

Ergonomic Risk Factors and Their Effects on Musculoskeletal Disorders (MSDs) among Karo's Uis Weavers

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ABSTRAK

Latar belakang: Penerapan ergonomi yang tidak tepat akan menimbulkan masalah kesehatan seperti cedera dan gangguan muskuloskeletal. Penelitian ini bertujuan untuk mengetahui gejala muskuloskeletal dan mengetahui tingkat risiko ergonomis pada pengrajin tradisional Karo di Desa Samura Kecamatan Kabanjahe Kabupaten Karo.

Metode: Penelitian ini merupakan penelitian deskriptif dengan desain cross sectional. Sebagai sampel diambil 14 pengrajin kain tradisional Karo. Data yang dikumpulkan menggunakan kuesioner peta tubuh Nordik dan Rapid Upper Lower Assessment (RULA).

Hasil: Hasil penelitian menemukan bahwa perubahan postur merupakan risiko ergonomi. Berdasarkan analisis risiko ergonomi pada tahapan menenun kain tradisional Karo didapatkan data bahwa pengrajin harus menyelidiki dan menerapkan perubahan posisi kerja, pengrajin perlu segera melakukan perubahan posisi kerja lebih lanjut. Keluhan muskuloskeletal tertinggi yang dirasakan pada bagian bokong, lainnya pada betis kiri dan kanan serta bahu, kemudian pada punggung, pinggang, leher bagian atas, leher bagian bawah, dan bokong.

Simpulan: Disimpulkan bahwa proses menenun masih menimbulkan risiko ergonomis bagi pengrajin dengan keluhan subjektif muskuloskeletal. Upaya untuk memperbaiki keadaan saat ini adalah dengan melakukan relaksasi di waktu istirahat yang singkat dan bantuan poster atau promosi pendidikan untuk mengingatkan perajin saat bekerja.

Kata kunci: ergonomi; muskuloskeletal; penenun

ABSTRACT

Background: The implementation of improper ergonomic will lead to health problems like injuries and musculoskeletal disorders. This study aims to recognize the musculoskeletal symptoms and determine the ergonomic risk level at traditional craftsmen of Karo in Samura village, Kabanjahe District, Karo Regency.

Method: This research was a descriptive study with a cross-sectional design. As the sample, it was collected, 14 Karonese traditional cloth craftsmen. Data collected used the Nordic body map questionnaire dan Rapid Upper Lower Assessment (RULA).

Result: The result found that the risk of ergonomic need to apply the changing of posture. Trough the analysis of ergonomics risk at the weaving stage of Karo traditional cloth, the following data were found that the craftsmen

must investigate and apply changes in the work position, the craftsmen need to conduct further changes in work position immediately. The highest musculoskeletal complaints felt were in the buttocks, other in the left and right calves and shoulder, then in the back, waist, upper neck, lower neck, and buttocks.

Conclusion: It concluded that the weaving process still posed ergonomic risks for the craftsmen with musculoskeletal subjective complaints. Efforts to improve the present situation are the doing relaxation in short break time and help by poster or promotion education to reminding the craftsman while they work.

Keywords: ergonomic; musculoskeletal; weavers

INTRODUCTION

Indonesia has a variety of tribes, ethnic cultures, customs arts and crafts that are historically well-known. One of the many handicrafts made by Indonesian people is traditional cloth. "Uis" is the traditional clothes from the Karo people's culture. It is usually used during traditional parties or cultural activities of the Karo tribe, and daily activities of the Karo community. Uis Karo is made by weaving using Non-Machine Weaving Tools (NMWT).

Quality products could be produced and influenced by three main elements namely workers, work tools, and the environment [1]. Interaction between them will contribute to the formation of work postures naturally and even not ergonomic [2,3]. Implementation of non-ergonomic work postures will trigger the emergence of health problems such as work accidents and musculoskeletal disorders.

Musculoskeletal complaints are one of the second complaints in the world [4,5]. It is one of the common reasons that patients seek medical care [6]. In developing countries, musculoskeletal complaints are considered the main cause of occupational complications and disability [7]. In several countries, MSDs as a major occupational health problem and are dominant happened as chronic or acute symptoms. It is a serious hazard as low back pain cases cause by work characteristics, work methods, awkward posture, or stress in occupation [8].

Every year WHO reports that Musculoskeletal Disorders (MSDs) are the most common occupational diseases and account for 60-70% of all occupational diseases [4,9]. It means that MSDs was the important thing to solve in public health. All types of work are inseparable from the formation of non-ergonomic work attitudes which ultimately contribute to causing musculoskeletal disorders [2,10].

Several studies have explained that work attitudes that are not ergonomic have a significant effect on musculoskeletal complaints. The sitting position, standing either static or dynamic puts pressure on the muscles that have the potential to experience musculoskeletal complaints. The MSDs are also caused by the duration of use and human device interaction techniques, frequency of work, repetitive motion, and high work activity in a long duration. Physical activity will certainly form an unnatural work posture. Other risk factors consist of lifting activities, psychosocial factors at work, work posture, and exposure to the working environment [11–13].

Based on the preliminary study, the Uis Karo weaving business in Samura village has been established since 2015. Uis Karo craftsmen work daily for more than eight hours per day with a risk for musculoskeletal complaints. The work process of sitting for a long time and the repetitive motion of the hands when weaving will put the weaver Uis Karo at risk.

This study aims to recognize the musculoskeletal symptoms and determine the ergonomic risk level of traditional craftsmen of Karo in Samura village, Kabanjahe District, Karo Regency.

MATERIAL AND METHOD

This is descriptive research with used a cross-sectional design. The population in this study is the traditional craftsman of Uis Karo in Samura Village, Kabanjahe Subdistrict, as many as 14 people as well as the study sample (total population) [12]. It's difficult to reach the traditional craftsman caused that is just a locally craftsman in one area specially in Samura village. The specially craftsman to made Uis Karo also doing in manual equipment in informal sector. The observation method was carried out to observe the patterns and work processes of weaving Uis Karo and determine the level of ergonomic risk experienced by the weavers. The research instruments used included cameras, protractors, and Rapid Upper Limb Assessment (RULA) worksheets. The sample is observed posture and caught by the camera and follows the movements and postures during several of the work cycles. When the posture is static it accounts for a stopwatches to conduct the duration of work. When using RULA, only the right or left side is assessed at the time. After interviewing and observing the worker, it can determine in only one side should be evaluated or if an assessment is needed for both sides.

To fulfil the worksheet it observes the body by using video which this assessment very quick but easy cause it obtained the correct body position angles for access. All results of observing and interviewing will help to reach the score decision and asses like the RULA assessment procedure. The total score from the RULA assessment will be given as the result of the level of ergonomic risk. The minimum RULA score=1 and the maximum RULA score=7. The method of direct interviews with workers was conducted to obtain musculoskeletal complaints data on the traditional craftsman Uis Karo. The instrument used was the Nordic Body Map (NBM) Questionnaire to map

complaints of pain felt during the weaving of Uis Karo [20]. RULA measurement is carried out at the time of weaving, while NBM was done at the time after weaving is completed. The data obtained were analyzed descriptively according to the guidelines for the analysis of the Rapid Upper Limb Assessment (RULA). The relationship between RULA and NBM was analyzed descriptively.

RESULT AND DISCUSSION

The Uis Karo weavers in Samura Village are 14 Karo women with various age groups ranging from 21 years to 45 years. Uis Karo is made in manual work and generally, weavers experience sitting posture in a static position. The weaving of the traditional Uis Karo cloth uses an NMWT with a simple design (Figure 1). NMWT is driven by the hands and feet and it is the development of the *gedogan* loom. This tool requires the hands and finger movements dynamically according to the pattern of Uis Karo [13].

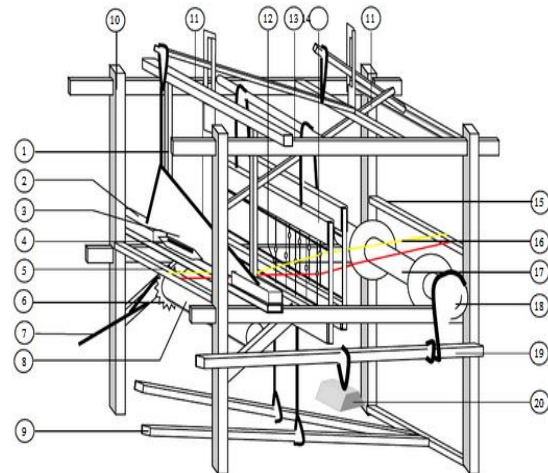


Figure 1. Non-Machine Weaving Tool (NMWT)



Figure 2. The posture of the craftsman Uis Karo

Uis Karo's handmade process consists of four stages. Starting from inserting the pack, pressing, adding motifs, and rolling the fabric. These stages need to be emphasized that the pressing process is the activity most often done by weavers. Checking is done by pulling the wood where the comb and movement of binoculars from left to right or vice versa.

The weaver's body position during the press creates a non-ergonomic posture, which is a sitting position, hands swing when pulling wood and feet that

are on the footing move up and down. It shows the static posture in sitting and repetitive movement in the weaver's hand. RULA scoring given the ergonomic risk level action for estimating the risks of work-related upper limb disorders. RULA tools use a systematic process to evaluate require of tasks on the neck, trunk, upper extremities, body posture, force, and repetition for the task (Figure 2).

Uncomfortable types of work tools and facilities and repetitive movements often cause problems and are

used for a long period. To produce Uis Karo is necessary to take a sitting position for a long time as a work posture. Long-sitting positions with long frequency on less ergonomic chairs will cause static muscle contractions so the load pattern is stronger than dynamic contractions.

The Assessment was done with the upper arm of the worker experiencing flexion resulting in an angle of 65°. The addition of the score is given because the shoulder position is raised and the forearm forms an angle of 95°. The wrist flexes with an angle of 20° and the wrist rotation is in the middle range (RULA score table A = 4). The worker's neck posture bent to form an angle of 30° and the addition of a score of 1 because the worker's neck turned a lot to the left and right side, so the final score of the neck position was 4. The position of the back was a position with an angle of 80° so given a score of 2. For the posture of the legs, both workers alternately up and down following the beat of the footing which makes the foot position becomes unbalanced (RULA score table B = 6). The use of the muscles of the forearms, forearms, and wrists of workers when carrying out wood-pulling activities also adds to the level of ergonomic risk. At this stage, there is a repetitive movement in which the wood is pulled with the amount of traction more than 10 times per minute (> 4 times per minute). The activity score increase due to this interesting stage of wood being carried out with rapid action causing major changes in the weaver's various postures. It causes of that the use of muscles related to the duration and frequency of this work to be one of the factors that increased the level of ergonomic risk for Uis Karo craftsmen. The use of muscles related to the frequency of repetitive movements adds 1 to the RULA worksheet both in the assessment of the posture of the upper arm, forearm, and wrist as well as the neck, back, and leg postures. The cumulative posture of the arms and wrists, neck, back, and legs is 7 (Score table 3). Interpretation of scores from the RULA action level, this printing process requires an investigation (investigation) and changes as soon as possible (urgent). The observed body posture presented in Table 1 shows the posture that requires immediate action as a high-risk occupation.

Table 1. RULA Measure Results on Uis Karo craftsmen

RULA Risk Level	Category	N	%
6	High risk, needs immediate improvement	6	43
7	The risk is very high are needs immediate improvement	8	57
Total		14	100

Based on the position of work with a repetitive frequency with irregular working time makes weavers often complain such as aches, pains, stiffness, numbness, or tingling. Musculoskeletal pain or

complaints that are felt dominantly experienced in the buttocks, left and right calf as much as 86%. The Pain was also felt in the left and right shoulders, back and waist of weavers felt complaints on the upper and lower neck. But complaints on the arms are rarely felt in the weaver (Table 2).

Table 2. Mapping of MSDs Based on the Part of Body Complaints

Left Part	Total (Person)	Right Part	Total (Person)
Upper neck	10	Neck down	10
Left shoulder	11	Right shoulder	11
Left upper arm	6	Right upper arm	8
Back	11	Waist	11
Buttocks	10	Ass	12
Left elbow	5	Right elbow	4
Left forearm	2	Right forearm	3
Left hand wrist	4	Right hand wrist	6
Left hand	6	Right hand	6
Left thigh	8	Right thigh	8
Left knee	8	Right knee	8
Left calf	12	Right calf	12
Left ankle	7	Right ankle	7
Left Foot	9	Right foot	9

Weaving of Uis Karo workplace is a manual job with very high ergonomic risk (RULA score 6-7) and requires immediate repair or immediate changes. Contributing factors as the cause of MSDs are the posture of the pressing process and the presence of very fast repetitive movements that cause musculoskeletal complaints on the part of the body used. Repetitive movements where the wood is pulled by the amount of traction more than 10 times in 1 minute. Repeated motion puts pressure on the muscles of the body causing musculoskeletal complaints due to the perceived overload [14,15].

At the stage of pressing, the position of the weaver's neck goes down and looks to the left and right with a bent posture. The legs take turns bobbing up and down to the beat of a fast wooden beat. The forearm and wrist flexed to form an abnormal angle when pulling wood. The physical ergonomic features of work frequently cited as risk factors for MSDs include rapid work pace and repetitive motion, forceful exertions, non-neutral body postures, and vibration. However, some posture still disputed the importance of these factors, especially relative to non-occupational causes. Work in unusual and restricted postures was associated with significantly higher rates of musculoskeletal complaints [16,17]. A stroking posture in a sitting position on a stool without a back tends to cause the weaver to experience an ergonomic posture as a cause of muscle injury. Increased muscle workload occurs significantly and affects skeletal muscle disorders. In addition to increasing the energy needed, it also causes the transfer of muscle energy into the skeletal system to be inefficient [18]. In general, work-related musculoskeletal disorders will occur due to repetitive motion and continuous working conditions so that there is an increase in load on the part of the body used

[19]. The physical ergonomic features of work frequently cited as risk factors for MSDs include rapid work pace and repetitive motion, forceful exertions, non-neutral body posture, and vibration [17]. MSDs are one of the biggest occupational diseases that effect the lower back, neck, and upper and lower extremities [20].

Based on the results, weavers complained of a feeling of aches and pains in the back after sitting and working monotone for 15 to 20 minutes. The sitting position both upright and bent over more than 30 minutes can cause back pain [21]. A bent posture shows the posture of the body from the centre of gravity of the body. Body angles that are formed from bending postures increase a person's energy so that the risk of experiencing musculoskeletal complaints is faster. In the end, workers will experience fatigue due to the burden and pressure and force received by the body [22,23].

The lack of relaxation or stretching of muscles during work experienced by the weaver shows that the pattern of work posture in static worsen despite repetitive movements. It is also monotonous where only the body part of the foot is more moving, whereas the hand tends to potentially be injured or at risk of work accidents. Besides, this pattern of sitting for long periods can also cause discomfort that triggers the onset of pain in the muscles. Prolonged sitting was the most frequent activity reported as the risk factor for low back pain [24,25].

Awkward posture always be the job hazardous in work-related musculoskeletal disorders. Increasing factors that follow the awkward posture-related with the work duration, heavy loads, and mental, work station design, frequency, and repetitive movement [5,26–30].

Repetitive movements that occur could increase the use of muscles in the arm and cause fatigue in the muscles and potentially to be carpal tunnel syndrome and tenosynovitis. Pain results from resisted gliding of the *abductor pollicis longus* tendon and the *extensor pollicis brevis* tendons in the fibro-osseous canal. These conditions involve the tendon entrapment affecting the first dorsal compartment of the wrist. Lumbago and fatigue due to repetitive work with improper posture are also felt by the weaver and decrease work productivity. These disorders, affecting the back, lower limbs, and especially upper limbs and neck, can be extremely costly if not addressed appropriately. Generally resulting from a combination of physical factors (including repetition, force, and awkward postures) as well as other workplaces environmental or organizational factors (including excessive work rates or durations, inadequate breaks, and a variety of psychosocial workplace characteristics), work-related musculoskeletal disorders can often be remediated when these factors are appropriately assessed and addressed.

Musculoskeletal pain is very common in the community while fibromyalgia is being recognized as

part of a continuum of chronic widespread pain rather than a narrowly defined entity. It is needed to understand that in a variety of diffuse pain syndromes. The availability of newer more effective therapies has resulted in efforts to initiate therapy at an earlier stage of diseases. The new criteria for rheumatoid arthritis, and the diagnosis of axial and peripheral involvement in spondyloarthritis, permit an earlier diagnosis without having to wait for radiological changes [14,15,31].

Craftsmen's left and right calves often feel aches and pains. This is caused by the pressing stage where when the hand is pulling the wood, then the foot on the automatic step is also up and down. For the body, buttocks, and waist, craftsmen feel complaints because those symptoms are influenced by the posture of sitting a long time. The left shoulder and right shoulder are affected by the work in weaving, especially in the pressing phase where the position of the hand pulls the wood. Repetitive movements can achieve more than 10 times in one minute.

The craftsmen's upper neck and lower neck experienced complaints because of their long-time bent position in the process of weaving. This is also commonly followed by complaints on the back because of the bending position when weaving for long periods. Working in a static position with an awkward posture for a long time can limit blood flow to the muscle tissue, so that the supply of oxygen and glucose also experiences resistance and will increase the amount of energy needed to do work. It causes pain due to the production of lactic acid that accumulates in muscle tissue. An awkward posture causes a condition where the transfer of energy from muscles to skeletal tissue is inefficient and it easily cause fatigue [10]. In general, musculoskeletal complaints are felt at the age of 35 years and over and increase at the age of 40 years. This is due to biological changes naturally in middle age and endurance of muscles, tendons, ligaments, and joints so that the risk of complaints in the muscles increases. The pain is often caused after excessive activity such as bending the body [32].

Injuries of the hands are often experienced from friction with warp threads in the process of adding motifs and joining. The complaints enable us to experience injury at shoulder and neck like bursitis. Bursitis is an inflammation or irritation that occurs in the connective tissue around the joints. This disease occurs due to an odd shoulder position such as lifting weights with the shoulders raised towards the head and working for a long time. Weavers also can experience back injuries such as low back pain and scoliosis. Weavers also have the potential to experience injuries to the waist, buttocks, and hand such as sciatica, ischialgia, tendinitis, carpal tunnel syndrome, epicondylitis, or tennis elbow or golfer's elbow. Weaver syndrome associated with congenital dislocation of bilateral hips, hypoplastic talus, and subtalar dislocation of the right ankle. In other research the prevalence of low back pain among traditional

weavers was quite high and strongly influenced by age and work posture [33,34].

CONCLUSION

It is to conclude that the traditional weaving of Uis Karo showed the ergonomic risk and immediate action with a high level that needs improvement. It is also related to subjective complaints of musculoskeletal disorders. The novelty in this study is a promotion program that recommended and solution to improve by changing the time of repetitive movements with no more than 4 times in 1 minute. The craftsmen also get the stretch of the muscles to reduce the MSDs complaint. Supports the program, in every workplace given by ergonomic posture poster related the ergonomic weaving to educate and reminded workers to change their style due to reduce the MSDs and fatigue.

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