

## INCREASING PRODUCTIVITY OF SCULPTOR IN KAPAL VILLAGE, BADUNG, BALI

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### Abstract

*To increase the productivity, modern hand tools such as electrical grinder, electrical drill and band saw have been used by the sculptor in Kapal village. Due to ignorance, in using them not all precaution were taken into consideration. Also squatting and bending positions produced many complaints. Therefore, an ergonomics intervention has been conducted. Using multistage random sampling technique, 20 subjects were sampled from the sculptors. Blood pressure, and heart rate were measured, and subjective feelings were recorded using Nordic Body Map, before and after working for a week. The results showed that after working; 1.2% increase in systolic blood pressure; 4.7% increased HR per minute; and 20.7% subjective complaints ( $p < 0.05$ ). To overcome the problems ergonomics intervention have been conducted which consist of three types as follows: 1) Advising to have rest pause 3-5 minutes in every one hour working; 2) The workplace for electrical grinder must be separated from another workplaces, and the operator of electrical grinder machine should have a rest after 30 minutes, in case the electrical grinder could not be separated all workers there should use cotton ear plugs. 3) The physical fitness of sculptors should be improved by doing exercise program 3-5 times per week. After two weeks of awareness program, responses found as follows: 87% of workers engaged in having short rest pauses 90% of workers engaged in using ear plugs and 77% were engaged fitness program. The preliminary results showed there are a decreased in systolic blood pressure 0.46%, ( $p > 0.05$ ). HR 4.96% ( $p < 0.05$ ), subjective complaints 18.39% ( $p < 0.05$ ), and associated by an increased of productivity at about 17.55% ( $p < 0.05$ ).*

**Keyword: productivity; sculptors**

### INTRODUCTION

Kapal is a sculptor village. To increase their productivity, sculptors use modern hand tools such as electrical grinder, electrical drill and band saw. Due to ignorance, in using them, all precautions are not taken into consideration Grandjean (1988) confirmed that electrical grinder noise level ranged from (105 - 115 dB(A)) although in electrical grinder instruction manual is written (101 - 111 dB(A)). The operator of electrical grinder should have a rest after 30 minute, in case that they do not wear ear protection. Manuaba (1983) and Grandjean (1988) confirmed that exposure to noise produces: 1) Raising of the blood pressure, 2) Acceleration of heart rate, 3) Contraction of the blood vessels of the skin, 4) Increase in metabolism, 5) Slowing down of the digestive organs and 6) Increased muscular tension.

Awkward working body positions such as squatting and bending position, produce many complaints and Pheasant (1991) confirmed that these position cause musculoskeletal disorder. Therefore an ergonomics intervention is conducted to attain the healthy, safety, comfort and efficient condition.

### METHODS

#### A. Subject

Subject for this study was 20 persons of sculptors in Kapal Village, Badung Regency who were chosen by using multistage random sampling technique. Multistage random sampling is a sampling technique that is carried out in stages / stratified, in this study choosing a Kapal Village as a place for research and then randomly selecting as 20 sculptors.

#### B. Methods

This study was done on June 2 - 16, 2015. The methods used: observation of working postures, measurement of systolic blood pressure, heart rate, anthropometric of sculptors hand, diameter of hand

tools grip and environmental factors, interview and filling questionnaire for recording biodata and subjective complaints.

Original working condition causes musculoskeletal disorders, increase in working heart rate and blood pressure. As a consequence the productivity will be affected at last. To overcome the problems an ergonomics intervention conducted of 3 types as follows: 1) advising to have rest pause 3 - 5 minutes in every one hour working; 2) the workplace for electrical grinder must be separated from another workplace, and the operator of electrical grinder machine could not be separated all workers there should use a cotton ear plugs; 3) the physical fitness of sculptors should be improved by doing exercise program 3 - 5 times per week.

The data collected was analyzed: 1) Descriptively for work postures, hand tools used and work environment condition, 2) Statistically using t test ( $= 0.05$ ) for the changes of heart rate, systolic blood pressure, subjective complaints, before and after working about one week (pre-test) and after intervening about two weeks (post-test).

## RESULT AND DISCUSSION

From 20 sculptors, in fact their age ( $24.57 \pm 6.08$  years), 36.7% are already married, education (13.3% finished elementary school, 40% secondary school and 46.7% high school), work experience (30% > 10 years and 70% < 10 years) and sport (36.7%, 3 - 7 times per week, 63.3% < three times per week).

Electrical grinder, electrical drill and band saw are modern hand tools and chisel, pad saw. "mutik" and "pangot" (small knife for refining) are traditional hand tools which are used in carving process. Traditional hand tools have a diameter hand grips around 1.92 - 3.82 cm and modern hand tools have a diameter hand grips around 3.18 - 3.82 cm. These diameter could be categorized as ergonomics, due to Nala (1996) confirmed that the hand grips must have a diameter around 0.5 - 1.5 cm (precise), around 2.5 - 3.5 cm (power force) and a diameter maximum hand grips of approximately 7.5 cm. The hand anthropometric data are pertinent to the design of hand protective gear and are also use full in defining lateral hand clearance (Woodson, et al. 1992). The anthropometric data of wood sculptor's hands is presented in the following table (table 1).

**Table 1. Anthropometric Data**

No	Variables (N=20)	Mean (cm)	SD
1	Hand length	18.30	0.61
2	Hand breadth and thumb	10.07	0.63
3	Hand breadth at metacarpal	8.42	0.63
4	Hand thickness at metacarpal	2.43	0.34

The hand grips of hand tools used are suitable to the anthropometric data above. During observation bending and squatting body postures were identified (in carving process and operating modern hand tools). Some the working postures can be seen in the following figures.



Figure 1 Smooth the sculpture with the tool palette.



Figure 2 Smooth the parts of the sculpture with the grinding machine



Figure 3 Smooth the dealing parts of the statue as needed

These working postures were also associated with complaints of musculoskeletal system. It is similar to Pheasant's (1991) opinion. After recording as long as one week, before and after working, in fact the number of complaints increased significantly ( $p < 0,05$ ) at about 20.7%.

Sculptors in Kapal village start working at their workplace early in the morning from 07.30 until 12.00 then continue from 13.00 until 16.00 pm. Break for lunch at 12.00 - 13.00 pm and coffee or tea break usually twice a day (before working and after lunch time).

Environment factors which disturb sculptors are noise and anorganic dust whereas influence of dry temperatures (23 - 30° C), wet temperatures (21 - 28° C), humidity (83-85%) and lighting intensity (100 – 600 lux) are not felt by them. Where ever Manuaba (1983) confirmed that comfortable for Indonesian people, dry temperature (22 - 28° C) and humidity (70 – 80%). Whereas lighting intensity minimal 200 lux so that the workers are glad to work in there (Manuaba, 1992). In case, the lighting intensity in the corner only 100 lux in the morning is overcome by flaming of the lamp until the natural light will be enough. Noise factor strongly disturb the sculptors due to noise intensity 101 – 111 b(B) A (on the electrical grinder instruction manual) and Grandjean (1988) confirmed the electrical grinder noise intensity (105 – 110 d (B)A). Beside that Manuaba (1983) confirmed that exposure to noise produces: 1) Raising of the blood pressure, 2) Acceleration of heart rate, 3) Contractions of the blood vessels of the skin, 4) Increase in metabolism, 5) Slowing down of the digestive organs and 6) Increased muscular tension. In fact, before and after working about one week indeed to increase heart rate significantly ( $p < 0.05$ ) at about (4.7%), also the systolic blood pressure increased significantly ( $p < 0.05$ ) at about (1.2%).

After one and two weeks of awareness program, it was found responses as follows (table 2).

**Table 2. The Percentages of Worker as Follow Awareness Program**

No	After One Week	After Two Week
1	87%	87%
2	90%	90%
3	77%	77%

After one week awareness program, the preliminary results showed that a decrease in systolic blood pressure (0.39%), heart rate (1.87%) subjective complaints (5.25%) and associated by an increase of productivity at about 8.67%. These changes, statistically are not significant ( $p > 0.05$ ), may be the workers were adaptable in these intervening. Whereas after two weeks of awareness program, the preliminary results showed that systolic blood pressure decrease are not significantly ( $p > 0.05$ ) at about 0.46%, subjective complaints decreased significantly ( $p < 0.05$ ) at about 4.96% and associated by increased significantly of productivity ( $p < 0.05$ ) at about 17.55%.

## **CONCLUSION**

As far as the data is concerned, the following conclusions could be drawn:

1. The working body postures and working hours when the sculptors are carving or operating modern hand tools, still need to be improved from an ergonomic point of view.
2. After ergonomics intervention, in fact shows there are a decrease in systolic blood pressure, work heart rate and subjective complaints, and associated by an increase of productivity.

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