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Physiological workload and musculoskeletal discomfort in areca growers: A study from the west Garo hills district, Meghalaya, north-east India

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Abstract

Agriculture is a major source of livelihood for rural masses in the district of West Garo hills. The livelihood of the region is based on the horticultural crops that are grown. Areca nut is major horticultural crop grown in the district of West Garo Hills. Women are observed to be involved in various cultivation practices of areca. In North-east India, women play an important role in agricultural activities. The study was carried out in the Gambegre block of West Garo hills district, Meghalaya. In areca cultivations, women are involved right from growing of nursery plant raising, clearing of plot, plantation, weeding, harvesting, collection of harvested crops and selling. While doing so the workers adopt various postures that leads to discomforts, cardiovascular stresses and health hazards. It was found that (1) average working heart rate (bpm) was 135.5 with maximum at 195, (2) average cardiac cost of work was 19001beats. These results are most likely due to the various difficult postures women are forced to adopt while collecting areca and carrying headloads in the hilly terrains. Ergonomic interventions are recommended for overall wellbeing of these women.

Keywords: Postures, discomforts, heart rate, energy expenditure

Introduction

Agriculture is the main source of livelihood, for the rural mass. In wetland and dryland cultivation except ploughing, women are found to involve in almost all the activities. Studies revealed that few activities are exclusively performed by women. Dutta (1978)^[2] revealed that all the back breaking work in agriculture like weeding, hoeing, transplanting, harvesting, winnowing etc. had been done by women. A study on "participation of rural women in agriculture in the hills of Uttar Pradesh" conducted by Singh *et al.* (1988)^[6] concluded that three fourth of the total work in agriculture is performed by female workers of the family alone and further they indicated an average per capita employment of 60 days for women worker in crop activities against only 199days for each male worker. Specifically, in dry land cultivation women play a major role right from sowing up to harvesting. More than half of the activities are exclusively performed by hill women. The study was carried out in Gambegre block of West Garo hills district, Meghalaya located in North-east India. Cent percent of the households are engaged in areca cultivation. The involvement of women under the study area begins with nursery plant raising up to collection of areca and carrying it to the collection point for sale. While accomplishing the activities, women adopt various postures where most of the postures are awkward leading to cardiovascular stresses and body discomfort. Mukhopadhyay, 2008^[4] revealed that in developing countries like India the farm workers suffer from assorted health problems due to awkward postures and carrying of heavy loads. Most of the musculoskeletal disorders resulted from frequent bending and twisting trunk, and repetitive handling of load at a time. Poor work posture constitute one of the main risk factor for work related musculoskeletal disorders ranging from minor back problems to severe handicapping. Poor posture increases the physiological cost of work and energy expenditure. The study was carried out with the following objectives.

1. The physiological workload involved in collection of areca nut.
2. The musculoskeletal discomforts faced by the women in collection of harvested nuts.

Materials and methods

The respondents are selected from three (3) villages under Gambegre development block of West Garo Hills, Meghalaya. A total of 60 female respondents who are involved in areca nut

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collection were considered for the study. The activity of collection is considered to study the physiological workload and musculoskeletal discomfort, as cent percent women folk in the study area are found to involve since their childhood.

Assessment of physiological workload

Physiological workload was determined by recording the heart rate (bpm) of the respondents involved in collection of nuts using Polar heart rate monitor. The receiver on the wrist and the transmitter of the heart rate monitor is tied on the chest of the respondents. The resting, working and recovery heart rate was recorded for every minute. To calculate the total cardiac cost of work and physiological cost of work.

Total Cardiac Cost of work

To calculate the Total cardiac cost of the work the following calculations were done.

Total Cardiac Cost of work = Cardiac Cost of work + Cardiac Cost of Recovery

(TCCW = CCW + CCR)

Where, Cardiac Cost of work (CCW) = Average Heart Rate (AHR) x Duration of work.

Average Heart Rate (AHR) = Average working heart rate -

Average resting heart rate

Cardiac Cost of Recovery (CCR) = (Average recovery heart rate - Average resting heart rate) x Duration of recovery

Physiological Cost of work

The physiological cost of work is calculated with the following formula

Physiological Cost of work = $\frac{\text{Total Cardiac Cost of work}}{\text{Total Time of work}}$

Energy Expenditure Rate

Energy Expenditure Rate was calculated from the average values of heart rate with the help of formulae given by Varghese *et al.* (1994) [7]. The formula.

EER (kj/min) = 0.159 x Average heart rate (bpm) - 8.72

Where, EER = Energy Expenditure Rate (KJ/min)

HR = Heart rate (beats/min)

Classification of workload

The Physiological workload was determined based on the physiological workload classification provided by Varghese *et al.*, 1994) [7].

Table 1: Classification of workload

Physiological Workload	Physiological Variables	
	Energy expenditure (kj/min)	Heart rate (bpm)
Very light	Up to 5.0	Up to 90
Light	5.0-7.5	91- 105
Moderately heavy	7.6-10.0	105 - 120
Heavy	10.0-12.5	121 - 135
Very heavy	12.6-15.0	136 - 150
Extremely heavy	< 15.0	151 Above

Source: Varghese *et al.* (1994) [7]

Perceived Rate of Exertion

Rated perceived exertion (RPE) was determined by using a modified 5-pointscale (1-very light, 2-light, 3-moderately heavy, 4-heavy, 5-very heavy} of perceived exertion developed by Varghese, *et al.* (1994) [7].

Results and Discussion

Respondent’s physiological responses *viz*; average resting heart rate, working heart rate, maximum heart rate, energy expenditure, peak energy expenditure, total cardiac cost of work, physiological cost of work, rate perceived exertion, and physiological workload are recorded in Table 1. Average heart rate of the respondents are found to be 109.7 b.min⁻¹, Average working heart rate (b.min⁻¹) and Average maximum heart rate (b.min⁻¹) are 135.5 and 195 respectively. Average energy expenditure (kJ. min⁻¹) is 8.722 and peak energy expenditure is 17.101. The Average total cardiac cost of work (TCCW) (beats) is found to be 19001 beats while performing the activity of collection. The activity of collection of areca nut is very heavy as perceived by the respondents. On the basis of the average working heart rate and average energy expenditure, the activity of collecting of nuts is found to be a heavy activity. The physiological cost of work for the activity of collection of areca nut is 43.23 bpm.

Table 2: Physiological responses of respondents involved in collection of harvested areca N=40

Parameters	Harvesting
Average resting heart rate (b.min ⁻¹)	109.7
Average working heart rate (b.min ⁻¹)	135.5
Average maximum heart rate (b.min ⁻¹)	195
Average energy expenditure (kJ. min ⁻¹)	8.722
Peak energy expenditure (kJ. min ⁻¹)	17.101
Average Total cardiac cost of work (TCCW) (Beats)	19001
Physiological cost of work (PCW) (b. min ⁻¹)	43.23
Average RPE	5
Physiological workload	
AWHR	Heavy
AEE	Very Heavy

Musculoskeletal discomfort faced by the women

Incidences of musculoskeletal problems during activity were studied with the help of body map (Corlett and Bishop, 1976) [1]. A close perusal of the table 3 divulges that the respondents felt very severe pain in lower back followed by severe pain in different body regions namely; shoulder, mid back, thighs and legs. The discomfort level is found to be moderate in neck, upper arm, lower arm and upper back regions of the body. The discomfort level is found to be very severe in lower back, mid back, and the legs may be due to adoptions of awkward postures like leaning, bending, twisting standing on legs for

longer duration of time and walking to and fro the hilly terrains with head loads.

Table 3: Overall discomfort at various parts of the body N=60

Body parts	Percentage of mean of score	Overall discomfort
Neck	79.0	Severe
Shoulder	61.4	Severe
Upper Arm	68.4	Severe
Lower arm	51.2	Moderate
Upper back	88.8	Very Severe
Mid back	92.8	Very Severe
Lower back	88.0	Very severe
Buttocks	54.4	Moderate
Right Thigh	72	Severe
Left Thigh	70.4	Severe
Right Leg	87.72	Very Severe
Left Leg	86.4	Very Severe

Overall discomfort Score attained: Very mild = upto 20%, Mild =20-40%, Moderate =40 -60% and Severe = 60-80%, Very Severe = >80%

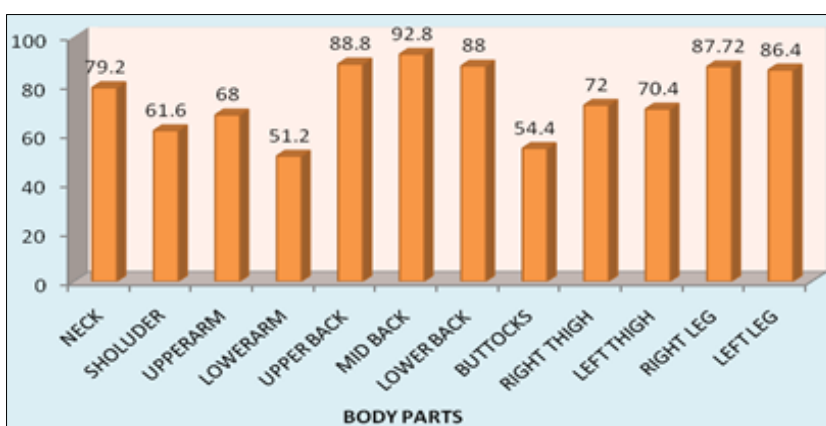


Fig 1: Musculoskeletal discomfort



Fig 2: Collection of Acreca nut

Conclusion

Form the above observation it can be concluded that the respondents involved in acacia nut collection perceived as a very heavy activity as it is a time taking and tedious activity. Due to the nature of the activity the respondents have to maintain awkward postures throughout the working hours. Therefore, the respondents have different level of body discomforts in upper and lower regions of the body. Respondents perceive very severe discomfort at most of the body parts. The physiological workload is moderately heavy because the respondents have to work under high heat of sun for maximum duration of the day and different postures and force applied to reap are also a cause. Physiological workload may lead to various occupational health hazards. Therefore, ergonomic intervention to limit the adoption of awkward

posture in the study area is essential for wellbeing of the population who is serving the nation.

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