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An Ergonomic Study on Human Drudgery and Musculoskeletal Disorders by Rice Transplanting

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ABSTRACT Manual rice transplanting is a task demanding high labour and directly associated with human drudgery. High labour demand during peak transplanting period adversely affects the timeliness of this operation, thereby reducing crop yield. The purpose of this study was to assess the level of human drudgery and musculoskeletal disorders of farm workers involved in mechanical and manual rice transplanting. This study was carried out in Kalinagar village of U.S. Nagar, District of Uttarakhand state in 2011. Experimental research design was used in this study. Total sample size was 20 in which 10 male and 10 female farm workers were selected randomly for experimental data. Mean, percentile values of musculoskeletal disorders through body map and NORDIC questionnaire were calculated during manual and mechanical rice transplanting and uprooting activity. Majority of respondents were suffering from pain in neck, both shoulder, upper back, lower back and thighs because they were compelled to adopt bending and sitting posture during manual uprooting and transplanting. To solve the problem of high physiological workload, human drudgery and musculoskeletal disorders mechanical rice transplanting could be considered as the most promising option.

INTRODUCTION

Rice *(Oryza sativa)* is one of the most important cereal crops in the world as it is the most important staple food. In India, about three-fourth of the population are dependent on rice. The area under rice cultivation is about 44.79 million ha, the largest in the world. (Singh 2009). There are basically two types of rice transplanting, that is, manual transplanting and machine transplanting. Manual transplanting is tedious, tiresome and labor consuming, because a person has to stand in puddle field and bend for hours for putting seedling into the soil by hand. In Tarai region, transplanting is accomplished mainly by manual method. Manual transplanting is one of the labor intensive operation comprising of nursery raising , uprooting of the seedling and transplanting them in the main field, with total labor requirement of about 280-350 man- hours/ ha. Some of the posture which were taken by them were very harmful. But they were compelled to adopt those postures during work for a long time. During transplanting the workers adopt strongly bent posture in the muddy field for a long time. In all the tasks of rice cultivation are repetitive in nature. Repetitive may be related to MSD. The workers change their posture very frequently and suffered from musculoskeletal disorder during performing their jobs (Kar and Dhara 2007). High labor demand during peak transplanting period adversely affects the timeliness of this operation, thereby reducing crop yield. Work-related Musculoskeletal Disorders (WMSDs) have become a major problem in many industrialized country (Hagberg et al. 1995) including India. These disorders have caused a considerable human suffering and are also economically very costly, because of reduced working capacity and lessoned production**.** High incidence rate for WMSDs of the upper extremities have been reported for workers in office work, manufacturing and agriculture which includes numerous material handling occupation in various factories (Faucet et al. 2002). A study conducted in Netherlands of 10,813 employees and this study used self-reported work-related neck and upper limb symptoms reported that the tailors (47 percent), building construction workers (43 percent), loaders/unloaders (42 percent), secretaries and typist (38 percent) were some of the occupations with the highest annual prevalence of symptoms. This compared to the lowest prevalence found for commercial occupations (21 percent), (Blatter and Bongers 1999).

To correct the problem, mechanical transplanting could be considered as the most promising option.

All of these contribute to increase in the physiological costs and physical loads to a great extent. It also causes unbalancing of body with

heavy work loads. Musculoskeletal disorders are common among farm workers especially lower and upper back disorders due to bending and squatting body posture in manual rice transplanting and uprooting activity.

Considering the above facts and point of views, it was proposed to investigate changes in the physiological responses and perceived exertion due to heavy work loads and body postures in manual and mechanical rice transplanting and uprooting.

The aim of this study was to better understand how mechanical and manual rice transplanting and uprooting activity perform, identify potential health risk factors and gain insight into the health effects of the task.

MATERIAL AND METHODS

Assessment of Musculoskeletal Disorders: Posture is the orientation of the person's body parts of the work place arrangement so that the work is performed with ease. In the activities Body map and NORDIC questionnaire was used to measure the body posture and musculoskeletal disorders. NORDIC questionnaire is a multiple page questionnaire and subjective responses of workers were taken into consideration.

Work-related pain/discomfort was reported in 12 month, six month and prevalence in 7 days. The questionnaire consisted of a series of objective questions with yes or no response and some were in multiple choice questions.

The participants were interviewed about any kind of discomfort affecting different body parts during every activity associated with raw brick making task and their health surveillance was also analyzed.

Hypothesis: The null hypothesis of the study was that body Posture influences the musculoskeletal disorders of the workers.

Statistical Analysis: Mean, Percentage, Chi-square test of independence was used.

RESULTS AND DISCUSSION

Assessment of Work-related Musculoskeletal Disorders

The work-related musculoskeletal problems and the body pain perceived by the workers were determined by administering of standardized Nordic questionnaire. All the selected workers had given their responses, which were analyzed.

Table 1 clearly envisages that total 55 percent respondents were having knowledge about the musculoskeletal pain/discomfort. Nearly 80 percent reported that they prevented themselves from normal activities and more than 90 percent said that they stay away from normal work activities because of the pain/discomfort.

Table 1: Pain and discomfort with the locomotive organs (N-20)

S.No.	*Questions*	*Male*	*Female*	*Total*
1	Do you know about musculoskeletal pain/ discomfort?	8(40)	3(15)	11 (55)
2	Have you ever been prevented from normal work activities because of musculoskeletal pain/ discomfort?	9(45)	7(35)	16 (80)
3	Do you stay away from your normal activities because of the pain/ discomfort?	8(40)	9(45)	17 (95)
4	Activities cause the pain and discomfort			
	Manual transplanting	10(50)	10(50)	20(100)
	Manual uprooting	10(50)	10(50)	20(100)
	Mechanical transplanting	2(10)	1 (5)	3 (15)
	Mechanical uprooting	4(20)	5(25)	9 (45)

Note: Values in parentheses indicate percentage.

When asked about the activities causing pain and discomfort it was reported that 100 percent of the respondents complained pain in manual transplanting and uprooting activities. Whereas 10 percent of males and nearly 5 percent females i.e. approx 15 percent respondents said that the activity of mechanical transplanting caused the pain and 45 percent respondents were suffering from pain during mechanical uprooting.

Self Reported Pain/Discomfort

Workers were asked few questions about perceived pain/discomfort, which lasted, for at least 24 hours. Pain was measured for past 12 months, six month and for 7 days. Majority of the respondents were feeling pain and discomfort in different body parts.

During the last 12 months 35 percent male and 40 percent female who were involved in manual transplanting had pain and discomfort in neck and 25 percent male and 45 percent female respondents who were involved in manual

uprooting were suffering from neck pain . When asked about pain in shoulders cent percent respondents reported discomforted during manual transplanting and uprooting. Total three-fourth of the total respondents reported pain in elbows during manual transplanting and majority (85 percent) respondents were suffering from elbow pain. All selected males and females had pain in wrist/hands, upper back, lower back and hips/ thighs, whereas 45 percent of males and 50 percent of females had complained pain in knees. In manual rice transplanting almost 80 percent respondents comprising 35 percent males and 45 percent females complained pain in ankles/ feet and in manual uprooting task 40 percent males and 50 percent females were suffering from discomfort in ankle/feet.

Regarding pain and discomfort during last six month total of 90 percent of respondents, that is, 35 percent males and 45 percent females complained of neck pain during manual transplanting and 40 percent males and 45 percent females were suffering from neck pain during manual uprooting. Concerning pain in both shoulders, all of the employees reported discomfort. On the other hand nearly 85 percent respondents, 45 percent male and 40 percent female complained pain in both elbows (Table 2).

Gangopadhyay et al. (2005) conducted a study to assess postural discomfort level of agriculture farmars, In that study fifty male and fifty female preadolescent agricultural workers were randomly selected and a detailed posture analysis was performed with the Ovako Working Posture Analysis System (OWAS) 2003. He observed that agriculture workers worked continuously in awkward postures during certain agricultural activities. Consequently they suffered from discomfort in different parts of their body.

Majority of the respondents complained of wrist/hand pain and hips and thighs. Studies clearly showed that all the males and females respondents said that they had pain in upper and lower back during manual uprooting and transplanting before six month. On the other hand approximately all the respondents reported the pain in knees. Nearly forty percent males and 50 percent females reported pain in ankles/ feet in during manual transplanting and all respondents were suffering from ankles/feet pain during manual uprooting.

Further all the males and females' respondents reported pain on neck and both shoulder during last 7 days (Table 3). Nearly 65 percent respondents, 30 percent males and 35 percent females had right elbow pain during manual transplanting, whereas 80 percent respondents complained pain in neck during uprooting task. All respondents were suffering from pain in shoulders, wrist/ hand and elbows wrist/hand, upper back, lower back, hips/ thighs and knees after manual transplanting and uprooting. Dur-

Table 2: Prevalence of 12 month musculoskeletal pain/discomfort in respondents

Body parts	*Manual transplanting*			*Manual uprooting*		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*
Neck	8(35)	7(40)	15 (75)	5(25)	9(45)	14 (70)
Shoulder						
• Right	-	-	-		-	-
• Left		-	-		-	-
• Both	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Elbow						
• Right	-	-	-	-	-	-
• Left	-	-	-	-	-	-
• Both	7(35)	8(40)	15 (75)	7(35)	10(50)	17 (85)
Wrist/Hands						
• Right	-	-	-			
• Left	-	-				
• Both	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Upper back	10(50)	10(50)	20(100)	8(40)	9(45)	17 (85)
Lower back	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Hips/thighs	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Knees	9(45)	10(50)	19 (95)	10(50)	10(50)	20(100)
Ankles/feet	7(35)	9(45)	16 (80)	8(40)	10(50)	18 (90)

Note: Values in parentheses indicate percentage

ing manual rice transplanting 35 percent males and 25 percent females complained of the ankles/feet, whereas 90 percent respondents were suffering from ankles/feet pain during uprooting. Data revealed that nearly 15 percent females first notice the problem before working in field. Of about 50 percent males and 45 percent females showed that they first noticed the musculoskeletal problem while working in field. With regard to medical treatment all respondents were taking medical treatment when they needed and also all male and female respondents reported that they were taking the treatment from the self, not from personal doctor, self and others.

Responses regarding the problems for which they take the treatment showed that 30 percent males and 40 percent female respondents took the treatment for headache; whereas all selected respondents agreed that they took the treatment also for body ache and cold/cough, calf muscles and shoulder pain. Gamperiene et al. (1999) conducted a study in that study group consisted of all workers in production (n = 363). Symptoms of the legs were the musculoskeletal symptom reported most often (61%). Many subjects had arms or neck (55%) or back problems (28%). 20% had experienced pain from all three sites. Almost 25% had had musculoskeletal pain every day and 16% had experienced constant pain during previous year. Packers had the highest risk of arms or neck problems whereas spinners had the highest risk of back or leg problems. Working in a strained posture (bending, work with arms raised up above shoulder level, and repetitive movements of the fingers) was associated with all three complaints. Only arms or neck complaints were associated with age. He concluded that Musculoskeletal disorders are a common problem among workers producing gobelin or synthetic thread in Lithuania and working in a strained posture as it is a risk factor for developing musculoskeletal disorders in three body sites: legs, arms or neck, and back. He reported that 25% subjects have musculoskeletal point everyday and 16% had experienced constant pain during the spinning activity.

As shown in Table 4 about 65 percent total respondents agreed that they were taking the treatment for stiffness in joints. Total 25 percent respondents were taking treatment for cut and wounds. Of all the employees, 65 percent indicated that they took the medicine for forearm pain, in which 35 percent were males and 30 percent were female respondents. With regard to pain in cuff muscles nearly 38 percent males and 40 percent females, total nearly 78 percent respondents had taken the treatment for the same. It was found that total 30, 15 male and 15 female respondents had agreed that they taken the treatment for numbness in finger. Nearly 80 percent of the total respondents, 35 percent males and 45 percent female workers also took the treatment for pain in trunk.

Table 3: Prevalence of seven days musculoskeletal pain/discomfort in respondents (N-20)

Body parts	*Manual transplanting*			*Manual uprooting*		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*
Neck	6(30)	7(35)	13 (65)	7(35)	9(45)	16 (80)
Shoulder						
• Right	-	-	-			
• Left	-	-	-			
• Both	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Elbow						
• Right	-	-	-	-	-	-
• Left	-	-	-	-	-	-
• Both	10[50]	10(50)	20(100)	10[50]	10(50)	20(100)
Wrist/Hands						
• Right	-	-	-	-	-	-
• Left	-	-	-	-	-	-
• Both	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Upper back	10(50)	10(50)	19 (95)	10(50)	10(50)	20(100)
Lower back	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Hips/thighs	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Knees	10(50)	10(50)	20(100)	10(50)	10(50)	20(100)
Ankles/feet	7(35)	5(25)	12 (60)	8(40)	10(50)	18 (90)

Note: Values in parentheses indicate percentage

Table 4: Health surveillance of respondents (N-20)

S. No.	*Question*	*Male*	*Female*	*Total*
1	*First Notice the Problem*			
	• Before working in field	-	3(15)	3 (15)
	• While working in field	10(50)	9(45)	19 (95)
2	*You Take the Medical Treatment*	10(50)	10(50)	20(100)
3	*Take the Treatment from*			
	• Personal doctor	-	-	-
	• Self	10(50)	10(50)	20(100)
	• Others	-	-	-
4	*Take the Treatment for*			
	• Headache	6(30)	8(40)	14 (70)
	• Body ache	10(50)	10(50)	20(100)
	• Irritation on eyes	-	-	-
	• Stiffness in hand joints	7(35)	6(30)	13 (65)
	• Burning sensation in fingers	-	-	-
	• Pain in palm	-	-	-
	• Forearm pain	7(35)	6(30)	13 (65)
	• Pain in cuff muscles	10[50)	10(50)	20(100)
	• Numbness in fingers	-	-	-
	• Cut and wounds	3[15]	2[10]	5 (25)
	• Fractures	-	-	-
	• Cough/cold	10(50)	10(50)	20(100)
	• Pain in trunk	7(35)	9(45)	16 (80)
	• Back ache	10(50)	10(50)	20(100)
	• Shoulder pain	10(50)	10(50)	20(100)
5	*Did the Treatment Help?*	8(40)	9(45)	17 (85)

Note: Values in parentheses indicate percentage.

Testing of Hypothesis

The Chi-square value showed that the musculoskeletal pain/discomfort was dependent on the body posture of farm workers. Hence the null hypothesis is accepted and alternate hypothesis is rejected (Table 5).

Table 5: Relationship between body posture and musculoskeletal disorders

Body posture	*χ^2 value for relationships*
Normal standing and MSD	1.87ns
Bending and MSD	29.754**
Sitting and MSD	24.87**

* Significant at 1 % level of significance at [(c-1) (r-1)] degree of freedom ns - Non significant

CONCLUSION

This study has highlighted the potential association between postural discomforts and rice transplanting activity. Thus, it can be concluded that manual uprooting and transplanting is more physically demanding activity as compared to mechanical uprooting and transplanting activity. Most of the times workers adopted standing, bending and sitting posture for performing manual and mechanical rice transplanting. They were not taking proper rests in between and during the activities. Respondents involved in manual method were suffering from high level of MSDs in back, neck, shoulders, legs and thighs whereas very low level of MSDs was found in farm workers performing the activity using mechanical uprooting and transplanting. Thus it can be concluded that through mechanization, the level of MSDs can be reduced or minimized.

IMPLICATIONS OF THE STUDY

The findings of the investigation brought out a number of important implications:-

1. The present study on ergonomics assessment of rice transplantation activity can be utilized by research and development established for mechanization activity.
2. The present study places human factors perspective firmly at the center of good practices in ergonomic agriculture product design.
3. It will be a valuable resource for academics and students, thus fostering a positive attitude which integrates the skills in a successful approach to product design.

4. Through extension training programme can transfer the suggestions to rural masses regarding effective product design guidelines so that they can be aware and comply with it to ensure safety.

RECOMMENDATIONS FOR FUTURE RESEARCH

1. Ergonomic assessment of farm workers involved in rice transplanting by RULA and REBA technique.
2. Coping with human drudgery- the impact on women's health.
3. The effect of body posture on WRMSD of the respondents involved in forestry sectors.
4. Inter comparison of various mechanized rice transplanters.
5. To assess occupational health hazards of transplanting activity.
6. Ergonomic assessment of post harvest techniques.

REFERENCES

Blatter BM, Bongers PM, de Witte H 1999. Work related neck and upper limb symptoms (RSI): High risk occupations and risk factors in the Belgian working population. *TNO Arbeid Rapport Project Nr. 40701179900409*, Hoofd dorp, The Netherlands.

Faucet J, Garry M, Nadler D, Ettare D 2002. A test of two training intervensions to prevent work-related musculoskeletal disorders of the upper extremity. *Applied Ergonomics*, 33: 337-347.

Gangopadhyay S, Das B, Das T, Ghoshal G 2005. An ergonomic study on posture- related discomfort among preadolescent agricultural workers of West Bengal, India. *International Journal of Occupational Safety and Ergonomics (JOSE)*, 11(3): 315-322.

Gamperiene M, Stigum H 1999. Work related risk factors for musculoskeletal complaints in the spinning industry in Lithuania. *Journal of Occupational Environment Medicine*, 56: 411-416.

Kar SK, Dhara PC 2007. An evaluation of musculoskeletal disorder and socio-economic status of farmers in West Bengal, India. *Nepal Medical College Journal*, 9(4): 245-249.

Hagberg M, Silverestein B, Wels R, Smith MJ, Hendrick HW, Carayon P, Perusse M 1995. *Work- related Musculoskeletal Disorders: A Reference Book for Prevention.* London: Taylor and Francis.

Singh SP 2009. Physiological workload of women workers in the operation of manual rice transplanters. *Gender, Technology and Development*, 13 (2): 271-284.

Vilkki Mika, Mattila Markku 2003. OWAS Methods. In: Waldemar Karwowski, William S Marras (Eds.): *Occupational Ergonomics Principles of Work Design.* Boca Raton, Florida, CRC Press.