

Factors Associated with Ergonomic Risk among Informal Workers in the Northeast of Thailand

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Abstract Several poorly controlled occupational hazards, such as ergonomic issues, are present in informal workers. This research aimed to investigate ergonomic risk factors among informal workers who are handwoven cotton weavers in the Northeast of Thailand (Khemarat District). Ergonomic risks were analyzed among 34 weavers. The Rapid Upper Limb Assessment (RULA) was used to measure work posture, and a questionnaire was utilized to gather data on the workers' personal characteristics and work-related information. The data were analyzed using descriptive statistics; percentage and inferential statistics using Fisher's exact test at the 95% confidence level. The findings showed that handwoven cotton weavers were exposed to a level 4 ergonomic risk (50.00%), with weaving and cotton planting accounting for 32.36% and 8.82% of that exposure, respectively. The types of tasks and working hours were found to be related to the level of ergonomic risks, with statistically significant p-values of 0.001 and 0.014, respectively. It is crucial for relevant agencies to concentrate on addressing ergonomic concerns for informal workers. Weaving groups, who collaborate to revive and carry on the forgotten craft of Ikat Khemarat weaving, should also be encouraged to promote healthy sleep and exercise habits.

Keywords Ergonomics, Weavers, Informal Workers, Rapid Upper Limb Assessment (RULA)

1. Introduction

Various informal sectors exhibit a wide range of poorly controlled occupational hazards. According to the 2013 study by Ametepeh et al. [1], informal workers in Ghana are exposed to a variety of physical, ergonomic, chemical, and psycho-social problems that can lead to illness. Most of them nearly 62.5% have not signed up for the National Health Insurance Scheme (NHIS), which could protect them from having to pay expensive medical fees in the event of major injuries. Most workplace fatalities and nonfatal accidents occur in low- and middle-income countries in South-East Asia and the Western Pacific region. The formal sector has implemented a variety of governmental and industrial occupational health interventions; however, the informal sector is still operating without defined control measures [2]. According to the study by Ahmed et al. [3], a significant portion of the informal workforce is employed in the construction sector, and the lack of Occupational Health and Safety (OHS) causes substantial human costs]. Thailand is one of the South-East Asian nations with documentation of informal workers. The National Statistical Office's survey conducted in 2022 revealed that there are 40.1 million people in Thailand who were of working age, of whom 39.6 million were employed. It also found that 18.8 million of those who were employed and worked in an informal sector. In Northeastern Thailand, informal workers

constitute 39.0% of total employment [4].

According to Janta's study, shortening work procedures and not wearing protective equipment are behaviors of informal workers over 45 in Mae Rim District that had statistically significant associations with accidents with p-values of 0.030 and 0.001, respectively [5], and Junsiri et al. [6] found that workers in junk shops in Ubon Ratchathani Province exhibited a moderate level of safety behavior (53.30%). That is, until an accident occurred, workers did not use PPE 26.70%. The study by Thanapop et al. [7] found that the health status of informal workers in Thai communities was correlated with income, work practices, occupational hazards, and access to OHS. Several ergonomic problems affect workers, especially those who spend a lot of time sitting. The study by Nasution et al. [8] found that 75% of weaving workers at the Ulos Sianipar Gallery had mild MSDs, while 25% had severe MSDs. The study by Pandit et al. [9] indicated that the most common pains reported by 50 women weavers while completing weaving tasks were found to be in the low back, shoulders, neck, and legs. Low back, shoulders, neck, knee, and legs were reported to experience the most severe pains. In Thailand, Chaiklieng et al. [10] reported that Rom Suk broom weavers (83.7%) in Thailand had the three-month prevalence of musculoskeletal and upper limb problems, the most common symptom of which was muscle fatigue (90.0%) caused by sitting in the same position for an extended period of time while at work (92.5%).

According to previous studies, handloom weavers repeatedly sat in uncomfortable positions while engaging in weaving tasks. As a result, they had severe discomfort in various body parts. The workers' neck, lower back, hip/thigh, right wrist, and left wrist all had high rates of pain and musculoskeletal disorders [11-12]. Furthermore, Dianat et al. [13] reported that the average Rapid Upper Limb Assessment (RULA) grand score for Iranian hand-sewn shoe workers was 6.2, suggesting that, in most circumstances, it is crucial to investigate the workers' postures at their workstations and implement some changes immediately. In Thailand, hand weaving is characterized as working with the hands and feet continually while seated, which raises the risk of developing muscle pain and aches. Chantaramanee et al. [14] found that back, neck, and shoulder pains were most frequently reported in traditional weaving, Kikratook weaving, and Teen Chok weaving on handlooms in Northern Thailand. In Kikratook weaving, the frequency of exertion was highest. The final Rapid Upper Limb Assessment (RULA) was revealed to be 6.80 + 0.41 points. According to Thanee et al. [15], female weavers in the province of Ubon Ratchathani experienced physical pain in the legs (54.8%), waist (49.2%), head (47.5%), knees (46.8%), and back (45%) during a period of one month.

A group of people who collaborate to revive and maintain the neglected crafting tradition of Ikat Khemarat

weaving is known as the Hand Woven Cotton Weaving Group, located in Khemmarat District, Ubon Ratchathani Province. Because handwoven cotton is a product created using the wisdom passed down from the past, workers must perform all of the processes by hand without using machines or technology. When a worker spends an extended period of time sitting in the same position while on the floor, the back muscles may stiffen up, resulting in pain in the shoulders, neck, waist, hands, wrists, and legs.

Based on the data, the researchers are interested in investigating ergonomic risk factors among informal workers who are handwoven cotton weavers in Khemarat District. No previous studies have used the RULA (Rapid Upper Limb Assessment) to assess ergonomic risks and further prevent and control ergonomic issues among handwoven cotton weavers.

2. Materials and Methods

This cross-sectional descriptive study used the RULA (Rapid Upper Limb Assessment) technique to assess ergonomic risks and investigate aspects related to ergonomic risks among informal workers who weave handwoven cotton in Khemmarat District, Ubon Ratchathani Province. It was conducted between June and December in 2022.

2.1. Population and Sample

Purposive sampling was used in this investigation. Nine tasks performed by the 34 handwoven cotton weavers, who made up the informal worker, were evaluated.

The majority of handwoven cotton weavers in Khemarat District are female (82.35%) between the ages of 45 and 64 (41.18%), married (52.94%), with the highest level of primary education (47.06%), and without any congenital diseases (85.30%). The weavers had slept less than 8 hours each night on average (70.59%), had not exercised at all (91.17%), had not consumed alcohol or alcoholic beverages (94.12%), and had not smoked (97.05%) (Table 1).

2.2. Research Tools

The questionnaire includes personal characteristics and work-related information about the workers, such as work tasks and behaviors. The content validity was confirmed by three experts, an index of item objective congruence (IOC) between 0.67 and 1.00 was achieved, and the confidence in the questionnaire was 0.81 after calculating Cronbach's Alpha Coefficient. For it to be regarded as acceptable, the alpha coefficient must be 0.70 or higher [16].

The Rapid Upper Limb Assessment (RULA) was used to measure work posture among handwoven cotton weavers [17] (Figure 1).

Table 1. Personal characteristics of the weavers in the handwoven cotton weaving unit (n=34)

Characteristics	Percentage
1. Gender	
1.1 Male	17.65
1.2 Female	82.35
2. Age (year)	
2.1 25-44	29.41
2.2 45-64	41.18
2.3 65-84	29.41
Mean = 54.35 S.D. = 16.15 Min = 25.00 Max = 84.00	
3. Marital status	
3.1 Married	52.94
3.2 Single/widowed/divorced	47.06
4. Education	
4.1 Primary School	47.06
4.2 Secondary School	17.65
4.3 High School	26.47
4.4 Bachelo's degree or more	8.82
5. Congenital diseases	
5.1 No	85.30
5.2 Yes	14.70
Diabetes	60.00
Eye disorder	20.00
Hypertension	20.00
6. Sleeping hours	
6.1 < 8	70.59
6.2 > 8	29.41
Mean = 7.88 S.D. = 1.22 Min = 5.00 Max = 10.00	
7. Exercise	
7.1 Not at all	91.17
7.2 1-2 days a week	8.82
8. Consumption of liquor or alcoholic beverages (e.g., beer, wine)	
8.1 No	94.12
8.2 Yes	5.88
9. Frequency of alcoholic beverage consumption (times per week) (n=2)	
9.1 1-2 times per week	100.00
10. Smoking	
10.1 Never	97.05
10.2 Yes	2.95
11. Smoking intensity (cigarettes per day) (n=1)	
11.1 < 5 cigarettes	100.00

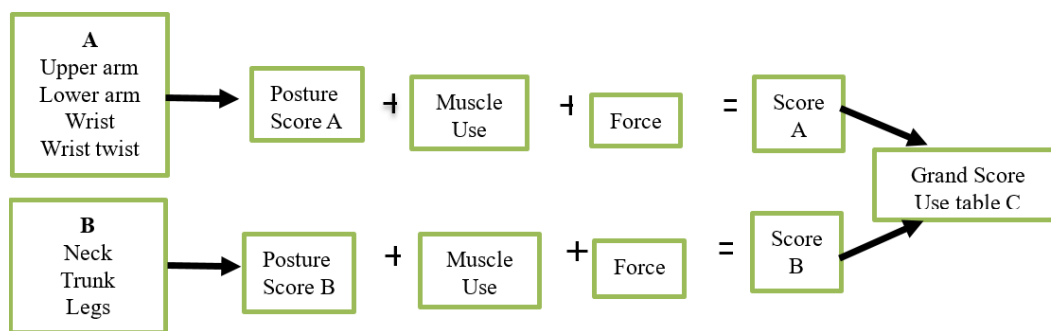


Figure 1. Rula Score

2.3. Data Collections

1. Face-to-face questionnaire was conducted to gather data on the workers' characteristics. Workers, workstations, workplace design, risk variables, and worker postures related to risk factors were examined using a questionnaire.
2. The Rapid Upper Limb Assessment (RULA) was utilized to measure work posture by taking pictures of respondents while they were at their stations. An arc ruler was used to determine the angle of the workers' posture in the photos. There are four levels based on the overall risk score (Table 2).

Table 2. Ergonomic risk rated for the calculation of the RULA

Risk levels	Score	Action levels
1	1-2	Posture is acceptable if not maintained or repeated for a long time
2	3-4	Further investigation is needed. Posture may need change
3	5-6	Further investigation and changes are needed soon
4	7	Investigation and changes are required immediately

Source: Blume et al., 2021 [18].

2.4. Data Analysis

Descriptive statistics; percentage were used to examine the data and inferential statistics for correlation using Fisher's exact test at the 95% confidence level.

2.5. Ethics

This study was approved by the Human Research Ethics Committee of Ubon Ratchathani University (code UBU-REC-143/2565).

3. Results

The results showed that 50.00% of the handwoven cotton weavers were at level 4 risk, indicating that they were exposed to ergonomic risks, while 35.29% and 14.71% of them were at level 2 and level 3 risks, respectively. Regarding the types of tasks, weaving and cotton planting were found to be at level 4 risk, constituting 32.36% and 8.82% of the risk exposure, respectively. Separating cotton husks from the seeds (14.71%) was at level 3 risk (Table 3).

The research found that the majority of the workers were engaged in the task of weaving (32.35%), had an occupation history of fewer than 25 years (55.88%), had no other jobs (91.17%), worked fewer than eight hours per day (64.71%), worked four to seven days per week (88.24%), and took breaks during the workday more than one hour per day (55.88%). The most troubling issues were that 82.36% of the weavers spent three minutes or more in a fixed position that created muscle stiffness, 76.41% focused entirely on their task for 3 minutes or longer, 79.41% worked repetitively for more than 1 hour, and 64.71% weaved sitting in a fixed position for more than 20 minutes.

When the relationship between factors and the degree of ergonomic risks was examined using Fisher's exact test, (Table 4) the task and the duration of time spent on working (hours) were found to be related to the degree of ergonomic risks with statistically significant p-values of 0.001 and 0.014, respectively (Figure 2).

Table 3. Ergonomic risk levels among handwoven cotton weavers in Khemmarat District, Ubon Ratchathani Province (n = 34)

Risk Level	Task Percentage									Total
	Cotton planting	Separating cotton husks and seeds	Ikat	Weaving	Indigo dyeing	Natural dyeing	Sewing	Seeking wood for a fire	Repairing	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	8.82	0.00	5.88	0.00	14.71	0.00	5.88	35.29
3	0.00	14.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.71
4	8.82	0.00	0.00	32.36	0.00	5.88	0.00	2.94	0.00	50.00
Total	8.82	14.71	8.82	32.36	5.88	5.88	14.71	2.94	5.88	100.00

Table 4. The relationship between factors and ergonomic risk levels among handwoven cotton weaver s (n = 34)

Characteristics	RULA risk levels Percentage				Total (Percentage)	Fisher's exact test	p-value
	1	2	3	4			
1.Tasks						47.674	0.001
1.1 Cotton planting		0.00	0.00	8.82	8.82		
1.2 Separating cotton husks and seeds		0.00	14.71	0.00	14.71		
1.3 Ikat		8.82	0.00	0.00	8.82		
1.4 Weaving		0.00	0.00	32.35	32.35		
1.5 Indigo dyeing		5.88	0.00	0.00	5.88		
1.6 Natural dyeing		0.00	0.00	5.88	5.88		
1.7 Sewing		14.71	0.00	0.00	14.71		
1.8 Seeking wood for a fire		0.00	0.00	2.94	2.94		
1.9 Repairing		5.88	0.00	0.00	5.88		
2. Work history in weaving (years)						3.932	0.162
2.1 < 25		11.76	8.82	35.29	55.88		
2.2 > 25		23.53	5.88	14.71	44.12		
3. Alternative occupations to weaving						0.562	1.000
3.1 No other occupations		32.35	14.71	44.12	91.18		
3.2 Occupy alternative occupations		2.94	0.00	5.88	8.82		
4. Working hours (hours/day)						8.182	0.014
4.1 < 8		32.35	11.76	20.59	64.71		
4.2 > 8		2.94	2.94	29.41	35.29		
5. Work frequency (days per week)						0.929	0.806
5.1 1-3		2.94	2.94	5.88	11.76		
5.2 4-7		32.35	11.76	44.12	88.23		
6. Work breaks (hours)						1.606	0.465
6.1 <1		14.71	8.82	32.35	42.88		
6.2 > 1		20.59	5.88	17.65	57.12		
7. Sitting in a fixed position for more than 20 minutes						1.646	0.544
7.1 Yes		23.53	5.88	35.29	64.71		
7.2 No		11.76	8.82	14.71	35.29		
8. Working in a fixed position that creates muscle stiffness for 3 minutes or longer						1.173	0.716
8.1 Yes		26.47	14.71	41.18	82.36		
8.2 No		8.82	0.00	8.82	17.64		

Table 4 continued

9. Focusing entirely on the task for 3 minutes or longer						1.892	0.458
9.1 Yes		32.35	11.76	35.29	76.41		
9.2 No		2.94	2.94	14.71	23.59		
10. Frequently reaching for tools or objects						1.692	0.396
10.1 Yes		14.71	8.82	14.71	38.24		
10.2 No		20.59	5.88	35.29	61.76		
11. Constantly making twisting movements						0.597	0.883
11.1 Yes		8.82	5.88	14.71	29.41		
11.2 No		26.47	8.82	35.29	70.59		
12. Working repetitively for more than 1 hour						0.491	0.854
12.1 Yes		26.47	11.76	41.18	79.41		
12.2 No		8.82	2.94	8.82	20.59		
13. Squatting while working						1.689	0.502
13.1 Yes		11.76	5.88	8.82	26.46		
13.2 No		23.53	8.82	41.18	73.54		
14. Exerting force when moving objects						0.578	0.898
14.1 Yes		14.71	5.88	26.47	47.06		
14.2 No		20.59	8.82	23.53	52.94		
15. Asymmetrical body posture						3.389	0.178
15.1 Yes		14.71	0.00	8.82	23.53		
15.2 No		20.59	14.71	41.18	76.47		

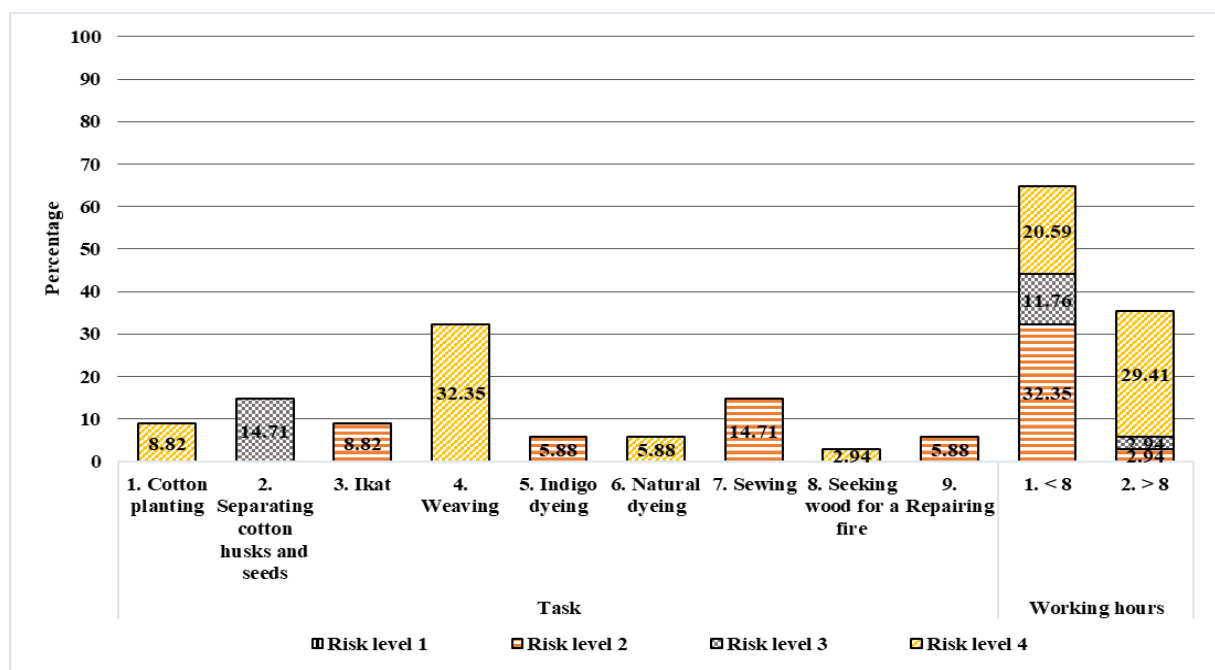


Figure 2. Ergonomic risks of statistically significant factors

4. Discussion

Half of the workers were exposed to a level 4 ergonomic risk, with weaving (32.36%) and cotton planting (8.82%) being the most significant risk factors. It implies that both tasks require the immediate investigation and change. Workers must lean forward over 60 degrees to sow cotton and indigo seeds in cotton planting. This posture can pose a risk of pain in the back, arms, and body. This is in line with the study by Kee et al. [19] and Benos et al. [20], which found that awkward postures contribute to musculoskeletal disorders, such as fatigue in employees or farmers. Therefore, it is important to conduct studies to address the issue of work-related musculoskeletal disorders. In the weaving process, the movements of the arms and the wrists are required as the feet step on the loom. As a result, the weavers experience not only arm and back pains while seated on a loom but also leg pain because of improper foot support. There will be an increased probability of skeletal and muscular anomalies. This is consistent with the research by Jamil et al. [21] and Naz et al. [11], which showed that handloom weavers have a significant prevalence of musculoskeletal disorders (MSDs) due to static labor and awkward working postures at the traditionally designed looms. This research also found that the workers who removed the cotton husks from the seeds (14.71%) were at level 3 risk. Therefore, more investigations should be conducted regarding ergonomic risks in this type of task, and appropriate changes of posture are required.

The types of tasks and working hours were discovered to be related to the level of ergonomic risks, with statistically significant p-values of 0.001 and 0.014, respectively. This is because each type performed by the handwoven cotton weavers had distinctive characteristics and required a long time to complete. As a result, it caused the weavers to worry about the deadline and led to pain in their arms, legs, neck, shoulders, elbows, hands, wrists, waist, upper and lower back, and other areas. Moreover, the majority of handwoven cotton weavers are elderly people, who are more at risk for ergonomic hazard than other age groups. According to the study's findings, there was a greater probability of having poor mental resources and poor perceived work abilities in the age group of 55 and older [22]. This is in line with the findings demonstrating that long working hours and ergonomic risk factors can have significant synergistic effects on musculoskeletal complaints [23-24]. In addition, this study discovered that the weavers slept for an average of fewer than 8 hours per night (70.59%) and did not exercise at all (91.17%), which may have increased the anomalies caused by ergonomic issues for the weavers. This is consistent with the 2019 study by Caldwell et al., which found poor sleep or sleep disruption to be the major contributor to fatigue [25]. According to the study, an ergonomic approach to improving the work environment and good posture are very helpful in reducing ergonomic issues. Informal

workers should be encouraged to participate in a health promotion program that includes exercise and education on safety. Future studies should use a qualitative study in addition to the biomechanical assessment in order to measure workloads in-depth information that might assist in the prevention of ergonomic issues.

5. Conclusions

This study revealed that handwoven cotton weavers (50.00%) were exposed to a level 4 ergonomic risk, with weaving and cotton planting making up 32.36% and 8.82% of that exposure, respectively. This risk increases the likelihood of experiencing back and arm pains and other body aches. The types of tasks and working hours (hours) were found to be related to the level of ergonomic risks, with statistically significant p-values of 0.001 and 0.014, respectively. Additionally, a lack of sleep and exercise could aggravate the weavers' ergonomic problems.

Therefore, relevant agencies should concentrate on solving ergonomic issues for informal workers, in this case, the weaving groups, which have worked together to revive and keep the art of Ikat Khemarat weaving and promote quality sleep and exercise techniques along the weavers to maintain good health.

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