

Assessment of Workload of Weeding Activity in Crop Production Through Heart Rate

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INTRODUCTION

About seventy per cent of the Indian women are engaged in agricultural work either in their own fields or as hired labourers. If eight hours of work is considered as one man day, the Indian rural women work more than two man days everyday both in home and farm together. Still women are considered as secondary workers in the economic scenario.

The farmwomen perform almost each and every agricultural activity right from land preparation and sowing to the harvesting and storage of the agricultural produce. The research on identification of maximum drudgery involved farm activities has revealed that weeding is one of the maximum drudgery involved activity performed for highest number of days in a year (AICRP-FRM, RHSC, UAS, Dharwad. Biannual Report, 1999-01). These women do the back breaking agricultural activities without any protections from sun, soil or shower with the traditional tools.

To increase the productivity of the women's work, there is a greater need for the ergonomic analysis of the activities performed by women and to study the circulatory stress and the physiological cost of each agricultural activity. Then suggest possible solutions or techniques to increase the productivity and bring the women in the main stream of work force. Hence an effort in this research is made to ergonomically analyse the work load of the maximum drudgery involved farm activity i.e. weeding through the heart rate method. Heart rate is one of the most accurate means of studying the energy expenditure while performing any activity. Generally heart rate is used as an ergonomic measure to evaluate the physiological or functional demands of work on the individual worker (Burger, 1969). Rao (1987) evaluated workload in home and farm activities based on the pulse rate. Similarly Varghese et al. (1989) studied household activities and proposed job classification table based on heart rate and energy expenditure. Tewari (1994) assessed the workload on fisher women and found it to vary between moderately heavy and heavy.

From the physiological point of view, the job demand or workload refers to the demands placed on the cardio-respiratory system and is determined by the energy cost and cardiac cost of work. (Chauhan, 1999).

METHODOLOGY

Thirty healthy rural women performing the weeding activity regularly, not pregnant and not having any major illness were selected for the study. Using the anthropometric rod and weighing balance respectively measured the physical characteristics like height and weight. The heart rate responses for every minute were recorded by using the heart rate monitor.

Every respondent was tied the heart rate monitor and switched on to record the heart rate at every minute. Five minutes rest was given to record the resting heart rate. Then they were asked to do the weeding activity for 20 minutes and then again five minutes rest was given. After a total time of 30 minutes the heart rate monitor was switched off and removed. The data from the monitor was electronically transferred to the computer through the interface. Two replications of each respondent's weeding activity data were taken for the study.

Based on the heart rate records the following parameters were calculated.

1. Average heart rate during rest, work and recovery period.
2. The energy expenditure per minute was estimated from heart rate using the following formula and the classification of work load was done as per Varghese et al (1994).
$$\text{Energy Expenditure (k j/min)} = 0.159 \times \text{Average Heart rate (beats/min)} - 8.72$$
3. The Total Cardiac Cost of Work (TCCW) was also estimated for the whole day based on the cardiac cost of work and cardiac cost of recovery.
$$\text{Cardiac Cost of Work (CCW)} = \text{Increased Average heart rate} \times \text{Duration of work}$$

$$\text{Increased Average heart rate during work} = \text{Average working heart rate} - \text{Average heart rate during Rest}$$

Cardiac Cost of Recovery (CCR) = Increased average heart rate during recovery x Duration

Increased Average heart rate during recovery = Average Recovery heart rate – Average Resting Heart rate

The respondents were asked to rate the perceived exertion soon after the weeding activity on the five point scale, from very light -1 to very heavy -5 as given by Varghese et al. (1994). The relationship between rate of perceived exertion and heart rate were analyzed by using the correlation co-efficient test.

RESULTS AND DISCUSSION

The mean age of the respondents selected for the study was 35.6 years with standard deviation ± 7.57 , height was 150.87 cms with standard deviation ± 6.13 and weight was 45.38 kgs with std. deviation ± 7.14 (Table 1).

Table 1: Physical characteristics of the subjects selected for ergonomic evaluation of weeding activity with existing and improved weeding tools.

N=30		
S. No.	Physical characteristics	Mean $\pm$ S. D.
1.	Age (yrs)	35.60 $\pm$ 7.57
2.	Height (cm)	150.87 $\pm$ 6.13
3.	Weight (kg) - Gross weight	45.38 $\pm$ 7.14

Weeding was performed with the traditional weeding tool-kurpi weighing about 250 gms and weeding was done in squatting position by applying the push-pull pressure by the hand.

The average resting heart rate recorded was 80.21 beats per minute, while performing weeding it was 94.36 beats per minute and during recovery period it was 82.27 beats per minute (Table 2). The average energy expenditure was 4.03 kj/min, 6.28 kj/min and 4.63 kj/min respectively during rest, weeding and recovery.

The peak heart rates recorded during rest, weeding and recovery period were 84.83, 102.80, and 90.35 beats per minute and the energy

expenditure was 4.77 kj/min, 7.63 kj/min and 5.65 kj/min. respectively (Table-2). The relation between the rate of perceived exertion and the heart rate was found to be positively significant.

Table 3 presents the Total Cardiac Cost Work, Physiological Cost of Work and the classification of workload of weeding activity based on heart rate and energy expenditure. The calculation of Total Cardiac Cost of Work for the whole day (8 hours), for weeding activity was 6162.87 beats and the average Physiological Cost of Work during weeding was 14.67 beats/min. As per the average heart rate and energy expenditure the weeding activity was classified as light activity and based on peak heart rate it is classified as moderately heavy activity. The correlation between the perceived exertion and the heart rate during weeding was found to be non-significant and women also felt weeding as a light activity.

Table 3: Total cardiac cost of work, physiological cost of work and classification of work load of weeding activity.

N=30	
Physiological Parameters	Weeding Activity
Total Cardiac Cost of Work (beats)	6162.87
Physiological cost of Work (beats/min)	14.67
Rate of Perceived Exertion (Light to Moderately heavy)	2.33

CONCLUSION

Weeding is one of the very important agricultural activities performed invariably by women in almost all the crops. Though this activity is performed for maximum number of days in a year, continuously from morning till evening in squatting position women perceived it as light to moderately heavy activity. The heart rate responses showed that the activity is a light activity. Though the activity is light, women feel it as a maximum drudgery prone activity because of its monotony in performance, continuous squatting posture and performing it for a longer period of time.

Table 2: The average and peak heart rate and energy expenditure of the farmwomen while weeding.

Activity	Working heart Rate(Beats/min)		Energy Expenditure(kj/min)		Classification of work load	
	Average	Peak	Average	Peak	Average	Peak
Rest	80.21	84.83	4.03	4.77	Very Light	Very Light
Weeding	94.36	102.80	6.28	7.63	Light	Moderately Heavy
Recovery	82.27	90.35	4.36	5.65	Very Light	Light

KEYWORDS Heart Rate. Energy Expenditure. Total Cardiac Cost of Work. Physiological Cost of Work.

ABSTRACT Heart rate is one of the accurate means to evaluate the physiological or functional demands of work on the worker. Hence the study was undertaken to know the workload of women in weeding activity. The results revealed that, the total cardiac cost of work while weeding was 6165.87 beats and the physiological cost of work was 14.67 beats/min. The average working heart rate during weeding was observed to be 94.36 beats/min and the average energy expenditure was 6.28 kJ/min. Though weeding was performed for maximum, number of days in a year, continuously from morning till evening in squatting position, majority of the women perceived it as light to moderately heavy activity. The heart rate responses showed similar result as far as the classification of workload is considered.

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