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Ergonomic evaluation of paddy storage activity of Assam

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Abstract
Paddy storage is one of the most drudgery prone post harvest activity of Assam, which is predominantly performed by rural women. Assessment of Physical fitness, rating of perceived exertion and postural stress which are very important for planning and implementing interventional ergonomics programs. In developing countries like India, the workers suffer from assorted health problems due to awkward postures and carrying heavy loads (Mukhopadhyay, 2008; Sett and Sahu, 2008). Health related problems are resulted from frequent trunk bending, twisting and repetitive handling of load at a time and women have a higher prevalence rate than men farmers. An attempt was made to assess physical fitness, rating of perceived exertion, and postural stress involved in the activity. Thirty subjects in the age group of 25-35 years who are having normal, non-pregnant, and non-lactating having normal blood pressure and without any major illness were selected for the purpose of the study. Electronic tread mill was used for assessing physical fitness and rating of perceived exertion was assessed by using a five-point scale develop by Varghese. (1994) and postural stress in different region was measured with inclinometer. For postural analysis Ovaku Work Posture Analysis System (OWAS) method was used. Thirty-three per cent of farm women had 'very good' level of physical fitness. Rating of perceived exertion was 4.22 in 5-point scales indicating that the exertion perceived by farm women. The angles of average flexion was highest in upper arm (90.62^0) and extension was in thoracic and it was observed to be 115.30^0 indicating deviation of body parts. The farm women perform the storage activity under acceptable level of temperature and humidity except illumination. An ergonomic intervention is necessary for lowering postural loads and for improving productivity and comfort to the farm women.

Keywords: Physical fitness, RPE, postural stress, range of motion

Introduction

Paddy storage is one of the most drudgery prone post harvest activity of Assam, which is predominantly performed by rural women. In Assam, more than 70 per cent of farm women are involved in post harvest activities such as threshing, sun-drying, sieving, winnowing, cleaning and storage of paddy grains. In developing countries like India the farm workers suffer from assorted health problems due to awkward postures and carrying heavy loads (Mukhopadhyay, 2008; Sett and Sahu, 2008) [2, 4]. Different types of health hazards resulted from frequent trunk bending, twisting and repetitive handling of load at a time. Assessment of physical fitness of farm women is very important for comfort and wellbeing. Poor work posture constitute one of the main risk factor for work related hazards ranging from minor back problems to severe handicapping. To improve the efficiency of the farm women their posture needed to be assessed and corrective measures should be suggested to avoid the musculoskeletal disorders. The assessment of ergonomic evaluation or human cost in farm activities will help to bring necessary modification in available tools or evolve needed technologies to reduce the drudgery of farm women. Keeping this in mind the study was carried out with the following objectives:

1. Assessment of physical fitness and rating of perceived exertion by farm women in storing paddy grains
2. Analysis postural stress and ranges of motions of farmwomen in storing paddy grains in conventional method.

Methodology

2.1. Selection of subjects

Thirty subjects in the age group of 25-35 years who are normal, non-pregnant, non-lactating and without any major illness were selected for the purpose of the study.

2.2 Determination of physical fitness

Physical fitness of the participants was determined by using electronic Tread mill. The test was administered according to the designed protocol; working and recovery heart rate was monitored continuously by using Heart Rate Monitor (Polar Sports Tester – PE 4000) during the test. The stepping exercise (30 steps/min.) was continued for a maximum of 5 minutes. The recovery pulse rate was recorded while the subject was sitting on a chair. PFI was measured with the following formula:

PFI = Duration of stepping in sec / Sum of 1^{st}, 2^{nd}& 3^{rd} min. recovery pulse count X 100

The scores thus obtained were interpreted using the physical fitness index (PFI) and categorized as poor, low average, high average, good, very good and excellent the scale proposed by Saha (1996) [3] was used.

2.3 Rating of perceived exertion

Subjective perception of exertion is a method for providing reliable information for the assessment of workload. Subjective rating of feeling of tiredness was studied by using the rating scale of perceived exertion (RPE) developed by Varghese (1994) [6]. The exertion perceived by the participants before and immediately after completion of storage of paddy activity was recorded and categorized as very light, light, moderately heavy, heavy and very heavy based on the scores 1,2,3,4 and 5 respectively.

2.4 Postural analysis

Postural analysis was considered during the performance of paddy storage activity with Dual Inclinometer (Dualer IQ^{TM}). The spinal curvature of the subjects in erect standing position at the cervical, thoracic, lumbro sacral and upper extremities (flexion and extension) was observed. The ranges of motion (ROM) in cervical, thoracic, lumbro sacral and upper extremities were recorded for each subject during the paddy storage activity. Ovaku work posture analysis system (OWAS) is a practical method for analyzing and controlling poor working postures of the workers which recommends the changes to be made in the body posture of the farm women while working with post harvest activities especially storing of paddy grains (Table 1)**.**

Table 1: The OWAS action categories for evaluation of working postures

OWAS Scores	OWAS categories	Description
1	Action category I	Work postures are considered usually with no particular harmful effect on musculoskeletal system. No actions are needed to change work postures
2	Action category II	Work postures have some harmful effect on musculoskeletal system. Light stress, no immediate action is necessary, but changes should be considered in future
3	Action category III	Work postures have a distinctly harmful effect on musculoskeletal system. The working methods involved should be changed as soon as possible
4	Action category IV	Work postures with an extremely harmful effect on musculoskeletal system. Immediate solution should be found to change these postures

2.5 Environmental parameters

Observations on the climatic conditions were important parameters. Measurements on ambient temperature, humidity and illuminance level were taken using digital hygrometer and lux meter at the place of work. The duration of the activity was 30 minutes and activity is performed in the house.

2.6 Statistical analysis

Mean, standard deviation and correlations were worked out for different parameters and data were interpreted accordingly.

Results

3.1 Details of activity

Paddy storage is performed by more than 70 per cent of the rural Assamese women. After proper sun drying, paddy is stored in traditional storage structures such as *bhoral*, *mer*, *duly*, gunny bags etc for consumption or for commercial purposes. *'Bamboo basket'* is a conventional tool used for carrying the grains from yard to the place of storage structures. Standing and bending postures were adopted by farm women in the paddy storage activity. The farm woman usually carried more than 16 kg of grains at a time and during the operation they are adopting an awkward posture which is above the permissible limits (ILO).

3.2 Determination of physical fitness index (PFI)

Data on physical fitness index (PFI) revealed that 33 per cent of farm women had 'very good' `physical fitness followed by 30 per cent belonged to 'good' and 27 per cent belonged to 'high average' physical fitness. Only 10 per cent farm women had 'low average' group and none of the respondents were found to be 'poor' physical fitness.

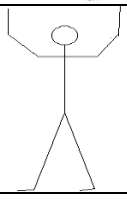
3.3 Rating of perceived exertion

Subjective perception of exertion is another method for providing equally reliable information for assessment of workload. Perceived exertion of respondents was assessed by using 5 point modified rating of perceived exertion (RPE) scale (Varghese., 1994) [6] just after completion of the activity. Data on perceived exertion revealed that average rating of perceived exertion was 4.22 in 5 point scales indicating that the exertion perceived by farm women was reasonably high throughout the storage of paddy grain activity.

3.4 Postural stress and range of motion (ROM)

From the analysis of working posture by OWAS method (Table 2) it was further evident that out of the three different types of postures adopted in storage activity the posture adopted in unloading paddy grains need 'corrective measures' as soon as possible while the postures adopted in loading grains required 'no immediate action' but changes are needed in near future. In carrying paddy grains, the adopted posture need not require any change. Thus, it was clear that by remaining in awkward postures repeatedly during those activities, these workers suffered from discomfort affecting different body parts.

Table 2: Analysis of working posture of farm women in paddy storage activity. (N=30)

Activity	Figure	Code	Action Category	Remarks
Loading grains from the floor		2122	2	Corrective measures in the near future
Carrying grains		3172	1	No corrective measures
Unloading grains		4322	3	Corrective measures as soon as possible

The ranges of motions (ROM) were recorded with the help of dual inclinometer. Both static and dynamic movements were adopted during storage activity. The postures assumed by the farm women in paddy storage were standing in forward bending position. The range of motion (ROM) in cervical, thoracic and lumbro scaral showed that the angle of average flexion was 30.60° and average extension was 38.00^0 in cervical, while it was observed to be 62.50° and

115.30° for thoracic and in lumbro scaral region average flexion was 32.33° and extension was 28.83°. The angles of average flexion were 90.62°, 35.09°, 57.80° and average extensions were 77.12°, 68.20°, 48.58° in upper extremities indicating deviation in the different body parts (Table 3).

Table 3: Average flexion and extension of farm women in storage activity (N=30)

Body parts	Flexion	Extension
Cervical	30.60°	38.00°
Thoracic	62.85°	115.30°
Lumbro Scaral	32.33°	28.83°
Upper extremities		
Upper arm	90.62°	77.12°
Lower arm	35.09°	68.20°
Wrist	57.80°	48.58°

3.5 Environmental stress

The temperature and relative humidity were recorded thrice in every 15 minutes during the storage activity. It was showed that the mean temperature was found to be 22°c and mean relative humidity (RH) was observed to be 49 per cent. Farm women performed storage activity within the acceptable limit or comfort zone limit of temperature and humidity is due to fact that the experiment was conducted in winter season. An assessment of visual comfort of the subjects regarding the lighting condition revealed that the illuminance level were 95 lux in paddy storage activity. The work place was found to be non-conducive to worker which is below the recommended standards for general work area especially in unloading grains (150 lx). This is due to the fact that there was no provision of windows for natural lighting in the storage structures

Conclusion

Ergonomic evaluation of storage of paddy grains shows that From the analysis of postural load it was found that work postures have a distinctly harmful effect on musculoskeletal system of the farm women. The working methods should be changed as soon as possible. For most efficient functioning of muscles, range of motion of body parts should be minimized. Ergonomic interventions are essential for reducing health hazards, improving productivity, comfort and workable life of the farm women during storage of paddy grains.

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