Knowledge regarding dental ergonomics and the occurence of musculoskeletal disorders in students at Hasanuddin University Dental Hospital, Indonesia

Pengetahuan tentang ergonomik dental dan terjadinya gangguan musculoskeletal pada mahasiswa di Rumah Sakit Gigi Mulut Universitas Hasanuddin, Indonesia

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ABSTRACT

Background: Musculoskeletal disorders (MSDs) are complaints that are felt when muscles receive static loads repeatedly for a long time, causing disorders in the form of damage to joints, ligaments and tendons. **Objective**: To determine the relationship between the level of knowledge about dental ergonomics and the occurrence of MSDs in students at Dental Hospital Hasanuddin University. **Methods**: This analytic observational study with a cross-sectional design included 83 dental interns and residents. Assessment of MSDs were derived from Nordic body map (NBM) and a 10-items questionnaire was used to determine the level of knowledge regarding dental ergonomic. Data were analysed with the Spearman correlation test and Pearson chi square test. **Results**: The Spearman correlation test shows a value of 0.000 ($p<0.05$), which means that there is a significant relationship between ergonomic knowledge and the occurrence of MSDs among the respondents. **Conclusion**: Level of knowledge regarding dental ergonomics, age, education, and the duration of work related with the occurrence of musculoskeletal disorders in residents and dental interns.

Keywords: dental ergonomic, musculoskeletal disorder, Nordic body map

ABSTRAK

Latar belakang: Gangguan muskuloskeletal atau *musculoskeletal disorders* (MSDs) merupakan keluhan yang dirasakan ketika otot menerima beban statis secara berulang-ulang dalam waktu yang lama sehingga menimbulkan gangguan berupa kerusakan pada sendi, ligamen dan tendon. **Tujuan**: Untuk mengetahui hubungan antara tingkat pengetahuan tentang ergonomi gigi dengan kejadian MSDs pada mahasiswa di Rumah Sakit Gigi Universitas Hasanuddin. **Metode**: Penelitian observasi analitik dengan desain *cross-sectional* mengikutkan 83 dokter gigi magang dan residen sebagai responden. Penilaian MSDs diambil dari *Nordic body map* dan 10 item angket digunakan untuk mengetahui tingkat pengetahuan tentang ergonomi dental. Data dianalisis dengan uji korelasi Spearman dan chi square Pearson. **Hasil**: Uji korelasi Spearman menunjukkan nilai 0,000 ($p<0,05$) yang berarti ada hubungan yang signifikan antara pengetahuan ergonomis dengan MSDs. **Simpulan**: tingkat pengetahuan tentang ergonomi, usia, pendidikan, dan lama kerja berhubungan dengan MSDs pada residen dan dokter gigi magang.

Kata kunci: ergonomi gigi, gangguan muskuloskeletal, *Nordic body map*
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INTRODUCTION

Literatures show a high prevalence of musculoskeletal disorders in dentists. Dentists are assumed to have static movements while working and require more than 50% body muscles to contract, hence the prevalence of musculoskeletal disorders in dentists ranges 63-93%.[1] Manpower Law No 13, 2003, article 86 paragraph 2, states that every workplace obligates to carry out occupational health and safety efforts to protect the safety and health of workers in order to achieve optimal work productivity. According to the International Labor Organization (ILO) in 2007, there are as many as 1.1 million deaths caused by diseases or caused by work every year. The data also states that there are 300,000 deaths occured out of 250 million accidents and the rest are death due to occupational diseases. Apart from occupational diseases that cause death, there are also other health problems, including deafness, musculoskeletal disorders, reproductive disorders, mental illness, nervous system and so on.[2]

Musculoskeletal disorders (MSDs) occur when the working posture does no adhere to proper ergonomic. Examples of these postures are, bending over or sitting on the floor and forcing unnatural postures. The implication of ergonomics is to try adjusting work with the workforce, so that work comfort will be created. Fatigue that quickly arises due to monotonous work, pain at work, physical and mental stress linked with heavy workload that lasts for a long time, can cause problems in mental health, where with ergonomics applications the problem of fatigue can be minimized. If ergonomics is not adhered, there will be discomfort or pain in certain parts of the body. Workers with the wrong working posture often cause complaints of pain in the waist.[2]

Ergonomics is the science of designing jobs, equipment and workplaces according to workers. Proper ergonomic design is vital to prevent repetitive strain injuries which can develop over time and could cause long-term disabilities.[2] Clark & Corlett stated

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that Ergonomics is the study of human abilities and characteristics that affect the design of equipment, working systems and jobs that are aims to improve efficiency, occupational health and safety as well as workers' welfare. While Wickens defined ergonomics as the study of human factors to design machines that can accommodate human limitations. The International Labor Organization (ILO) stated that ergonomics is a science that studies or measure work. Ergonomics is a multidisciplinary science, which is a combination of health and engineering sciences. In health science, human anatomy, biology, physiology, health anthropology and psychology are studied. Meanwhile, engineering studies include mechanical engineering, industry, design and mechanics. Health or medical disciplines provide boundaries and explanations of human capabilities and limitations. Whilst engineering disciplines design assignments or jobs, workplaces also working systems.[3-5]

Dentists' profession has many potential hazards in the workplace, including when the professional is doing their job. If ignored this would cause disturbance to the dentist.[5] Dentists in carrying out their work have quite a lot of potential hazards, including potential physical hazards such as vibrations from dental handpiece, electromagnetic waves from dental instruments that use electricity, ultra violet light from instruments during the tooth filling process, lighting, noise from compressors or handpiece.[6] Dentists' jobs have certain characteristics, where precision is required, in a limited and narrow area, and requires a long time and sometimes the work object is rather dark (oral cavity) also requires special and certain equipment. The components of the dentists' workplace consist of dentist's chairs, patient's chairs, tool tables, lamps/lighting equipment and instruments.[7-9]

In clinical settings, dentists should always pay attention to their posture or body position so that it is always adhere to ergonomic standards and also should not do static body positions for too long such as sitting, standing or examining patients. Dental professionals should thrive to be balanced in doing this. The characteristics of the dentist's chair are as follows 5 legged, adjustable heights, backrest according to body curves, adjustable armrests. Dentists always use chairs that can be adjusted and have lumbar, thoracic and hand supports. The patient chair is one thing that must be considered. This is useful so that the patient feels comfortable during the examination. The patient's seat back should be adjustable, that is, it can be upright or supine. This is tailored to the needs. The patient's legs should be straight, so that the patient feels more comfortable and relaxed. The dentists' using their feet can adjust the height of the patient chair. It is advisable if possible to minimize the use of feet by making patient more comfortable in a horizontal position.[7-9]

Dental instruments storages must be moveable, stable and the height should be adjustable. These are all considered for the comfort of the user. In addition, the instruments storage should also be ergonomically arranged (Ergonomic Lay-Out), meaning that it must be within the reach of the user, in this case the dentist. Also pay attention to avoid excessive use of fingers when practicing dentistry.[7-9] Ergonomic body posture based on tests of visual perception are 1) the angle between the lower and upper leg, with the legs slightly spread, must be 110º or slightly more, 2) the dentist should sit symmetrically upright and as far back as possible in the seat, tilting the upper body forward to a maximum of 10-20º, avoiding rotation and lateral slopes, 3) the head of the dentist can be tilted forward to up to 25º, 4) the pedal drive must be positioned close to one of the feet, 5) the upper limbs are lifted up to 10-25º from horizontal axis, and 6) a dental operating light from the dental chair must be able to be positioned above the head of the dentist, before and after they finish working, so that the light beam is running parallel to the viewing direction.[11]

Musculoskeletal disorders are a series of pain in muscles, tendons, and nerves. Activities with a high repetition rate can cause fatigue to muscles, damage to tissues to pain and discomfort. This can happen even when the level of force exerted is light and the work posture is satisfactory. The occurence of musculoskeletal disorders, such as low back pain, cervic spindolysis, carpal tunnel syndrome, and tennis elbow, are very common in humans. Musculoskeletal complaints or MSDs are complaints that are felt when muscles receive static loads repeatedly for a long time, causing complaints in the form of damage to joints, ligaments and tendons.[10,11] MSDs can be caused by duration of work, age, gender, years of service, body mass index, and history of MSDs.[11]

There are researches, which state that musculoskeletal disorders occurrence is very common in dentists. Screening results using body discomfort map and brief survey in Faculty of Dentistry Universitas Indonesia revealed that about 80% of 70 students have musculoskeletal disorders specifically in neck, shoulder, lower limb, arms, and back.[12] The World Health Organization established MSDs as a disorder of muscles, tendons, peripheral nerves or vascular system that indirectly results from an acute or momentary event (for example, a fall). The disorders are thought to be work-related when the working environment and working performance contribute significantly to it, but only one of the factors contribute to multifactorial diseases.[12,13] Common types of MSDs reported

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among dental professionals include back, neck, shoulder, and hand as well as wrist problems (carpal tunnel syndrome, Guyon's canal syndrome, De Quervain's disease, and trigger finger).[14-16]

Dentists' job is a complete service in the field of dental and oral health, which aims to improve oral health status. When providing services in hospitals, dentists are in direct contact with patients for a long period of time, where their duties include emergency services (injuries, repositioning of jaw joint dislocations), preventive services (early treatment measures, special protective measures), basic medical services (dental care, tooth extraction, abscess treatment, etc.) and specialist medical services (conservation, orthodontics, oral surgery, etc.).[2] In providing care/treating patients, dentists must understand ergonomics. Ergonomics is the science of regulating work and job demands, according to the abilities of the working population. If one does not understand ergonomics and apply it in everyday life when treating patients, then the risk is very high for developing musculoskeletal disorders, or in other words that if ergonomics is applied correctly, it can be ascertained that there will be a large reduction in the prevalence of MSDs among dentists.[17] Therefore, the researcher is interested in conducting a study that aims to determine the relationship between the level of knowledge regarding dental ergonomics and the occurrence of musculoskeletal disorders in students at the Dental Hospital of Hasanuddin University.

METHODS

This observational analytic study with a cross sectional design was conducted in the Dental Hospital of Hasanuddin University during December 3rd-14th 2019. This research has received ethical clearance from the Ethical Committee for Medical Research at Hasanuddin University Dental Hospital (0280/PL.09/KEPK FKG-RSGM UNHAS/2019), protocol number: UH 17120283. The total population are 489 people, consisting of 390 dental interns and 99 residents. To determine the number of samples, Slovin formula was employed. Slovin formula was used because of the large number of samples and limited research time, so that with this formula, a small sample will be obtained but can represent the entire population. Hence, the numbers of samples used in this study were 83 dental interns and residents at the Dental Hospital of Hasanuddin University.

The independent variable of this study was the level of ergonomic knowledge, and the dependent variable is the musculoskeletal disorder. The level of ergonomic knowledge is assessed from the position during treatment procedures, how to position patients before the procedure, how to take instruments, and whether microbreaks were taken or not. Musculoskeletal disorder: assessed from symptoms of disturbances in hands, shoulders, neck, legs that arise due to unadherence in practicing ergonomic positions whilst providing care to patients, this was determined based on the Nordic Body Map (NBM). Inclusion criteria, namely willingness to be a respondent and filling out a questionnaire, being present at the time the research was carried out and being able to communicate well and cooperatively. The exclusion criteria for this study were respondents that did not complete the questionnaire.

The assessments of musculoskeletal disorders complaints were determined from the NBM. A 10-questions questionnaire adapted from Journal of Advanced Oral Research published in 2018 titled Insight about dental ergonomics among dental students: the need of the hour to recommend dental ergonomics in academic curriculum were employed to assess dental ergonomics knowledge level, the score was then tallied, scores ranging from 1-5 were considered poor, 6-10 were considered enough. The study procedures were 1) explanation of research aims and objectives, also tutorials on how to fill out the questionnaire, 2) respondents filled the questionnaire provided with honest information, 3) research data processing using MS Excel, then continued with data analysis and then draw a conclusion, 4) type of data obtained from this study is primary data. Data were analyzed using SPSS version 22 for windows. Spearman correlation and Pearson chi square for bivariate test was employed to analyze data.

RESULTS

From table 1, based on the characteristics of the respondents obtained, it is found that most of the respondents were in 21-24 years-old age group with 46 respondents in total, whilst the lowest number of respondents was from the 46-55 years-old age group, which only had 1 respondent. While, the rest of the respondents both in 26-35 years-old age group and 36-45 years-old age group were 30 and 6 respondents, respectively. From table 1, the characteristics of respondents based on gender indicate that the number of female respondents is greater than that of male respondents. There were 60 female respondents and 23 male respondents. Based on the characteristics of respondents according to education, it was found that the number of respondents who were dental interns was more than respondents in dental resident category. There were respectively 50 and 33 dental intern and resident respondents. Based on table 1, the number of respondents who worked under 8 hours per day was

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Table 1 Distribution of students' demographic information

Characteristics	n (%)
Ergonomic knowledge level:	
Dental interns	50 (60.24)
Residents	33 (39.76)
Gender:	
Male	23 (27.71)
Female	60 (72.29)
Education:	
Dental interns	50 (60.24)
Dental residents	33 (39.76)
Age:	
21-24 year-old	44 (53.01)
25-28 year-old	14 (16.86)
29-32 year-old	11 (13.25)
33-36 year-old	7 (8.43)
37-40 year-old	5 (6.02)
41-44 year-old	1 (1.20)
45-48 year-old	1 (1.20)
Working duration:	
≤ 8 hours/day	78 (93.98)
>8 hours/day	5 (6.02)

78 respondents, while the number of respondents who worked more than 8 hours per day was 5 respondents.

Based on table 2, it can be concluded that ergonomic knowledge level, age, education, working duration variables were related to the occurrence of MSDs. As for the gender variable, it was not related to the occurrence of MSD. Based on the results of the Spearman correlation test, seen in the table above, it can be concluded that there is a significant relationship between ergonomic knowledge level and occurrence of MSD (p-value = 0.000; p <0.05). This means that there is a significant relationship between ergonomic knowledge and MSD scores, where the correlation coefficient shows a value of -0.718 (negative correlation). This means that the higher the ergonomic knowledge possessed by individuals, the lower the MSD score will be and vice versa, the lower the ergonomics knowledge, the higher the MSD score will be. Based on the results of the correlation coefficient obtained, namely -0.718, the relationship between ergonomic knowledge and MSD obtained in this study was in the strong correlation category.

Table 2 Musculoskeletal disorder distribution based on the Nordic body map category

Nordic Body Map	n (%)
Low (28-49)	37 (44.57)
Medium (50-70)	38 (45.78)
High (71-91)	8 (9.63)
Very high (92-112)	0

Table 3 Index frequency rate related to the ergonomic knowledge level

Variable	n (%)
Ergonomic knowledge	
Low (1-5)	7 (8.43)
Good (6-10)	76 (91.56)

DISCUSSION

Literatures show a high prevalence of MDs in dentists. Dentists are assumed to have static movements while working and require more than 50% of their body muscles to contract, therefore the prevalence of MSDs in dentist ranges 63-93%.[1] This study found a significant relationship between the level of ergonomic Hasanuddin University Dental Hospital.

Table 4 Relationship between characteristics and the occurrence of musculoskeletal disorder

Characteristics	Number of Respondents	Percentage	*p-value*
Ergonomic knowledge level			
Dental intern	50	60.24%	0.000*
Resident	33	39.76%	
Gender:			
Male	23	27.71%	0.598
Female	60	72.29%	
Education:			
Dental intern	50	60.24%	0.004*
Dental resident	33	39.76%	
Age:			
21-24 year-old	44	53.01 %	
25-28 year-old	14	16.86 %	
29-32 year-old	11	13.25 %	
33-36 year-old	7	8.43 %	0.000*
37-40 year-old	5	6.02 %	
41-44 year-old	1	1.20 %	
45-48 year-old	1	1.20 %	
Working duration:			
≤ 8 hours/day	78	93.98%	0.000*
>8 hours/day	5	6.02%	

*Significant (p<0.05)

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Table 1 shows demographic distribution of students based on gender, education, age, and duration of work per day. In terms of gender characteristics, the largest numbers of respondents are female. For education, most respondents are dental interns. In terms of age, most respondents were aged 17-25 year-old. In terms of duration of work, most respondents worked less than 8 hours per day. One literature explained that factors that could cause musculoskeletal complaints are duration of work, age, years of service, body mass index, and a history of musculoskeletal disorders.[11]

Some researchers report that the increase of MSD found in dentists could be triggered by longer period of work without any rest.[15,18,19] Most dentists find it difficult to avoid long-standing static posture. Stretching exercises done in the reverse direction can prevent pain and MSDs.[12,20,21] Stress can also cause muscle tension. Stretching exercises during microbreaks and daily yoga exercise to relieve stress can also reduce MSDs.[2,23] For age characteristics, most respondents were aged 17-25 year-old. Skeletal muscle complaints began to be felt at the working age, namely 25-65 years. The first complaint is usually felt at the age of 35 and the level of complaints will continue to increase with age, as a result muscle strength and endurance begin to decrease hence the risk of muscle complaints increases.[24] At the age of 30, some deterioration began to develop such as tissue regeneration to scar tissue, decrease of fluid level, and tissue damage. This results in decreased stability of muscles and bones. Individual's risk in developing muscle elasticity deterioration that triggers symptoms increase along with age.[25] In relation to the duration of work, excessive and tremendous work load will accelerate body's muscles contraction, thereby accelerating the manifestations of complaints.[26,27]

In table 2 it can be seen that the number of respondents who have a good level of knowledge is higher than those who are in the "poor" category. Students who have less knowledge about ergonomics have a higher risk of developing musculoskeletal disorders than students who have a good level of knowledge.

In table 3, it can be seen that the number of respondents who experienced musculoskeletal problems based on the NBM were mostly in the medium category, namely 38 people (45.78%). This means that there are 38 people who might need to fix their current position. Meanwhile, there were 37 respondents in the low category, this group of people is not required to fix their working position, and there were 8 respondents in the high category, which translates to them needing to change their working position, there were no respondent in the very high category (require immediate change).

From table 4, there is a relationship between dental ergonomics knowledge level and occurrence of MSDs in residents and dental interns at Hasanuddin University Dental Hospital. MSDs are found in various areas of the body, especially in the neck (47%) and back (35%). More than 29% of dentists had problems with their fingers, 23% with their waist, 20% in the mid-back, and also on the shoulders (20%).[12]

Based on table 2 it can be concluded that age, education, working duration and ergonomic knowledge are related to the occurrence of MSDs. As for gender, it is not related to the occurrence of MSDs. Relationship between sex and MSDs, this is in accordance with the results of this study which obtained a p-value of 0.598 which means that there is no significant relationship between sex and MSDs. Some experts have different opinions regarding the effect of sex on musculoskeletal complaints, but several studies have found that gender shows a significant effect on the risk of muscle complaints. The number of female respondents, which were higher than men and also respondents age cause different results from previous studies, because age can also affect the occurrence of musculoskeletal complaints. The muscle strength/ability possessed by women is only about two-thirds of the muscle strength of men, therefore the muscle capacity of women is smaller when compared to the muscle capacity of men.[29]

It was concluded that there is a relationship between dental ergonomics knowledge level, age, education, and duration of work with the occurrence of musculoskeletal disorders in residents and dental interns at Hasanuddin University Dental Hospital. The occurrence of MSDs in dentists is caused by lack of knowledge regarding ergonomics and non-adherence to ergonomic positions when performing dental procedures.

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