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Working Position Improvement by Adding Supporting Tool Reduced Subjective Complains and Increase Productivity of Weavers in *Tenganan* Village Karangasem Regency

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ABSTRACT

Background Pegringsingan weaving products is a part of handicraft or home industry. They are still confessed at present and produced by simple technology with hand in hand. This activity as a business of income from the most of women in *Tenganan* village of Manggis sub district, Karangasem Regency. A work position with no planned well and they do not use a tool instruments for helping their working correctly, it is caused a subjective complaints of the workers so the production is not maximally and will cause the productivity of the workers come down. Woven products workers is required a carefulness and neatness of the workers, by long sitting position on the floor covered by something material. It is not aware of this problem into the anatomy and physiology of the workers and they will have a lot of complaint, sick, or pain on their neck, hand, low back, anus, thigh, eyes. It is caused static work load frequently, so that they will be to come a decrease activity and low motivation, it's activity and the work is not done efficient and effective.

Objective The variable that is measured in this study is decrease workload, subjective complaint, work efficiency (long work), and work productivity.

Methods The research has been studied to the sixteen weaving workers that were chosen without rules with treatment by subject program with cross over design, its analyses unit considering group variance. It has been intervened by work positions with supporting tool for instant 'peliper, tinglik, por (supported by sponge), barble, and using eyes glasses and group workers.

Results This study is analyzed by t-paired, and there is a significant work load reduction ($p < 0.005$), which is the pulse of the workers come down from 89.62 beats per minutes to be 82.56 beats per minutes (± 5.60) in the same of the light work load category. The subjective complaints of the work load come down showed significant value ($p < 0.005$) that is from Nordic body map score 56.92 (16.14) to be 28.86 (7.32). By the efficient work 7 hours a day with support tools, it is to be come the productivity increase (0.34%) and work productivity (7.9%) significantly ($p < 0.005$).

Keywords: Woven supporting tools; subjective complaint; productivity; Pegringsingan weavings

INTRODUCTION

Pegringsingan weavings is an heritage home industry which combines art and simple technology fully

produced by hand. To make *Pegringsingan* weavings is the job of some of women in *Tenganan* village, in Manggis sub-district, Karangasem regency. Based on preliminary survey, the weaving process is done by women workers by themselves, starting from making the threads, coloring, and weaving. Weaving is a manual job using muscle power, the body locomotive organs, by sitting on the floor, with simple mat, and legs straight to the front.

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An unwell-designed working condition could create subjective complaints, working loads and works can be not efficient, which could caused decreasing in work quality^{1,2,3}. Weaving job unconsciously could make a forced pose that is not according to natural pose of the worker, at the end will caused tiredness and or neck pain, shoulder, arms, waist, butt, hips and legs. So the work cannot be done effective and efficiently^{4,5}.

Based on preliminary survey, founded that average working artery pulse of the weavers is 84,62 per minutes, and subjective complaints as follows: wrist pain and pain on legs from the knee down average 46,03%, weaken in activities 68,4%, weaken in motivation 38,6%, physical tiredness (after working more than 3-4 hours) 78,2%, complains on eyes 42,5%, complains on fingers 72,4%.

Sitting position on the floor with 90 degree angle between *trunk* and *thigh*, slowly will make the *trunk* stressed out which caused flexi on the lumbar-spinal¹. With that position for a long period of time, will occurs tiredness and possibly caused the organ degradation⁶.

Through a participatory approach to the workers and operator (*Kelian Banjar Tengah Tegeh Tenganan*), there are some alternatives in order to reduce subjective complaints and the way to increase productivity, such as working position improvement by adding supporting equipment 1) Using eyeglasses, 2) Using *barbel* on fingers during rest time, 3) Using *tingklik* short stool, 4) Adding kapok cushion on *por* and 5) Using *plipir*. The position improvement alternative by adding supporting equipments was chosen because considered easy to do, also by their request, hence it could reduce subjective complaints and increase productivity.

MATERIALS AND METHOD

This research is an experimental design with *treatment by subject* in the shape of *cross over design* and the analysis unit is considering *group's variance* not individual *variance*. Research held in *Tenganan* village, in Manggis sub-district, Karangasem regency.

Women weaving workers resides in Tenganan village on the list is 65 persons. From that number sample 18 persons that meet the inclusive criteria is chosen. In this case 16 persons was chosen randomly according to *Pocock* formula⁷

Data is presented in table and textual form, then processed and analyzed using statistic analysis to test

the normality of productivity and working load, between control and treated ones using *Kolmogorov Smirnov* (KS) test, evaluation of the working duration between control and treated ones using *t*-Paired test, , evaluation of the working load between control and treated ones using *t*-Paired test.

RESULTS

Subject's characteristic data after evaluated using KS test, shown that it's normally distributed ($p > 0.05$).

Tabel 1. Tenganan Pegringsingan Weavers Characteristic

Variable	Average	Deviation Standard
1. Age (years)	34,81	± 5,10
Height (cm)	158,310	± 7,32
Weight (kg)	59,69	± 4,97
Blood Pressure :		
- Systole (mm Hg)	120	± 0,00
- Diastole (mm Hg)	70	± 7,32,00
Working Experience (years)	15,50	± 7,82

Anthropometry data characteristic of research subjects with calculation of percentil 5, 50 and 95 can be seen in Tabel 2.

Tabel 2. Percentil 5, 50 and 95 from Anthropometri Data

	Percentil		
	5 th	50 th	95 th
Waist width (cm)	32,56	34,14	37,30
Butt width/length (cm)	37,00	38,50	40,00
Leg length from knee to sole (cm)	49,62	52,81	56,00
Feet range from butt to sole (cm)	82,28	88,24	95,48
Leg length from butt to knee (cm)	46,14	50,84	54,02
Length from knee to sole (cm)	46,00	51,50	57,00

Working climate condition consists of Wet Temperature, Dry Temperature, and Relative Humidity, are still in normal range. Working climate condition during the research is shown in Tabel 3. From the Average data of working climate that consists Wet

Temperature, Dry Temperature, and Relative Humidity after evaluated using K-S test, proved that the data is in normal distribution ($p > 0.05$)

Table 3. Average Working Climate

No	Variable	Average \pm Dev.Std
1	Wet Temp ($^{\circ}$ C)	27,16 \pm 0,81
2	Dry Temp ($^{\circ}$ C)	28,58 \pm 1,21
3	Relative Humidity (%)	79,66 \pm 1,21

The weaving cloth production using existing position (control) and new one using supporting equipments *peliper*, *por* with foam cushion, using eyeglasses and massaging barbell during rest time (treated) in

this research measured in the width of product (cm^2) of woven cloth produced in 7 hours in a group. The average of production in existing position (control) is 349,68 ($\pm 111,79$) cm^2 , while the average production with supporting equipments position (treated) is 352,12 ($\pm 112,27$) cm^2 . The average product of woven cloth (control and treated) after evaluated using *paired t-test* is significantly different ($p > 0,05$)

Resting pulse per minute, Working pulse per minute, Recovery pulse per minute, and Work pulse per minute in control (weaving in existing old position) and treated (weaving with supporting equipments position *peliper*, *por* with foam cushion, using eyeglasses and massaging barbell during rest time) shown in Tabel 4.

Table 4. Rest pulse, working pulse, recovery pulse, and Work pulse

Variable	Control (ppm)	Treated (ppm)	P
	Average \pm S.D	Average \pm S.D	
Resting pulse	80.25 \pm 2.68	80.50 \pm 2.20	0.78
Working pulse	89.62 \pm 3.96	82.56 \pm 5.60	0.01
Recovery pulse	79.75 \pm 4.64	75.31 \pm 4.84	0.00
Work pulse	8.75 \pm 4.55	2.06 \pm 0.85	0.00

ppm = pulse per minute. SD = standard deviation. p = probability

Productivity incline by changing the working position, from weaving in existing old position (control) in working position using supporting equipments (treated), from above calculation founded that the average control productivity: 5,33 ($\pm 1,41$) is lower than the treated one: 21,96 ($\pm 0,13$). From both productivity value after evaluated using statistic test *t-Paired* shown significant different ($p < 0.05$).

Table 5. Average Working Productivity of Control and Treated

Variable	Average (\pm Std.Dev)	Value p
Working Productivity :		
Control (old working position)	5,33 ($\pm 1,41$)	
Treated (with support equipments)	21,96 ($\pm 0,13$)	0.001

Subjective complaints data before and after work measured using *Nordic Body Map*. Average Data and Standard Deviation shown in Tabel 6. Subjective complaints Score of control : 56,92 ($\pm 16,14$) bigger than treated one: 28,86 ($\pm 7,32$) with *t-Paired* test founded $p = 0,00$ means significantly different ($p < 0,05$).

Table 6. Average and Standard Deviation of Subjective complaints of Control (C) and Treated (T)

Variable	Average ± S.D	p
Subjective Complaints change		
Control (old working position)	50,92 ± 16,14	0,00
Treated (with support equipments)	28,86 ± 7,32	

DISCUSSION

From Subjects characteristic including body weight dan high, founded that the average body weight 53,19 (± 2,07) in the range of 48 kg - 65 kg, average 53,19 (± 2,07) kg, while height is in the range of 148 cm - 170 cm, average 153,50 (± 2,00) cm. By observing the comparison of that body weight and height, shows that weavers in *Tenganan Pegriingsingan* has a normal weight and height or ideal according to *Broca* index, while body weight is ideal when the value is smaller than the height deducted by 100 ± (the value than times 10%)¹³

Ambient Temperature in *Tenganan Pegriingsingan* during research between 08.00 - 17.00 wita is, wet temperature is around 26° C - 28,50° C average 27,16 (± 2,50)°, dry temperature is around 27° C - 30° C average 28,58 ± 3,00° C. Topographic of *Tenganan Pegriingsingan* is located in high plateau with lush trees, has a lower temperature compared to other research location. Lowest Ambient Dry temperature is 27° C considered comfortable. The lowest threshold is 21° C and the highest is 30° C. Relative Humidity is around 78 % - 81 %, average 79,66 (± 3,00)% is still in comfortable range with threshold of 70% - 80%¹².

Treatment given to the weavers, by giving working position on a supporting equipment called *peliper*, sit on *tingklik* small stool, *por* (with foam cushion) on the waist, using eyeglasses, and massaging *barbel* during resting time for 5 minutes each time. With those several treatments, the weavers has a chance to reduce their tiredness, because the weight of the body caused by sitting on the floor and the legs to the front rests on the feet in a long period of time, possibly caused cumulative tiredness, and feet organ *degenerative*¹¹.

Weaving job need accuracy since the tools is operated by each women worker with high sight accuracy. So it

needs eyeglasses to operate, beside to avoid the eyes tiredness it is also to avoid the thread dust get in into their eyes, hence the products become maximum result¹². For one unit of Control Group (C) weavers, founded that average production of cloth daily in existing old position is 349,68 (±111,79) cm². This is different with the job using new working position, where one unit Treated Group (T) produced 352,12(±112,2) cm² of cloth. This is mean working with supporting equipments is more efficient by producing 2.44 cm² of cloth daily or 0.34% compared to old position.

From the research we know the subject's resting pulse is not significantly different (p > 0,05) between old working position (control) and working position using supporting equipments (treatment). Old working position (control), average resting pulse is 80.25 (±2.68) pulse per minute, while with working position using supporting equipments (treatment) is 80.50 (±2.20) pulse per minute. It means that subject's resting pulse between both condition (control and treated) relatively the same, or we can say the starting condition (before working) is the same.

Average Work pulse before and after treatment declined by 7.06 pulse per minute (4.1%) With statistic test *t*-Paired founded p = 0.01 < 0.05. It means subject's working pulse between both condition (control and treated) significantly different, hence the end condition (after working with supporting equipments) is better than the old condition (when on existing working position). This situation shows that weaving job can be objectively seen from physiologic reaction such as working pulse increase, it is not only related to how hard the work is, but also related to accuracy and the frequency accuracy^{13,14}.

Recovery pulse on subjects with old working position (control) shows decline from average 79.75 (±4.64) to (working position using supporting equipments) average 75,31 ±(4.84) pulse per minute. It shows that the working load is considered easy, because the lower the recovery pulse, means that the working load being done considered easy or the subject's condition is good, usually when condition is good and the work is easy, so within 5 minutes the recovery pulse is back to normal¹⁵.

Working productivity on Treated (working position using supporting equipments) is 23.06 (± 14,32) and on

Control (old working position) is 6.09 (\pm 3.24) shows significant difference ($p=0.001-0.05$). This is caused by the decrease of working pulse and also by the increase of product by using supporting equipments. Hence we can say that using the supporting equipments *peliper, por* (with foam cushion, *tingklik*, eyeglasses and massaging *barbell* (during resting time) in this research can boost productivity of weavers in *Tenganan Pegringsingan* up to 60.93%. The ergonomic changes in working position, could increase economic value related to performance, indirectly reduce operational cost that have to spent¹⁶. In other words, productivity boost means efficiency boost¹⁷.

The working position with supporting equipments (treated) can reduce subjective complaints of the weaving workers in *Tenganan Pegringsingan* significantly ($p < 0.05$). Before practicing working position with supporting equipments, subjective complaints shown by the value of *nordic body map* up to 56.92%. By practicing working position with supporting equipments, the value of *nordic body map* becomes 28.86 %, that means the subjects felt their working load become easier and the feeling of disturbance can be solved^{10,12,14,19}.

CONCLUSION

The different of working and resting pulse also decreasing from 9.37 pulse per minute that shown light working load, becomes 2.29 pulse per minute which also indicating light working load.

Subjective complaints of the weavers also declined. It shown from the score before using supporting equipments was 56.92%, then becomes 28.86%.

Working duration or time needed to weave is still the same, 7 hours a day, before and after conditioning, hence the efficiency is remain the same.

With the decrease of working load, the same subjective complaints and working duration efficiency, the productivity is increasing 16.97%, because with the decline of working load then the ratio of products (*ouput*) compared to working load and working duration (*input*) becomes bigger.

Conflict of Interests: The authors declare that they have no competing interests

Ethical Clearance: Ethical clearance was obtained from the University committee and respondent's approval.

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