http://ejournal.seaninstitute.or.id/index.php/healt
Jurnal eduhealth, Volume 13, No 02, 2022
E-ISSN., P-ISSN. 2087-3271

Application of Physiotherapy to Occupational Health and Ergonomics Issues in Stone-Breaker Employees

Utomo Wicaksono[1*], Dadan Prayogo[2], Bernadus Sadu[3]
[1,2,3]Program Studi Sarjana Fisioterapi, STIKES Suaka Insan, Banjarmasin, Indonesia

ARTICLE INFO

Keywords :
Workload, Ergonomics, Physiotherapy, Pain complaints, Occupational health

ABSTRACT

It is not a violation of the code of ethics for physiotherapists who wish to work in the field of occupational health and ergonomics, as the field of ergonomics requires knowledge of anatomy, anthropometry, physiology, and biomechanics, all of which are required knowledge for graduates of physiotherapy study programs. Under these circumstances, it can be said that physiotherapy is prepared and linear to work in the field of occupational health and ergonomics. This study aims to apply physiotherapy-based interventions to occupational health and ergonomics issues in stone crushers. This investigation is an experimental study employing the same subject design (treatment by subject design), which is comprised of Periods I and II. There were fourteen respondents to the study. On the dorsalis pedis artery, the 10-pulse method is utilized to calculate the workload. Hand and arm musculoskeletal complaints were measured using a 100mm visual analog scale. Wrist splints, short breaks of 5 minutes every 55 minutes of work, and stretching every 2 hours of work had no effect on reducing workers' pain complaints, but reduced their workload by 11,29 % significantly. There is a need for more specific research to determine whether workers suffer from more serious health issues or chronic diseases.

Email :
tomwicaksono@gmail.com
dadanprayogo@gmail.com
bernadussadu@gmail.com

1. INTRODUCTION

Historiographically, physiotherapy has been influenced by economic, cultural, educational, public policy, and research factors that have prioritized one area of expertise over another. From a variety of new specialties, physiotherapy, occupational health, and ergonomics are gaining in clinical significance and professional dissemination. The increasing number of physiotherapists involved in occupational health and ergonomics initiatives worldwide demonstrates the significance of this statement.

The impact of this relevance is also seen in the growing calls for enhancing employee wellness and business productivity. Therefore, it is essential that physiotherapists show that they have the advanced skills and clinical proficiency that are needed to advance their careers and increase the visibility of physiotherapy. In contrast to other physiotherapy specialties, practicing physiotherapy professionals do not fully comprehend the paucity of recommendations or weak scientific evidence references regarding the efficacy of interventions and the validity of tools used for the identification of workplace risk factors as well as for evaluating the physical and functional health of workers [1].

The World Confederation for Physical Therapy (WCPT) encourages the integration of physiotherapists working in occupational health and ergonomics into international research groups comprised of physiotherapy professionals. The original objective of this screening was to establish a forum for professional discussion and to organize meetings during the world physiotherapy congress. So that occupational health physiotherapy and ergonomics have the same aspects globally and must be expanded and strengthened [2].

The WCPT guidelines for physiotherapy professional beginner education include areas that must be mastered, including the ability to conduct examinations, assessments, and interventions related to ergonomics and body mechanics factors, such as worker functional capacity, worker agility and coordination, occupational health, worker safety, working environmental conditions, specific work, equipment or work equipment, and body mechanics during work activities, either with or without the use of assistive devices[3].

In addition, knowledge of anatomy, anthropometry, physiology, and biomechanics is necessary in the field of ergonomics [4]. These are required knowledge of physiotherapy study programs that must be mastered by physiotherapy graduates [5]. Given this, physiotherapists who wish to work in the field of occupational health and ergonomics do not violate the code of ethics; in fact, physiotherapy can be considered prepared and linear for work in the field of occupational health and ergonomics. Based on the preceding context, the researcher intends to implement a physiotherapy-based intervention for occupational health and ergonomics issues in stone crushing workers.

2. METHOD

This research is an experimental study employing the same subject design (treatment by subject design), which is comprised of Periods I and II. Each Period I and Period II lasts five days, with two days of washing out between periods. This study was conducted in Awang Bangkal Barat Village, Karang Intan District, Banjar Regency, South Kalimantan Province, at a home industry that produces split stones. The study was performed in July 2022. Random sampling was used as the sampling method. The sample size is calculated using Colton's formula [6], resulting in a minimum sample size of 14 workers. Inclusion criteria include workers aged 30 to 50 with a minimum 2-year work history; exclusion criteria include those with upper extremity deformities and a body mass index (BMI) below 25kg/m2. Respondents who fell ill or were injured during the course of the study and did not complete the research program for more than one day were considered to have dropped out. In a standing position, the average increase in pulse rate was measured every period using the 10-beat method on the left dorsa pedis artery. Hand and arm musculoskeletal complaints were measured using a 100mm visual analog scale.

3. RESULTS AND DISCUSSION

According to the findings of the study's observations and evaluations, the stone-breaking process is still conducted on an unorganized, irregular household scale, and work activities are conducted outdoors under trees, so the working environment is highly susceptible to climatic influences. The task of breaking stones is performed manually, relying on human physical strength and employing a very simple tool, namely an 8 kg to 10 kg sledgehammer.

The use of sledgehammers to break stones involves repeated movements and the use of upper extremity muscle strength to generate impact forces on the rock surface, causing vibrations to propagate to the hands and arms of the workers. The presence of musculoskeletal complaints [7] is also caused by awkward wrist postures and prolonged isometric muscle contractions.

Increased carpal tunnel pressure causes tissue compression, which can result in recurrent minor injuries. Long-term exposure can cause tendonitis, compression conditions worsen, resulting in inadequate tissue circulation, then tissue ischemia occurs easily, resulting in pain complaints that gradually reduce the functional capacity of workers [7], [8].

Application of a physiotherapy approach to occupational health and ergonomics pertaining to the working conditions of stone crusher employees by minimizing exposure to risk factors for repetitive motion, muscle strength exertion, vibration, and awkward postures by providing acceptable treatment for wrist splint workers, short breaks of 5 minutes every 55 minutes of work, and stretching every two hours of work.

Table 1. Subject Characteristics

Variable	n	Average±SD	Range

Age (yr)	14	44,57±2,56	41 – 49
Work Period (yr)	14	15,71±2,30	12 – 19
Body Mass Index (Kg/m^2)	14	22,40±1,36	20,94 – 24,84

SD = Standar Deviation

Based on the data in Table 1, the participants in this study were classified as still being of productive age. A person is considered to be in their productive age between the ages of 15 and 49 [9]. The subject as a whole is experienced in terms of years of service and has a healthy body mass index (BMI).

Table 2. Prerequisite Analysis of Treatment Effects

Variable	Period I	Period II	p
	Average±SD	Average ±SD	
Relative Humidity (%)	92,17±0,24	92.17±0.24	0.08 ƚ
Temperature (°C)	29,77±0,20	29.77±0.19	0,08 ƚ
Pain complaints before going to work (mm)	0,28±0,26	0,15±0,17	0,02 ƫ

SD = Standar Deviation; ƚ = Paired T Test; ƫ = Wilcoxon Testing

According to Rezalti and Susetyo [10], the relative humidity range that meets industrial work environment standards is between 65% and 95%. Lady and Wiyanto [11]determined that the optimal temperature range for an industrial working environment is between 18°C and 30°C. According to the results of the prerequisite test for the treatment effect, the environmental conditions of the two periods did not differ significantly (p>0,05), indicating that environmental factors could be controlled and had no influence on the research findings. Pain complaints before work differed significantly between the two time periods (p<0,05). Thus, the analysis of the effect of treatment on pain complaints by comparing the differences in pain complaints before and after work of each group, so that the initial conditions of the study subjects did not affect the results of the study.

Table 3. Treatment Effect Analysis

Variable	Period I	Period II	p
	Average ±SD	Average ±SD	
Pain Complaints After Work (mm)	2,26±0,28	2,18±0,25	0,02 ƚ
Difference in Pain Complaints (mm)	1,99±0,21	2,03±0,22	0,25 ƚ
Workload (x/menit)	98,33±1,40	87,23±1,27	0,00 ƚ

SD = Standar Deviation ; ƚ = Paired T Test; ƫ = Wilcoxon Test

The results of statistical analysis of pain complaints after work between Period I and Period II revealed a significant difference (p<0,05); however, these results could not be used to answer the hypothesis regarding the effect of treatment because the initial condition of pain complaints before work between Period I and Period II was also found to be significant. So, the analysis was conducted to test the difference in pain complaints before and after working Period I and Period II to test the treatment effect hypothesis. Based on the statistical analysis of the difference in pain complaints, it was determined that there was no significant difference (p>0,05) between Period I and Period II, meaning that wrist splinting treatment, short breaks of 5 minutes every 55 minutes of work, and stretching every 2 hours of work had no effect on the decrease in pain complaints reported by workers after work.

In contrast to the findings of Hermawan [12] on batik workers, Nooryana [13]on Adhi Fashion garment industry workers, and Damantalm [14] on oil palm workers in PT. Berau SSD, rest and stretching arrangements between work can significantly reduce musculoskeletal complaints by 6,43%, 7,72%, and 31,77%, respectively. Short breaks and stretching can have a physiological effect to increase blood flow to the muscles and increase the supply of tissue nutrition so as to prevent tissue ischemia and tissue tension so as to prevent tissue strain or sprain and prevent accumulation of fatigue, which can cause pain [12].

The addition of treatment in the form of wrist splints to workers is inconsistent with the findings of Trevithick's [15] cohort study, which found that wrist bandages significantly reduced and prevented wrist pain complaints in gymnast adolescents by 53,5%. Wrist splints can prevent pain complaints caused by tissue ischemia and repeated tissue micro-injury through the effects of absorption and transfer of external forces, stabilization or prevention of wrist posture deviation, which can cause increased pressure in the carpal tunnel when the wrist is extended or flexed [15]–[17].

The researcher hypothesizes that the reason the treatment does not have a significant improvement effect is because the bandage used is not a commercial product with soft pads, so the splint only functions as a stabilization of wrist posture and does not have an optimal effect on the ability to absorb and transfer external forces that can cause tissue trauma. In addition, it is highly probable that the workers' complaints of pain are indicative of a more serious health condition, such as carpal tunnel syndrome or tendinitis, which requires more specific treatment to treat anatomical structures or tissues in the wrist region.

According to the statistical analysis between Period I and Period II, there was a significant difference ($p<0,05$) in the workload variable, which indicates that the administered treatment resulted in an 11,29 % decrease in workload. According to this study, the worker's heart rate has increased due to the physiological stress caused by the heavy workload associated with breaking stones. The heart rate increases linearly with the amount of work performed and continues to rise until work is interrupted or the worker ceases performing work-related activities due to fatigue. The return of blood to the heart, which influences cardiac output and vascular resistance, increases as heart rate and mean arterial pressure increase. During physical activity, the body's cells require energy; consequently, the heart must beat faster to supply more blood to the muscles in order to meet this demand [18] [19].

The use of wrist splints, short breaks of 5 minutes every 55 minutes of work, and stretching every two hours will have a physiological effect. Wrist splints can limit or minimize forced or conscious awkward backward and sideways wrist postures, thereby preventing overuse of muscles, tissue compression, and tissue injury [15]–[17]. Short breaks and stretching between tasks prevent employees from working continuously for extended periods of time, thereby preventing the accumulation of physiological stress and fatigue, which is indicative of the high workload [20]. The decrease in heart rate is also caused by a decrease in muscle tension and an improvement in blood circulation, allowing the physiological system of the heart's work to return to normal [12].

4. CONCLUSION

Giving wrist splint treatment, short rest and stretching had a significant improvement effect on reducing workload by 11,29%, but did not have an improving effect on reducing pain complaints after working in stone crushers who were highly exposed to the risk factors of repetitive motion, exertion great power for a long time. Observation or further research is needed to design wrist straps that have soft pads and are practical for workers to use. As well as the need for more specific studies to determine whether workers have more serious health problems or chronic diseases.

REFERENCES

[1] R. S. Padula, A. B. Oliveira, R. L. Carregaro, and T. O. Sato, "Physical therapy in occupational health and ergonomics: practical applications and innovative research approaches," *Brazilian J. Phys. Ther.*, vol. 20, no. 5, pp. 490–492, 2016.

[2] World Confederation for Physical Therapy, “Physical therapy network for occupational health and ergonomics,” *World Confederation for Physical Therapy*, 2015.
[3] World Confederation for Physical Therapy, “WCPT guideline for the clinical education component of the physical therapist professional entry-level programme,” London, 2011.
[4] E. R. Vieira, “Work physical therapy and rehabilitation ergonomics: a review and discussion of the scope of the areas,” *Disabil. Rehabil.*, vol. 28, no. 4, pp. 1563–1566, 2006.
[5] Asosiasi Pendidikan Tinggi Fisioterapi Indonesia, *Keputusan kongres nasional asosiasi pendidikan tinggi fisioterapi indonesia iv tentang profil lulusan, capaian pembelajaran, dan kurikulum inti asosiasi pendidikan tinggi fisioterapi indonesia (aptifi)*. 2022.
[6] T. Colton, *Statistik kedokteran*. Yogyakarta: Gadjah Mada University Press, 1985.
[7] I. Ibrahim, W. S. Khan, N. Goddard, and P. Smitham, “Carpal tunnel syndrome: a review of the recent literature,” *Open Othopaedics J.*, vol. 6, no. 1, pp. 69–76, 2012.
[8] S. F. Duncan and R. Kakinoki, *Carpal tunnel syndrome and related median neuropathies: challenges and complications*. Switzerland: Springer, 2017.
[9] M. A. Nurjana, “Faktor risiko terjadinya tuberculosis paru usia produktif (15-49 tahun) di indonesia,” *Media Litbangkes*, vol. 25, no. 3, pp. 165–170, 2015.
[10] D. T. Rezalti and S. A. E., “Kadar suhu dan kelmbaban di ruang produksi wedang uwuh universitas sarjanawiyata tamansiswa,” *Ind. Eng. J. Univ. Sarjanawiyata Tamansiswa*, vol. 4, no. 2, pp. 70–78, 2020.
[11] L. Lady and A. S. Wiyanto, “Tingkat kelelahan kerja pada pekerja luar ruangan dan pengaruh lingkungan fisik terhadap peningkatan kelelahan,” *J. Ind. Serv.*, vol. 5, no. 1, pp. 58–64, 2019.
[12] A. Hermawan, N. Adiputra, and I. P. A. Griadhi, “Active rest and stretching batik dyeing workers reduce musculoskeletal complaints and increase productivity,” *J. Ergon. Indones.*, vol. 8, no. 1, pp. 57–64, 2022.
[13] S. Nooryana, I. P. G. Adiatmika, and S. Purnawati, “Latihan peregangan dinamis dan istirahat aktif menurunkan keluhan muskuloskeletal pada pekerja di industri garmen,” *J. Ergon. Indones.*, vol. 6, no. 1, pp. 61–67, 2020.
[14] Y. Damantalm, K. Tirtayasa, I. P. G. Adiatmika, I. B. A. Manuaba, I. D. P. Sutjana, and L. Sudiajeng, “Pemberian buah pisang, istirahat pendek dan peregangan menurunkan keluhan muskuloskeletal, kelelahan dan meningkatkan produktivitas pemanen pengguna alat egrek perkebunan kelapa sawit pt. ssd kalimantan timur,” *J. Ergon. Indones.*, vol. 4, no. 1, pp. 47–56, 2018.
[15] B. Trevithick, R. Mellifont, and M. Sayers, “Wrist pain in gymnasts: efficacy of a wrist brace to decrease wrist pain while performing gymnastics,” *J. Hand Ther.*, vol. 33, no. 3, pp. 354–360, 2020, doi: https://doi.org/10.1016/j.jht.2019.03.002.
[16] M. Coutinho, “The wrist wrap as a protective and performance enhancing device in powerlifting,” 2007.
[17] Y. C. Shih and B. F. Tsai, “Splint effect on the range of wrist motion and typing performance,” in *International Conference on Ergonomics and Health Aspects of Work with Computers*, 2007, pp. 144–150.
[18] M. Garet, G. Boudet, C. Montaurier, M. Vermorel, J. Coudert, and A. Chamoux, “Estimating relative physical workload using heart rate monitoring: a validation by whole-body indirect calorimetry,” *Eur. J. Appl. Physiol.*, vol. 94, no. 1, pp. 46–53, 2005.
[19] B. Das and S. Gangopadhyay, “An ergonomics evaluation of posture related discomfort and occupational health problems among rice farmers,” *Occup. Ergon.*, vol. 10, no. 1–2, pp. 25–38, 2011.
[20] U. Wicaksono, I. M. Muliarta, and L. M. I. S. H. Adiputra, “Reducing cts complaints and the fatigue of rock breaker through ergonomics approach by exercising nerve-tendon mobilization and short break,” *Eduvest-Journal Univers. Stud.*, vol. 1, no. 10, pp. 1141–1151, 2021.