% computer used in small scale company, 97% computer used in medium scale company, and 100% computer used in large scale company (KEMKOMINFO, 2011). In household and personal use, the growth of computer uses also widespread over time, with 24,7%, 25,2%, 29,8%, 31,4% of household access to computer in year 2013 to 2016, respectively (KEMKOMINFO, 2016).

The most activity spent by computer users is working, including operating document processing software, studying, and communicating (KEMKOMINFO, 2017), which requires typing activities. The increasing frequency of computer use related to typing activities has been associated with the increasing risk of Musculoskeletal Disorders especially in upper extremity, including hand, wrist, and arm (Qin et al., 2013), one of them is Carpal Tunnel Syndrome.

Carpal tunnel syndrome (CTS) is one of the most common neuropathies. Carpal tunnel syndrome (CTS) occurs when the median nerve, which runs from the forearm into the palm of the hand were compressed at the wrist (Latinovic et al., 2006; Salawati & Syahrul, 2014). Median nerve is a major upper extremity peripheral nerve which innervates all of the muscles which pass through carpal tunnel, one of them is *Flexor*

Digitorum Superficialis and some forearm and hand muscles, one of them is *Abductor Pollicis Brevis*. The prevalence range of CTS in the world population is identified around 10.5% for frequent computer users in general (Stevens et al., 2001). In Indonesia, there were 238 patients suffering from CTS in Jakarta and decreased in the incidence rate in 2002 which was 149 patients (Tana et al., 2004). There were also 28% of bank employees in North Sulawesi which show CTS indication in right unilateral (13%), left unilateral (2%), and bilateral (13%) with higher keyboard placement in the workstation become one of the factors (Saerang et al., 2015). Suherman et al. (2012) also reported 97.3% on computer rental workers with non-ergonomic hand positions when typing positively diagnosed with CTS.

The symptoms when Carpal Tunnel Syndrome occurs are numbness, tingling, pain, weakness, and fatigue in the affected hand. These symptoms can disturb the ability to perform work-related activities, and potentially resulting in work disability (Turner et al., 2007). Based on preliminary survey done by the researcher, 96% out of 50 people of productive age and capable of using computers admit that they have felt fatigue and discomfort in wrist, with percentage of 33% slightly uncomfortable, 48% uncomfortable, and 19% very uncomfortable. It is strengthened by a study from Hermanto (2017) which conducted body discomfort survey through 503 students in Jakarta. The result of the study shows that the participants felt wrist discomfort during study, including study using personal computer with 22% slightly uncomfortable, 40% uncomfortable, and 28% very uncomfortable.

Several studies have summarized that the well-known risks of work-related CTS is caused by forceful and repetitive movement (Septiawati et al., 2013), prolonged use of the hands and wrists (You et al., 2014), exposure to vibration (Sharma, 2016) as well as non-neutral wrist posture (Rempel et al., 2008). The function of the hand mostly focuses on wrist and thumb which will influence daily activities if there is a less functioning of wrist and thumb (Raven, 2017). Moreover, the continued and increased use of portable computing device will increase the number of people working in temporary computing environments such as coffee shops, hotels, and restaurants which has different standardization for standard workstation and can result non-neutral postures (Hoang, 2016). The wrist typing posture that always taken place excessively whether in flexion,

extension, ulnar, or radial will increase load to the muscle contraction. Extension describe the raising wrist posture, flexion describe the bending wrist posture down, ulnar describe the bending wrist posture towards the ulnar bone or little finger side, and radial describe the bending wrist posture towards the radial bone or thumb side (Norkin & White, 2016). Recent conditions based on a study that identifies the wrist posture involved in computer task using motion analysis techniques in Ireland shows that the mean of motion in extension, flexion, ulnar, and radial are 18.825˚, 10.013˚, 5.228˚, and 11.703˚, respectively (Donoghue et al., 2013).

Both extension, flexion, ulnar, and radial motions will always be generated in typing activity posture. Oikawa et al. (2011) stated that the more incline the wrist posture, might cause an increase burden for the wrist as the consequence. Therefore, it is necessary to identify how much load on the wrist occurs during typing activity in those four motions. Each muscle movement will produce electrical activities caused by muscle fiber depolarization (Drum et al., 2016) and can be recorded using electromyograph (EMG) (Tayyari & Smith, 1997). EMG is one of electrodiagnosis technique to record, analyze and display the muscle contraction at the junction of neurons and muscle fibers (Criswell, 2011; Roman-Liu & Bartuzi, 2013). EMG become one of the electrodiagnosis methods which has been regarded as an objective, reliable, and valid test for CTS (Wang, 2013) to identify the muscle activities produced by the wrist. Muscle contraction activity can be analyzed using this method by identifying electrical signal produced by muscle.

A study about Carpal Tunnel Pressure thresholds analysis in California shows that the increasing of Carpal Tunnel Pressure along with the increase angle increment of the experiment towards extension, flexion, ulnar, and radial wrist posture with the result of 32,7˚ wrist extension, 48,6 ˚ wrist flexion, 21,8 ˚ radial deviation, and 14,5˚ ulnar deviation of 30 mmHg Carpal Tunnel Pressure applied (Keir et al., 2007). The result of a study about the effect of wrist posture on carpal tunnel pressure while typing found that carpal tunnel pressure is influenced by wrist posture (Rempel et al., 2008). However, there has not been a corresponding research held in Indonesia. The significance difference between body anthropometric between American and Asian, even among Asian countries (Nakanishi & Nethery, 1999; Rahman et al., 2018) affirm the needs of further study. It is necessary to narrow the thresholds into the hand-intensive task in the workplace which

comprise the wrist posture in typing especially for Indonesian. Thus, the aim of this study is to define wrist posture maximum range in flexion, extension, and radial as well as ulnar by evaluating the muscle contraction at wrist.

1.2. Problem Formulation

Based on the description on the background above, the problem that came up is formulated as follows:

1. How is the wrist muscle contraction activity in typing using electromyograph?
2. What is the maximum range of wrist angle in flexion, extension, ulnar, and radial for typing activity for Indonesian?

1.3. Objectives of Research

Based on the problem formulation above, the objectives of research can be arranged as follows:

1. Identify the wrist muscle contraction activity in typing using electromyograph.
2. Develop the maximum range of wrist posture in flexion, extension, ulnar, and radial in typing activity.

1.4. Scope of Problem

Every research requires the scope and focus of the study that is directed in order to focus on a certain scope.

1.4.1. Assumption

The assumptions made on this study are as follows:

1. Physical work environment during experiment are assumed to be good by the subject of the study.

2. The subjects of the study were in good health and had no history related to Carpal Tunnel Syndrome and wrist musculoskeletal disorders.

3. The subject of the study is familiar with using computer with 6 months minimum experience (Kumar, Sambyal, & Vij, 2013).

1.4.2. Problem Limitation

In order to focusing the scope of the study, the problem restriction of this study is set as follows:

1. The case study is typing activity in computer interaction.
2. This study focuses on wrist posture in flexion, extension, ulnar, and radial.
3. The subject of the study is Indonesian university student.
4. This study located in Work System Design and Ergonomics Laboratory.
5. This study is based on percentage of the Maximum Voluntary Contraction (%MVC) that was recorded by electromyograph.

1.5. Benefits of Research

This research is expected to provide benefits as guideline to design and use a safe computer workstation and computer keyboard design.

1.6. Systematical Writing

The writing in this study was based on the rules of scientific writing in accordance with the systematics which consists of Chapter I into Chapter VI; Introduction, Literature Review, Research Methodology, Data Collection and Processing, Discussion, Conclusion and Recommendation.

Chapter I contains a research background, which become the basis of the research, formulation of the problem, the objectives to be achieved, assumptions, problem limitation, and the benefits of research.

In Chapter II, the theories of reference books and journals as well as the results of previous research related to the research problem which is used as reference for problem solving are elaborated in order to support the state of the art of this study continued with Chapter III which represents the concept framework as well as the research object, research subject, research apparatus, experimental design, and methodology.

Chapter IV contains the data obtained during the research, in forms of description, tables, graphs, or figures, and the data analysis. This chapter also become the references for the next chapter, chapter V.

Chapter V provides the results from data processing in chapter IV will be discussed further in order to obtain the result from the problem formulation as well as produce the recommendation.

The last chapter, Chapter VI, consists of conclusion of the research being conducted and completed with the recommendation for future research.