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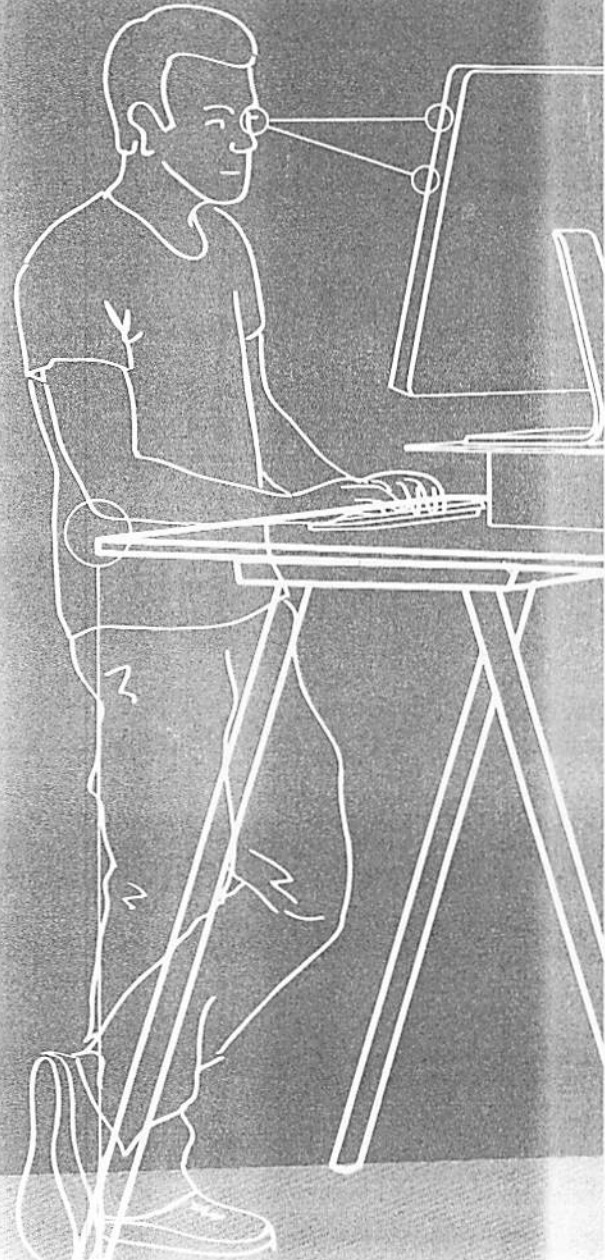
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# Analysis of Dentist's Working Posture and Lactic Acid Level on the Risk of Musculoskeletal Disorders

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## ABSTRACT

**Introduction:** The aim of the study was to determine the relationship between the working posture and lactic acid levels on the risk of MSDs of dentists working in the Health Center of Surabaya. MSDs have been common complaint among dentist in the dental profession. High activity of the dentist can cause a built-up of lactic acid level that lead to obstruction of the ATP and the onset of fatigue. **Method:** The study was an analytical observational with cross sectional approach. The sampling technique was using cluster random sampling with sample number of 19 subjects. REBA method was used to analyzed working posture of the subject while MSDs complaint were recorded using Nordic Body Map. **Results and discussion:** There was a significant relationship between the working posture and lactic acid levels with the risk of MSDs with significant value of  $p=0.036$ . Relationship between the working posture and lactic acid levels to MSDs significant value of  $p=0.025$ .

## KEYWORDS

*Lactic acid; musculoskeletal disorders; Dentist working posture; REBA*

## INTRODUCTION

Occupational health hazards are common in many sectors of industry and are on the increase. Musculoskeletal disorders (MSDs), which are problems of musculoskeletal system, are significant and costly workplace problems affecting occupational health, productivity and the careers of the working population. Musculoskeletal diseases, including pain, weakness and paresthesia, are reported to be associated with wide range of occupations. Nearly 2 million workers suffer from musculoskeletal disorders each year. These problems are caused by repetitive, awkward, or stressful motions. Dental personnel had an increased risk of developing such disorders (Abduljabbar A.T.2000).

Work-related musculo skeletal disorder have been identified as a significant occupational health problem among dental professionals (Hayes 2010; Leggat 2007). Workrelated MSDs can be defined as any injury to the human support system, including the bones, cartilage, muscles, ligaments, tendons, blood vessels, nerves due to exposure to hazards at the workplace (Lalumandier 2001; Rolander 2001). MSDs are not limited to any specific region of the body, however, for dental professionals they occur commonly in the neck, shoulder, lower back and wrists (Hayes 2009). Sufferers of MSDs may experience numbness, tingling, pain, decreased strength or swelling of the affected area (Michalak-Turcotte 2000). These symptoms can manifest through a variety of mechanisms, including decreased muscle function, impaired nerve conduction, strains and ruptures of muscles, tendons and ligaments or degeneration or microfracture of the bones (ASCC 2006). MSDs have become a common in the dental profession world wide.

The prevalence of MSDs among dental practitioner is not well documented in Indonesia, especially in Surabaya. It was relatively high in several country as in Saudi Arabia, the prevalence was 82.9%. The reported prevalence studies in Australia reached 87.2%, India 78%, Lithuania 86.5%, and Turkey reached 94%. In Indonesia, study conducted by Faculty of Dentistry University of Indonesia reported that using instrument of discomfort of body Map and Brief Survey, found 80% of practicing dentist suffered musculo skeleton disorder mainly on the shoulders, forearms, hands, and back (Wijaya, et al. 2011).

One of the cause of musculo skeletal disorder among the dentist is that while working on passient, dentists usually are only cares about the comfort for patients they treated, but less attention to their own comfort. In doing so, the dentists very often consider that they need to move toward the patient, rather than adjust the seating position of the patient on the dental chair. Most MSDs occur because the dentist unknowingly be in the position of that his body is less support when caring for patients. When performing a tooth preparation or extracted teeth, for example, sometimes dentists bent towards the patient, moving abruptly, turned from one side to the other. The entire movement is done many times in every day. This may cause the syndrome muskulo skeletal (Andayasari, L.; Anorital. 2012). Beside, there are some factors like lighting, lay out of dental equipment, and life style of dentist act in causes MSDs, that make dental personnel had an increased risk of developing such disorders (Guyton, Arthur C. 1995; Sitepu, Indra Darma. 2007). This causes a practicing dentists in musculo

skeletal disorders, so often they experienced pain or discomfort in the neck, shoulder, wrist, and spine (Alexopoulos, et al. 2004).

Long strong contractions muscle results in a condition known as muscle fatigue. Fatigue was the result of the inability of contraction and metabolic processes of muscle fibers to continue producing the same work output. Nerves continue to work well as normal nerve impulse running through the muscle-nerve enters to muscle fiber. However, but the contractions increasingly weak because of the muscle fibers themselves suffers ATP deficiency. Barriers flow of blood to the muscles that are contracting lead to muscle fatigue quickly in one minute or more for losing the supply of nutrients (Guyton, Arthur C. 1995).

Feeling tense or tired in the body is an indication accumulated lactic acid in the muscles. The lactic acid occur in the combustion process in the active muscle. Fox (1984) mentioned that during the combustion process occurs, in addition to the energy generated from the combustion, it also result in the form of lactic acid. The longer the activity is executed, the smaller the energy generated in the combustion, but the combustion residue in the form of lactic acid was actually accumulated. Buildup of lactic acid in the muscles that causes tiredness or tired (Sitepu, Indra Darma. 2007).

Lactic acid is closely related to the ability of muscles to contract. The body has a number of limitations to tolerate lactic acid and for each individual the threshold tolerance of lactic acid is different.

Lactic acid levels, will increase during the muscle movement (Dyah, WarihAnjani. 2016). The source of energy of the movement is from glycolysis system anaerob. From this background, this study aims to determine the relationship between the working posture the dentist, the lactic acid levels and musculo skeletal disorders. Based on the relationship, a recommendation can be made for the practicing dentist to adopt better posture while treating patients.

## METHOD

This research is an analytic observational with cross sectional approach. The sampling technique in this study using cluster random sampling with a total sample of 19 dentists participate in the study as subject. Criteria sample in this study include: a maximum age of 50 years, premenopausal, are not menstruating (time of blood sampling), minimum term of 5 years practicing, physically and mentally healthy, and willing to be sampled in the study.

To assess the working posture of the dentist, this study used REBA method (Sutrio dan Firdaus, 2011). Posture of the working dentists were rated by giving risk scores between one to fifteen. The highest score indicated the highest risk of hazard arising from the typical dentist posture, while the lowest score assure the working posture is free of ergonomic hazard. The complaint of dentist in relation with musculo skeletal discomfort were collected through format questioner from Nordic Body Map. This questionnaire uses images of the human body that was divided into nine main sections, namely: the neck; shoulder; upper back; elbow; lower back; wrist / hand; waist / buttocks; knee; heel(Dewayana, et. al. 2008) . Questionnaire Nordic Body Map are divided into four categories, namely low with a score of 0-20, mild with the score 21-41, high with the score 42-62, and very high with a score of 63-84 (Tarwaka. 2015).

To measure the lactic acid level, the blood samples of the subject was taken and examined. Researchers took blood samples in the vein of respondents use as much 2 cc syringe. The blood samples were stored in red blood sample tubes. In the laboratory, the blood sample were centrifuged and its serum were taken. The blood serum dropped on the test strip and then inserted into the test strips Accutrend Plus instrument and lactic acid levels appeared.

## RESULTS

In this study, respondents working posture seen by using REBA method. The researcher observed and questioned the individual subjectsto determine the REBA score. Table 1 shows that respondents with the highest frequency of 11 respondents (57.9%) on a score of 2-3. with 1 risk level is low risk category. This means allowing the necessary action to reduce working posture that contribute to high risk level.

**Table 1.** Overview of Respondents Frequency Distribution Dentist's Working Postures In Surabaya City Health Center 2016

No	Scores Working Posture (REBA)	Risk level	Amount	Percentage (%)
1	1	0	0	0
2	2-3	1	11	57,9
3	4-7	2	8	42,1
4	8-10	3	0	0
5	11-15	4	0	0
TOTAL			19	100

Table 2 shows the descriptive overview mean standard deviation in the working posture the dentist by using REBA method amounted to  $3.16 \pm 1.259$  and the mean standard deviation in lactic acid levels of  $3.28 \pm 1.853$  Mm/l. This shows that physical activity done by the dentist lead to increased lactic acid levels of 3.28 mM / l.

**Table 2.** Descriptive Overview Dentist's Working Postures and Lactic Acid Levels In Surabaya City Health Center 2016

	WorkingPosture (REBA)	Lactic Acid Levels (mM/l)
n	19	19
Mean±SD	3,16±1,259	3,28±1,853

In this study musculo skeletal disorders was assessed by using a questionnaire Nordic Body Map. Classification of risk level is divided into four, namely low, medium, high, and very high. Here is a picture of a frequency distribution of respondents rate musculo skeletal disorders which can be seen in Table 3. Table 3 shows that of the 19 respondents there is only a low risk category, medium, and high. A total of 11 respondents (57.9%) had no complaints with low-level, 5 respondents (26.3%) had complaints of moderate and 3 respondents (15.8%) had no complaints with the high level.

**Table 3.** Overview of Respondents Frequency Distribution Dentist's Musculoskeletal Disorders In Surabaya City Health Center 2016

No	Musculo skeletal Disorders	Amount	Percentage (%)
1	Low	11	57,9
2	Moderate	5	26,3
3	Height	3	15,8
TOTAL		19	100

The mean standard deviation in musculo skeletal disorders with Nordic Body Map method amounted to  $19.63 \pm 15.148$  can be seen in Table 4.

**Table 4.** Descriptive Overview Dentist's Musculoskeletal Disorders In Surabaya City Health Center 2016

	Musculoskeletal Disorders (Nordic Body Map)
n	19
Mean±SD	19,63±15,148

From Table 5, it can be seen musculo skeletal disorders are most numerous in the right shoulder (78.9%), then on the back (68.4%) and upper neck (63.2%). This shows the majority of dentists perform dental fillings in the posterior maxilla with the wrong posture resulting in pain in the shoulder area, back, and neck.

**Table 5.** Frequency Distribution Overview Location of Dentist's Musculo skeletal Disorders In Surabaya City Health Center 2016

No	Location Musculoskeletal Disorders	Amount	Percentage (%)
1	Neck top	12	63,2
2	Neck down	10	52,6
3	Left shoulder	11	57,9
4	Right shoulder	15	78,9
5	On left arm	11	57,9
6	Back	13	68,4
7	Upper right arm	10	52,6
8	Waist	9	47,4
9	Buttock	6	31,6
10	Bottom	1	5,3
11	Left elbow	2	10,5
12	Right elbow	1	5,3
13	Left forearm	3	15,8
14	Right forearm	5	26,3
15	Left wrist	4	21,1
16	Right wrist	9	47,4
17	Left hand	8	42,1
18	Right hand	7	36,8
19	Left thigh	2	10,5
20	Right thigh	2	10,5
21	Left knee	4	21,1
22	Right knee	2	10,5
23	Left calf	7	36,8
24	Right calf	6	31,6
25	Left ankle	4	21,1
26	Right ankle	5	26,3
27	Left leg	5	26,3
28	Right leg	5	26,3

Tables 6 show the statistical test using Pearson correlation and significance values obtained between the working posture and lactic acid levels with musculo skeletal disorders amounted to 0,036 respectively. While the value of significance between the working posture with lactic acid by 0.025. For the correlation coefficient of each show the positive value which means the relationship between a working posture, lactic acid levels and musculo skeletal disorders directly proportional. One working posture will affect the increased levels of lactic acid. The higher levels of lactic acid, the greater the level of risk of musculo skeletal disorders.

**Table 6.** Analysis of Relationship Dentists's Working Posture With Lactic Acid Level and Musculoskeletal Disorders In Surabaya City Health Center 2016

Independent Variable	Dependent Variable	p	r
Working Position (REBA)	Nordic Body Map	0,036	0,484
	Lactic Acid Levels	0,025	0,513

## DISCUSSION

Rating working posture dentists in this study was using REBA (Rapid Entire Body Assessment). In the field of ergonomics, the method was used to quickly assess the posture of the neck, back, arms, wrists and ankles of a worker. REBA as a posture analyzer method was used to measure work activities. REBA as a tool for postural analysis is highly sensitive to involve work involving sudden changes in posture. Application of this method is intended to prevent the risk of injury associated with the posture, especially in the muscles of the musculoskeletal system. Therefore, this method can be useful for the prevention of risk and may be used as a warning that there is a improper working conditions in the workplace (Tarwaka, 2015). In this study the level of REBA for most of the respondent were still on a score of 2-3 with risk level of 1. Risk level of 1 mean that the activity is low risk category. This means allowing the necessary action. The rest of the respondent on the score of 4-7 with 2 risk level. Risk level of 2 mean that the activity is mild risk category. This means need an action.

From the analysis using Pearson correlation test, there was significant correlation between working posture and musculoskeletal complaints, with significant value of  $p = 0.036$ . Musculo skeletal disorders on dentists in this study the most occured in the right shoulder, back and upper neck. This is because during treating patients, the majority of dentists bend their body in standing posture and bending, while their neck position is likely to come forward in a long time and repeatedly. This study is in line with research Andayasari (2012) which states the general type of dentistry characterized by their static posture and rigid in taking care of the patient. Patients treated at top of the dental chair causes a dentist should be sitting or standing bent for a long time. This causes the body posture as a practicing dentist who often experience pain or discomfort in the neck, shoulder, and spine that can lead to musculoskeletal disorders, among others, in the form of lower back pain.

According to Arnita (2006) for the case of standing for a long periods of time, the body actually can tolerate still remains standing by one position only for 20 minutes. If more than the limit, slowly tissue elasticity will be reduced and eventually muscle pressure rises and discomfort in the hip area. If your back muscles are receiving static loads when standing for long periods, it can lead to complaints of damage to the joints, ligaments, and tendons. A Study has found that while the short term effects are aching joints and shore feet, in the long term they could suffer painful back problems or permanent muscle damage. Complaints to the damage this is what is usually termed a musculoskeletal disorders or injuries on the system musculoskeletal (Susanti, N et al. 2015).

Dentists in practice often perform a variety of extreme static postures such as: bow, leaned over, raised his hand, and lifted up the shoulder. The extreme postures causes muscle fatigue and mechanical pain in the neck, shoulders, and lower back. According to Effendi (2007) during work needs blood circulation can increase ten to twenty times. Increased blood circulation in the muscles working, forcing the heart to pump more blood. When long standing, the muscles tend to work in a static, static muscle work is characterized by muscle contractions that long usually corresponds to the posture. Not recommended for static muscle to continue to work in the long term because it will cause pain. In the study Arda (2007) also mentioned that one of the causes of back pain is sitting or standing for long periods, or a similar motion performed continuously, resulting in stiff muscles (spasms) (Susanti, N et al. 2015).

Nurmianto (2004) states that working in sitting posture requires less energy than in standing posture. Obviously, sitting position reduces the amount of static load on leg muscles. The wrong sitting posture will lead to problems such as back, neck and waist pain. Pressure on the back of the spine will increase when the sitting posture than when standing or lying down. Tense posture requires more muscle activity or spinal cord. Therefore, posture affects a worker's performance (Bayu; Darmadi; Mahayana. 2014).

All the activities and movements of the human body continuously requires contraction of muscles, including the respiratory process for necessary work of the muscles for inspiration and expiration to contracting and relaxing. This process requires muscle energy sources available in the metabolism of the body, namely the formation of ATP, muscle glycogen breakdown to glucose and aerobic processes with  $O_2$ . The process of taking this energy is necessary to maintain the quality of contraction. While the force of muscle contraction is continuous, in a fatigue condition, there is accumulation of metabolic wastes such as lacticacid, reduction of muscle glycogen, and increase in  $CO_2$ . This would cause the inability of the muscle to maintain the same work output, eventually will decrease the power resistant (Guyton, Arthur C. Hall & John E. 2008).

Muscles get their energy from aerobic and anaerobic metabolism in the form of adenosine triphosphate (ATP). If a continued contraction and the need for ATP can not be met through aerobic metabolism, anaerobic metabolism becomes the alternative to meet the body's needs. Disadvantages of anaerobic metabolism is to produce a product called lactic acid. Lactic acid is what gives the sensation of pain and stiffness (Sukedana, P dan Made, L. 2016).

Fox (1993) suggested that lactic acid in the blood there is always derived from anaerobic metabolism in the erythrocytes. But the total amount of lactic acid in the body is relatively fixed. In a healthy person in a state of having a rest, the amount of lactic acid is about 1-2 mM / l, 1 to 1.8 mM / l. While Jansen (1993) showed that blood lactic acid levels that exceed 6 mM / l can interfere with the working muscle cells to the level of coordination of movement (Dyah, WarihAnjani. 2016).

In this study, out of 19 respondents obtained an average lactic acid levels by  $3.28 \pm 1.853$  mM / l with high lactic acid levels of 7.3 mM / l and the lowest lactic acid levels of 0.2 mM / l.

Tolerance limits height of lactic acid concentration in the muscles and blood during physical exercise activity is not known for sure. However, the tolerance levels of lactic acid in humans is estimated at above 20 mM / l blood and 25 mM / kg / wet muscle weight, and can even reach above 30 mM / l in dynamic exercises with high intensity.

Fox (1993) also states that the lactic acid will lower the pH in the muscles and blood. Further decrease in pH will inhibit enzymes, glycolytic and interfere with chemical reactions in muscle cells. This situation will result in contraction of muscles getting weaker and eventually muscle fatigue. According to Janssen (1987) in Purnomo (2011) high lactic acid can arise as a result of heavy workload, this is because of the inability of the aerobic energy system supplier, so that the supply of energy from an energy source anaerobic dominate. High intensity exercises will increase the levels of lactic acid (Dewayana 2008; Kato, et al, 2013 ).

## CONCLUSION

In conclusion, working posture of the dentist will increase the levels of lactic acid. Increased levels of lactic acid, affecting the muscles so that the risk of musculo skeletal disorders will also increase. This was described on the descriptive overview that mean standard deviation of the working posture of dentist measured using REBA method amounted to  $3.16 \pm 1.259$  and the mean standard deviation in lactic acid levels of  $3.28 \pm 1.853$  Mm / l. This shows that physical activity done by the dentist lead to increased lactic acid levels. There was a significant relationship between the working posture and lactic acid levels with risk of MSDs with significant value of  $p=0.036$  respectively for the relationship between the working posture and lactic acid levels to MSDs, and  $p=0.025$  for the relationship between the working posture with lactic acid.

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