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Comparative assessment of grain picking activity using existing and improved grain picking tool

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ABSTRACT

Filling of cleaned grains in gunny bags for storage is one of the post-harvest operation which requires human physical efforts. Labourers while filling gunny bags with grains, using traditional tool, have to put in more efforts which results in lower output and increased time consumption. More number of repetitive motions also causes various musculoskeletal disorders (MSDs). The present study was, therefore, planned with an aim to test the efficiency of an improved tool, grain picker, designed and developed by department of FRM, G.B. Pant University of Agriculture and Technology, Pantnagar in terms of reduction in muscular stresses and increase in work efficiency. The study was conducted on 15 randomly selected workers of grain market in Mullanpur town of Ludhiana district. Results revealed that improved tool, grain picker, enhanced work efficiency and increased work output. Hand grip fatigue was also reduced after working with improved tool.

INTRODUCTION

Agriculture is the backbone of Indian economy and holds the key to economic development of the country.The agriculture sector employs nearly half of the workforce in the country and it contributes to 17.5% of the GDP. India's production of food grains has been increasing every year, and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. In 2013, India contributed 13% to the world's wheat production (Deshpande, 2017).

Punjab (the five rivers region) is one of the most fertile regions on earth. Punjab holds place of pride among the Indian states for its outstanding achievements in agricultural development (Singh *et al.*, 2012). The region is ideal for growing wheat crop. Farmers who raise grain crops often have need for storage facilities for their grain.Agricultural commodities have to undergo a series of operations such as harvesting, threshing, winnowing, grading, bagging/packing, transportation and storage before they reach to the consumers. Although most of the agricultural operations are mechanized but some activities are still performed by the human labour, using drudgery prone tools which not only reduce the work efficiency but also cause many health hazards. If the tools used by the workers are made ergonomically sound they will help to perform the work more efficiently, quickly and with less fatigue (Kaur, 2005).

Filling of cleaned grains in gunny bags for storage is one of the post harvest operation which requires human physical efforts. Labourers while filling gunny bags with grains, using traditional tool, have to put in more efforts which results in lower output and increased time consumption. More number of repetitive motions also causes injuries to wrist and arms and can even cause strain, discomfort, muscle tension, etc. In order to make this activity comfortable, redesigning of the traditional tool or some changes in the traditional tool are needed to improve the efficiency while doing work and to increase the output. An improved tool, grain picker, is designed and developed by Dept. of FRM, GBPUA&T, Pantnagar to fill wheat grains in gunny bags comfortably and quickly.

The present study was, therefore, planned with an aim to test the efficiency of the grain picker in terms of reduction in muscular stresses and increase in work efficiency.

MATERIAL AND METHODS

Locale of the study:

The study was conducted in grain market in Mullanpur town of Ludhiana district.

Selection of Sample:

For conducting the study, fifteen grain market workers with average to good health status and normal physiological parameters were randomly selected.

Procedure :

To minimize the experimental error, the new tool was given to the workers for one day to become familiar with it. In order to collect the reliable experimental data, the selected workers were given enough of rest before putting them on selected task. The activity was performed by the workers using both the traditional tool and improvised tool for half an hour each.

Muscular stresses:

Muscular stresses during the performance of the activity were measured with the following methods.

Grip strength :

Grip dynamometer was used to measure the grip muscular strength during rest and after the activity. Grip dynamometer consists of a handle for handgrip connected with a spring to a pointer on a marked dial. The subject was asked to pull the handle separately with right and left hand before and after the work and the reading given on the dial in kg was recorded for both the hands.

The fatigue of the grip muscles was calculated by using the following formula:

$$\text{Grip strength in } \% = \frac{Sr - Sw}{Sr} \times 100$$

where,

Sr = Strength of muscles during rest (kg)

Sw = Strength of muscles during work (kg)

Decreased strength of grip muscles after the performance of selected activity was interpreted as grip fatigue of the muscles.

Musculoskeletal discomforts :

To assess the musculoskeletal discomforts and intensity of pain in different body parts after performing the activity, Body Map (Corlett and Bishop, 1976) was used. The intensity of pain reported in each body part was determined on a five point scale ranging from very severe pain to very mild pain. Scores of all the subjects were added to get a total mean score. Score 1 was given to very mild pain and 5 to very severe pain.

Analysis of data:

Simple averages, percentages and mean scores were calculated and the results are presented in the form of tables. Frequencies and mean scores were calculated for analysis of data regarding musculoskeletal disorders.

OBSERVATIONS AND ANALYSIS

The results of the present study are given below:

It can be observed from Table 1 that mean age, height and weight of the respondents were 26.7 years, 158.3 cm and 51.3 kg, respectively. Nearly half of the respondents were doing this work for about 5 years followed by 33.33 per cent respondents who were in this job for 6-10 years and 13.34 per cent of the respondents were doing this work for 11-15 years. Respondents were working for about 8 hours a day. Body Mass Index of the respondents (BMI) unveiled that 73.33 per cent of the respondents had normal body weight and 26.67 per cent of the respondents were underweight.

Table 2 reveals the time and work study of the activity and shows the comparison between the conventional method and improved method. Grain

Table 1 : Physical characteristics of respondents involved in grain picking activity

Sr. No.	Parameters	Mean±SD
1.	Age (Years)	26.7 ± 4.2
2.	Height (cm)	158.3 ± 1.3
3.	Weight (kg)	51.3 ± 9.6
4.	No. of years working in the field	
	Upto 5	8 (53.33%)
	6-10	5 (33.33%)
	11-15	2 (13.34%)
5.	Working hrs/day	8
6.	BMI	
	Underweight (18.5 or less)	4 (26.67%)
	Normal weight (18.5 to 24.99)	11 (73.33%)

picking with improved tool, grain picker, helped in picking more quantity of grain per lift. Weight of grain picked per lift was 4.18 kg with conventional method and with improved method it was 4.63 kg. When working with existing tool, number of lifts made by workers to pick grain were 5 per minute and with improved tool workers could make 7 lifts per minute. Work output per hour was 12 quintals with conventional method which increased to 19 quintals per hour with improved method. Time load was moderate during work with conventional method however working with improved method resulted in fast performance of work. Kaur (2005) in her study also reported that quantity of work done per unit was more with the use of improved tools as compared to traditional tools for grain cleaning and storage activity.

Anonymous (2003) also revealed that the weight of the tea leaves plucked by women had comparatively increased with the use of improved tool (*kilta*) during a specified period of time.

Table 3 unveils that when the activity was performed with the traditional tool, at rest, the grip strength of right and left hand was 28.32 kg and 27.16 kg, respectively, which was reduced to 22.16 kg for right hand and 21.83 kg for left hand after the performance of the activity. Percentage reduction in grip strength for right and left hand was 21.75 and 19.62, respectively.

When the activity was performed with the improvised grain picker, the percentage reduction in grip strength after the performance of the activity in right hand was 14.28% and left hand was 14.23%. The higher reduction in grip strength when working with existing tool may be due to the faulty design of the tool. The results are supported by another study by Anonymous (2003) who also reported that there was decrease in grip strength while the activities like groundnut decortication, maize shelling, cotton picking, cleaning of grains and cutting and bringing fuel wood were performed with traditional tools.

Another study by Kaur (2005) also revealed that there was less decrease in grip strength of both hands with the use of improved tools because of proper grip of handle of grain cleaner.

The intensity of body pain was recorded both during

Table 2 : Time and work study

Sr. No.	Parameters	Conventional method	Improved method
1.	Weight of grain picked/lifted (kg)	4.18	4.63
2.	No. of lifts per min	5	7
3.	Work output/ hr (q)	12	19
4.	Rating for time load		
	Very slow (5)	-	-
	Slow (4)	-	-
	Moderate (3)	3.5	-
	Fast (2)	-	2.6
	Very fast (1)	-	-

Table 3 : Grip strength (kg) of the respondents after working with existing tool and improved tool

	Existing tool		Improved tool	
	Right hand	Left hand	Right hand	Left hand
At rest	28.32 ± 2.45	27.16 ± 2.63	28.36 ± 2.69	27.82 ± 2.18
After the activity	22.16 ± 2.36	21.83 ± 2.39	24.31 ± 2.46	23.86 ± 2.57
Reduction in grip strength (%)	6.16 (21.75)	5.33 (19.62)	4.05 (14.28)	3.96 (14.23)

Table 4: Mean Score of intensity of Musculoskeletal pain felt by the respondents with existing tool and improved tool			
Body parts	Existing tool	Improved tool	Percentage reduction
Neck	3.71	3.42	7.82
Shoulder	3.64	3.12	14.28
Upper arms	3.90	2.72	30.25
Lower arms	3.42	2.21	35.37
Wrist/Hands	4.16	2.01	51.67
Fingers	4.02	1.99	50.50
Upper back	3.42	3.11	9.05
Legs/Calf muscles	3.82	2.90	24.08

the performance of activity with existing tool and improved tool. Mean scores of pain were calculated and the results are presented in Table 4.

The data enfolds that when the activity of picking grains and filling the gunny bags was performed with existing tool, severe pain was felt in wrist/hands (mean score 4.16), fingers (mean score 4.20), moderate to severe pain was felt in leg/calf muscles (mean score 3.82), upper arms (mean score 3.90), neck (mean score 3.91) and shoulders (mean score 3.64). However, with the use of improved grain picker, intensity of pain was reduced in all the affected body parts. In wrist/hands and fingers, pain was reduced from severe to mild (mean score 2.01 and mean score 1.99), respectively. In upper arms, lower arms, calf muscles and shoulders pain was reduced from moderately severe to mild. This reduction in body pains may be due to the reason that the improved grain picker is light in weight and it has a rope/string covered with rubber material to aid in better gripping of the tool and picking of grains comfortably. Grip diameter of the improved grain picker fitted comfortably in the palm. This helped in easy lifting and filling of the grains in the gunny bags and minimized the body discomfort.

Conclusion :

Grain picker helped in picking more grains per lift and performing more lifts per minute. Work output increased as well as time load decreased with the use of improved tool. Hand muscles fatigue was less after working with improved tool as compared to the hand muscles fatigue after working with existing tool. Intensity of pain in affected body parts such as shoulders, upper arms, lower arms, hands and fingers was reduced from severe to mild pain when the activity was performed with improved grain picker. So, it can be concluded that work efficiency increased and muscular stresses reduced with the use of improved tool, grain picker.

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