Study of Ergonomic Risks of Maize Farmers in Lampang, Thailand

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Abstract

Maize farmers are agricultural workers who are at risk due to their working conditions—especially, ergonomic problems that result in long-term health complications. The purpose of this study was to assess the ergonomic risks among the maize farmers in the Mueang Pan district, Lampang province. Purposive sampling was used to select 320 participants. This research used measures such as RULA techniques and questionnaires about health hazards and working conditions. The result showed a mean score of 7, using RULA techniques. It indicated that the ergonomic problems are concerning and need improvement urgently. In regard to pain, the study found that about 44.1% of maize farmers reported pain in their lower back and 39.1% on their hands. The analysis of the correlation between personal factors and body pain showed that age and experience of participants were significantly correlated with body pain ($p<0.01$). The results suggested that maize farmers have high ergonomic risks. Stakeholders should seek solutions and cooperate to improve the working environment, encourage proper work behaviours, reduce ergonomic risk factors, and improve the living standard of maize farmers.

Keywords : Ergonomics, Risk assessment, Maize farmers, Working conditions

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1. Introduction

Maize, as livestock feed, is an important economic crop of the world that consistently increased demand. The agriculture ministry of the United States estimated the global demand for maize as animal feed in 2017 to be about 1 billion tons, an increase of 4.62% because of the growth of livestock and grain industry, and the increase of ethanol production [1]. According to the data from Agricultural Economic Officials, Thailand has produced roughly 4 million tonnes with an export value of about 5 billion Thai baht [2]. The majority of maize farming is located in the Northern part of Thailand. Lampang is one of the upper-northern provinces which has the most production. Agricultural sites are scattered around the entire province and this has gradually created jobs for locals.

Nonetheless, agricultural jobs carry ergonomic risks, both from the work environment and behaviour. Both the International Labour Organisation and the International Ergonomic Association have stated that, agriculture is the most dangerous occupational sector in both developing and developed countries [3]. The physical dangers from agricultural work include high risks of using machinery and equipment and the exposure to chemicals. These can cause work-related injuries and illnesses. Specifically, ergonomic risks, which are counted as 54.8% of the total external labour force in Thai farmers [4]. In 2016, the National Statistic Officials revealed that the most problem caused by regular external workforce is an unnatural work posture. It calculated 46.8% of all the problems [4].

According to the study by Chanprasit and Kaewthummanukul [5], they found that maize farmers usually experience work-related musculoskeletal disorders because of inappropriate work postures, repetitive movements, and long hours of working. Thus, these problems can result in the long-term health of the workers as well as on their work efficiency. Based on all of the information above, our team have interests in the ergonomic problems of maize farmers. This study aimed to assess the ergonomic risks among the maize farmers in the Mueang Pan district, Lampang province. The result showed that ergonomic risks can be classified into different levels. This result should be used as a fundamental knowledge to monitor and protect the health of Thai farmers.

2. Materials and Method

2.1 Participants

In the first phase, we surveyed 320 (N=1525) Thai maize farmers in Mueang Pan district, Lampang province, Thailand. The appropriate sample size was determined by the study of Krejcie and Morgan [6]. The farmers answered the modified Nordic Musculoskeletal Questionnaires (NMQ), the more focus version about work-related musculoskeletal disorders for maize farmers [7]. In the second phase, the research team selected 30 farmers from phase one,

using these criteria: (1) the farmers must have a minimum of 1-year experience in harvesting maize; and (2) they volunteered themselves to be part of the research project. Thirty farmers were assessed using Rapid Upper Limb Assessment (RULA). A study was conducted from April 1, 2017, to March 31, 2018. This study was approved by the Ethics Committee for Research in Human Subjects of the Boromrajonani College of Nursing Nakorn Lampang (Ref. No. E2560/007).

2.2 Research instrument

2.2.1 We conducted a questionnaire survey of participants, using a survey developed from the NMQ [7]. There are three parts: (1) collecting information on sociodemographic factors; (2) examining ergonomic conditions; and (3) inquiring about exhaustion and pain-which were classified into four levels: no pain, mild pain, moderate pain, and severe pain. The content validity was reviewed and approved by five experts in ergonomics and occupational health. The internal consistency reliability coefficient was 0.86.

2.2.2 RULA [8] was used to assess the maize harvesting procedure with appropriate ratings. The scores were categorized into four groups: acceptable posture, with the score of 1-2; further investigation and change may be needed, with the score of 3-4; further investigation, with the score of 5-6; and investigate and implement change, with the score of more than 7 (Fig. 1).

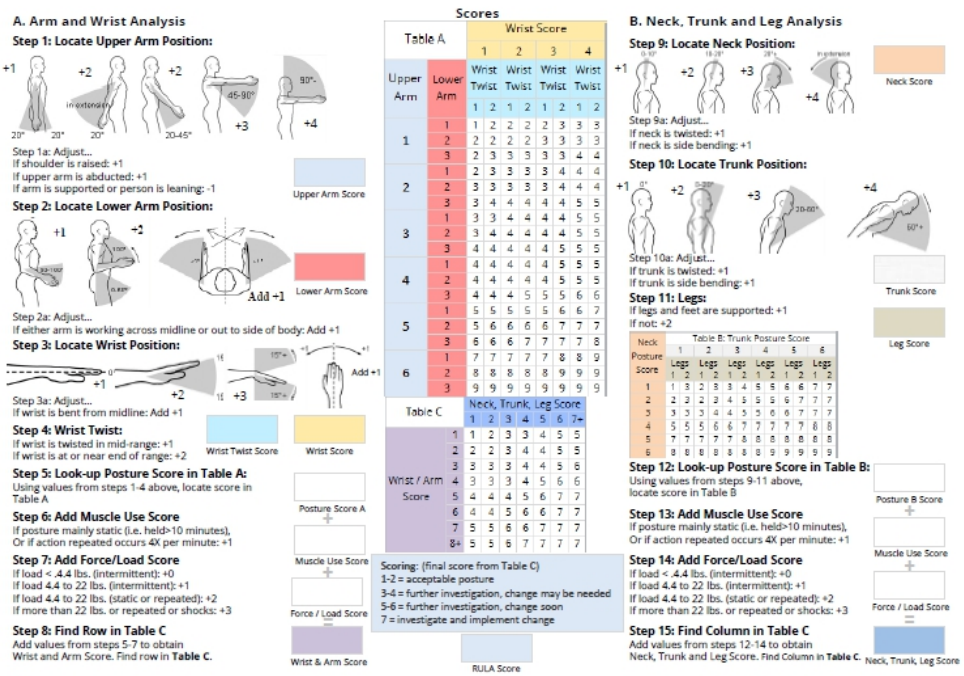

Fig 1. Rapid upper limb assessment (RULA) [8]

2.3 Data analysis

This study used Statistical Package for the Social Science Version 22 to analyze the survey. The descriptive statistics, such as frequencies, percentages, and correlation coefficients were used to describe and analyze data.

3. Results

3.1 Characteristics of the participants

In the sample group of 320 participants, there were 80.3% male and 19.7% female. The most common age group was 51-60 years old, which considered as 40% (mean age = 52.4 $\pm$9.8 years). Less than 11% of farmers were smokers. About 21% of farmers consume alcohol. The most common education level was a primary school (75.9%). Most of the sample group had experience maize farming for 6-10 years (51.6%) and 92.5% of participants had ownership of the land.

3.2 Assessment of symptoms of participants

The research showed that 44.1% of sample group suffered from severe pain in the lower back area. Followed by 39.1% in the area around both hands (Table 1).

Table 1 Subjective assessment of pain of participants (n=320)

Body	Pain			
	No(%)	Mild(%)	Moderate(%)	Severe(%)
1.Neck	104(32.5)	101(31.6)	97(30.3)	18(5.6)
2.Shoulder	55(17.2)	177(55.3)	83(25.9)	5(1.6)
3.Upper back	29(9.1)	121(3.8)	166(51.9)	4(1.3)
4.Lower back	27(8.4)	102(31.9)	50(15.6)	141(44.1)
5.Upper arm	65(20.3)	107(33.4)	139(43.4)	9(2.8)
6.Elbow	103(32.2)	105(32.8)	104(32.5)	8(2.5)
7.Lower arm	63(19.7)	153(47.8)	67(20.9)	37(11.6)
8.Hand	26(8.1)	82(25.6)	87(27.2)	125(39.1)
9.Thigh	67(20.9)	150(46.9)	86(26.9)	17(5.3)
10.Knee	25(7.8)	75(23.4)	118(36.9)	102(31.9)
11.Calf	29(9.1)	107(33.4)	156(48.8)	28(8.8)
12.Foot	16(5.0)	72(22.5)	178(55.6)	54(16.9)

Analysis of the correlations between personal factors and pain showed that age was significantly correlated with the pain of the neck, upper back, lower back, upper arm, elbow, and hand ($p<0.01$). And the experience was significantly correlated with the pain of the shoulder, lower arm, hand, calf, and foot ($p<0.01$) (Table 2).

Table 2 Correlation between personal factors (age and experience > 1 year) and fatigue of participants (n=320)

Body	Factor	
	Age	**Experience**
1.Neck	0.509*	0.028
2.Shoulder	0.081	0.153*
3.Upper back	0.224*	0.025
4.Lower back	0.208*	0.048
5.Upper arm	0.164*	0.050
6.Elbow	0.163*	0.037
7.Lower arm	0.081	0.186*
8.Hand	0.211*	0.257*
9.Thigh	0.079	0.040
10.Knee	0.123	0.070
11.Calf	0.095	0.292*
12.Foot	0.113	0.422*

* $p < 0.01$

3.3 Upper body assessment with RULA

This study involved actual field-research. A walk-through survey showed that maize planting activities begin from the preparation of soil to harvesting. These activities consisted of long hours of work and, occasionally, and unnatural postures. The fundamental assessment found that the harvesting process had the highest ergonomic risks. During harvesting process, the farmers use arms and shoulders unnaturally while standing with all of their weight on both legs. There were also constant twisting and bending of the wrists during this process (Table 3).

The research used RULA techniques to assess farmer's harvesting behaviors, using both still and moving pictures from 30-participants. The detail of stated working characteristics is displayed in Fig. 2.

The assessment of ergonomic workload during harvesting showed that the farmers lift their shoulders the entire time of harvesting. The participants lift the upper arms more than 90 degrees, and the lower arms more than 100 degrees (referenced to the vertical line). Moreover, there was the twisting and bending of wrists more than 15 degrees when collecting maize. The mentioned movements were repetitive. During the work, legs and feet were on unsupported surfaces because they involved maize fields, which naturally have rough surfaces (fig. 2).

Table 3 The criteria according to the working postures characteristics which are at risk in harvesting process

Maize harvesting procedures that involve risk	Awkward posture
	Standing work with all of the weight on both legs
	-Upper arm abducted > 90 degree -Lower-arm abducted > 100 degree -Shoulder abduction -Raised shoulder
	-Shoulder abduction -Raised shoulder -Arm exertion during working
	-Wrist flexion, bent, and twisted > 15 degree -Shoulder abduction -Raised shoulder -Repeated work
	-Heavy workload > 20 Kg

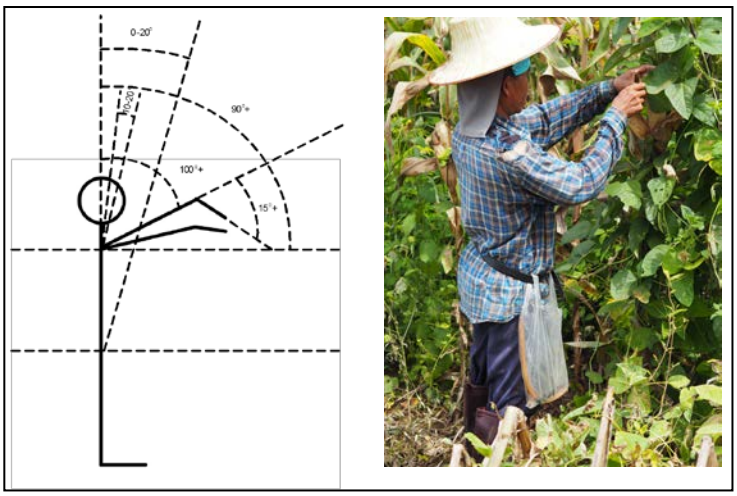

Fig 2. Maize harvesting postures

The result of RULA techniques showed to a score of 7—meaning that the maize harvesting procedure needed to be instantly analysed and improved (Fig 1).

4. Discussions

The purpose of this study was assessing the ergonomic risks among the maize farmers in the Mueang Pan district, Lampang province. The study found that most participants experienced pain in the lower back area (44.1%) and hands (39.1%). A part of this problem comes from their work posture, which consists of continuous standing and statistic work-types in the middle of the torso the entire time of harvesting. This correlates with the research about the pain in muscles and bones among para rubber farmers [9-12], who also experience lower back pain. The pain caused by lifting, leaning, twisting, and bending in inappropriate and unnatural positions. Thus, it results in tension and soreness in muscles [9-12]. In addition, our research also correlates with David & Kotowski [13]. They found that the farmers in the United States, who occasionally lifted heavy objects with inaccurate postures, experienced back pain and needed to be urgently fixed to reduce further complications. The analysis of the correlation between personal factors and pain showed that, age was significantly correlated with the pain of the neck, upper back, lower back, upper arm, elbow, and arm. This is because most of the maize farmers are elderly and had been working for many years. The farming season also lasts up to eight months a year in Thailand. Moreover, repetitive working positions result in soreness and declining health. This correlates with the research about the age of the external workforce and pain [14]. The number of a year working in a field was significantly correlated with the pain of the shoulder, lower arm, hand, calf, and foot. This result corresponds to the study of Teerachitkul, Naka and Boonphadh [15]. The score of the maize harvesting procedure from the participants was 7, using RULA. This means that the ergonomic problems need to be solved immediately [16-18]. The result is similar to the ergonomic state of para rubber farmers assessment, which also has a score of 7 [19]. This correspondence is a result of inappropriate postures and repetitive movements, such as the lifting of both upper and lower arms, the spreading of shoulders, and the tilting of wrists during work.

5. Conclusions

Maize farmers encounter severe ergonomic risks. The results should be used as fundamental information for individual farmers, occupational health management, and agricultural related department, to find methods to improve working environment by supporting safe work behaviors. This would lead to better living standards for the maize farmers in sustainable and suitable ways. Moreover, this study could raise awareness of the ergonomics risk among maize farmers. The stakeholders can use the results as a plan to improve the quality of life of the targeted

groups of the farmer. However, future research should study different training methods to effectively implement them into real practices.

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