**American Journal of Engineering and Technology Management**
2023; 8(1): 1-6
http://www.sciencepublishinggroup.com/j/ajetm
doi: 10.11648/j.ajetm.20230801.11
ISSN: 2575-1948 (Print); ISSN: 2575-1441 (Online)

# *Lampit* Seating Design Reduce Musculoskeletal Complaints in Semaja Tabanan Bali Indonesia

**I Nyoman Artayas[1], I Kadek Pranajaya[2], Putu Riana Artyanti Putri[3]**

[1]Faculty of Fine Arts and Design, Indonesian Institute of the Arts Denpasar, Denpasar, Indonesia
[2]Interior Design Department, Bali Design and Business Institute, Denpasar, Indonesia
[3]Faculty of Economic and Business, Undiknas University, Denpasar, Indonesia

## Email address:

artayasa01@yahoo.com (I Nyoman Artayas), pranajaya@std-bali.ac.id (I Kadek Pranajaya), rianaartyantiputri@gmail.com (Putu Riana Artyanti Putri)

## To cite this article:

I Nyoman Artayas, I Kadek Pranajaya, Putu Riana Artyanti Putri. *Lampit* Seating Design Reduce Musculoskeletal Complaints in Semaja Tabanan Bali Indonesia. *American Journal of Engineering and Technology Management*. Vol. 8, No. 1, 2023, pp. 1-6.
doi: 10.11648/j.ajetm.20230801.11

**Received**: September 13, 2022; **Accepted**: October 8, 2022; **Published**: March 21, 2023

**Abstract:** *Lampit* is one of the customary apparatuses for handling rice fields to even out the land for establishing rice. The activity caused different objections in the outer muscle framework, particularly in the rump and back by reason of the little size and hard stick of *the lampit*. Improvements were made to overcome this situation by designing a flat seat with foam pads and adjusting the press lever found on the attached rod. This experimental research study used the same subject design, chose 30 examination subjects from ranchers in Dusun Semaja Bengkelsari, Tabanan Bali. The musculoskeletal system's complaints were obtained by using the Nordic Body Map which was measured before and after repairing the *lampit* design. The data were contrasted and the mean qualities when improvement, analyzed using the paired t-test ($\alpha = 0.05$). The result showed a decrease in the musculoskeletal system by 51.52% ($p < 0.05$). It could be concluded that by repairing the design of the *lampit* reduced complaints of the musculoskeletal system, it is recommended to continue to use and improve the *lampit* that has been repaired for farmers.

**Keywords:** *Lampit*, Seating Design, Reduce Musculoskeletal Complaints

## 1. Introduction

Dusun Semaja is one of the villages in Bengkelsari Village, West Selemadeg District, Tabanan Regency, where most of their local people work in the agriculture sector. This present circumstance causes conventional rice field handling devices to be utilized frequently, for instance, *lampit*. It is a rice field furrow for evening out the ground, pulled by two cows, where the land evening out is the last cycle prior to establishing rice. It has several advantages, easy to move from one place to another; damage is handily to deal with; environmentally friendly, fuel-efficient, while the cows only require grass and serve as a financial reserve for farmers. Sitting on the sticks, the task is carried out with hands pressing down on the sticks to level the rice fields if necessary and maintaining balance. In order to move the *lampit* from one field to another while smoothing the ground that has just been leveled, the *lampit* user occasionally gets up from his seat. If we examine this work's completion closely, the user or farmer will experience pain in the musculoskeletal system, particularly in the buttocks and back. The complaints that surface in the region can range from pain to *bubul* (calluses) Rainbird and O'Neill revealed that complaints of the musculoskeletal system are a very important general problem in most developing countries in tropical agricultural areas [1]. The *lampit* stick might be too small and difficult to use as a seat during the procedure, which could explain the complaint. The height of 6 centimeters from the hanging stick that serves as a seat does not adequately distribute the user's weight. While sitting, the ischial tuberosities bear the most weight. When sitting on the *lampit*, the body weight is supported only by one of the

ischial tuberosities or by the middle between the two protrusions of the ischial tuberosities. According to McCormick and Sanders, the seat should be designed with the distribution of body weight, especially in the buttocks area and around the ischial tuberosities [2]. With this condition, the workload of farmers or users when operating a *lampit* is increased from the actual workload.

Pressing the *lampit* holder with the hands at a height of 43.3 cm causes an unnatural working posture and forward inclination of the body to the head and neck, which should be avoided [3]. This working position causes a change in the center of gravity outside the body, where any change from the center of gravity from a normal state will cause an additional load on the muscles to maintain balance. Regarding the height of the pressure lever on the field plow, several studies have been carried out by Mehta [4], who found complaints of the musculoskeletal system in the elbows, hands, and shoulders. Likewise, Hoozemant, et al [5]. revealed that pressing cause complaints in the musculoskeletal system caused by the height of the pressure field, work attitude, environment, and others.

As previously stated, farmers operate the *lampit* by bending over and sitting on the stick, which has a width of 6 cm and a height of 43.3 cm, and pressing the lever. This puts an additional strain on the musculoskeletal system and causes complaints. Farmers' activities after finishing working in the fields were disrupted by complaints and an increased workload, making it difficult to carry out the usual activities after working in the fields..

To reduce the inclination and complaints of the musculoskeletal system especially in the buttocks and back, several alternatives can be implemented, including replacing the *lampit* with modern equipment (tractor), or improving the seat design, adjusting the height of the press lever on the *lampit* stick (Figure 4). When the first alternative approach was held, it caused many problems, so the second alternative became an option. It was carried out for a number of reasons, including; In addition to the lack of research on complaints of the musculoskeletal system that arise during the operation of *lampit*, it is technically more efficient, economically more profitable, socioculturally peaceful, does not harm the environment, saves energy, and does not cause the possibility of new diseases. It is hoped that complaints related to the musculoskeletal system will decrease as a result of this effort. In some other rice fields, processing can be done by women or men, but *lampit* is typically carried out by men. Men were used in this study as a result of this..

## 2. Material and Method

This type of research is an experimental design with the same subject (treatment by subject). In this study, a washing-out is required to eliminate the effects of previous treatments so as not to leave an effector response (residual effect) [7]. The research design can be shown as follows:

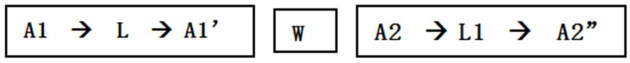


***Figure 1.*** *The Research Plan.*

A1 and A1' show that data collection carried out on *lampit* before repairs to:

The problems of the musculoskeletal system, which were carried out twice before work (A1) and after work (A1'), with the value before repair being the difference between A1 and A1'.

A2 and A2' show data collection carried out on the *lampit* after repairs to:

The problem of the musculoskeletal systems were carried out twice before work (A2) and after work (A2'), with the value after repair being the difference between A2 and A2'.

W = washing out.

L= shows the use of *lampit* before repair as the control

L= shows the use of *lampit* before repair as the control

The research was conducted in the planting season for the February-November 2018 period in Dusun Semaja, the population in this study were farmers in Dusun Semaja, Antosari Village, Tabanan Regency, totaling 54 people with an age range of 25-60 years. By using Pocock formula [6] and the results of preliminary research, the number of farmers involved as a sample is calculated as follows:

Formula:

$$n = \frac{2(\delta)^2}{(\mu 2 - \mu 1)^2} \times f(\alpha, \beta)$$

n = total of sample

$\delta$ = standar deviation (SD)

$\mu 1$ = working pulse with clamps before repair (control)

$\mu 2$ = average working pulse with repair (treatment)

f = ( $\alpha = 0{,}05, \beta = 0{,}05$ ), from preliminary research it is known:

$\delta$ = 4,9, $\mu 2$ =110, $\mu 1$ =116, f= 13

By using the above formula and based on preliminary research, the sample size is 18.14 and rounded up to 20 people. So according to the calculation of the sample size with the formula above, the minimum number of samples is 20 people. To meet the requirements of the normality test, in this study the number of samples was set at 30 people. To avoid any deviations in data collection and to avoid bias, in this case, the operational definitions of variables are described as follows:

The problems of the musculoskeletal system are the skeletal muscle system caused by work factors and the work environment when doing work, which using a Nordic Body Map modified with a Likert scale. The assessment is based on an increase in the average score of musculoskeletal disorders before and after work.

The *Lampi*t before the repairs was commonly used by the farmers of Dusun Semaja to level the fields, with a seat height and a push lever of 43.3 cm.

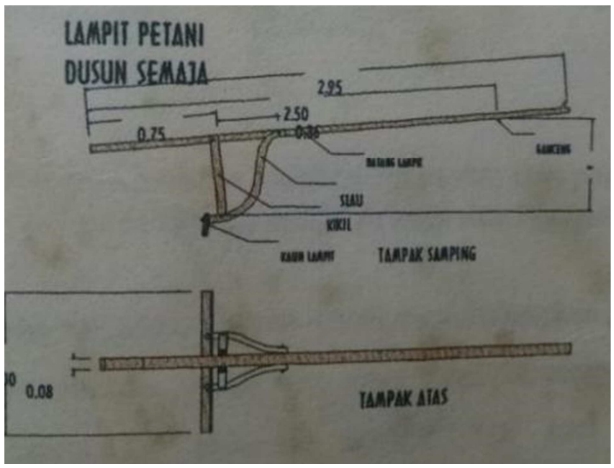


***Figure 2.*** *The lampit before the repairs.*

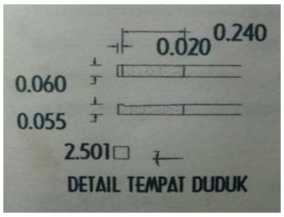


***Figure 3.*** *Detail for Lampit seat.*

The *lampit* after repair was the one with the addition of foam padding and adjustment of the height of the press lever to 61.3 cm.

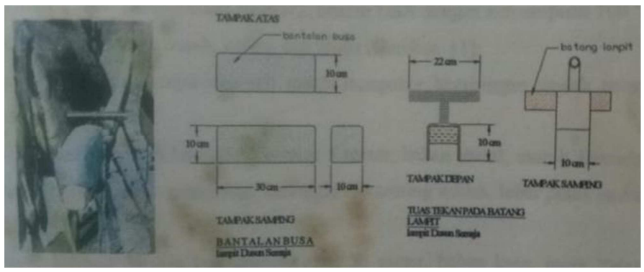


***Figure 4.*** *The height of the press lever on the lampit stick.*

Washing out was an attempt to remove the effect of using *lampit* before repair so as not to leave an effect or response. The implementation is for a minimum of three days based on the disclosures of farmers who use *lampit*.

# 3. Result

This study's participants were farmers in Dusun Semaja who were harvesting their fields during the 2018 planting season, which ran from February to July and September to November. As was the case in Dusun Semaja, men typically carried out the *Lampit* operation. There are 60 people living there, most of whom are between the ages of 24 and 58. As subjects, the male farmers met the requirements and continued to participate until 30 people had completed the study. The following table shows the age, weight, height, anthropometric data, and systolic and diastolic blood pressure of the study participants:

***Table 1.*** *The characteristic of 30 male farmers in Dusun Semaja, in the average, standard deviation (SD) and range.*

| No | Variable | Average | Standar Deviation (SD) | Range |
|---|---|---|---|---|
| 1 | Age (years) | 33,33 | 4,83 | 24-40 |
| 2 | Height (cm) | 164 | 3,72 | 155-172 |
| 3 | Weight (kg) | 56 | 1,67 | 49-70 |
| 4 | Anthropometry (cm) | | | |
| | - Popliteal height | 43 | 1,67 | 40-46 |
| | - Hand reach height | 62 | 2,20 | 59-67 |
| | - Elbow height | 100,83 | 3,39 | 90-106,40 |
| 5 | Blood pressure (mm Hg) | | | |
| | - Systolic | 114 | 5,04 | 100-130 |
| | - Diastolic | 76 | 7,07 | 80-70 |

***Table 2.*** *The average of Musculoskeletal problems before and after treatment by 30 male farmers in Dusun Semaja,*

| No | Variable | Group | | | | *t-Test paired* | p |
|---|---|---|---|---|---|---|---|
| | | Control | | Treatment | | | |
| | | Average | S. D | Average | S. D | | |
| 1 | The problems of musculoskeletal after 4 hours working | 43,4 | 6,1 | 35,43 | 4,5 | 9,18 | 0,00 |
| 2 | The average of different musculoskeletal problems | 14,37 | 6,02 | 7,03 | 4,35 | 8,84 | 0,00 |

From the table 2 can be concluded that the differences occurred significantly from the pulse of working and the problems of musculoskeletal at the control and treatment with t = 7,75 and t = 9,18 ($p<0,01$); and also different average of pulse working and musculoskeletal with t = 6,73 dan 8,84 ($p<0,01$).

Based on the table 2 above, it can be concluded some explanation as follow:

1) the average of age is 33,33 ± 4,83 with the age range of 24-40 years old. It can be categorized as the productive age conducting the work;
2) the average of height is 164 ± 3,72 cm with the height of 56 ± 1,67 kg as the ideal height and weight based on Broca index;
3) the popliteal height range is 43 ± 1,67 cm, based on the anthropometry of Indonesian people in general;
4) the length of reach and elbow height is 62 ± 2,20; 100 ± 3,39 cm, based on anthropometry Indonesian people in

general.

## 4. Discussion

The participants in this study ranged in age from 24 to 40, with an average age of 33.33 4.83 years. According to Sutjana's research, farmers in Bali are between the ages of 25 and 45 [8], indicating this age range as their active age. In a similar vein, the farmers in Manuaba and Kamiel's study were between 25 and 45 years old [9]. As a result, farmers in Dusun Semaja are approximately the same age as farmers in other areas. In Dusun Semaja Antosari Tabanan, subjects ranged in weight from 49 to 70 kilograms, with an average of 56.3 to 5.45 kilograms. With a range of 155 to 172 cm, the average height is 164.72 cm (table 1). According Manuaba and Kamiel [9], the farmers' height and weight are not significantly different. The Broca index [10], includes people of average height and weight for ideal body weight..

In order to level the rice fields as needed, the *lampit* operation consisted of sitting on the *lampit* stick with one hand held there to balance and press. With this, a forced attitude occurs caused several body muscles such as the waist, back and leg muscles to receive a long static load and result in static muscle contractions, according to Grandjean static muscle contractions have disadvantages, among others: require energy the more; pulse rate increases higher and requires a longer recovery time [11].

The forward inclination in the *lampit* operation was the farmer's effort to press the *lampit* stick, the low-pressure area (43 cm), and achieve the balance and leveling of the soil as needed. The seat on the mat has a width of 6 cm, is made of wood, so the surface is hard and cannot support weight perfectly. With a width of 6 cm, bodyweight is not evenly distributed on the seating surface and can cause pain. As stated by McCormick and Sanders, the seat should be designed to the distribution of body weight, especially in the buttocks area around the ischial tuberosities (button bone), and any distribution of body weight in the buttocks area can be distributed evenly with the contours of the surface of the good seat [12]. These things are thought to be the cause of musculoskeletal disorders, especially in the buttocks and back. Hoozemans revealed [13], one of the factors that cause musculoskeletal problems in work related to the pressure is the height of itself, a study conducted in India by Singh and Gite regarding the pressure lever for tools rice plow (*tenggala*), concluded that the most optimal was between 63.7-73.2 cm [14]. And for the fixed-type lever (can not be raised and lowered), the height is 68.5 cm. Meanwhile, Gite suggested that for a ground leveler which is operated by walking beside it (without sitting) the pressure lever is 77.0 cm high [14].

The Research which was conducted by De and Sen on farmers plowing fields in India, found that 79% of farmers experienced pain in the lumbar region and 36% in the lower back [15], as well as the research conducted by Park and Sung Kyoo Bae, stated that more than 40% of workers in automotive electronics factories experienced musculoskeletal disorders, especially in the back, wrists, and palms [16], as same as research conducted on computer operators at the Kopertis Region VIII Bali office by Susila which revealed that 57% of computer operators experience lower back pain [17]. In contrast to the research conducted in India by Ahasan, on steel factory workers in Bangladesh found that 37.5% of workers experienced back pain and 52% lower back pain in workers whose type of work was pressing, twisting, move and others [18]. Similarly, a study conducted by Sun, Yee, and San on typists found that the most common symptoms of musculoskeletal system disorder were the lower back 53%, neck 50%, hands 27%, and fingers 27.6% [19]. In this study, musculoskeletal disorders were increasing in controls reached 50.17% of complaints of musculoskeletal disorders before work. After treatment, the increase in musculoskeletal disorders reached 24.32% of the complaints of musculoskeletal disorders before work. Meanwhile, if you look at the average difference in the increase in musculoskeletal disorders from before to after work, before treatment is 14.36 points, and after treatment is 7.03 points. This shows that the addition of foam on the chair and the addition of the press lever can reduce musculoskeletal complaints very significantly with t count = 8.84 (p 0.01) or 51.04%.

This decrease happened due to the change in the working position of the farmer from bending to an upright position as the effect of the compression height (61.3cm) so that the center of gravity is not outside the body. Meanwhile, the bodyweight has also been distributed to other parts of the body, especially in the ischial tuberosities in the spine attached to the sticks that have been given foam padding. Meanwhile, research conducted by Ruliati on improving working conditions can reduce the problems of the musculoskeletal system by 23.37% [20]. Based on Djestawana, found that improving working conditions on the process of drinking in Tihingan Banjarangkan can reduce problems of the musculoskeletal system by as much as 46.98% [21]. The following pictures and photos show the working position of farmers after treatment.

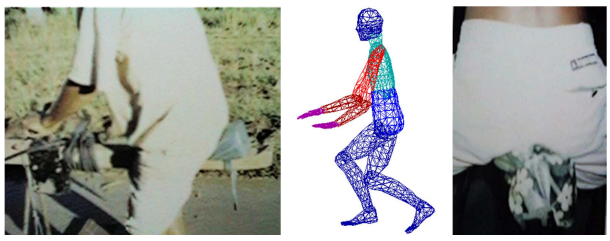

***Figure 5.*** *The farmer positions in operating lampit after treatment.*

Figure 5 shows the farmer when operating the *lampit*, where the press lever can reduce the inclination of the body and with the addition of foam on the stick of the *lampit* can distribute weight, especially in the area between the two protrusions of the ischial tuberosities, so that the workload caused can be reduced. By reducing the complaints of the musculoskeletal system in farmers, it means that afternoon activities which are usually carried out after working by operating the *lampi*t can be carried out properly.

The recorded ambient temperature was the morning ambient temperature from 700 to 1100. The recorded temperature consists of wet, dry, and globe temperatures. The radiant heat of the sun is evaluated by checking the temperature of the globe, which is measured with an ordinary thermometer which reservoir is placed in a copper ball with a diameter of 15 cm in black (not shiny) because the black color absorbs radiation, the temperature inside the ball will rise. In the control of the globe temperature value of 32.80 2.72°C and the treatment of 32.46 2.12°C, the globe temperature in the control and treatment was not significantly different (p 0.05), it can be said that the farmers in this study were exposed to high global temperatures. The temperature of this globe is not much different from the research conducted by Djestawana in Tihingan Banjarangkan Klungkung [21]. And according to Suma'mur, various measurements of the temperature of the ball showed that outside the room the temperature exceeded 30°C [22].

The mean value of dry temperature at control 31.52 1.49°C and dry temperature treatment 31.56 1.31°C, there was no significant difference (p 0.05). By looking at this dry temperature, it can be concluded that the environmental situation of the rice fields in Dusun Semaja is uncomfortable and quite hot. Slightly different from what was expressed by Manuaba, the comfort for Indonesians is the dry temperature between 22-28°C with a humidity of 70-80% [23]. Similar to the research study by Sutjana located in Subak Yeh Gde, Kediri District, Tabanan Regency a dry temperature is 28.29°C [24]. While the research by Kerana, et al., (1997) revealed results that were not much different from the dry temperature of 29.94°C, Manuaba, and Vanwonterghem, stated that the temperature in the dry season increased by 31-32°C in the dry season, in the shade and up to 36°C in direct sunlight [25].

The wet temperature in control 29.83 1.37, treatment 29.93 1.48°C, statistically there was no significant difference (p 0.05). Relative humidity before treatment was 88.9 6.46% and after treatment 89.93 6.23%, there was no significant difference between control and treatment, which means that this study was exposed to the same relative humidity, but still much higher than the relative humidity. comfortable to work with.

WBGT index in control 31.40 1.33°C and treatment 31.34 1.36°C, there was no significant difference (p 0.05), slightly different from the maximum requirements recommended by NIOSH (National Institute for Occupational Safety and Health).) for moderate work, namely 28°C and heavy work, namely 26°C or 79 and 82°F [26], but not much different from the provisions recommended by OSHA (Occupational Safety and Health Administration), for medium work 30.6°C and heavy work 32.2°C or 87°F and 90°F. Meanwhile, Fadjar who researched Denpasar obtained a WBGT index which was not much different, namely 30°C or 85.87°C [27], as well as research conducted by Paula in the Kediri Tabanan area, which was 29.03°C [28]. By paying attention to the WBGT Index and ambient temperature before and after treatment, it can be said that this study was exposed to the same environmental conditions.

The area of the rice field from the use of *lampit* was in the control of 2351 161.95m$^2$ and the treatment 2489 87.49 m$^2$, there was a significant increase in the area of the *lampit* with t = 4.56 with p 0.05, the increase was 138 m$^2$ or 5.54%. It showed that foam pads and pressure levers on the attached sticks can significantly increase the working area.

# 5. Conclusion

From this research, it can be concluded that the repair of the *lampit*, by adding the foam pads and pressure levers on the *lampit* sticks were able to reduce the mean difference score of musculoskeletal problems from 14.5 to 7.03 or by 51.52% and, there is an increase in the yield of 138 m$^2$ of rice fields or 5.54%. Suggestions that need to be conveyed in this study are to reduce musculoskeletal complaints and, it is suggested to the farmers to improve the *lampit* by adding foam pads and pressure levers on the *lampit* sticks.

# References


[1] Rainbird, G dan D. O'Neill 1998. OCCUPATIONAL DISORDERS IN GHANAIAN SUBSISTENCE FARMERS. Contemporary Ergonomics, Proceedings of the Annual Conference of the Ergonomics Society, Royal Agricultural College, Cirencester, 1-3 April 1998. M. A. Hanson, (ed): 592-597. Avaliable at: https://www.researchgate.net/publication/267256095_Occupational_disorders_in_Ghanaian_subsistence_farmers

[2] McCormick, E. J dan M. J. Sanders 1998. Human Factors in Engineering and Design, Fifth Edition. New Delhi: Tata McGraw-Hill Publishing Company.

[3] Pheasant, S. 1991. Ergonomics Work and Health. London: Macmillan Press Scientific & Medical.

[4] Mehta, C. R., Gite, L. P., Pharade, S. C., Majumder, J., & Pandey, M. M. (2008). Review of anthropometric considerations for tractor seat design. *International Journal of Industrial Ergonomics*, *38* (5-6), 546-554.

[5] Hoozeman MJM, Kigma I, Wiebe HK, Jaap H (2008) Effect of lifting height and load mass on lower back loading. Ergonomics 51: 1053–1063.

[6] Pocock, S. J. (2003). The pros and cons of noninferiority trials. *Fundamental & clinical pharmacology*, *17* (4), 483-490.

[7] Surata, I. W., Manuaba, A., Adiputra, N., & Sutjana, D. P. (2011). Changing Body Posture and Working System Improves Wokers Performance and Product Quality. *Indonesian Journal of Biomedical Sciences*, *5* (1), 18-31.

[8] Adiatmika, I. P. G., Manuaba, A., Adiputra, N., & Sutjana, D. P. (2007). Perbaikan kondisi kerja dengan pendekatan ergonomi total menurunkan keluhan muskuloskeletal dan kelelahan serta meningkatkan produktivitas dan penghasilan perajin pengecatan logam di Kediri-Tabanan. *Indonesian Journal of Biomedical Science*, *1* (3), 224849.

[9] Yusuf, M., & Santiana, M. A. (2014). Mesin Pengasah Batu Permata. *Jurnal Energi Dan Manufaktur*, *7* (1).

[10] Laurent, I., Astère, M., Paul, B., Liliane, N., Li, Y., Cheng, Q., & Xiao, X. (2020). The use of Broca index to assess cut-off points for overweight in adults: A short review. *Reviews in Endocrine and Metabolic Disorders*, *21* (4), 521-526.

[11] Grandjean, E., & Kroemer, K. H. (1997). *Fitting the task to the human: a textbook of occupational ergonomics*. CRC press.

[12] Vandyck, E., Oppong, S., Senayah, W., & Ba-ama, E. (2013). A review of ergonomically designed work seats; the situation of small-scale garment producers in Ghana. *International Journal of Educational Research and Review ISSN*, *2329*, 9843.

[13] Hoozemanst, M. J. M. 1998. Pushing and pulling in relation to musculoskeletal disorder: review of risk factors. *Journal of Research and Practice in Human Factors and Ergonomics*, 41: 758-777.

[14] Singh, S. P., & Gite, L. P. (2007). Ergonomical evaluation of a hand operated paddy winnower by women workers. *Journal of Agricultural Engineering*, *44* (4), 67-71.

[15] Huck-Soo, L., & Richardson, S. (2012). Ergonomics in industrially developing countries: A literature review. *Journal of Human Ergology*, *41* (1_2), 1-16.

[16] Park, D and Sung Kyoo Bae 1997. The application of ergonomics guidelines in automobile electronics part industry. Proceeding of the 5th SEAES Conference, Kualalumpur.

[17] Susila, I G. N. 1997. OCD and fatigue complaints of VDU operators at Bali Kopertis office. Proceedings of Asean Ergonomics 97, 5th SEAS Conference. Malaysia: IEA Press.

[18] Ahasan, M. R. (1999). Work-related problems in metal handling tasks in Bangladesh: obstacles to the development of safety and health measures. *Ergonomics*, *42* (2), 385-396.

[19] Sun, Y. T. I., T. Y. Yee dan T. Y. Yan 1993. Self reported musculoskeletal problems amongst typist and possible risk factor. *Journal of Human Ergology*, 22: 83-93.

[20] Ruliati, L. P., Adiputra, N., Sutjana, I. D. P., & Sutajaya, I. M. (2017, November). Modification of working conditions based on ergo THK reducing workload, muscle tension, and fatigue of rice milling workers in J village. In *AIP Conference Proceedings* (Vol. 1902, No. 1, p. 020042). AIP Publishing LLC.

[21] Djestawana, I Gst. Gd. 1999. Perbaikan sikap kerja pada proses manggur mengurangi beban kardiovaskuler dan keluhan pada otot perajin gamelan Bali di Desa Tihingan Kecamatan Banjarangkan Kabupaten Daerah Tingkat II Klungkung. Tesis Program Pascasarjana Universitas Udayana, Denpasar.

[22] Suma'mur, P. K. (2017). Higiene perusahaan dan kesehatan kerja (HIPERKES).

[23] Manuaba, A. 1998. Bunga Rampai Ergonomi: Vol I. Program Pascasarjana Ergonomi-Fisiologi Kerja Universitas Udayana, Denpasar.

[24] Sutjana, D. P. (2000). Use of serrated sickle to increase farmer's productivity. Journal of Human Ergology, 29 (1–2), 1–6.

[25] Manuaba, A dan V. W. Kamiel 1996. Improvemnet of quality of life: determination of exposure limits for physical strenuous tasks under tropical condition. Dept. Of Physical School of Medecine Udayana Universuty-CERGO International Brussels. Belgium- The Commission of the European Communities Brussel, Belgium.

[26] Nurmianto, E. (2005). Ergonomi, konsep dasar dan aplikasinya.

[27] Fadjar, W. S. 1999. Rota metropolitan mengurangi keluhan subjektif, gangguan muskuloskeletal dan kelelahan serta meningkatkan kepuasan kerja paramedis di RSAD Udayana. Tesis Program Pascasarjana Universitas Udayana, Denpasar.

[28] Paula, J. A. 1999. Perbaikan Sikap Kerja dengan Memakai Kursi dan Meja Kerja yang sesuai dengan Data Antropometri Pekerja dapat Meningkatkan Produktivitas kerja dan Mengurangi Gangguan Sistem Muskuloskeletal Pekerja Perusahaan M. I Kediri Tabanan. Tesis Program Pascasarjana Universitas Udayana, Denpasar.