The use of sitting grinder reduces musculoskeletal complaints disorders, workload, and increases work productivity of blacksmith in Tabanan, Bali, Indonesia

Ida Ayu Made Sri Arjani¹, Cokorda Dewi Widhya Hana Sundari¹, Nyoman Mastra¹, I Made Bulda Mahayana¹, I Gusti Agung Ayu Putu Swastini¹

INTRODUCTION

Health is a very important factor in increasing labor productivity as human resources. Good health conditions have the potential to achieve good work productivity as well.¹ Poor work methods will risk causing musculoskeletal complaints in every worker. When the body moves away from its natural position, the further the position of the body parts from the center of gravity, and the higher the skeletal muscle complaints will occur.²

Labor protection covers several aspects that are quite broad, namely protection of occupational safety and health, maintenance of work morale and treatment in accordance with human dignity and national morals. This protection aims to provide safety guarantees and improve the health status of workers.¹ In general, all positions or fields of work are at risk for musculoskeletal disorders, both static work, sitting positions, bending or standing for too long and in fields of work that require excessive physical strength and heavy workloads.³ Musculoskeletal complaints are disorders that affect the normal function of skeletal muscles due to repeated exposure to various risk factors in the workplace. Musculoskeletal causes significant work problems due to increased health compensation costs, decreased productivity, and low quality of life.¹

Conclusion: There is a significant decrease in musculoskeletal complaints and workload between the Control group with treatment I and the control group with treatment II (p<0.05), and there is a significant increase in work productivity in the control group with treatment I and in the control group with treatment II.

Keywords: musculoskeletal disorders, workload, productivity,

grinding with a combination of factors such as grip strength, repetition of wrist movements, posture of the hand and wrist, and long duration of work increases the risk of musculoskeletal problems.\(^5\)

In high-risk work jobs, the prevalence of Carpal Tunnel Syndrome is between 5.6% and 15%. Musculoskeletal complaints found include tingling and pain in the fingers, reduced grip strength, difficulty holding small objects.\(^4\) There are vascular disorders, nerve disorders caused by pressure on the median nerve that passes through the carpal tunnel, this nerve disorder is related to work that has long-term repeated exposure to vibration.\(^5\)

The World Health Organization (WHO) states that occupational risks are the top ten causes of death and illness worldwide. In the 2017 global estimates of occupational accidents and work-related illnesses published by the Workplace Safety and Health Institute, the number of workers who died from occupational diseases in 2015 was 2.4 million. Then in 2014, 380,500 workers in the world experienced fatal work accidents and 374 million workers experienced non-fatal work accidents. Meanwhile in 2016-2017, there were about 507,000 workers in the United Kingdom who suffered from disorders of the musculoskeletal system caused by their work.

Based on Indonesian Ministry of Health basic health research in 2013, the prevalence rate of morbidity due to diagnosed musculoskeletal diseases was 24.7%. One of the factors that influence the onset of musculoskeletal complaints is work attitude, this is based on the theory that musculoskeletal complaints are chronic diseases that require a long period of time in their development and manifestation.\(^2\) When muscles receive excessive workloads that are carried out repeatedly and for a long time, complaints will arise due to damage to joints, ligaments and tendons, these complaints are called musculoskeletal complaints. Based on this theory, one of the causes of musculoskeletal complaints is workload.

A previous study found there is a relationship between workload and musculoskeletal complaints in pelvic workers in the Candi Industrial Area of Semarang City.\(^8\) Based on data from the International Labor Organization (ILO) in 2013, one worker in the world dies every 15 seconds due to work accidents and 160 workers experience occupational diseases. The ILO recorded the number of deaths due to accidents and occupational diseases as many as 2 million cases each year. This incident caused the world to experience losses equivalent to 1.25 trillion dollars or 4% of world gross national product (GNP).\(^9\)

Blacksmithing is one of the small industries developed in Gubug village, Tabanan Regency. These blacksmith craftsmen have been working for a long time and are hereditary from their ancestors. They accept the inheritance as it is and do this work as a responsibility from their ancestors. One of the processes in making household tools in the form of small knives, large knives, scythes, and machetes, they are faced with a tool in the form of a grinder to smooth and sharpen knives. In this process, the worker holds the vibrating grinder, which weighs more than 1.5 kg, with one hand, while the other hand has the knife to be smoothed. Working with hands exposed to vibration for long periods is a burden that will cause musculoskeletal complaints and diseases for workers such as hand-arm vibration syndrome, Raynaud's syndrome, tenosynovitis, and carpal tunnel syndrome.\(^10\)

Vibration in machines used with the help of hands to operate can cause carpal tunnel syndrome disease where there is a disturbance in the nerves caused by trapping the median nerve and or due to the pressure on the median nerve passing through the carpal tunnel, this nerve disorder is related to work that has long-term exposure to vibration repeatedly. Musculoskeletal disorders (MSDs) are a set of symptoms related to muscle tissue, tendons, ligaments, cartilage, nervous system, bone structure, and blood vessels.\(^11\)

Based on the results of limited interviews with ten blacksmiths in the grinding section, they stated that after work they experienced stiffness in the hands until they could not be moved, pain, tingling and trembling. In addition, due to poor working position, workers experience pain in the chest, back, waist, neck, as a result of bending and bowing.

Based on this, researchers raised the above issues with the use of sitting grinders to reduce complaints of MSD, workload and increase the work productivity of blacksmiths in Tabanan Regency, Bali, Indonesia.

**METHODS**

This research is an experimental model. The population was workers in the small blacksmith industry in Tabanan Regency. Samples were determined based on small industry groups by simple random sampling with a random number table. Inclusion criteria: Male or female blacksmith workers living in Tabanan Regency aged 20 – 60 years, physically healthy with a doctor’s examination, work experience of at least one year, and willing to be a research subject. Dropout criteria: absent during the study, suffering from illness during the study, for some reason withdrew as a sample. The sample size was determined based on the score of musculoskeletal complaints so that the number of small industry groups was obtained as many as 3 groups. Each group consisted of 11 people so that the sample size was 33 people. It was determined that the sample size in this study was 33 workers in 3 small industry groups.

**RESULT**

**Study participant characteristics**

The research subjects totaled 33 blacksmith workers living in Tabanan Regency consisting of a Control Group of 11 people, Treatment Group I of 11 people and Treatment Group II of 11 people. The subject conditions recorded in this study were age, height, weight and body mass index (BMI). A descriptive analysis of subject conditions is presented in Table 1.

Based on table 1 below shows the mean age of respondents 42.03 ± 10.34 years, height 164.61 ± 3.40 meters, weight 62.58 ± 3.96 kg and body mass index (BMI) 23.03 ± 1.01 kg / m.\(^2\)

**Physical Environment**

In this study, the environmental conditions measured were air temperature, humidity, and noise. Descriptive analysis and normality test of environmental condition data are presented in Table 2.
Table 1. Characteristics of study participant

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject condition</th>
<th>Mean ± SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age (yrs)</td>
<td>42.03±10.34</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Height (cm)</td>
<td>164.61±3.40</td>
<td>160</td>
<td>172</td>
</tr>
<tr>
<td>3</td>
<td>Body Weight (kg)</td>
<td>62.58±3.96</td>
<td>57</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>Body Mass Index (BMI (kg/m²))</td>
<td>23.03±1.01</td>
<td>21</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 2. Descriptive analysis and normality test of physical environment condition data in control, treatment I and treatment II groups

<table>
<thead>
<tr>
<th>No</th>
<th>Physical Environment</th>
<th>Control group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air Temperature</td>
<td>30.33 ±2.082</td>
<td>0.000</td>
<td>28.33 ± 1.528</td>
<td>0.000</td>
<td>29.00 ± 1.000</td>
<td>1.000</td>
<td>0.500</td>
<td>0.667</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Air Humidity</td>
<td>80.67 ±2.082</td>
<td>0.000</td>
<td>79.67 ±2.517</td>
<td>0.000</td>
<td>79.33 ±3.055</td>
<td>0.000</td>
<td>0.756</td>
<td>0.529</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Noise</td>
<td>79.00± 1.000</td>
<td>1.000</td>
<td>51.67 ±0.577</td>
<td>0.000</td>
<td>51.00±1.000</td>
<td>1.000</td>
<td>82.000</td>
<td>0.001</td>
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<td></td>
</tr>
</tbody>
</table>

Table 3. Differential test results of physical environment data in control, treatment I and treatment II groups after work

<table>
<thead>
<tr>
<th>No</th>
<th>Physical Environment</th>
<th>Control Group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>t</th>
<th>p</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air Temperature</td>
<td>26.67 ±0.577</td>
<td>26.33 ± 0.577</td>
<td>26.00 ±1.000</td>
<td>0.500</td>
<td>0.667</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Air Humidity</td>
<td>81.33 ±1.155</td>
<td>80.67 ±0.577</td>
<td>79.60 ±0.407</td>
<td>0.756</td>
<td>0.529</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>Noise</td>
<td>79.00± 1.000</td>
<td>51.67 ±0.577</td>
<td>51.00±1.000</td>
<td>82.000</td>
<td>0.001</td>
<td></td>
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</tbody>
</table>

Table 4. Descriptive analysis and normality test of complaint data on control, treatment I and treatment II groups before and after work

<table>
<thead>
<tr>
<th>No</th>
<th>MSDs Complaints</th>
<th>Control Group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before Work</td>
<td>34.45 ±2.04</td>
<td>0.22</td>
<td>30.62 ± 1.471</td>
<td>0.683</td>
<td>30.36 ±1.47</td>
<td>0.264</td>
<td>0.221</td>
<td>0.221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>After Work</td>
<td>72.18 ±1.50</td>
<td>0.22</td>
<td>35.82 ±1.461</td>
<td>0.221</td>
<td>34.82±1.43</td>
<td>0.221</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Differential test results of musculoskeletal complaints data in control, treatment I and treatment II groups before and after work

<table>
<thead>
<tr>
<th>No</th>
<th>MSDs Complaints</th>
<th>Control Group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before Work</td>
<td>2.37 ±0.819</td>
<td>2.12 ± 0.654</td>
<td>1.87 ±0.910</td>
<td>2.733</td>
<td>0.120</td>
</tr>
<tr>
<td>2</td>
<td>After Work</td>
<td>2.47 ±0.647</td>
<td>2.43 ±0.287</td>
<td>1.95 ±0.638</td>
<td>1.698</td>
<td>0.254</td>
</tr>
</tbody>
</table>

Table 6. Descriptive analysis and normality test of workload data in control, treatment I and treatment II groups before and after work

<table>
<thead>
<tr>
<th>No</th>
<th>Workload (Mean±SD)</th>
<th>Control group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
<th>Mean ± SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before Work</td>
<td>94.50±11.030</td>
<td>0.211</td>
<td>80.00±1.41</td>
<td>0.181</td>
<td>79.00±1.155</td>
<td>0.064</td>
<td>0.086</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>After Work</td>
<td>105.75±4.425</td>
<td>0.332</td>
<td>91.25±2.21</td>
<td>0.798</td>
<td>8.25±1.893</td>
<td>0.086</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Differential Test Results of Workload Data in control, treatment I and treatment II groups before and after work

<table>
<thead>
<tr>
<th>No</th>
<th>Workload</th>
<th>Control group</th>
<th>Treatment I</th>
<th>Treatment II</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before work</td>
<td>92.18 ± 13.235</td>
<td>79.18 ±1.079</td>
<td>78.55 ± 1.968</td>
<td>1.193</td>
</tr>
<tr>
<td>2</td>
<td>After work</td>
<td>104.64 ± 4.433</td>
<td>89.91 ±3.360</td>
<td>89.27 ± 3.165</td>
<td>0.779</td>
</tr>
<tr>
<td>3</td>
<td>Improved</td>
<td>1.13</td>
<td>1.13</td>
<td>1.13</td>
<td></td>
</tr>
</tbody>
</table>
Group with Treatment II is meaningful or not, a paired samples t-test was conducted because the value in the normality test was p<0.05. The results of the analysis of the significance of environmental conditions are presented in Table 3.

Statistical analysis of environmental temperature (air temperature, air humidity) in the Control, Treatment I and Treatment II Groups showed no significant difference because the p value>0.05. This shows that the environmental temperature has the same condition in the Control, Treatment I and Treatment II Groups. While noise shows there is a significant difference because the p value<0.05, in the control group with Treatment I and p value> 0.05 in the control group with Treatment II.

Musculoskeletal Disorders (MSD) Complaints
Musculoskeletal complaints data were obtained using the Nordic Body Map questionnaire with a direct interview method on workers. Measurements were taken in the Control, Treatment I and Treatment II groups before and after work. Descriptive analysis and normality test of complaint data as in Table 4.

Table 4, shows the average complaints in the Control Group before and after work increased by 37.73%, from 34.45 ± 1.508 to 72.18 ± 2.040. In Treatment I there was an increase of 14.52% and in Treatment II there was an increase of 14.69%. When compared between the Control Group with Treatment I and the control group with treatment II will experience a decrease after work. Before working there was a decrease between the control group and treatment I, which amounted to 11.11%, and between the control group and Treatment II by 11.87%. While after work there will be a decrease, namely in the Control group with Treatment I, which is 51.51% and between the Control group and Treatment II by 51.75%.

The data normality test with the Shapiro-Wilk test at the α = 0.05 confidence level showed that all data were normally distributed (p>0.05) so that to determine differences in treatment effects in the Control Group with Treatment I and Control Group with Treatment II, a Paired Sample-t-Test was conducted at the α = 0.05 confidence level. Paired Sample-t- Test analysis of musculoskeletal complaints data is presented in Table 5.

Table 5, shows the paired sample-t-test analysis in the Control Group with Treatment I and Control Group with Treatment II before work, getting no significant difference (p>0.05), indicating that the initial conditions in the Control Group, Treatment I and Treatment II I are the same. Analysis of Control Group with Treatment I and Control Group with Treatment II after work found there was a significant difference (p<0.05).

Workload
Workload was assessed by measuring the pulse rate in the Control, Treatment I and Treatment II groups before and after work. Descriptive analysis and normality test of workload data are presented in Table 6.

Table 6, shows the average workload in the Control group before and after work increased by 11.90%, from 94.50 ± 11.030 to 105.75 ± 4.425. In Treatment I there was an increase of 14.06% and in Treatment II there was an increase of 12.97%. When compared between the Control Group with Treatment I and the control group with treatment II will experience a decrease after work. Before working there was a decrease between the control group and treatment I which amounted to 18.12%, and between the control group and Treatment II amounted to 19.62%. While after work there will be a decrease, namely in the Control group with Treatment I, which is 13.71% and between the Control group and Treatment II by 15.60%.

Data normality test with Shapiro-Wilk test at the α = 0.05 confidence level showed all data were normally distributed (p>0.05) so that to determine differences in treatment effects in the Control Group with Treatment I and Control Group with Treatment II, a Paired Sample-t-Test was conducted at the α = 0.05 confidence level. Analysis of workload difference test is presented in Table 7.

Paired Sample-T-Test analysis of workload data in the Control Group with Treatment I and Control Group with Treatment II before work shows no significant difference because the p-value is 0.452> 0.05. This shows that there is no difference in initial conditions in the Pre-Treatment or it can be interpreted that the initial conditions of the three Periods are the same or comparable. There is a
significant difference in the Control Group with Treatment I because the p-value = 0.000 < 0.05. While between the Control Group and Treatment II there was no significant difference because the p-value > 0.05.

**Productivity**

It is the ratio of output to input per unit time. In this study, productivity is assessed through the comparison of successfully forged plates (output) with work pulses (input) in one working hour (time). Descriptive analysis and normality test of productivity data are presented in Table 8.

The average plate produced in the Control Group with Treatment I increased by 7.61%, namely 3.64 to 3.94, between the Control Group and Treatment II also increased by 11.21%, namely from 3.64 to 4.10 and after calculating productivity in the Control Group with Treatment I also increased by 20.93%, namely from 0.034 to 0.043 and in the Control group with Treatment II there was an increase of 24.44%. All data were normally distributed after testing the normality of data in the Control Group with Treatment I and Control Group with Treatment II using the Shapiro-Wilk Test at α = 0.05 confidence level. To determine the difference in treatment effects in the Control Group with Treatment I and Post Treatment, a t-test was conducted at a confidence level of α = 0.05. T-test analysis of productivity data is presented in Table 9. Wilcoxon’s difference test analysis of productivity data in one hour in Treatment I and Treatment II had no significant difference (p>0.05).

**DISCUSSION**

**Complaints of Musculoskeletal Disorders**

The subject’s musculoskeletal complaints were measured with the Nordic Body Map questionnaire which contains 28 question items. In this study when compared between the Control Group with Treatment I and the control group with treatment II will experience a decrease after work. Before working there was a decrease between the control group and treatment I which amounted to 11.11%, and between the control group and Treatment II by 11.87%. While after work there will be a decrease, namely in the control group with treatment group I, which is 51.51% and between the control group and treatment II by 51.75%. Analysis of the difference test on the three treatments after work got a significant difference (p<0.05).

The results of the data normality test with the Shapiro-Wilk test at the α = 0.05 confidence level showed that all data were normally distributed (p>0.05) so that to determine differences in treatment effects in the Control Group with Treatment I and Control Group with Treatment II, a Paired Sample-t-Test was conducted at the α = 0.05 confidence level. Paired Sample-t-Test analysis on Control Group with Treatment I and Control Group with Treatment II before work, getting no significant difference (p>0.05), indicating that the initial conditions in the Control Group, Treatment I and Treatment II I are the same. Analysis on Control Group with Treatment I and Control Group with Treatment II after work found there was a significant difference (p<0.05).

MSDs are complaints or disorders felt by someone ranging from mild complaints to severe pain in the skeletal muscles which include joints, nerves, muscles and the spine due to unnatural work. If the muscles are impaired, then the activity of doing daily work can be disrupted, because muscle strength is one of the most important parts of the body's organs to be able to move. This study found that the decrease in complaints in workers who used sitting grinders was 13.23%. This study's results align with other studies that state that ergonomics-based work system improvements can reduce worker complaints. Research by Ulfah et al., which explains that the work is in a static posture on the lower body and experiences repetitive movements on the hands. When in a static position, the body will experience blockage of blood flow resulting in a lack of oxygen and glucose from the blood in that section. In addition, the body will produce lactic acid which can cause pain. Muscles cannot work naturally if someone works with an unnatural posture, this causes the muscles to require more strength to carry out their duties, thus triggering fatigue and tension in the muscles and tendons. Research by Arjani et al. in the form of improving work attitudes reduced musculoskeletal complaints by 34.6%, Santosa’s research et al. in the form of improving the work system and work environment reduced worker fatigue by 22.09%, Setiawan et al. study in the form of ergonomics-based workstation improvements reduced worker fatigue by 18.84%, and Yusuf et al. study in the form of ergonomics-based tool improvements reduced worker fatigue by 30.31%. According to Diana et al. study the higher the assessment of work attitude, the higher the musculoskeletal complaints felt.

In the work of grinding knives, workers are faced with repetitive movements of the hands by carrying a fairly heavy hammer, so that the load on the right hand is more dominant. When the grinding stone rotates and hits the steel plate, vibration arises and propagates from the tool to the hand or wrist even though the worker does not feel the vibration. Vibrations that are felt continuously during work will accumulate over time and can have an impact causing hand-arm vibration syndrome (HAVS), a disease caused by exposure to vibrations in the hands. Exposure to hand-arm vibration, prolonged work with flexed wrists, and high repetition are also associated with carpal tunnel syndrome (CTS).

**Workload**

Workload is an important factor in assessing a job’s lightness or heaviness, including grinding work. The workload given to workers must be adjusted to the physical and psychological abilities of the workers so that it cannot affect the health conditions of the workers. As an effort to reduce the workload of workers can be done by planning and/or designing a tool that can minimize complaints due to inappropriate workload. Workload can be predicted from the pulse frequency of workers because the pulse is one of the indicators that can be used to determine a person’s workload level.

When compared between the Control Group with Treatment I and the control group with treatment II will experience a decrease after work. Before working there was a decrease between the control group and treatment I, which amounted to 18.12%, and between the control group and control group with treatment II which amounted to 0.34%.
and Treatment II by 19.62%. While after work there will be a decrease, namely in the control group with treatment group I, which is 13.71% and between the control group and treatment II by 15.60%. Analysis of the difference test on the three treatments after work got a significant difference (p<0.05).

The decrease in workload in the Control Group with Treatment I and between the Control Group and Treatment II is predicted due to decreased external stress in the work environment. One of the effects of external stress conditions is an increase in pulse rate. In this study, after external stress can be overcome by improving the form of providing sitting grinders. There is an efficient use of energy so that it can reduce the workload measured through the work pulse. Some similar research results also obtained a decrease in workload of 18.3 in research on redesigning work stoves, a decrease in workload of 21.43% in modifying working conditions based on Tri Hita Karana ergonomics for rice mill workers, a decrease in workload of 15.3% for dodol industry workers in Bali, and a decrease in workload of 3.41% for steamed bread industry workers in Denpasar. The results of the research conducted are in accordance with the theory stating that an increase will follow an increase in workload in musculoskeletal complaints.

**Work productivity**

The ultimate impact of improving working conditions is an increase in productivity and income for artisans and entrepreneurs. The increase in productivity in this study is seen from the increasing number of metal plates successfully forged by workers in one hour. When compared between the Control group and Treatment I, the result of work amounted to 7.61%, and between the control group and Treatment 2 amounted to 11.21%. Worker productivity by calculating output divided by input per unit time also increased by 20.93% between the Control Group and Treatment I and an increase of 24.44% between the Control Group and Treatment II found a significant difference (p<0.05). Increased productivity through the number of plates produced will have an impact on increasing the number of knives produced by workers so that it will increase their income. In addition to increased income, this improvement will reduce the risk of workers getting occupational diseases.

Some similar research results also found that improvements with an ergonomic approach can increase productivity. The increase in productivity obtained is due to improvements in physiological responses, faster processing time, and an increase in the amount of production. The increase in productivity was obtained by 36.96% in the improvement of the work system, in the application of total ergonomics for pottery industry workers in Bantul 59.49%, interventions with stretching and giving sweet tea totailors were also reported to increase worker productivity by 66.67%, an increase in productivity of 54.95% in the use of solar dryers with a Techno- Ergonomic approach to dodol making in Singaraja, and an increase in productivity of 12.1% in the steamed bread making industry with the intervention of total ergonomics-based pouring tool applications.

Understanding how musculoskeletal function and symptoms impact workload and productivity, and by regularly assessing functional and activity limitations, and recommending ergonomic adjustments, in this study by providing blacksmith workers with seated grinders is a strategy to maximize worker functional ability and quality of life.

**CONCLUSIONS**

This study concludes that there is a significant decrease between musculoskeletal complaints, workload, and noise before and after the use of a seated grinder (p<0.05), and there is a significant increase in work productivity.

**CONFLICT OF INTEREST**

All author declares there is no conflict of interest.

**FUNDING**

None.

**AUTHOR CONTRIBUTION**

All author had contributed to manuscript writing and agreed to final version of manuscript for publication.

**ETHICAL CONSIDERATION**

This study has been approved by Ethical Committee Politeknik Kesehatan Kemenkes Denpasar with ethical clearance reference number : LB.02.03/EA/KEPK/0654/2023.

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