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RESEARCH ARTICLE

A TOTAL ERGONOMICS APPROACH IMPROVES THE PHYSIOLOGICAL RESPONSE OF DENTISTS IN A COMMUNITY HEALTH CENTER IN DENPASAR CITY

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ABSTRACT

Background: Dental filling service procedures in the dental clinic of the health center with the application of the total ergonomics approach no longer seem appropriate. Unergonomic work attitudes, long working hours and repetitive movements in awkward positions are the causes of increased musculoskeletal complaints so it is deemed necessary to overcome with a total ergonomic approach. **Objective:** This study aimed to improve physiological responses in the form of decreased musculoskeletal complaints, workload and fatigue in dentists through the application of actions with a total ergonomics approach. **Materials and Methods:** This research was a true experiment with a same-subject design. There were 18 research subjects actively involved in this study who were taken by simple randomization. This study was conducted on dentists who performed dental filling services in the dental clinic of the Denpasar city health center from October 2022 to December 2022. Data collection on physiological responses in the form of musculoskeletal complaints, workload and fatigue was carried out for four consecutive days while working in Period 1 and while working in Period 2. Period 1 was an activity carried out by dentists conventionally without intervention, while in period 2 dentists worked using a total ergonomic approach. The data obtained were then statistically analyzed with a significance level of $p < 0.05$. **Results:** The results of the analysis showed that the average of musculoskeletal complaints decreased significantly by 7.28% ($p < 0.05$); workload decreased significantly by 4.46% ($p < 0.05$); and the level of fatigue decreased significantly by 8.23% ($p < 0.05$). **Conclusion:** It can be concluded that the total ergonomics approach can reduce musculoskeletal complaints, workload and fatigue in dentists working on dental filling services in the dental clinic of the Denpasar City health center. The results of this study can be used as a clinical reference in implementing interventions to improve physiological responses in the form of a decrease in musculoskeletal complaints, workload and fatigue of dentists while doing their work.

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INTRODUCTION

In order to improve the level of dental health, maximum efforts are needed from dental health workers in providing oral health services (Rundungan et al., 2015). In providing dental services, dental health workers in Denpasar city often experience health complaints in the form of musculoskeletal disorders, workload to fatigue. Based on the results of identifying ergonomic problems, the following problems were found: 1) monotonous work in performing dental filling services, 2) continuous repetition, namely movements in performing services where dentists make back and forth movements in a sitting position and the risk of cumulative trauma disorder (CTD) in dentists who perform services for picking up tools and filling equipment, 3)

awkward posture where the position of the body (legs, joints and back) deviates significantly from the neutral position when performing actions caused by the limitations of the dentist's body against awkward positions for a long time. It is important to prevent and control complaints and fatigue by reducing, modifying and eliminating factors related to the dentist's work (Mulimani et al., 2018) so that dentists can work healthily, safely, comfortably, effectively and efficiently (Ristyowati and Wibawa, 2018). The application of the total ergonomics approach is a concept that has been shown to be able to solve ergonomic problems that occur on an ongoing basis (Manuaba, 2006; Adiatmika et al., 2007). The total ergonomics approach emphasizes the application of a systemic, holistic, multidisciplinary and participatory approach in all

interventions by selecting technologies based on the concept of appropriate technology (Sutjana, 2015; Susihono and Adiatmika, 2021). These efforts were combined with attention to the balance between task demands and nutritional intake, work attitudes, muscle use, environmental conditions, temporal conditions, informational conditions, socio-cultural conditions, and human-machine interactions (Manuaba, 2000). From the preliminary survey, it was formulated that the dental filling service procedure at the Denpasar city health center dental clinics were not in accordance with the concept of ergonomics. Un-ergonomic working postures, long working hours and repetitive movements in awkward positions were the causes of increased musculoskeletal complaints. There was an urgent need to address this with a total ergonomics approach. This study aimed to prove that the total ergonomics approach can reduce musculoskeletal complaints, workload and fatigue among dentists providing filling services at the dental clinic of health centers in Denpasar city.

MATERIALS AND METHODS

Research ethics statement: This study has passed the ethical feasibility review process of the research ethics committee of Prof. dr. I. N. G. Ngoerah Central General Hospital, Sanglah Denpasar, Bali, with Letter No. 2720/UN14.2.2.VII.14/LT/2022.

Research design: This research was a true experiment with a single subject design. There were 18 research subjects actively involved in this study who were selected by simple random sampling. This study was conducted on dentists who provided filling services in the dental clinic of the health center in Denpasar city from October 2022 to December 2022. Data was collected for four consecutive days while working in Period 1 (P1) with conventional work patterns; and while working in Period 2 (P2) with work patterns applying a total ergonomic approach. The washing out period was given for three days to restore normal conditions before the intervention in period 2. Adaptation to the new work procedure was carried out until the sample mastered the work procedure well, which was seen based on the accuracy of the work steps according to the procedure and based on the readiness of the sample to start collecting data. During the adaptation period, the sample was also given an awareness program in the form of counseling on the importance of maintaining health at work and ergonomic work procedures.

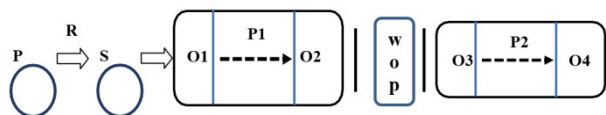


Figure 1. Research design. Figure Description: P: Population (dentists who are included in the inclusion criteria in the dental clinic of health center in Denpasar City); R: Random Sampling with simple random method; S: Samples (dentists in the dental clinic of health center in Denpasar City who were selected as research samples by simple random sampling); P1: Conventional work procedure; P2: Work procedures with a total ergonomics approach; O1: Observation of the work procedure of samples before the Period 1 for musculoskeletal complaints, pulse rate and fatigue; O2: Observation of the work procedure of samples after Period 1 for musculoskeletal complaints, pulse rate, and fatigue; O3: Observation of the work procedure of samples before Period 2 for musculoskeletal complaints, pulse rate and fatigue; O4: Observation of the work procedure of samples after the Period 2 for musculoskeletal complaints, pulse rate and fatigue; WOP: Washing out period for three days aimed to eliminate the influence of conditions before improvement and adaptation of the new procedure was carried out until the sample masters the procedure well.

Research variable

Independent variable: The independent variables in this study are the total ergonomics approach to dental filling services in the form of *Nutri Den*, work attitude, and *Dentist Exercise*. *Nutri Den* was a fruit concoction consisting of dragon fruit, orange fruit, and banana fruit, which was liquefied in the form of dragon fruit + orange + banana

juice (Mix) with a weight/volume of 600 cc, which was a fresh drink for dentists to increase energy, improve brain performance, increase work enthusiasm and prevent various diseases. Work attitude was a work procedure by paying attention to and complying with ergonomic work attitudes. In this study there were 11 work attitudes applied by dentists, such as: (1) Joints in a neutral position, (2) Avoid bending, (3) Bring work closer to the worker's body, (4) Avoid spinal rotation, (5) Avoid sudden movements and forces, (6) Avoid the same position and movement for a long time, (7) Prevent muscle fatigue both large and small muscles, (8) Short and frequent breaks are better than once and long, (9) Avoid abnormal body positions, (10) Avoid fixed extension movements of the arms both forward and sideways, (11) Static work was reduced to a minimum. *Dentist Exercise* was a 12-minute fitness exercise that begins and ends with diaphragmatic breathing and then continues with 28 moves consisting of (1) upper neck stretch, (2) lower neck stretch, (3) left shoulder stretch, (4) right shoulder stretch, (5) left upper arm stretch, (6) right upper arm stretch, (7) side stretch, (8) waist stretch, (9) upper arm stretch, (10) Waist stretch 2, (11) Buttock stretch, (12) Buttock stretch 2, (13) Elbow stretch, (14) Elbow stretch 2, (15) Right upper arm stretch, (16) Left upper arm stretch, (17) Left forearm stretch, (17) Left Hand Stretch, (18) Right Hand Stretch, (19) Left Thigh Stretch, (20) Right Thigh Stretch, (21) Left Knee Stretch, (22) Right Knee Stretch, (23) Left Calf Stretch, (24) Stretch of the right calf, (25) Stretch of the left ankle, (26) Stretch of the right ankle, (27) Stretch of the left foot, (28) Stretch of the right foot, and ending with diaphragmatic breathing.

Dependent variable: The dependent variable was the outcome of the process, namely physiological responses in the form of musculoskeletal complaints, workload, and fatigue in dentists who performed dental filling services in the dental clinic of health centers in Denpasar city.

Control variable: Control variables in this study included: (1) internal conditions assessed from: age, body mass index (BMI), standing elbow height; range; (2) external conditions assessed from: humidity, lighting, noise.

Data collection procedure: Musculoskeletal complaints are subjective complaints that occur in the muscles of certain limbs measured using the Nordic Body Map (NBM) questionnaire which contains 28 question items (Akbar, 2021) with choices using a Likert scale. The criteria for assessing musculoskeletal complaints were then scored as in table 1.

Table 1. Assessment criteria for musculoskeletal complaints

Score	Clinical findings
Score 0	Without complaints
Score 1	Uncomfortable (sample felt pain but did not interfere with work and could be ignored).
Score 2	Pain (the sample felt pain and interfered with work, but the pain eased with short breaks).
Score 3	Very painful (the sample felt very painful and it interferes with work. Complaints were still felt even after resting, even the pain was felt until the evening and can reach the next day or days later).

Workload is the external and internal load received by the body and acts as a physical and mental burden. In this study, pulse frequency is a manifestation of workload, measured using a stopwatch with the ten pulses method. Fatigue is a condition characterized by a reduction in a person's work capacity and is accompanied by feelings of tiredness and weakness. This data was measured using a 30-item rating scale questionnaire from the Japan Association of Industry and Health. At the end, the data will be categorized to activity fatigue (items 1-10); motivational fatigue (items 11-20) and physical fatigue (items 21-30) (Suastini and Adiputra, 2015).

Data analysis: The data were tabulated and subjected to descriptive analysis, data normality test and comparison test. Paired Sample T Test was conducted to compare normally distributed data, while Wilcoxon test was conducted to compare non-normally distributed

data. Data on musculoskeletal complaints before and after period 1 and period 2 were all non-normally distributed ($p < 0.05$) with homogeneity met ($p > 0.05$), so the Wilcoxon test was used. Workload data before period 1 and period 2 (O1 and O3) were normally distributed ($p > 0.05$) with homogeneity fulfilled ($p > 0.05$), so the parametric Paired Sample T Test was used. While the workload data after working in period 1 and period 2 (O2 and O4) was not normally distributed ($p < 0.05$) with homogeneity fulfilled ($p > 0.05$), the Wilcoxon test was used. Fatigue data before and after period 1 and period 2 were all non-normally distributed ($p < 0.05$) with homogeneity met ($p > 0.05$), so the Wilcoxon test was used.

RESULTS

Analysis of dentists' musculoskeletal complaints: Musculoskeletal complaints were measured with the NBP questionnaire in all samples group before and after work. The analysis results are shown in Table 2.

Table 2. Wilcoxon signed rank test for differences in mean scores of dentists' musculoskeletal complaints before and after work

Working Period		Mean	St. dev	Mean difference	Z	P
Before working	P1	29.17	0.013	0.34	-1.211	0.226
	P2	28.83	0.001			
After working	P1	32.83	0.517	2.39	-3.126	0.002*
	P2	30.44	0.019			

* Significant

The analysis results in Table 2 shows that the mean score of musculoskeletal complaints before work in P1 and P2 was not significantly different ($p > 0.05$). This indicates that the condition of musculoskeletal complaints before the intervention in P1 and P2 was the same. The analysis in also found that the score of musculoskeletal complaints after work in P1 and P2 was significantly different ($p < 0.05$) which means that there was a significant difference between the respondents' musculoskeletal complaints after conventional work procedures and after work procedures with a total ergonomic approach. The mean score of musculoskeletal complaints after work in P1 was 32.83 and P2 was 30.44. The difference in the mean score of musculoskeletal complaints after work in P1 and P2 was 2.39 so that a percentage of $2.39/32.83 \times 100\% = 7.28\%$ was obtained. This data shows that the total ergonomics approach could reduce musculoskeletal complaints by 7.28%. The results of this study indicated that the total ergonomics approach improved physiological responses in the form of a decrease in musculoskeletal complaints in dentists who perform dental filling services at the Denpasar City health center dental clinics.

Analysis of dentist's workload: The work pulse frequency was used as a parameter to determine the workload of dentists who perform dental filling services. The results of the analysis of the data on the workload of dentists before and after performing dental implant services in the dental clinics of health centers in Denpasar City are described in Table 3. Table 3 shows that the mean pulse frequency before work in both periods was not significantly different ($p > 0.05$). This indicates that the workload conditions before work in P1 and P2 are the same.

Table 3. Test of differences in mean score of dentists' workloads before work with paired sample t-test and after work with Wilcoxon test

Working period		Mean	St. dev	Mean difference	t	Z	P
Before working	P1	76.83	9.141	0.22	1.719		0,104
	P2	76.61	8.991				
After working	P1	90.83	8.740	4.05		-3.434	0,001*
	P2	86.78	8.829				

* Significant

The analysis results (Table 3) of the average workload of dentists who perform dental filling services in the dental clinic after work shows significantly different results ($p < 0.05$).

This result shows that there was a significant difference between the workload after work in the conventional method and after work with a total ergonomic approach. It is measured that the mean workload of dentists who perform dental implant services after work in P1 was 90.83 and P2 was 86.78. The mean difference between P1 and P2 was 4.05. So that $4.05/90.83 \times 100\% = 4.46\%$. This data shows that the total ergonomics approach could reduce workload by 4.46%. The results of this study indicated that the total ergonomics approach improved physiological responses in the form of a decrease in workload on dentists who perform dental filling services in the dental clinic of health centers in Denpasar City.

Analysis of dentist's fatigue: Fatigue was measured with a 30-item rating scale questionnaire from the Japan Association of Industrial and Health. The results of the analysis of the fatigue data of dentists before and after performing dental implant services at the dental clinic of the health center in Denpasar City are described in Table 4.

Table 4. Wilcoxon signed rank test for differences in mean scores of dental fatigues before and after work

Working period		Mean	St. dev	Mean difference	Z	P
Before working	P1	30.83	0.514	0.05	-0.378	0.705
	P2	30.78	0.428			
After working	P1	34.39	1.944	2.83	-3.429	0.001*
	P2	31.56	2.406			

* Significant

The results of the analysis in Table 4. show that the mean fatigue scores before work in P1 and P2 were not significantly different ($p > 0.05$). This indicates that the fatigue conditions in P1 and P2 were the same. The results of the analysis of the average fatigue score of dentists after work in P1 and P2 showed significantly different ($p < 0.05$). This data also proves that there was a significant difference between fatigue after conventional work procedures was higher than fatigue after work using a total ergonomics approach. The mean score of dentists' fatigues after work in P1 was 34.39 and in P2 was 31.56. The mean difference between After Work in P1 and P2 was 2.83. So that $2.83/34.39 \times 100\% = 8.23\%$. This data shows that the total ergonomics approach could reduce dentist's fatigue by 8.23%. The results of this study indicated that the total ergonomics approach improves physiological responses in the form of decreased fatigue in dentists who perform dental filling services in the dental clinic of health centers in Denpasar City. Table 5. shows that fatigue data consists of three categories; activity fatigue (items 1-10); motivational fatigue (items 11-20) and physical fatigue (items 21-30). These results show that activity fatigue, motivational fatigue and physical fatigue decreased after working with the total ergonomics approach. The decrease in activity fatigue score was 0.44 (3.85%), while motivational fatigue decreased by 0.33 (3.11%) and the decrease in physical fatigue was 1.83 (14.98%). Of the three categories, the largest decrease was seen in the physical fatigue category.

Table 5. Fatigue score of dentists after work by category

Category	P1	P2	Mean difference	%
Activity fatigue	11.44	11.00	0.44	3.85
Motivational fatigue	10.61	10.28	0.33	3.11
Physical fatigue	12.22	10.39	1.83	14.98

Discussion

The total ergonomics approach improves the physiological response of dentists in terms of reduced musculoskeletal complaints: Static work and the existence of unnatural work postures such as bending and reaching for distant objects cannot be avoided in the dental filling service procedure, so the application of the total ergonomics approach must be carried out on work exposure while still paying attention to the quality of the intervention. This was evidenced by a 7.28% reduction in musculoskeletal complaints following the application of the Total Ergonomics Approach. One of the concerns about musculoskeletal complaints is the prolonged use of incorrect

working postures, which can lead to loss of lumbar and cervical lordosis, weakened postural muscles, reduced flexibility and increased tension in the spinal extensor muscles (Gandolfi et al., 2021). Therefore, many dental procedures have the potential to trigger the onset of musculoskeletal disorders in dentists, including the position of bending or twisting the back or sitting for long periods of time (Afif et al., 2021). The results of the study have recommended that dentists, when providing dental services, should not only focus on managing patient handling activities, but also pay attention to activities of daily living in order to prevent symptoms of musculoskeletal disorders in a lifelong perspective (Harnani and Shoumi, 2020). This is in line with the results of the FGDs that made dentists aware of work attitudes aimed at increasing knowledge of ergonomic work postures to reduce musculoskeletal complaints. Musculoskeletal complaints are generally caused by excessive muscle contractions due to the provision of workloads that are too heavy with a long duration of loading (Agusdianti et al., 2017). Musculoskeletal complaints are also caused by poor work postures and the provision of workloads that are too heavy with a long duration of static movement. Static and prolonged muscle contractions result in reduced blood flow to the muscles, which affects the reduction of oxygen supply to the muscles, inhibits the process of carbohydrate metabolism and leads to the accumulation of lactic acid and the onset of muscle pain (Dewi et al., 2020). The total ergonomics approach, which refers to the use of minimal muscle effort, allows dentists to work in a more relaxed and comfortable manner.

The total ergonomics approach improves the physiological response of dentists in terms of reduced workload: Workload is the ability of a person's body to accept work. Any workload must be appropriate and balanced with the physical and psychological capabilities of the worker (Manuaba, 2000). Each worker has a different workload, depending on their level of skill, physical fitness, nutritional status, gender, age and body size (Suma'mur, 2014). The results of the workload measurements in period 2 show that the workload category of the dentists at the Denpasar City health center was in the light category. Therefore, it can be assumed that the application of the total ergonomics approach can reduce the workload of dentists. The results of calculating the percentage between the two variables showed that the application of the total ergonomics approach could reduce workload by 4.46%. The results of this study show a small percentage decrease in workload, which can be explained by the fact that the nature of the work of filling teeth was not work that required physical strength, but also mental ability. For this reason, changes in pulse rate as an indicator of workload did not show much change. This is in line with the findings of Febriyanti (2015), who found that the average resting pulse rate was 60 beats per minute, while the average working pulse rate was 77.5 beats per minute. The results showed that the mean pulse frequency of the dentists after work in period 1 and period 2 was significantly different ($p < 0.05$). These results indicate that the intervention provided was able to improve physiological responses in the form of a 4.46% reduction in workload in dentists performing dental implant services by applying a total ergonomic approach.

Physical strain at work with the total ergonomics approach intervention is minimal compared to conventional procedures. This intervention has made it possible to eliminate working postures that keep the joints in a neutral position, to avoid slouching, to bring the patient closer to the worker's body, to avoid spinal compression, to avoid sudden movements and forces, to avoid the same position and movement for a long time, to take short and frequent breaks, to avoid abnormal body positions, to avoid fixed stretching movements of the arms, and to reduce static work. The demands of fulfilling patients' health needs and the high responsibility of providing dental implant services are a considerable workload for dentists. The number of complaints and demands from patients themselves also increase the workload of dentists (Nurhaidah et al., 2016; Puspasari, 2022). Therefore, it is necessary to create a balance between the task demands, the work environment and the workers' abilities (Grandjean, 1993; Manuaba, 2000). The total ergonomics approach includes several interventions that can be carried out simultaneously.

The complexity of work processes can be simplified to reduce the emotional level of workers. The work steps in the total ergonomics intervention are simplified so that they are easy to perform. This is also known to be effective in preventing burnout due to excessive workload (Santoso, 2021).

The total ergonomics approach improves the physiological response of dentists in terms of reduced fatigue: The test results showed that the dentists' fatigue in period 1 and period 2 had a significant difference ($p < 0.05$). These results proved that the application of the total ergonomics approach could improve physiological responses in the form of an 8.23% reduction in the level of fatigue in dentists performing dental filling services. Fatigue is a source of health and safety problems for workers. Fatigue reduces work performance and morale and has been shown to contribute to more than 50% of work accidents (Bausad and Muchlisa, 2023). Fatigue leads to a loss of empathy and responsiveness to patients and a deterioration in work performance (Mulyani et al., 2021). Dentists who experience job burnout show feelings of hopelessness and boredom with their busy work (Juda et al., 2022). There was also evidence that dentists who have experienced job burnout were more likely to have an expectation of early retirement from the practice of dentistry (Utami et al., 2020).

Dental implant services at health centers in the city of Denpasar were performed in a sitting position. This was known to cause accumulation of blood and various body fluids in the legs (Frizka and Martiana, 2014)). Sitting must be done in the correct position with the joints in a neutral position, not slouching, bringing the work closer to the worker's body, and the normal body position (Suwandi, 2015). Through the intervention of a total ergonomic approach that addresses the effectiveness and efficiency of time, so that working time can be reduced and have an impact on reducing fatigue. Modification of work procedures also has an impact on changes in fatigue. The intervention of a total ergonomic approach makes it easier to perform work and minimizes the onset of fatigue caused by non-ergonomic work postures. The fatigue questionnaire consisted of three categories: activity fatigue, motivational fatigue and physical fatigue. The analysis showed that fatigue levels decreased in all categories in period 2. Of the three categories, physical fatigue decreased the most. This indicates that the physical activity at work with the application of total ergonomics is lighter than at conventional work. The results of this study support a previous study that found that the ergonomic participatory intervention reduced fatigue in general by 12.91%, and the most dominant decrease was in the physical aspect by 16.36%, activity by 11.55%, and motivation by 10.69% (Susihono, 2017). The decrease in fatigue in the physical aspect shows that the intervention was able to reduce unnatural work attitudes, more efficient and comfortable using the new intervention. Tabita et al. (2017) concluded in their research that the use of an ergonomic approach can reduce fatigue by 36.44%.

CONCLUSION

Physiological responses can be improved in the form of a 7.28% decrease in musculoskeletal complaints, a 4.46% decrease in workload, and an 8.23% decrease in fatigue by applying a total ergonomics approach to dentists providing dental fillings at the dental clinic of health centers in Denpasar City.

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REFERENCES

- Rundungan, R. O., Rattu, A. J. M., Mariaty, N. W. (2015). Analysis of Dental Health Personnel Performance of Dental and Oral Health Services in Dental Polyclinic Hospital Datoe Binangkang Bolaang Mongondow. *JIKMU*. 5(2a): 414-426.
- Mulimani, P., Hoe, V. C., Hayes, M. J., Idiculla, J. J., Abas, A. B., and Karanth, L.(2018). Ergonomi interventions for preventing musculoskeletal disorders in dental care practitioners. *Cochrane Database Syst Rev*. 10 (10): CD011261
- Ristyowati, T. and Wibawa, T. (2018). Designing Work System to Improve Production Results through Macroergonomic Analysis And Design Approach in Ayu Arimbi Sleman Batik Industry Center. *Opsi*. 11(2): 125-133.
- Manuaba, A. (2006). A Total Approach In Ergonomics Is A Must To Attain Humane, Competitive And Sustainable Work System And Products. In : Adiatmika and Putra, D.W. editors. *Proceeding Ergo Future 2006 : International Symposium On Past, Present And Future Ergonomics, Occupational Safety and Health*. 28 - 30th August. Denpasar: Department of Physiology Udayana University – School of Medicine. Pp. 1-6.
- Adiatmika, I. P. G., Manuaba, A., Adiputra, N., and Sutjana, D. P. (2007). Improving working conditions with a total ergonomics approach reduces musculoskeletal complaints and fatigue and increases productivity and income of metal painting craftsmen in Kediri-Tabanan. *Indonesia Journal of Biomedical Science*, 1(3): 1-6.
- Sutjana, I. D. P. (2015). Ergonomic Aspects of Psychosocial Risks in the Workplace. *Jurnal Ergonomi Indonesia*, 1(1): 317980.
- Susihono, W., and Adiatmika, I. P. G. 2021. Assessment of inhaled dust by workers and suspended dust for pollution control change and ergonomic intervention in metal casting industry: A cross-sectional study. *Heliyon*. 6(2020): e04067.
- Manuaba, A. (2000). *Ergonomics, Occupational Health and Safety*. In *Proceeding Seminar Nasional Ergonomi*. Surabaya: PT. Guna Widya.
- Akbar, F. H. 2021. Knowledge regarding dental ergonomics and the occurrence of musculoskeletal disorders in students at Hasanuddin University Dental Hospital., Indonesia. *Makassar Dental Journal* 10 (1): 14-19.
- Suastini, N, K., and Adiputra, I. N. (2015). Relationship between fatigue and work ability of housekeeping employees in a three-star hotel in Denpasar. *The Indonesian Journal of Ergonomic*. 1 (2): 58-65.
- Gandolfi, M. G., Zamparini, F., Spinelli, A., Risi, A., and Prati, C. (2021). Musculoskeletal disorders among italian dentists and dental hygienists. *International Journal of Environmental Research and Public Health*, 18 (5): 2705.
- Afif, N., Jayanti, S., and Wahyuni, I. (2021). Relationship between work posture, driving duration, and low back pain (Npb) in inter-city goods truck drivers at Cv Semeru Putra Semarang. *Jurnal Kesehatan Masyarakat*, 9 (1): 65-71.
- Harnani, Y. E., and Shoumi, A. B. (2020). The Effect of Length of Work Activities of Dentists in Malang City Health Center on the Risk Level of Musculoskeletal Disorders (MSDs). *E-Prodenta Journal of Dentistry*, 4(2): 353-359.
- Agusdianti, L. N., Sudirman, P. L., and Muliarta, I. M. (2017). Ergonomics education reduces musculoskeletal complaints and improves posture consistency in Udayana University PSPDG students. *Bali Dental Journal*, 1 (2).
- Dewi, N. L. S. S., Sudirman, P. L., and Pertiwi, N. K. F. R. (2020). The relationship between the application of ergonomic posture and musculoskeletal complaints during scaling in dental practices in Denpasar City, Bali-Indonesia. *Bali Dental Journal*, 4(2): 83-87.
- Suma'mur, P. K. (2014). *Occupational Health in the Perspective of Hygiene and Occupational Safety*. Jakarta Erlangga.
- Febriyanti, N. K., Adiputra, I. N., and Sutadarma, I. W. G. (2015). The relationship between body mass index and physical activity on cardiovascular endurance in students of the Faculty of Medicine, Udayana University. *Fakultas Kedokteran Universitas Udayana*. Denpasar.
- Tanzila, R. A., and Bustan, M. F. (2017). Effect of high intensity interval training on pulse rate of medical students. *Global Medical and Health Communication*. 5(1): 47-50.
- Santoso, M. D. Y. (2021). Factors associated with burnout in health workers in the covid-19 pandemic situation. *Jurnal Keperawatan Tropis Papua*. 4(1): 1-10.
- Puspasari, D. (2022). *Psychological Condition and Social Life of Cleft Lip and Palate Patient*. Doctoral Thesis. Universitas Hasanuddin. Makassar.
- Grandjean, E. 1993, *Fitting the Task to The Man* 4th edition. London: Taylor and Francis.
- Nurhaidah, N., Harijanto, T., and Djauhari, T. (2016). Factors Causing Incomplete Filling of Inpatient Medical Records at the University Hospital of Muhammadiyah Malang. *Jurnal Kedokteran Brawijaya*, 29 (3): 258-264.
- Bausad, A. A. P., and Muchlisa, N. (2023). Risk Factors for Occupational Fatigue in Informal Sector Workers in Soppeng Regency. *Jurnal Dinamika Kesehatan Masyarakat (JDKM)*, 1(1): 34-39.
- Mulyani, R. A., Erawan, A. N., and Karana, I. (2021). Workload of Nurses in Hospital Inpatient Rooms. *Jurnal Sehat Masada*, 15(1): 212-221.
- Juda, E. S., Zarfinal., Z., and Maiyestati, M. (2022). Legal and Ethical Responsibility of Doctors for Waiting Times for Medical Services in the Outpatient Unit of the Tk Iii Dr. Reksodiwiryo Padang Hospital., Doctoral Thesis. Universitas Bung Hatta.
- Utami, R. I. W., Susanto, H. S., and Setyaningsih, Y. (2020). Ergonomic Hazard Prevention and Control Management of Dentists in Hospitals. *HIGEIA Journal of Public Health Research and Development*, 4(4): 681-692.
- Frizka, M., and Martiana, T. (2014). The relationship between individual characteristics of work units and ergonomic factors with health complaints in the small shoe industry of Mojokerto City. *The Indonesian Journal of Occupational Safety, Health, and Environment*, 1: 37-47.
- Suwandi, T. (2015). *Dental Ergonomics*. *Stomatognatic-Jurnal Kedokteran Gigi*, 7(3): 1-5.
- Susihono, W. (2017). Identification of 8 Aspects of Ergonomics in the Construction and Machinery Service Industry. *Journal Industrial Servicess*, 2(2): 181-186.
- Tabita, A., Adiputra, N., and Sutarja, I. N. (2017). Organisation of Housekeeping Work with an Ergonomic Approach Can Reduce Musculoskeletal Complaints, Fatigue, and Speed Up Work Time. *Jurnal Ergonomi Indonesia*, 3 (1): 39-48.
