



Influence Work Station Design and Firm Constitutional Complaint Against Musculoskeletal on Stone Crusher Worker Progo in Magelang

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Abstract

A rock-breaking work that engaged in the informal sector and contain a great job risk to health and safety of workers. Solving Stone in the river Progo an informal jobs into one livelihood. In working stone crushers appears work attitude accordance with his needs. Work attitude or ergonomic working conditions caused by the design of work stations that were not appropriate in turn can lead to complaints such as disorders of the musculoskeletal system. This research is quantitative, using observational design "observational". These samples included 33 respondents. The sampling technique used in this research is purposive sampling. The instrument uses anthropometer set, the meter rolls, verbal numeric scale questionnaires, observation sheets body constitution, Checklist health conditions, stationery, and cameras., Data collection techniques through musculoskeletal complaints data collection before and after work design in the form of appropriate ergonomic chair that has been adapted to the body anthropometric and body constitution by means of direct observation and interviews in the study. Statistical analysis using one-way ANOVA test (one-way ANOVA). The research found $p = 0.000$, where the value ($p < 0.05$), there is the effect of changes in the work station of the musculoskeletal complaints (skeletal muscle) workers Progo river stone crushers in Magelang, because there is the average difference between the value before work by after work and test results revealed very significant. Z value in the Wilcoxon test was -4.808. Price is negative (-) indicates complaint skeletal muscles before work is smaller than complaints skeletal muscles after work.

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INTRODUCTION

A rock-breaking work that engaged in the informal sector, contain a great job risk to health and safety of workers. Quarry on the river Progo an informal job into one livelihood. In working stone crushers appears work attitude accordance with his needs. Work attitude or ergonomic working conditions caused by the design of work stations that were not appropriate in turn can lead to complaints such as disorders of the musculoskeletal system. Designs like these seats will obviously cause postural heavy burden. If this happens postural load in the long term, it will cause postural strain which is a static mechanical load to the muscles (Sundari, 2011).

The results of research in accordance with the above theory is research Setianingsih (2010), with the title Potential Hazard Analysis and Hazard Control Efforts In Full breaking stones with results respondents all women a number of 41 people, with ages above 30 years amounted to 75.6%, not school by 82.9%, not wearing PPE amounted to 51.2% and had experienced by 61%, and the rate of work hazard to workers stone crushers each of each variable: workers with medium category, work tools such as basket, hammer, ganco and wheelchair in the category of medium, material of stone with medium categories, work processes, such as collecting, break, collect and collate stone with medium category, and the work environment in the category of medium

Other research on rock-breaking labor that is Suhartini (2010), about Struggle of Women Living Stone Crusher, Based on the results of research and analysis can be concluded that women stone crushers benefit by working as rock breakers because it can expand social links with the wider community and not just interact with children and husband. Economic life of the female rock breaker has not changed because of earned income has not been able to meet the needs of primary, secondary and tertiary.

Sulistiyanto Research (2013), Women's Business Analysis Solver Stone And Contribution to Meeting the Needs Families In the village of Kemiri Purworejo Rebug Subdistrict with the results Based on the analysis of the percentage of

women's business revenue contribution to the fulfillment of stone crushers earned income family needs of women as rock-breaking effect on total household income amounted to 39.45% and the analysis of the percentage contribution of women stone crushers operating revenues to meet the needs of families earned income of women as influential rock breaker to the average cost of meeting the needs of households amounted to 50.70%.

The dimensions of the seating is very instrumental in achieving comfort and safety. High-object is done and the hands of workers determine the accuracy of work. A job that is done by sitting very old need to require design seating suitable anthropometry of the wearer, if the position is too low eat will cause shoulder lifted so that it can cause pain in the area Lehr and shoulders, and if psosisi sit terlalau high it would menyebabkan backs rsa bending that causes pain in the lower back(Sundari, 2011), Chairs and tables are one important tool in the working place, seats ergonomics will memebankan posture and good circulation so will memebantu avoid the inconveniences and fatigue, the draft suartu kusri should be based on anthropometric data is right, because if it does not fit will lead to doubts that the design results can not create comfort for the wearer, Execution jobs incorrect and not in accordance with the norms of ergonomics can cause fatigue and pain in musculoskeletal disorders (Tarwaka, 2011),

Related research conducted Sumardiyono (2011) about the influence of the disturbance muskuloskleletal ergonomic chair obtained significant results ($t = 16.74$; $p = 0.000$), there is a difference in the average scores of complaints musculoscleletal before and after labor using an ergonomic chair. Ergonomic chair is useful to reduce interference musculoscleletal the batik industry workers, particularly the pattern. Research conducted by Silvia Trias Princess (2015) showed no difference in the average value before and after redesign the gazebo chairs.

Research by Ika Wardhiningsih (2010) showed there is no match between the size of the working chair with anthropometric woman labor

machine parts prick in PT Iskandar Indah Printing Textile Surakarta, there is the influence of the work attitude sitting on a work chair that is not ergonomically against complaints musculature skeletal for female workers beak machine parts in PT Iskandar Tex Surakarta with a total score pre test = 33.24 + 2.36 and post-test = 53.34 + 7.76, and the results of Paired T-test is very significant (value sign. = 0,000 because the value of P value <0.01), and complaints of skeletal muscle due to work attitude ergonomic seating dominant on the back (88%), hips (84%), buttocks (80%), buttocks (68%) and shoulder (56%).

Research by Dian suggestion Ning (2016) showed no significant difference between the difference of the complaints in the control group and the treatment group. In the treatment group, after using an ergonomic chair, a decrease of complaints found to waist, back, left arm and left leg, while the control group, almost all complaints to the measurement of the pre-test and post-test showed similarities.

Research (Istighfaniar, 2014) shows the working posture assessment by REBA method and RULA majority have a high risk level. Musculoskeletal complaints that often occur in workers are at the waist, hips, lower neck and upper part. Recommended agencies to provide training on ergonomics in their daily work so that workers can avoid the mistakes of the working posture, workers are recommended regular exercise, especially aerobic exercise. Research (Ulfah, Harwanti and Nurcahyo, 2014) find work attitude associated with the risk of skeletal muscle disorders is on the leaching ($p = 0.014$, $p < 0.05$). While working attitude weighing section ($p = 0.77$), drying ($p = 0.257$), ironing ($p = 0.109$) and packaging ($p = 0.370$) was not associated with risk of MSDs (p values > 0.05), Only a part laundering work attitude that has risk of MSDs, so it needs to be done in the form of training interventions wash right work attitude.

Research Yustica (2016), about the relationship between work posture with the level of subjective complaints Musculoskeletal toll gate keeper Tembalang Semarang. There is a correlation between work posture with the level of subjective complaints musculoskeletal toll gate keeper Tembalang Semarang with p value = 0,002,

the strength of the relationship is being with the value of $r = 0.537$.

Research Eldest and Mutia (2016) states that there is a significant relationship between the payload, transport position, length of service and age with musculoskeletal complaints Port of Muara Padang.

Research Maakip, Keegel and Oakman (2017). MSD inconvenience obtained significantly associated with predictors include gender ($\beta = 14$), physical ($\beta = 0.38$) and psychosocial hazards ($\beta = -0.10$), and work-life balance ($\beta = -0.13$). In Australia, a regression model was also significant ($F [6, 539] = 16:47$; $p < 0.001$) with models that explain 15.5% ($r = 0.39$) variance MSD discomfort. Predictors such as gender ($\beta = 0.14$), physical hazards ($\beta = 24$) and psychosocial ($\beta = -0.17$), associated with MSD discomfort in Australian office workers.

Research Sekarsari (2017) with Judu a long relationship working, repetitive motion and posture awkward in hand with symptoms of carpal tunnel syndrome (CTS) in workers breaking stones in the sub Moramo northern South Konawe 2016 showed no relationship between the length of work with complaints Carpal Tunnel syndrome ($p = 0.032$), there is a link between repetitive motion with complaints Carpal Tunnel syndrome ($p = 0.020$), and there is a relationship between awkward posture of the hands with complaints Carpal Tunnel syndrome ($p = 0.014$).

Researchers then conducted observations of quarry workers in Progo River in October 2017 and found the number of employees by approximately 50 people. Researchers then conducted interviews at 5 workers rock breaker. The five workers often complain of back pain, back, knees and hands. Workers also complained of the hands of workers often feel cramps due to prolonged work hit the rocks. Besides sitting position much less ergonomic workers where they there sitting on a small chair, pedestal sacks of rice and there's hair that sits directly on the stone.

METHOD

This research is quantitative, using observational design "observational". In this study before and after the administration of the work station design will do an assessment of musculoskeletal disorders.

The population in this study all workers Progo river stone crushers in Magelang regency as many as 50 people, The number of samples in this study sebanyak 33 respondents. The sampling technique used in this research is purposive sampling. The independent variable in this research is the design of work stations and the constitution of the body. As for the dependent variable in this study is bound musculoskeletal complaints. Instruments in this study anthropometer set, the meter rolls, verbal numeric scale questionnaires, observation sheets body constitution, Checklist health conditions, stationery, and cameras. Data collection techniques in this research was conducted by collecting data musculoskeletal complaints before and after work design in the form of appropriate ergonomic chair that has been adapted to the body anthropometric and body constitution by means of direct observation and interviews in the study.

On research processing techniques and data analysis performed by one-way ANOVA test (one-way ANOVA)

RESULTS AND DISCUSSION

Univariate analysis

Table 1. At the Work Station Design Workers Progo breaking stones in Magelang

	N	m	maximu m	Std.		
				mea n	deviatio n	varianc e
PP	3	36	46	41.8	2.929	8579
	0			0		
LB	3	35	46	39.3	2.743	7.523
	0			3		
TB	3	53	59	55.8	2.034	4.137
D	0			7		
LP	3	29	35	31.2	1.751	3.065
	0			5		
PL	3	23	28	25.3	1.418	2010
	0			0		
TP	3	34	41	38.8	1.677	2.811
O	0			2		
JT	3	63	83	73.1	7.003	49 040
	0			7		

from table The above shows the measurement of the work station design Progo river stone crushers in Magelang with butt popliteal (PP) an average of 41.80 and a standard deviation of 2.929. Shoulder width (LB) average of 39.33 with a standard deviation of 2.743. High-shoulder seat (TBD) an average of 55.87 with a standard deviation of 2.034. Hip width (LP) averaging 31.25 with a standard deviation of 1.751. Long sleeve (PL) average of 25.30 with a standard deviation of 1.418. Average high popliteal 38.82 with a standard deviation of 1.677. Reach arms (JT) an average of 73.17 with a standard deviation of 7.003.

Table 2. Somatotype workers breaking stones in Progo district of Magelang

Somatotype	frequency	Percent	valid Percent	Cumulative Percent
valid Ectomorphy	1	3.3	3.3	3.3
Endomorphy	16	53.3	53.3	56.7
Mesomorphy	13	43.3	43.3	100.0
Total	30	100.0	100.0	

The chart above shows somatotype stone-crushing workers in the river Progo which shows that of the 30 respondents, including body type endomorphy workers as much as 16 respondents (53.3%), body type mesomorphy workers including as many as 13 respondents (43.3%), and body types of workers including ectomorphy as one respondent (3.3%)

Table 3. Data Description Musculoskeletal Complaints workers breaking stones
Keluhan Musculoskeletal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Keluhan ringan	2	6.7	6.7	6.7
	Keluhan berat	28	93.3	93.3	100.0
	Total	30	100.0	100.0	

The above data shows the data description musculoskeletal complaint of 30 respondents working in the stone breaker Progo rivers indicating that there were 2 respondents (6.7%) who had musculoskeletal categorized as mild, and there were 28 respondents (93.3%) who had severe musculoskeletal complaints,

Bivariate analysis

The bivariate analysis was conducted to analyze the relationship between the two variables

studied were the design of work stations, and the constitution of the body (somatotype) with musculoskeletal complaints in stone-crushing workers in Progo river.

The bivariate analysis in this study conducted using the inferential statistical parametric technique if the data were normally distributed, and non-parametric techniques berdistribusi if the data is not normal.

Testing normality using the Kolmogorov-Smirnov test for the amount of data (samples) of less than 100. normality test data is presented as follows.

Table 4. Bivariate analysis

variable Measurement	Value Sig.	Mean
Popliteal (PP)	.596	normal Data
Shoulder Width (LB)	.247	normal Data
Shoulder High-Speed Internet (TBD)	0.785	normal Data
Hip width (LP)	0.185	normal Data
Long Sleeve (PL)	0.506	normal Data
High-popliteal (PO)	0.147	normal Data
Reach Hands (JT)	0,404	normal Data
Endomorphy	0.094	normal Data
Mesomorphy	0.481	normal Data
Ectomorphy	0.019	Data is not normal
Musculoskeletal complaints (KM)	0.000	Data is not normal

The above data shows the results of the research data normality testing criteria if significant value > 0.05 then the normal distribution of data. The test results showed that the value of data normality significant design work station includes popliteal, shoulder width, shoulder height sitting, wide hips, sleeve length, popliteal height and arm reach normal distribution. Testing normality of the data indicates that the data Endomorphy somatotype and while ectomorphy mesomorphy normal distribution is not normal. Testing normality musculoskeletal complaint data indicates the data are not normally distributed because of significant value <0.05.

Table 5 Wilcoxon test

Test Statistics ^b	
	Code KM - KM
Z	-4.808a
Asymp. Sig. (2- tailed)	
.000	

- a. Based on positive ranks.
- b. Wilcoxon Signed Ranks Test

From the above results shows the test results with the Wilcoxon test hypotheses obtained probability value (p-value) 1.000, which means the null hypothesis is accepted. It is clear that there is no difference between musculoskeletal complaints before and after the measurement of body constitution.

Influence the design of work stations and the constitution of the body against musculoskeletal complaints

Table 6. Summary models

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	15.672 ^a	.577	.770

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The above data Shows test results summary regression model with significant value Nagelkerke R square that can be interpreted as the value of R² in multiple regression. The summary table model at Nagelkerke R square column shows the value of 0.770 which means the variability of the dependent variable that can be explained by the variability of the independent variable of 77%.

Based on the analysis using logistic regression assisted with SPSS 17.0 results obtained probability value (p-value) on the value of Hosmer and Lemeshow test is greater than 0.05 then it means that the model is able to predict the value of observation or can be said models to be accepted as suitable with the data observations. Then a summary of the model on test how much influence the views of Nagelkerke R square shows the value of 0.770 means the variability of the dependent variable that can be explained by the variability of the independent variable of 77%.

Based on these results the design of work stations and the constitution of the body gives the effect of 77%, while the remaining 23% are outside of this study. The magnitude of the effect of the independent variable (the design of work stations and the constitution of the body) to the dependent variable (musculoskeletal complaints) included in the strong category for more than 50%.

The results of this study also supports the theory of ergonomics that a poor working environment (beyond the threshold value that has been set), which exceed human tolerance to deal with it, not only lowers prproduktivitas work but also would cause occupational diseases, work accidents (Budiono, 2009: 80).

Monotonous work activities often lead to the imposition of the monotony of the various parts

of the muscle and cause fatigue. Fatigue is a form of body protection mechanism of the body to avoid further damage resulting in the recovery after the break. (Grandjean, 2000).

As it is known that the rock-breaking generally work in a standing position and bowed to the old position. While working on the long standing position of static and involve more muscle contraction intensity than sitting or standing half sitting and relaxation (Santosa, 2004). By the time work more muscle to contract and in a state of so much faster anaerobic exhausting as glycogen as a source of energy the body quickly reduced, and muscle fatigue due to their pile of lactic acid increased (Santosa, 2004).

In addition, working in an environment which is less convenient because it is located in an open environment and workers rarely use protection from the hot sun like a place with a roof that can protect from the sun. This condition greatly increased risk of skin damage due to exposure to direct sunlight in a long time. In addition, the work load that exceeds 8 hours a day for the pursuit of wages depending on how much rock is broken down according to size is determined as well berisiki the ability of the body's physiology when workers work beyond the allotted time.

Treatments that by changing the design of work stations and constitutional bodies give effect to the musculoskeletal complaint after giving treatment which resulted in reduced complaints. This suggests that in the work, to look for a natural position or a position that does not involve a lot of physiological muscle contraction intensity, not easily tired that labor productivity can be increased (Ngadiman et al, 2017).

When the muscles of the body receive a static baban repeatedly and for a long time, it will cause complaints in the form of damage to the joints, ligaments and tendons. The complaint is often called musculoskeletal disorders or MSDs (Grandjean, 2000). Fatigue or damage to muscles can result in spasms (muscle cramps), muscle spasms, loss of balance, and sprains. Muscle fatigue can also cause severe pain and cause loss of sensation (numbness) in the body of the encumbered (Ng, Swapna, Michelle, and Acharya, 2011).

Muscle fatigue can also be caused by less correct work postures (Purwaningsih et al, 2017). The evaluation of the design of work stations and the constitution of the body in this study give a good contribution to the conditions of reduced muscle for musculoskeletal complaints.

CONCLUSION

Based on the results of research and discussion of the data of this study it can be concluded that There is the influence of the work station design interventions against musculoskeletal disorders in workers, where there are differences in musculoskeletal complaints in workers Progo river stone crushers in Magelang as evidenced by the probability value (p-value) 0.000 <0.05.

REFERENCES

- Budiono, A. M. S, Jusuf, dan Adriana Pusparini. (2009). Bunga Rampai Hiperkes dan Keselamatan Kerja. Semarang: Badan Penerbit UNDIP.
- Grandjean E. (2000). Fitting Task To The Human. A Textbook of Occupational Ergonomics, Fifth Edition, Taylor & Francis Inc., Philadelphia.
- Istighfaniar, K. (2014) Pekerja Instalasi Farmasi, (2001), pp. 81–90.
- Maakip, I, Keegel, T. and Oakman, J. (2017) 'Predictors of musculoskeletal discomfort: A cross-cultural comparison between Malaysian and Australian office workers', *Applied Ergonomics*, 60, pp. 52–57. doi: 10.1016/j.apergo.2016.11.004.
- Ng, E., Swapna, G., Michelle, Y. L., & Acharya, U. R. (2011). Classification of Normal, Neuropathic, and Myopathic Electromyograph Signal Using Non Linear Dynamic Method. *Journal of Medical Imaging and Health Informatic*, 375-380.
- Ngadiman., Saudin Yuniarni., dan Siti Harwani. (2017). Identifikasi Sikap Kerja dan Keluhan Gejala Cumulative Trauma Disorder (CTD) Pada Pekerja Pemecah Batu di Kecamatan Patikraja Kabupaten Banyumas. *Jurnal Kesehatan Masyarakat*

- Fakultas Kedokteran Universitas Jenderal Soedirman.
- Purwaningsih, R, Dyah Ayu P, dan Novie Susanto. (2017). Desain Stasiun Kerja dengan Menggunakan Analisis Biomekanik untuk Mengurangi Beban Statis dan Keluhan Pada Otot. *Jurnal Teknik Industri* Vol. XIII No1 Januari 2017. pp. 15-22.
- Santoso, G. (2004). Pengaruh Posisi Kerja Terhadap Timbulnya Nyeri Punggung Bawah Pada Pengrajin Rotan di Desa Transan Kabupaten Sukoharjo. *Info Kesehatan*, 54-68.
- Sekarsari. (2017). Hubungan lama kerja, gerakan repetitif dan postur janggal pada tangan dengan keluhan carpal tunnel syndrome (cts) pada pekerja pemecah batu di kecamatan moramo utara kabupaten konawe selatan tahun 2016. *Jurnal ilmiah kesehatan masyarakat Unsyiah*.
- Setianingsih. (2010). Analisis Potensi Bahaya dan Upaya Pengendalian Risiko Bahaya Pada Pekerja Pemecah Batu, Disertasi Semarang: Pascasarjana Undip.
- Silvia, Solichin, dan Erianto. (2015). Pengaruh Redesain Kursi Gazebo Fik Yang Ergonomis Terhadap Musculoskeletal Disorder, disertasi Malang: pascasarjana UNM
- Sugesti Ningsih, (2016). Penggunaan Kursi Ergonomis Untuk Mengurangi Keluhan Nyeri Otot Rangka (Musculoskeletal Disorders) Pada Pekerja Laundry Di Wilayah Kota Yogyakarta
- Suhartini. (2010). Analisis Pergulatan Hidup Perempuan Pemecah Batu, Disertasi Semarang: Pascasarjana Unnes.
- Sulistiyanto. (2013). Analisis Usaha Perempuan Pemecah Batu Dan Kontribusinya Terhadap Pemenuhan Kebutuhan Keluarga Di Desa Rebug Kecamatan Kemiri Kabupaten Purworejo. thesis Semarang: Pascasarjana Unnes
- Sulung, M. (2016). Beban Angkut, Posisi Angkut, Masa Kerja Dan Umur Dengan Keluhan Muskuloskeletal Pada Pekerja Bongkar Muat
- Sumardiyono. (2011). Pengaruh kursi ergonomis terhadap gangguan muskuloskeletal. *Jurnal Ilmiah kesehatan keselamatan kerja*.
- Sundari, K. N. (2011) 'Sikap Kerja Yang menimbulkan Keluhan Muskuloskeletal Dan Meningkatkan Beban Kerja Pada Tukang Bentuk Keramik', *Jurnal Ilmiah Teknik Industri*, 10(1), pp. 42-47.
- Tarwaka. (2011). Ergonomi Industri Dasar-Dasar Pengetahuan Ergonomi dan Aplikasi di Tempat Kerja. Surakarta: Harapan Press.
- Ulfah, N, Harwanti, S. dan Nurcahyo, P. J. (2014). Sikap Kerja dan Risiko Musculoskeletal Disorders pada Pekerja Laundry Work Attitude and Musculoskeletal Disorders Risk in Laundry Worker. *Jurnal Kesehatan Masyarakat*, 8(7), pp. 313-316.
- Wardiningsih. (2010). Pengaruh sikap kerja duduk pada kursi kerja Yang tidak ergonomis terhadap keluhan Otot-otot skeletal bagi pekerja wanita Bagian mesin cucuk di pt iskandar Indah printing textile; Surakarta.
- Yustica, Suroto, dan Ekawati. (2016). Hubungan antara postur kerja dengan tingkat keluhan subyektif muskuloskeletal pada penjaga pintu tol tembalang Semarang, *Jurnal Kesehatan Masyarakat Undip*.