

THE ERGONOMIC INTERVENTION ON PREPARING THE OFFERINGS FOR PRANAWA CREMATION CEREMONY IMPROVES THE WORKER'S EFFICIENCY AT DENPASAR CITY.

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Abstract.

Pitra yadnya is the the ceremonies as a holy sacrifice performed by Hindu followers as a manifestation of devotion to parents who have died. So everyone who believe on Hinduism, especially, in Bali will perform cremation ceremonies which called *ngaben*. In this ceremony required some form of offerings and it is quite a lot. During process of making the offerings involved many people. In the process of making cremation offerings involving physical and mental activity, in an integrated manner can cause fatigue. that fatigue usually occurs at the end of working hours caused by various factors, such as monotony, static muscle work, tools and working facilities that do not fit the worker's anthropometry, work station that is not ergonomically sound, forced attitude and work-break timing is not right , and muscle complaints; therefore, it is needed ergonomic intervention. There are four issues: 1) Is ergonomic intervention while preparing the offerings for *ngaben pranawa* improves the efficiency of the worker seen from the decrease of fatigue? 2) Is ergonomic intervention while preparing the offerings for *ngaben pranawa* improves the efficiency of worker seen from the decrease in musculoskeletal complaints? 3) Is ergonomic intervention while preparing the offerings for *ngaben pranawa* improves efficiency of worker seen from the decrease in the workload? 4) Is ergonomic intervention while preparing the offerings for *ngaben pranawa* improves efficiency of worker seen from productivity? A study with the same subject design was carried out on 18 person adult female Balinese. In the first period of study the subject preparing the offerings with the existing working condition, while in the second period an ergonomic intervention was introduced, using tables and working chairs, and guidance book in preparing the same offerings. Based on the results of research and discussion, the following conclusions can be drawn. 1) Ergonomics intervention in the process of making offerings for *ngaben pranawa* improved work efficiency seen from the decreased in fatigue, that is equal to 36.24% ($p < 0.005$). 2) Decrease musculoskeletal complaints, amounting to 37.98% ($p < 0.005$). 3) Decreased the workload. that is equal to 13.22% ($p < 0.005$), and 4) Increased work efficiency viewed from the offering makers productivity, namely by 78% ($p < 0.005$). Ergonomic interventions proven to reduce fatigue, musculoskeletal complaints decreased workload, and can increased work productivity. Therefore, it is advisable to apply the ergonomic intervention at the cremation offerings and another religious ceremonies. Benefit of ergonomics intervention in this study was the participation and collaboration, a commitment from all parties, and the interaction between the participant of making offerings, and ergonomics intervention can improve efficiency in the process of making offerings for cremate ceremony in Denpasar city.

Keywords. Fatigue, workload, musculoskeletal disorder, productivity

INTRODUCTION

Ngaben is the one of the *pitra yadnya* ceremony in Bali. It is according to the Hindu believe. It is a ceremony that must be done by a Balinese representing their respect to their ancestors. *Ngaben* is means a process by which

the soul and the dead body is re-processed into it's sources. *Ngaben pranawa* is the one and the most popular of the cremation ceremonies in Denpasar City (Kasmini, 2008.). It is due to the fact that practical reason as well as economical reason. Based on the existing traditions while

anyone is willing to conduct a cremation ceremony, it can be understood that the intended family having a lot of money to be expended. It also take time, one month before the intended day, the family had been involved in several activities and need some helps from other as a community member. Therefore the family who is going to conduct the ceremony is quite busy. Their relations, neighbours, and members of society will also busy to help them. Another problem encounter is that there is no a detail planning for that, in terms of how many budget, how many raw materials or natural material must be prepared. Also in making the necessary offerings, or temporary instruments there is no fixed number or without well-planning. In the such condition, with many people coming to make any preparation, every body busy, but, unfortunately without knowing what should be done and what are the appropriate target. The planning who doing what, how many things should be done, is another examples as evident for no detail plan. Therefore, it is very common, that there will be more offerings still left after conducting ceremony. It means that more resources is needed. While working they used to be work at their ease. In the spirit of *gotong-royong* (mutual benefits) there is no appropriate numbers of personals are really needed, every body busy doing or performing any kind of offering elements without knowing how many thing should be made. Whenever there is a command to stop working, every body just stop to work. Then the work can be continued on the next day or next time. In so doing, they are used to work from the morning until night time. From the ergonomics view point, it is very easy to find out, the overdue working hours, until mid-night. Unergonomic working body position, such as sit on the floor while doing a certain task for a longer time, and without tight management and control applied. As a result that at the end it is very easy find out every one is complaining low back paint, muscle or general fatigue, headache

due to lost of sleep. As it is stated in the goals of ergonomics, in whatever activity we are doing, the work can be done successfully without any burden or side effect in terms of symptoms and signs of the bodily system (Brown, 2000; Warren and Sander,2004; McKeown, 2008). In achieving the stated goals, the work must be managed ergonomically. It can be done by applying a better planning of the work, managing time and existing resources needed, and every one who is involved should be given a responsibility and job description (Wilhelmson and Doos, 2002; Manuaba, 2009; 2010). Frequently, evaluation and control is needed, therefore, monitoring and control is a must. In Denpasar City, the most popular cremation ceremony conducted is *ngaben pranawa* (Kasmini, 2008), due to simple one, and it is also economically sound. To achieve that, an ergonomic intervention study was conducted in making the offerings for *ngaben pranawa* (*pranawa* cremation ceremony). The research questions are: 1) is the ergonomic intervention would reducing the workload of making offerings for pranawa cremation ceremony? 2) is the ergonomic intervention would reducing the work fatigue after making offerings for pranawa cremation ceremony? 3) is the ergonomic intervention would reducing the musculoskeletal disorders after making offerings for pranawa cremation ceremony? 4) is the ergonomic intervention would improving worker's productivity in making offerings for pranawa cremation ceremony?

MATERIAL AND METHOD

Subjects in this study were 18 persons of adult female Balinese. They joined the study voluntarily, based on the inclusive criteria, such as a willingness to participate along the study, there is a skill to make the offering elements, they are in the healthy condition. The design of research applied was the same subject design ().

The study was carried out in an air-conditioned room, which was set at 22 oC.

Protocol of study are as follows: in the first period, all subjects performed the similar task as in the second period, made offering elements for *pranawa* cremation ceremony. In the first period the subject were working at their ease. Subjects seat at the floor at their ease, and also without any discussion before working. The task goal just mentioned to make offering elements for *ngaben pranawa* ceremony, completely. After the first period finished, then followed by one day off as a washing out. While doing washing out, improvement of working tools were conducted, such working tables, and chairs, which is ergonomically sound, based on their anthropometric data. To all subjects involved, there was a focus group discussion carried out to discuss what is going to do, the goals of task, and also discussing about what kind of offerings is to make and how many for each item is needed for the complete *pranawa* cremation ceremony. Modern management in terms of job division, monitoring and control was applied. A guidance book was resulted from the FGD and provided for all subjects. Subject while working in the second period were seat on the chair and the objects performed located on the working table. Before starting to work all of subjects are engage in focus group discussion, discussing about the target of work per time unit per person, what offering's element should be made, how many unit of item should be made. By doing so, every body aware about what to do, how many thing should be made, and in the last step was to check for the quality control of products. The parameters being measured were the workload (by measuring the mean of the working heart rate), muscle complaints (by applying the self rating questionnaire), fatigue (by measuring 30 items of fatigue questionnaires), and productivity (based on individually products using the productivity

formula), how many days is needed for preparing the complete offerings, at the first and second period. The data gathered then was analysed for it's normality, and it's inferential value, using t-student test.

RESULTS

Subjects of study were 18 persons of adult female Balinese. Their physical characteristics in terms of body height, stature and body mass index is presented in Table 1.

Table 1. The physical characteristics of subject involved in the study

Variables	n	mean ± standard deviation
1. Age (yrs)	18	20.9 ± 0.93
2. Body weight (kg)	18	51.5 ± 8.35
3. Height (cm)	18	159.5 ± 6.17
4. Body mass index	18	19.9 ± 1.95

Table 1 showing the physical characteristics of subjects. There is no one of subject belong to overweight or obese. All of them are categorized into an ideal body weight, considering their body weight, height and mean of body mass index.

Table 2. The anthropometrics data of subjects (measured in standing position) in Cm.

Variables	n	mean ± S.D	5- percenti	90-percentil
1.Uper reach	18	156.30 ± 4.56	151.76	165.54
2.Sitting height	18	125.12 ± 1.49	122.0	126.88
3.Eye height	18	113.91 ± 1.25	113.80	115.57
4.Shoulder height	18	53.33 ± 1.43	35.00`	44.67
5.Hip height	18	18.39 ± 2.95	11.20	21.26
6.Elbow height	18	19.52 ± 2.57	14.30	43.40
7.Knee height	18	51.44 ± 1.57	47.00	52.18
8.Popliteal height	18	41.37 ± 1.47	40.00	43.81
9.Thigh width	18	10.87 ± 1.39	8.80	12.68
10.Shoulder width	18	39.46 ± 3.04	35.00	44.67
11.Hip width	18	35.82 ± 1.80	31.50	37.81
12.Elbow- elbow breadth	18	43.65 ± 2.73	39.00	47.39
13.Buttock- popliteal length	18	56.76 ± 1.71	42.40	47.84
14.Buttock- knee length	18	54.76 ± 2.14	51.30	58.45
15.elbow- tip of finger	18	43.54 ± 2.21	40.00	46.81

The anthropometric data is intended to design the working table and chair for the subjects. By doing so, the physiological body posture could be guaranteed, so will be no more un-natural working body posture as shown in the first period of study. The such body postures were corrected in the second period of study by providing an ergonomics table and chairs.

Table 3. The parameters measured during the first period and second period of study and it's statistical analysis

Variables	n	First period	Second period	t	p
Resting heart rate (bpm)	18	74.44 ± 0.61	74.56 ± 0.78	0.62	0.54
Working heart rate (bpm)	18	110.89 ± 0.78	96.22 ± 1.	54.69	0.000*
Ambient heart rate (bpm)	18	36.44 ± 1.46	21.72 ± 1.	35.17	0.000*
2 mnt Recovery					
heart rate (bpm)	18`	82.06 ± 1.34	78.29 ± 0.	17.23	0.000*
5 mnt recovery					
heart rate (bpm)	18	74.56 ± 0.51	74.39 ± 0.5	1.14	0.26
MSD before work	18	29.22 ± 0.94	29.11 ± 0.75	0.32	0.74
MSD after work	18	53.11 ± 0.60	30.94 ± 1.0	36.62	0.000*
Fatigue (30 items) before	18	30.89 ± 0.90	31.11 ± 0.	75 -1.00	0.33
Fatigue (30 items) after	18	61.00 ± 0.68	38.89 ± 2.49	33.94	0.000*
Products	18	21.33 ± 10.38	22.00 ± 2.21	15.62	0.001*
Productivity	18	35.00 ± 5.47	72.50 ± 5.00	15.00	0.001*
Materials used	18	376.91 ± 93.88	202.96 ± 59.94	3.47	0.001*

Note: * statistically significant (p< 0.05)

From the Table 3 it is found that the mean of resting hear rate is almost similar in the first and the second periods of study, as the statistical analysis showing the p>0.05. The working hear rate while preparing the offerings for ngaben pranawa cremation ceremony, the means are significantly difference between the first and the second periods (p< 0.05). For the recovery heart rate it is found that in the second minute of recovery still giving significant difference (p< 0.05) and at the 5 minutes recovery the mean of recovery heart rate had been achieved the similar mean (p>0.05). It means that the subject had been recovered to the similar level to the resting level. Musculoskeletal disorder (MSD) before starting to work almost showing a similar means (p>0.05), but after working, there is a significant difference (p<0.05). The same thing for the mean of fatigue; before working there is no significant difference (p>0.05) but after working

the mean of fatigue is significant difference ($p < 0.05$). The product resulted during the study for both groups, the productivity and the materials used showing significant difference between the first and second periods of study ($p < 0.05$).

Table 4. The environmental aspects of study conducted

Variables	First period	Second period	t	p
Room temperature (oC)	25.50 ± 1.04	25.50 ± 1.04	0.79	0.46
Relative humidity (%)	72.33 ± 0.51	72.50 ± 0.54	0.54	0.61
Wind speed (m/mnt)	0.19 ± 0.00	0.18 ± 0.00	1.00	0.36
Light intensity (lux)	210.50 ± 0.83	210.33 ± 1.03	0.34	0.74

Looking at the data of environmental, there is no any significance different between the first and the second periods of the study as analysis of statistic is depicted in Table 4.

DISCUSSION

The cremation ceremony is so importance for those who believe on Hinduism to release the soul and the physical dead body to the intended sources. The ceremony is becoming the responsibility of the decessor or young generation to representing the respect to the anchestor. But, it does not meant that in doing the intended ceremony we should do all out in expending the resources. Traditionally, people in Bali still do believe that for conducting cremation ceremony for the anchestor we should prepare a lots of money. It could be done by selling the land in terms of rice field or dry land, just for ceremony. That is really an old fashion culture. It is timely, to conduct a certain ceremony, whatever the ceremony is, should be based on a well-planning according to economic capacity. The goal of conducting ceremony is to achieve a better quality of life and prosperity (Adiputra, 2010). That is also a goal of applying ergonomics (Brown, 2000; Mc Keown, 2008). From that side it is wise if ergonomics is

adopted while conducting ceremony. The future- and time- management is another example, by which ergonomics supports in conducting ceremony to be efficiently and effectively carried out, for attaining the sustainability (Manuaba, 2009; 2010).

In the first period of this study, was conducted preparation for a pranawa cremation ceremony as the worker' ease. In making the offerings is needed 6 days at least to prepare complete offerings and needed 53 items of raw materials. It was needed 938.84 coconut leaves and the total workers were 18 persons adult female Balinese. Of course, there was one manager who is called tukang banten. But, based on the tradition, every body just come and eager to work, without knowing how many items and how many per item are made. As a result it is very common to happen, at the time of ceremony, there are still some thing left behind or providing the intended item more then needed. Those are examples by which more resources were unefficiently used. It is due to the fact that there is very limited communication or not at all among the host, workers, and the skillful person on offerings (tukang banten) to discuss on what should be done. It is inherent with the study of Sukarsa ().

In the second period of study, a modern management was applied. Before starting to work it was preceeded by a focus group discussion, to discuss what is going to do and with a job description among the group. Every member of the group know who is doing what, and also know how many items of offerings exactly made. Also the knife for making the ornament was prepared and accompanied by an improvement of working condition by introducing the table and working chair ergonomically. After the first period it was followed by some days of washout period then followed by second period making the offerings for *pranawa* cremation ceremony in which

ergonomics intervention applied. The room was maintained as in the first period an air conditioned room and set in the same values as in the first period of study. By applying ergonomics interventions found that in making the offerings for *pranawa* cremation ceremony it was needed only 4 days to prepare the completely offerings. The quality of products were similar, but, the difference was the rejected items and the raw materials used, reduced significantly. In the first period there were more raw materials used around 938.84 pieces of coconut leaves. In the second period is needed only 599.45 pieces of coconut leaves. Statistically there was very significance different. It is inherent with what have been introduced by Manuaba (2009; 2010) that by applying the total ergonomic approach we shall have humane, sustainable work systems dan products. It is also stated by Wilhelmson and Doos (2002) that sustainability is related to processes concerning four different aspects of the ongoing business: in products, in organisation structure, in principle how work is organised, and for individuals. It could also trying to bridge the gap (Frick, 2002).

Beside that, the consequence benefit effects were the means of musculoskeletal disorder reduced from 53.11 ± 2.39 to 30.94 ± 1.05 . It means reducing at about 37.98 %. The means of fatigue also decreased significantly from 61.00 ± 0.68 to 38.89 ± 2.49 ; it is about reducing at 36.24 %. The workload decreased from 110.89 ± 0.75 bpm to 96.22 ± 1.46 bpm with significant value; it was amounting of 13.22 %. The productivity increased from the mean of 32.00 ± 5.77 to 57.00 ± 5.00 ; it is about 78 % of change. The said results are similar to the study of Bradley (2001), Kogi (2006), Vink et al.(2006), and Sudiajeng et al. (2010) that by implementing ergonomic principle reduced the workload, the fatigue, the MSDs and increased productivity. This study also able to show an evidence that in

making the similar amount of offerings with similar quality saved two days (equal to 18 person x 2 days= 36 person days; it is about 33.33 %) and saved more raw materials as well for about 173.92 pieces of coconut leaves (46.14 %). The rejected items also decreased. This is also inherent with what had been proposed by Robert and Brangier (2010) that ergonomics concerns with three categories: correction, design and prosppection. Corrective ergonomics is relates to the fast and to the demand of a client. It is turned towards the correction of existing artefcats in order to reduce or eliminate problems and improve human performance and satisfaction (De Looze and Pikaar, 2006).

The conclusions that can be drawn are as the followings: the ergonomic intervention on making the offerings for *pranawa* cremation ceremony, improved the worker performances, seen from:

- a) decreased the work load;
- b) decreased of fatigue;
- c) decreased of the musculoskeletal disorders; and
- d) increased the productivity.

Therefore, based on the aboved evidences it is recommended: 1) to apply the ergonomic intervention on making the offerings for *pranawa* cremation ceremony in Bali; 2) it is much better if in doing the ergonomic intervention the socio-cultural and socio-religious matter is being adopted.

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