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by Hendrik .

Submission date: 19-Aug-2022 12:11PM (UTC+0800)
Submission ID: 1884219281
File name: artikel-The_Effect_of_Work.pdf (454.05K)
Word count: 3724
Character count: 19058

Dama International Journal of Researchers (DIJR), ISSN: 2343-6743, ISI Impact Factor: 0.878
Vol 1, Issue 10, October 2016, Page 33 - 37, Available @ www.damaacademia.com

The Effect of Work Position on Fatigue on the Arm Muscles of Computer Operator

[1]Hendrik, [2]Tjipto Suwandi, [3]Harjanto JM, [4]Hari Basuki Notobroto

[1]*Doctoral Program, Faculty of public Health, Airlangga University, Indonesia.*
[2]*Department of Occupational Safety & Health, Faculty of Public Health, Airlangga University, Indonesia*
[3]*Department of Physiology, Faculty of Medicine, Airlangga University, Indonesia*
[4]*Department of Biostatistic & Population, Faculty of Public Health, Airlangga University, Indonesia*
Kampus C UNAIR, Jalan Mulyorejo, Surabaya, Indonesia; Email: padanghendrik@yahoo.co.id

Abstract
Skeletal muscle fatigue generally occurs due to excessive muscle contraction as a result of the provision of the workload is too heavy with long duration loading. Instead of muscle fatigue is not likely if muscle contractions ranged only between 15-20% of maximal muscle strength. This research aims to study the effect of various positions of the shoulder joint abduction angle to the forearm muscle fatigue computer operator. The study was designed using this type of experimental research in the field of design one group pre-posttest design. The study population was a computer operator-sex male, aged 25-40 years who worked as a computer operator. Samples are computer operators with the following criteria: minimum term of one year, weight 50-70 kg, an arm's length 65-75 cm and height 50-70 cm, proficient typing ten fingers, long sleep at night over 6 hours, conditions fingers and arm muscles when the research was in good condition. Results of research on paired samples t test was obtained differences in the ability of muscle contraction before and after typing for 30 minutes at positions 0-200 and 41-600 both static and dynamic contraction. In the static contraction was no significant difference between the position of 0-200 and 21-400 and positions 21-400 and 41-600. In dynamic contractions were no significant differences between groups of positions 0-200 and 21-400. There is the influence of the working position against the computer operator arm muscle fatigue after working for 30 minutes, both the static and dynamic contraction.

Keywords: *Working Position, Muscle Fatigue, Computer Operator.*

I. INTRODUCTION

Nowadays the use of computers is becoming more popular in the community in line with advances in telecommunications and information. Ranging from private companies, governments, students and other non-commercial users are already familiar with the use of computers. The use of computers for a long time without being accompanied by adequate rest periods will cause interference on hard and soft tissues (musculoskeletal) include a headache, arm, stress and stiffness (Sueb, 2000). Fatigue is a protective mechanism of the body to the body avoid further damage resulting in the recovery after the break. The term fatigue is showing different conditions in each individual, but it all boils down to loss of efficiency and a reduction in work capacity and endurance. Fatigue is classified into two types, namely muscle fatigue and general fatigue. Muscle fatigue (muscular fatigue) is indicated by symptoms of reduced muscle response such as muscle tension and tension around the joint (Ramandhani, 2003; Enoka, 2008; Suma'mur, 2013). Local muscle fatigue is reduced muscle response to respond repeatedly seen in the reduction of motor unit potential amplitude (Kisner, 2012). General fatigue (general fatigue) can be seen in the emergence of a number of complaints in the form of feeling sluggish and aversion to activity. Muscle fatigue can occur tremors in the muscles or feel pain in the muscles, while general fatigue is usually characterized by reduced willingness to work (Grandjean, 1997). On the computer operator fatigue will eventually cause health problems such as repetitive strain injury (RSI) and cumulative trauma disorder (CTD) thus causing carpal tunnel syndrome, tendinitis and muscle pain (Savage, 2006). To reduce disruption of soft tissue and muscle fatigue due to the use of computers, it is necessary to an understanding of the influence of the working position against fatigue (Peddie, 1998).

II. METHODS

A. Research Location

Research conducted in the communities where it operates from a computer typing services in the city of Makassar

B. Research Design

This study was designed using this type of experimental research in the field. This study measured muscle fatigue finger and arm between the control group and two treatment groups as a result of computer operator working shoulder position. Measurements were taken at 7 at the respective different angles using a hand dynamometer and handgrip day

before work and after working for 30 minutes with the distance between the position of the measurement time for one day. The design of this kind of experiment is called pre-posttest control group design.

C. Population and Sample

The study population was typing services worker, sex male, aged 25-40 years who worked as a computer operator. Samples were workers typing services who worked as a computer operator who meets the following criteria: minimum term of one year, weight 50-70 kg, fitness is good (based on the doctor's recommendation), arm length 65-75 cm and height 50-70 cm , adept at typing with ten fingers, long sleep at night over 6 hours, the condition of the finger and arm muscles when the research was in good condition so that the number of samples 7 people.

D. Data Collection Methods

Data obtained from measurements using a hand dynamometer to measure muscle fatigue handgrip for measuring static and dynamic muscle fatigue. Both measurements are done on the same subject just before work and after working with computers for 30 minutes at each position angle of the shoulder.

E. Data Analysis

To analyze the static and dynamic muscle contraction before and after typing for 30 minutes each group used a paired t- test analysis.

III. RESULTS

A. Analysis of Research Variable

Table 1 shows the ability of static contraction before and after working on the computer for 30 minutes in each group. Measurement capability static contraction performed twice at each position of the day before making typing and when after doing the typing. Measurement of static contraction is a measurement of the ability of muscle contraction statically arms using a hand dynamometer. This ability needs to be known and controlled to obtain the homogeneity of the ability of each sample. With the ability of contraction on average homogeneous (in the same range), it can be known with certainty that the change in the ability of contraction static (fatigue) arm muscles operator typing services computer are not influenced by the ability of muscle contraction arm, but because of the influence of the treatment position of abduction joints shoulder turn.

Table 1: *Comparison of Static Contraction before and after Typing Each Position*

Position	Static Contraction				The difference of mean (kg)	t	p
	Before		After				
	Mean (kg)	SD (kg)	Mean (kg)	SD (kg)			
0 - 20^0	37.43	1.27	36.29	1.11	1.14	2.489	0.047
21 - 40^0	37.43	1.27	36.86	0.90	0.57	0.285	0.285
41 - 60^0	37.43	1.27	36.14	0.90	1.29	0.049	0.049

Results of paired samples t- test of the ability of static contraction of muscles in your arms before and after typing in a position between positions 0-200. positions 41-600 differ significantly ($p < 0.05$). whereas in the position 21-400 showed no significant difference ($p > 0.05$). It can be concluded that the positions 21-400 is the position of the shoulder joint abduction which does not cause changes in static muscle contraction after working at the computer for 30 minutes.

Table 2 Static contraction after the typed between the position after typing on the computer for 30 minutes. Static contraction after typing position is the difference between the average ability of static contraction arm muscles between the position of the one of other positions after doing the typing. On average ability static contraction arm muscles after typing can be seen in Table 2.

Table 2: *Comparison of Static Contraction After Typing Delivery Position*

Position	Contractions After Typing		The difference of mean (kg)	t	p
	Mean (kg)	SD (kg)			
0 - 20^0	36.29	1.11	-0.57	-2.828	0.030
21 - 40^0	36.86	0.90			
0 - 20^0	36.29	1.11	0.15	0.354	0.736

41 - 60^0	36.14	0.90			
21 - 40^0 41 - 60^0	36.86 36.14	0.90 0.90	0.72	2.500	0.047

Results of paired samples t- test of the ability of static contraction after typing between positions 0-200 with positions 21-400 and position 21-400 with positions 41-600 showed a significant difference ($p < 0.05$). whereas the positions 0-200 with 41-600. showed the ability of static contraction arm muscles after typing there was no significant difference ($p > 0.05$). It can be concluded that the position 0-200 and positions 41-600 has a great influence on the changes in static muscle contraction after working at the computer for 30 minutes.

Table 3 shows the ability of dynamic contractions before and after working on the computer for 30 minutes in each group. These measurements were performed at each position. the day before making typing and when after typing. Dynamic contraction capabilities need is known and controlled to obtain the homogeneity of the ability of each sample. Because of the ability of the average contraction homogeneous. it can be known with certainty that changes the dynamic capability arm muscle contraction operator of computer typing services is not influenced by the ability of muscle contraction arm. but because of the effect of treatment of the shoulder joint abduction position has changed.

***Table 3**: Comparison of Dynamic Contractions Before and After Typing Every Position*

Position	Dynamic Contraction				The difference of mean (kg)	t	p
	Before		After				
	Mean (kg)	SD (kg)	Mean (kg)	SD (kg)			
0 - 20^0	35.00	0.58	33.86	0.69	1.14	3.361	0.015
21 - 40^0	35.00	0.58	35.00	1.15	0.00	0.000	1.000
41 - 60^0	35.00	0.58	33.86	0.90	1.14	2.828	0.030

Paired samples t- test results on the ability of dynamic contractions before and after typing to positions 0-200 and 41-600. showed a significant difference ($p < 0.05$). in the position 21-400. dynamic contraction of muscles in your arms before and after typing there was no significant difference ($p > 0.05$). Thus the position of abduction 21-400 shoulder joint does not cause a decrease in the ability of contraction or arm muscle fatigue does not cause the computer operator at the time of typing for 30 minutes.

Table 4 dynamic contraction after working at the computer for 30 minutes between groups. Dynamic contraction after typing position is the difference between the average ability of dynamic contraction arm muscles between the position of one of the other positions after doing the typing. The average ability of dynamic contraction arm muscles after typing can be seen in Table 4.

***Table 4:** Comparison of Dynamic Contractions After Delivery Typing Position*

Position	Contractions After Typing		The difference of mean (kg)	t	p
	Mean (kg)	SD (kg)			
0 - 200 21 - 400	33.86 35.00	0.69 1.15	-1.14	-2.489	0.047
0 - 200 41 - 600	33.86 36.14	0.69 0.90	0.00	0.000	1.000
21 - 400 41 - 600	35.00 36.14	1.15 0.90	1.14	1.706	0.139

Paired samples t- test results on the ability of dynamic contraction after typing between positions 0-200 with 21-400 showed a significant difference ($p < 0.05$). while the ability to dynamically contraction after typing between positions 0-20 to 41-600 and position 21-400 to 41-600 did not show any significant difference ($p > 0.05$). Thus the position of the shoulder joint abduction between positions 0-200 and 21-400 have a big difference compared with the position of the shoulder joint abduction of another.

IV. DISCUSSION

In this study. there are three groups that carried out on samples of the same and different samples. consisting of group I with the position of 0-200 abduction of the shoulder joint. group II. positions 21-400 abduction of the shoulder joint and group III. positions 41-600 abduction of the shoulder joint . Group I. II and III were each given the same 7 (same sample) so that the number of samples 7 people. To ensure that the capability of static and dynamic contractions can be used as a parameter level of fatigue. then before you type the static and dynamic contraction capabilities of each group should be the same. Each group was given treatment of the shoulder joint abduction position different. namely the position of 0-200. 21-400 and position 41-600. Then after typing for 30 minutes checked the ability of static and dynamic contraction. This is to know the difference of the static and dynamic contractions before and after typing.

Based on data analysis. that the ability of static and dynamic muscle contraction operator arm typing on the computer before the same sample no difference for all groups of positions. (Tables 1 and 3). But after typing for 30 minutes. the ability of contraction static and dynamic arm muscles operator typing services computer each group position is no difference. in which the position of 0-200 and 41-600 shows the differences in the ability of contraction static and dynamic arm muscles operator typing services computer before and after typing. the position 21-400. there was no difference in the ability of static muscle contraction operator arm computer typing services before and after typing. It shows that the position of the shoulder joint is different. namely 0-200. 21-400 and 41-600 so that the workload of different muscles in the arms. which ultimately arm muscle fatigue level computer typing services provider after typing each group is different.

The differences in the ability of contraction static and dynamic arm muscles operator typing services computer before and after typing each position can be explained by the interpretation that. at the time of typing the arms provide load on the shoulder joint so that the muscles in the shoulder joint will contract against the force of the hands. consequently the muscles in the shoulder joint to contract continuously (static) giving rise to the occurrence of fatigue. Although the weight of the arm roughly 5 percent of body weight. but when laid horizontally will produce a large torque on the arm that must be resisted by the shoulder muscles (Susan. 2012). At the time of typing. elbow joint in flexion so that the center of gravity and the fulcrum of the arm will be concentrated in the area of wrist joint. consequently increasing the load arm muscles work so easily happen fatigue. At the time of maximum flexion of the elbow joint. then the power arm movement will be in the forearm and hand so as to increase the burden on the working arm muscle (Susan. 2012; Kumar. 2007).

The number of muscles in the shoulder joint contract depends also on a large or small angle formed by the shoulder joint. The greater the angle formed by the shoulder joint. the more the involved muscles to contract so that the torque on the arm are also great. but the smaller the angle formed by the shoulder joint. the fewer muscles to contract so that the center of gravity and the fulcrum to be centered on the arm so easy fatigue occurs in the muscles of the arm. It can be concluded that the abduction of the shoulder joint position may affect the occurrence of fatigue in the muscles of the arm operator of computer typing services (Oatis. 2009; Murray et al. 2009).

Measurement capabilities of static and dynamic contraction arm muscles after typing done once. The measurement is carried out using a hand dynamometer for contraction to contraction static and dynamic handgrip. The test results showed a difference in the ability of static and dynamic contraction arm muscles between positions 0-200 with 21-400 and position 21-400 to 41-600 for static contraction as well as on the position of 0-200 with 21-400 to dynamic contraction. While in the position of 0-200 to 41-600 for the contraction of the static and the position of 0-200 with 41-600 and positions 21-400 to 41-600 for the contraction of the dynamic showed no difference in the ability of contraction static and dynamic arm muscles between the position (table 2 and 4). The test results can be concluded that the position of 0-200 and positions 41-600. for static and dynamic contractions have in common the greater the burden posed so as to facilitate the operator's arm muscle fatigue in computer typing services.

Analysis of the average differences that occur between the position also shows that there is a big difference between the position of 0-200 and position 41-600 with positions 21-400. That is the comparison the average difference between the position shows large differences between the position of 0-200 and 41-600 with positions 21-400. so that in the second position (0-200 and 41- 600) arm muscles tired more easily than in the position 21-400. Workers while sitting with his hands on the table should be the position of 20 - 250 abduction of the shoulder joint and slightly flexed (Susan. 2012). Because the activity with different work positions. the amount of muscle involved and the necessary power is also different. The quality of the performance of muscle and non muscle (gravity and velocity associated with the power) has contributed to various parts of the power and acceleration (Neptune et. al. 1998). Therefore typing

with the position of the shoulder joint abduction different. will involve the amount of muscle contraction is also different. Typing with the position of the shoulder joint abduction of 0-200 and 40-600 will involve more muscle contraction intensity and thus require more energy. As a result. the energy in the muscles anaerobically processed so that the concentration of glycogen in the muscle decreases and increases lactic acid. The increase in lactic acid will cause fatigue. lactic acid occur causing fatigue (Poedjiadi. 2009; Oatis. 2009).

Muscle fatigue increases almost in direct proportion to the speed of decline in muscle glycogen (Guyton et. al. 2003). Based on the opinion of Guyton. it can be interpreted that when the intensity of work has increased and their position imposes muscle work in a long time. then the glycogen in the muscles that are available are not met. Because the concentration of glycogen in the muscles are not fulfilled. then it needs to be replenished. The glycogen replenishment taken from outside the muscle cells of the blood sugar (glucose). It can be concluded that the position of 21-400 is the position of the least cause fatigue when typing compared with the position of 0-200 and 41-600.

V. CONCLUSION

There is a working position against the influence of muscle fatigue computer typing services provider arm after working for 30 minutes. both the static and dynamic contraction in positions 0-200 and 41-600. while in the position 21-400. there is no influence. Static and dynamic contraction capabilities of each group is the same. but after typing for 30 minutes there is a difference.

A. Acknowledgements

Thanks to Head of Tamalanrea District which has provided the opportunity for researchers to carry out research and employees who agreed to become subjects in our study. Thanks are also forwarded to the Director of Health Polytechnic of Makassar that has facilitated to complete our study.

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