

An ergonomic study on the assessment of work related musculoskeletal disorder risks among agriculture workers of Uttarakhand, India

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Abstract— Safety of the workers and productivity of work in rice cultivation is impacted by the human drudgery. Musculoskeletal disorders (MSDs) are the most common work-related problems among farm workers involved in rice transplanting activity. The main aims of the present study were to investigate the causation of discomfort related to working postures and to assess the work related musculoskeletal disorder among the farmers. For this study, 60 agricultural workers aged 25-45 years were selected randomly from the Kalinagar Village of Udham Singh District of Uttarakhand and a detailed posture analysis was performed among them by REBA and VAS methods. For the study, only uprooting and transplanting activity were selected from the rice cultivation activity. Agricultural workers suffered from pain especially in the low back, knees, hands shoulder and neck. The average REBA score observed was 10. Prolonged work activity, high repetitiveness, and remaining constantly in an awkward posture for a prolonged period of time etc. were the major factors of drudgery, acute pain and discomfort among farm workers.

Index Terms— Rice Cultivation, Musculoskeletal Disorders, Drudgery, Posture Analysis, Ergonomics, Rapid Entire Body Assessment, Visual Analogue Scale

1 INTRODUCTION

Nearly two-third of Indian population lives in the villages and depends mainly on agriculture and other related occupations for their livelihood. They work very hard, but live a poor life due to number of constraints, such as poor village community facilities and resources [1]. In India, large number of human resource is mainly associated with agricultural work (Rice cultivation) in rural areas due to poor socioeconomic status and poverty. Agricultural workers, especially rural people suffer from musculoskeletal disorders (MSDs) in different parts of the body, especially low and upper back pain, during different activities in rice cultivation. Farm workers have to perform a fair amount of manual, continuous rigorous tasks in the agricultural field. There are some activities that are mainly engaged in during rice cultivation i.e. uprooting and rice transplanting.

According to Sekimpi [2], musculoskeletal pain, especially back pain, is common among agricultural workers. He also believes that new ergonomically designed agricultural hand tools and machinery or equipment will reduce the work load and MSDs among agricultural workers. Agriculture work is mainly considered to be a highly physically demanding occupation [3]. More than half of the Indian population is engaged in traditional agricultural activities. Gangopadhyay et al. [4] stated that preadolescent agricultural workers are continuously exposed to bending posture in different environments, and as a result, they suffer from acute pain and discomfort in different parts of the body. During rice cultivation, farmers usually use a variety of different awkward postures while performing various manual tasks for an extended period of time. Because of awkward and stressful postures for prolonged period of time Indian agricultural workers are suffering with high work related musculoskeletal disorders. Low back problems are common among farmers, and appear to be associated with the frequency of using postures requiring back flexion,

carrying and lifting of heavy loads and exposure to whole body vibration [5]. Postures, especially those involving severe flexion or lateral twisting and bending, have been found to be significantly related to low back pain [6]. The main aims of the present investigation were (1) to determine the prevalence of work related musculoskeletal disorders (WMSDs) and drudgery among agricultural workers (2) to analyze the causation of discomfort resulting from awkward and stressful postures during rice cultivation.

2. MATERIALS AND METHODS

2.1 Selection of subjects

For the study, 60 agricultural workers (30 male and 30 female) aged 25-45 years, were selected by simple random sampling method from the village in Udham Singh Nagar of Uttarakhand.

2.2 Visual Analogue Scale

The Visual Analog or Analogue Scale [7] is designed to present to the respondent a rating scale with minimum constraints. Respondents mark the location on the 10-cm line corresponding to the amount of pain they experienced. This gives them the greatest freedom to choose their pain's exact intensity. It also gives the maximum opportunity for each respondent to express a personal response style. The VAS frame measures exactly 10 cm. The distances from zero to the markings in cm are result indicators to be processed as continuous variables for statistical analysis.

2.3 Postural analysis

Rapid Entire Body Assessment (REBA) method was applied for postural analysis of work related musculoskeletal risk factors. REBA (Rapid Entire Body Assessment) was developed by Hignett, S. and McAtamney, [8] to provide a quick and easy obser-

ventional postural analysis tool for whole body activities (static and dynamic giving musculoskeletal risk action level. The development of REBA is aimed to divide the body into segments to be coded individually with reference to movement planes. It provides a scoring system for muscle activity caused by static, dynamic, rapid changing or unstable postures. It reflects that coupling is important in handling of the loads but may not always be via the hands. It also gives an action level with an indication of urgency. This method was specifically developed to be useful for assessing MSD risks/working postures found in healthcare and other service industries. However, it can be used to assess a variety of tasks, in any setting, where: the whole body is being used, the posture is static, dynamic, rapidly changing, or unstable, or animate or inanimate loads are being handled either frequently or infrequently [9].

3 RESULTS AND DISCUSSION

It was observed from Table 1 that means score of age and height of selected respondents (agriculture workers involved in uprooting and transplanting activity) was 34.5 and 152.8 respectively. The mean value of weight of the selected subjects was found 48.5 kg. The average duration of work per day was observed 9.06 hours whereas the mean score of the duration of rest per day was calculated 1.5 hours. The average rate of years of work experience of agriculture workers was found 18 years.

Visual Analogue scale- Respondents were asked to mark the location on the 10-cm line corresponding to the amount of pain they experienced. This gave them the greatest freedom to choose their pain's exact intensity. It also gave maximum opportunity for each respondent to express a personal response style. Table 2 shows Visual analogue scale ratings for farm workers involve uprooting and transplanting activity. The mean score of VAS rating in uprooting and transplanting activity was 7.3 and 7.0 respectively which indicated a high intensity of pain in different body parts.

Postural Analysis- Rice uprooting and transplanting activities performed by the agricultural workers were analyzed with the Rapid Entire Body Assessment (REBA) to determine the postural load and to categorize the potential harmfulness of the work posture (Table 3, 4). The posture codes of the REBA indicate that, postures in different phases of uprooting and transplanting activities, demand immediate attention (i.e., Work must cease until a safer solution can be found). Thus it is clear that the agricultural laborers adopt awkward postures at work and suffer from musculoskeletal disorders because they remain in such awkward postures for a prolonged period of time.

4 TABLES

TABLE 1
PHYSICAL AND PHYSIOLOGICAL CHARACTERISTICS OF THE SUBJECTS

Physical characteristics	Mean	± S.D.
Age (yrs)	34.5	± 6.04
Height, cm	152.8	± 4.2
Weight, kg	48.5	± 5.4
Duration of work per day (hours)	9.06	±1.32
Duration of rest per day (hours)	1.5	± 0.5
Years of Experience	18	±2.97

TABLE 2
VAS rating among agricultural workers

Study groups (Agricultural Workers)	VAS Rating
Uprooting	7.3 ±2.36
Transplanting	7.0 ±2.18

TABLE 3

Analysis of working posture with the REBA method during rice cultivation among agricultural workers (Uprooting)

Activity	REBA Score	Risk Level	Action category
Task A – Manual uprooting- Bending			
Phase 1: Bending to reach the seedling on the seed bed	11	Very high	Necessary urgent- Work must cease until a safer solution can be found
Phase 2: Uprooting the seedling by both the hands until those become hand full	12	Very high	Necessary urgent- Work must cease until a safer solution can be found
Phase 3: Washing the bundle of rice seedling	9	high	Action needs to be taken very soon
Phase 4: Tying the bundle	7	Medium	Further consideration should be given as to how risk can be lowered
Phase 5: Keeping the bundle on the ground	10	high	Action needs to be taken very soon
Task B- Uprooting- Sitting			
Phase 1: Reach the seedlings in squatting posture	12	Very high	Necessary urgent- Work must cease until a safer solution can be found
Phase 2: Uprooting by double hand operation alternately in same posture	12	Very high	Necessary urgent- Work must cease until a safer solution can be found
Phase 3: Washing the bundle	10	high	Action needs to be taken very soon
Phase 4: Tying the bundle	6	Medium	Further consideration should be given as to how risk can be lowered
Phase 5: Keeping the bundle on the ground	8	high	Action needs to be taken very soon

TABLE 4

Analysis of working posture with the REBA method during rice cultivation among agricultural workers (Transplanting)

Activity	REBA Score	Risk Level	Action category
Task C – Manual transplanting			
Phase 1: Taking the bundle of seedling and untying it	11	Very high	Necessary urgent- Work must cease until a safer solution can be found
Phase 2: Making the bundle into two halves and gripping one half in one hand	8	High	Action needs to be taken very soon
Phase 3: Taking few seedlings by the right hand and planting them into soil. Left hand) remained on the left thigh near the folded knee	12	Very high	Necessary urgent- Work must cease until a safer solution can be found

4 ERGONOMICS INTERVENTIONS

The following are possible ergonomic interventions that we identified to increase the value of this investigation.

Repetition of work in uprooting and transplanting activity, which causes musculoskeletal disorders, should be avoided. Kogi [10] also recommended brief intra-work pauses to decrease fatigue in repetitive work in which the muscles can rest after experiencing a static load and a break after a period of continuous work.

To avoid excessive physical and mental stress, short rest break should add to work schedule of agriculture workers. Muscular fatigue, level of drudgery, boredom and monotony of a job of agriculture workers can be reduced with the implementation of job or work rotation policy.

5. CONCLUSION

1. This study mainly indicates that farm workers involved in Rice transplanting and uprooting activities are mainly suffering from work related musculoskeletal disorders (especially in the lower back, upper back, legs, shoulder, hand and neck) due to prolonged awkward (squatting, bending and twisting) postures with a high amount of repetitiveness.
2. REBA posture analysis indicated that in different phases of uprooting and transplanting activities implementation of immediate corrective measures are needed.
3. Manual uprooting and transplanting is very physically demanding activity because of prolonged work activity, high repetitiveness, and remaining constantly in an awkward posture for a prolonged period of time which leads to work related musculoskeletal disorders among farm workers.
4. The present study recommends that there is dire need of implementation of ergonomics interventions with proper awareness among agriculture workers involved in rice cultivation.

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