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# The relationship between repetitive motion and level of fatigue among weaver craftsman

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## ABSTRACT

**Background:** The weaving process is a repetitive activity because of the repetitive hand movement pattern with a load period of < 3 kg. Work patterns that do not pay attention to ergonomics will cause problems such as fatigue, injury, musculoskeletal disorders, work accidents, and issues due to excessive repetitive motion. This study aimed to determine the relationship of repetitive motion to the level of fatigue in weaving workers.

**Methods:** This study used a cross-sectional approach using a sample of 44 weaving artisans who joined the association in the Special Region of Yogyakarta. This study used non-parametric statistical tests with *Kendall Tau* correlation test techniques.

**Results:** Based on data analysis in the study, a positive correlation was obtained with a significance value of $p = 0.001$ ($p < 0.05$), which means a significant positive correlation exists between repetitive motion and fatigue level in weaving workers.

**Conclusion:** Based on the results of research and discussion, it can be concluded that there is a relationship between repetitive motion and fatigue in weaving artisans in the Special Region of Yogyakarta. It is also proven by the *Kendals Tau* test, which has a $p$-value = 0.001 or $p < 0.050$, so it can be said that there is a relationship between repetitive motion and fatigue in weaving artisans in Yogyakarta.

**Keywords:** extremities, fatigue, weaving craftsmen, repetitive motion.
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## INTRODUCTION

Weaving crafts in Yogyakarta, Indonesia, still use traditional non-machine looms tools. With an average worker of more than 40 years old, weavers can spend 8 hours in 1 day and rest for 1 hour in the middle of working time. For the work pattern, weavers will sit on a bench with legs constantly moving and working to unite the threads.[1]

Work patterns that do not pay attention to ergonomics will cause problems such as fatigue, injury, musculoskeletal disorders, and accidents.[2] Most problems occur due to excessive repetitive motion. Repetitive motions are repetitive movements in the joints and upper extremities, such as joints in the fingers, wrists, elbows, shoulders, and neck. While in the lower extremities, such as the pelvis, knees, ankles, and toes.[3]

Repetitive working conditions can create a monotonous atmosphere that accumulates into boredom, categorized as fatigue.[4] Static muscle loading for a long time will result in RSI (repetition strain injuries), which is muscle, bone, and tendon pain caused by repetitive work. The working atmosphere with static muscles can cause decreased blood flow, so lactic acid accumulates and causes local muscle fatigue.[5,6]

From the observation of the weaving process, it can be said that the activity is a repetitive motion because of the repetitive movement pattern and the load period < 3 kg. In Moyudan, 20 workers perform repetitive motion processes, and all experience fatigue. In Sewon Bantul, there are 24 weaving craftsmen, and 85% of all craftsmen admit to experiencing fatigue. Data from the activities of workers in carrying out their actions shows that, for one time, the movement of swinging forward takes 0.27 seconds, while when pulling the lever, it takes 0.25 seconds. For one time swinging back and forth, the time needed is around 0.52 seconds, and this is done repeatedly for at least 6.72 seconds and produces 12 repetitive movements, while the longest time in this activity I got a record time of 29.31 seconds and produced 46 signs.[7]

One of the things that might cause issues with worker health and safety is occupational weariness. Fatigue has the potential to impair performance and raise the likelihood of work errors leading to accidents at work.[8,9] Based on the problems described, this study was conducted to determine the relationship between repetitive motion in weaving craftsmen and the level of fatigue.

## METHODS

This quantitative research uses a correlation study that connects the two variables to be studied. The approach in this study was *cross-sectional*, with the number of samples in this study as many as 44 weaving craftsmen who joined the association in the Special Region of Yogyakarta area by fulfilling the inclusion and exclusion criteria. The inclusion criteria are daily activities as weaving craftsmen, willingness to be respondents, incorporating craftsmen who perform repetitive movements, joining the weaving association, age> 40 years, and craftsmen with *high risk* based on Brief Measurement. The exclusion criteria include subjects withdrawing from research and injuries that cause craftsmen to be unable to carry

out weaving activities.

The data collected in the data collection stage, such as age, foot arch shape, and injury history, were measured using a stopwatch and fatigue severity scale sheet. Five activities were carried out in the data processing stage: editing, coding, data entry, cleaning, and tabulating. Data entry is each respondent's answers in the form of codes (numbers) entered in a computer program or software. The program used in this research is *SPSS*.[9] The bivariate analysis was a *non-parametric* statistical test with the *Kendall Tau* correlation test technique. This correlation technique is used to find relationships and prove the hypothesis of the relationship between two variables if the data of the two variables are ordinal or ranked.[10]

## RESULTS

This descriptive correlational study looks for the magnitude of the influence or relationship between the independent and dependent variables. The characteristics of respondents in the study are shown in Table 1 shows the characteristics of respondents in the form of age, body mass index, gender, tenure, workload, sleep quality, and medical history. Age characteristics have a *mean of* 4.13 and a standard deviation of 0.81. Body mass index characteristics have a mean body *of* 2.86 and a standard deviation of 0.50. The gender characteristic has a mean *of* 1.59 and a standard deviation of 0.49. The tenure characteristic has a mean *of* 2.79 and a standard deviation value of 0.70. Workload characteristics had a mean *of* 1.40 and a standard deviation of 0.69. Sleep quality characteristics have a mean *of* 1.40 and a standard deviation of 0.49. The disease history characteristics have a mean *of* 2.81 and a normal variation of 1.29.

Table 2 shows a description of sample data according to age grouping. Based on the sample's age, it is dominated by older adults aged between 56 and 65 years, with a total of 25 samples and a percentage of 56.8%. The last sample is the early adult age group of 1 person, with a calculation of 1 sample and a rate of 2.3%.

Table 2 shows a description of sample data according to body mass index grouping based on the body mass index of the research sample. The number is dominated by respondents with a standard body mass index, with a total of 35 respondents and a percentage of 79.5%. The smallest number of respondents is Samoel, with an obese body mass index of 1 sample and a rate of 2.3%.

Table 2 shows an overview of sample data according to gender grouping based on the gender of the research sample. The number is dominated by female respondents, with a total of 26 respondents and a percentage of 59.1%. As for the smallest number of respondents, there were 18 male samples, a rate of 40.9%.

Table 2 describes the sample data according to the grouping of tenure. Based on the craftsman of the research sample, the number is dominated by respondents that have a craftsman of 20 years with a total craftsman of 30 respondents and a percentage of 68.2%, while for the smallest number of respondents is a sample that has a tenure of 3 respondents and a craftsman of 6.8%.

**Table 1. Descriptive data of respondents**

| Characteristics | Sample (n=52) | | |
|---|---|---|---|
| | *Mean* | ± | SD |
| Age | 4.38 | ± | 0.81 |
| Body mass index | 2.86 | ± | 0.50 |
| Gender | 1.59 | ± | 0.49 |
| Length of service | 2.79 | ± | 0.70 |
| Workload | 1.40 | ± | 0.69 |

**Table 2. Distribution variable**

| Variable | Classification | Frequency | % |
|---|---|---|---|
| Age | 26-35 | 1 | 2.3 |
| | 36-45 | 6 | 13.6 |
| | 46-55 | 12 | 27.3 |
| | 56-65 | 25 | 56.8 |
| | Total | 44 | 100.0 |
| Body mass index | Obese (>25) | 1 | 2.3 |
| | Overweight (23-24.50) | 6 | 13.6 |
| | Normal (18.5-22.5) | 35 | 79.5 |
| | Underweight (<18) | 2 | 4.5 |
| | Total | 44 | 100.0 |
| Gender | Male | 18 | 40.9 |
| | Women | 26 | 59.1 |
| | Total | 44 | 100.0 |
| Period of service | 10 Years | 3 | 6.8 |
| | 15 Years | 7 | 15.9 |
| | 20 Years | 30 | 68.2 |
| | > 20 Years | 4 | 9.1 |
| | Total | 44 | 100% |
| Workload | 6 Hours | 31 | 70.4 |
| | 7 Hours | 8 | 18.3 |
| | 8 Hours | 5 | 11.3 |
| | Total | 44 | 100% |
| Repetitive motion | Repetitive motion | 38 | 86.4 |
| | No Repetitive motion | 6 | 13.6 |
| | Total | 44 | 100.0 |

**Table 3. Results of the relationship between repetitive motion and fatigue**

| | No Fatigue | Experiencing Fatigue | *p*-value |
|---|---|---|---|
| Repetitive Motion | 6 | 27 | 0.001 |
| No Repetitive Motion | 11 | 0 | |
| Total | 17 | 27 | 44 |

Table 2 shows a description of sample data according to workload grouping based on the workload of the research sample. The number is dominated by respondents with a workload of 6 hours with a total of 31 respondents and a percentage of 70.4%, while the smallest number of respondents is a sample with a workload of 8 hours with five respondents and a rate of 11.3%.

Table 2 shows the distribution based on the stopwatch. Out of 44 samples, the results obtained by doing repetitive activities were 23, with a percentage of 86.4%. In contrast, those who did not do repetitive movements were six people, with a rate of 13.6%.

Table 3 shows the relationship between repetitive motion and fatigue. Out of 44 samples, the results of respondents who performed repetitive motion activities and experienced fatigue were 27 samples with a percentage of 61.36%. 11 respondents did not perform repetitive motion but experienced fatigue as much as 25%, and six respondents performed repetitive motion activities. Still, they did not experience fatigue with a percentage of 13.63%.

## DISCUSSION

Work that requires constant Not only does lactic acid exist in the bloodstream but it can also build up in the muscles, causing fatigue. Reduced muscle activity can result from the buildup of lactic acid, and the process of exhaustion is probably influenced by peripheral and central nervous system variables. Lactic acid is produced when muscles contract from glycogen, and this acid can limit the length of time that muscles can perform, leading to exhaustion. sta effort, such as splitting big logs, hoeing, lifting, and moving, is referred to as repetitive work. Muscle complaints arise from the strain that an ongoing workload without a break causes on the muscles.[11,12] Not only does lactic acid exist in the bloodstream but it can also build up in the muscles, causing fatigue. Reduced muscle activity can result from the buildup of lactic acid, and the process of exhaustion is probably influenced by peripheral and central nervous system variables. Lactic acid is produced when muscles contract from glycogen, and this acid can limit the length of time that muscles can perform, leading to exhaustion.[13,14]

This correlation study uses a descriptive correlational method to determine the relationship between repetitive motion in weaving craftsmen. Repetitive motion tends to trigger physical problems, namely fatigue or, better known as fatigue, repetitive movements over a long time, which identify acute or chronic fatigue depending on the factors.[15,16] This research conducted by Nurmianto in 2018 shows that work fatigue reduces performance and increases work errors and accidents in the industry.[17] Long-term static muscular loading can lead to repetition strain injuries (RSIs), which are pains in the muscles, bones, tendons, and other tissues brought on by repetitive labor tasks. Repetitive motions are one thing that makes tired in the industry.[17]

Factors that cause various kinds of errors, but based on the identification conducted by researchers in the field of weaving craftsmen in Gamplong Village and Kurnia Lurik, both those who incorporate stage and those who rock stage all the same, most of the fatigue felt by craftsmen is caused by repetitive motion, also supported by weaving activities containing repetitive motion activities (repetitive motion), especially in the upper extremities (hands) and lower extremities (feet).

Based on the results of these studies, the age of 56 years to 65 years affects the level of fatigue. The higher the period, the faster the sample feels fatigued, and the level of fatigue is also higher, such as weaving craftsmen who carry out weaving activities that contain elements of repetitive motion and are dominated by old age, the results of which the samples identified fatigue that increases with high age and decreased performance and decreased work.

Fatigue will become more prominent as we age. This is due to the decline and resilience of the muscles so fatigue will increase. As age increases, the rate of fatigue will accelerate. Work capacity, including mental and social functional capacity, will decline towards the age of 45 years, and the ability for some (not all) work, according to reports, will continue to fall towards the age of 50 years to 55 years. According to Setyawati (2010), as people get older, they will experience a decrease in muscle strength, which impacts fatigue in doing work.[18] Meanwhile, Budiono states that the phenomenon of reduced muscle performance after physical stress is called physiological muscle fatigue.[19]

This research is by Budiman (2016) on the relationship between age and workload index with fatigue in PT Karian Tebing Kencana workers. This researcher obtained the results of the condition, ability, and capacity of the human body that will experience a decline. The older the age, the more susceptible to fatigue; aging will gradually damage the physiological, circadian, and sleep systems. At the age of 40- 49, the decline in conditions begins to be seen from the discovery of disease diagnoses, and at the age of 50-55, a person's work capacity will further decline.[20,21]

Based on the data according to the table, 27 people experienced fatigue, and 17 people experienced fatigue. The data was taken using the Fatigue Severity Scale (FSS) measurement. This data identifies that more than half of the sample, or 61.4% of the total respondents, were experiencing fatigue.

Thus, 38 people are included in the repetitive motion category, 27 experience fatigue, 11 do not experience fatigue, and six people are not included in the repetitive motion and fatigue categories. This data explains that 27 out of 38 samples who did repetitive motion activities were identified as experiencing fatigue with various levels. These results are also proven by the Kendals Tau test in getting the results of p = 0.001, which means that it has a value smaller than ($p$ = 0.05), so it can be said that there is a relationship between repetitive motion and fatigue in weaving craftsmen.

The research limitations faced by the authors in conducting this study are that researchers do not control the daily activities carried out by research subjects, which can affect repetitive motion and fatigue. This study was limited to knowing the relationship to exhaustion, which has not led to fatigue specifically.

## CONCLUSION

Based on the results of research, it can be concluded that there was a significant

relationship between repetitive motion and fatigue in weaving craftsmen in Special Region of Yogyakarta.

## ETHICAL CLEARANCE

The Research Ethics Commission, Universitas Muhammadiyah Surakarta, stated that this research is ethically feasible with number 1778/UN14.2.2.VII.14/LT/2023.

## CONFLICT OF INTEREST

There are no competing interests in this study.

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## AUTHOR CONTRIBUTIONS

IRY, designed the study, gathered and analyzed the data, and wrote the manuscript; W, interpreted the data analysis and wrote the manuscript.

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