

International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2023; SP-8(1): 15-17
© 2023 Stats & Maths
<https://www.mathsjournal.com>
Received: 14-10-2022
Accepted: 23-12-2022

Pragya Ojha
Subject Matter Specialist,
Department of Home Science,
KVK, BUAT, Banda,
Uttar Pradesh, India

Poonam Singh
Assistant Professor,
Department of Family Resource
Management, College of
Community Science, ANDUA&T
Kumarganj, Ayodhya,
Uttar Pradesh, India

Rakumari
Subject Matter Specialist,
Department of Home Science
Krishi Vigyan Kendra, Jalaun,
Uttar Pradesh, India

Sarita
Subject Matter Specialist,
Department of Home Science,
Krishi Vigyan Kendra, Lalitpur,
Uttar Pradesh, India

NR Meena
Assistant Professor, Department
of Agriculture Extension, College
of Agriculture, ANDUA&T
Kumarganj, Ayodhya,
Uttar Pradesh, India

Corresponding Author:
Pragya Ojha
Subject Matter Specialist,
Department of Home Science,
KVK, BUAT, Banda,
Uttar Pradesh, India

Assessment of musculoskeletal discomfort and postural stress among the farm women involved vegetable transplanting

Pragya Ojha, Poonam Singh, Rakumari, Sarita and NR Meena

Abstract

Traditional method of transplanting of vegetable seedlings in field is extensively accepted cultivation practice in India and high labor-intensive operations in agriculture. During these operations farm workers are suffered with the high risk of musculoskeletal discomfort and postural stress. Hence, this study aimed to study the postural stress and musculoskeletal problems of the farm women while performing vegetable transplanting operation with traditional method and to reduce their musculoskeletal discomfort with the mechanized method and ergonomically evaluate both the methods. Twenty female subjects with normal health, without any major illness or cardio-vascular problems were selected for the study. The age range of the subjects was 20-55 years. While performing the vegetable transplanting operations with traditional method majority of the women complained Very Severe (75 percent) and severe (55 percent) pain in the different body regions. But reduction in the percentage of women complaining about the musculoskeletal problems was observed with the use of improved methods of vegetable transplanting. The percentage reduction in grip strength was also observed to be lower in improved method (53 percent) compared to traditional method. With mechanized method, the physiological workload and drudgery of farm women can reduce and increase their working efficiency and productivity significantly.

Keywords: Vegetable transplanting, hand grip strength, postural stress, agriculture

Introduction

India is the second largest producer of vegetables after China. In India, transplanting of the vegetable seedlings of different crops depend completely on human labour. In changing scenario of agricultural mechanization, ergonomics plays crucial role for effectiveness of the operation (Kumar *et al.*, 2018) [3]. Vegetable production is labour intensive and can generate 3 - 10 times the employment and income per hectare of land compared to that of cereals like maize. Vegetables also create a number of job opportunities in complementary businesses that arises such as marketing, processing and transportation. The demand for horticultural products is projected to grow significantly in the coming decades, due to an increase in the awareness of their nutritional importance and the resultant increase in their consumption. This offers an opportunity to absorb an ever-increasing unemployed labour force. Manual transplanting of vegetable seedlings in field is a tedious job. It also involves enormous drudgery, as women workers have to work in bending posture in sweltering weather (Singh, 2009) [4]. Musculoskeletal disorder is the leading cause of the occupational ill health. An awkward and static posture has been recognized as a risk factor for work related musculoskeletal problems. While modern mechanized agriculture has eliminated much of the manual work in many sectors, vegetable production throughout the world still involves hazardous repetitive manual labour. The working conditions in vegetable fields are similar around the world in many aspects, and minority workers provide most of the labour; migrant and new immigrant workers in the developed countries, and women farmers in developing as well as in developed countries. Vegetable production is likely to rely on manual labour long into the future. Therefore, the main aim of this investigation was to know the postural stress and an attempt was made to compare the level of musculoskeletal discomfort with conventional and mechanized method of vegetable transplanting.

Materials and Methods

Selection of Subjects

Twenty female subjects with normal health, without any major illness or cardio-vascular problems were selected from Banda district. The age range of the selected subjects was 20-55 years. Care was taken to select the farm women who are non pregnant and perform the agricultural activities regularly. The vegetable transplanting operation was performed for 7:00A.M.12:30 P.M. and 2:00 P.M. to 5:30 P.M. vegetable transplanting was performed by conventional and mechanized method. For conventional method, female agricultural workers were adopted bending posture and perform the activities manually whereas the mechanical vegetable transplanting was done by hand operated vegetable transplanter in standing posture. The detail of specifications of hand operated vegetable transplanter is given in table 1.

Table 1: Specification of hand operated vegetable transplanter.

Name of the Part	Particulars	Measurements
Pipe	Material Used	Stainless steel pipe
	Thickness of the Pipe	2.2 mm
	Weight	2.21 kg
	Height	97.3 cm
Handle	Pipe girth	17 cm
	Length of handle	15 cm
Lever	Handle girth	7 cm
	Lever grip length	14 cm
	Lever grip girth	6 cm
	Space between handle and lever	3 cm
	Length of lever rod	69.1 cm
	Girth of lever rod	1.7cm
	Length of the lever spring	9 cm
Trans-planter outlet	Space between pipe and lever	3.6cm
	Height of the diagonal outlet	9.5 cm
	Width of the diagonal outlet	5.6 cm
	Diagonal opening after lever function	3.8 cm

Musculoskeletal Pain

Pain in musculoskeletal system is recorded by showing the body map to the subjects and asking them to identify the region of any pains/aches in the body parts after the performance of the activity by traditional and improved methods. Five point scales ranging from very mild pain (1) and very severe pain (5) is used to quantify the stress on muscles used in work.

Hand Grip Strength

Grip dynamometer was used to measure the strength of grip muscles before and after performance of the activity. It was measured separately both for the right and left hand and the percentage change in grip strength was calculated using the following formula,

Change in grip strength

$$(\%) = \frac{Sr - Sw}{Sw} \times 100$$

Where, Sr= Strength of muscles at rest

Sw= Strength of muscles after work

Decreased grip strength was interpreted as grip fatigue of the muscles.

Overall discomfort rate (ODR)

ODR was measured on a 10-point visual analogue scale (0- no discomfort, 10-extreme discomfort) that is an adoption of a technique developed by Corlett and Bishop (1976)^[1]. A scale of 70 cm length was fabricated having 0 to 10 digit marked on it equidistantly. A movable pointer was provided to indicate the rating. At the end of each trial, the subjects were asked to indicate their overall discomfort rating on the scale.

Results and Discussion

Physical characteristics of the subjects selected for the study are depicted in table 2. The mean age of the women was 37.03±4.03 years with the height of 149.92±1.80 cms and weight of 52.24±5.14 kgs. The mean blood pressure was observed to be 119.4/80±9.44/7.32. Based on height and weight of the sample the mean Body Mass Index was calculated and found to be 21.04±3.78 Kg/m², which means that the sample belonged to the Normal range. Gandhi *et al.* (2007)^[2] studied ergonomic assessment of bundling activity reported that bundling consisted of three sub-activities *i.e.* collection and preparation of tying material, collection of straws and tying of bundles; out of which tying of bundles was considered as heavy activity due to increasing values in heart rate and energy expenditure.

Table 2: Physical characteristics of the subjects selected for uprooting and transplanting operations

Physical characteristics of subjects	Range	Mean± S.D.
Age	(20-55)	37.03±4.03
Height, cm	(146.11-154.78)	149.92±1.80
Weight, kg	(48.16-55.76)	52.24±5.14
BMI, Kg/m ²	(20.9-24.52)	21.04±3.78
Blood pressure (Sys/Dias), mmHg/mmHg	(108/71-127/91)	119.4/80±9.44/7.32

Table 3 presents the percentage of women experiencing musculoskeletal problems after performing the vegetable transplanting operation with conventional and mechanized methods. While performing the transplanting in traditional method majority of the women complained ‘Very Severe’ and ‘Severe’ pain in neck (55 percent), shoulder (60 percent), upper back (75 percent), lower back (45 percent), upper arm (45 percent), wrist/hands (45 percent), thighs (60 percent), knees (65 percent) and lower legs (55 percent) as they adopted bending and squatting body posture for longer duration and performed the tasks in repetitive motions. Reduction in the percentage of women complaining about the musculoskeletal problems was observed with the use of hand operated vegetable transplanter (mechanized method). Negligible percentage of women experienced moderate pain in neck (80 percent), shoulder (75 percent), upper back (75 percent), lower back (80 percent), upper arm (75 percent), wrist/hands (65 percent) and thighs (65 percent). The percentage of women experiencing pain in thighs (91.67 percent) and shoulder (66.67 percent) also has reduced considerably with the use of mechanized method. Percentage reduction in incidence of musculoskeletal problems by improved technique over the traditional method is depicted in table 3. Awkward posture, lifting, forceful movement and manual work at rapid rate contribute to musculoskeletal disorder (Singh, 2012)^[5].

Table 3: Average incidence of musculoskeletal problems (N=20)

Body parts	Incidence of pain during Transplanting										Percentage reduction in improved over traditional method
	Traditional method					Mechanized method					
	5	4	3	2	1	5	4	3	2	1	
Neck	11 (55)	4 (20)	3 (15)	1 (5)	1 (5)	-	-	2 (10)	2 (10)	16 (80)	60.00%
Shoulder	5 (25)	12 (60)	3 (15)	-	-	-	1 (5)	1 (5)	3 (15)	15 (75)	66.67%
Upper back	2 (10)	15 (75)	3 (15)	-	-	-	-	2 (10)	3 (15)	15 (75)	33.33%
Lower back	6 (30)	9 (45)	5 (25)	-	-	-	-	3 (15)	1 (5)	16 (80)	40.00
Upper arm	4 (20)	7 (35)	9 (45)	-	-	-	-	2 (10)	3 (15)	15 (75)	77.78%
Wrist/hands	4 (20)	9 (45)	4 (20)	-	3 (15)	-	-	2 (10)	5 (25)	13 (65)	71.43%
Thighs	5 (25)	8 (40)	12 (60)	-	-	-	-	1 (5)	19 (95)	-	91.67%
Knees	-	13 (65)	7 (35)	-	-	-	-	3 (15)	2 (10)	15 (75)	57.14%
Lower legs	4 (20)	11 (55)	4 (20)	-	-	-	-	3 (15)	17 (85)	-	25.00%

(Values in parenthesis indicate percentages)

After performing the vegetable transplanting with the mechanized method, the percentage of incidence of musculoskeletal discomfort had significantly reduced in different body regions.

Change in grip strength while performing the vegetable transplanting both with traditional and improved method is

shown in table 4. The grip strength of both hands was reduced after performing the transplanting tasks with both traditional and improved methods. But the percentage reduction in grip strength of left hand was observed as 53.15 percent and of right hand was 18.66 percent which was lower in improved method compared to traditional method.

Table 4: Change in grip strength while performing vegetable transplanting

Parameters	Traditional method		Improved method		Percentage change in improved over existing method	
	Right (Kg.)	Left (Kg.)	Right (Kg.)	Left (Kg.)	Right (%)	Left (%)
After work	18.65	16.01	18.96	17.32	18.66	53.15
Before work	19.65	17.35	19.78	17.97		
Percentage change in grip strength	5.09	7.72	4.14	3.62		

Overall discomfort rating (ODR)

Transplanting is an activity where musculoskeletal problems are very pronounced because the activity is time taking and performed continuously for prolonged hours. The traditional method employs continuous sitting posture which results in

heavy work load and high rate of perceived exertion where as mechanized prototype was used in standing posture and thus resulted in less musculoskeletal problem and work load (Table 5).

Table 5: Overall discomfort rating (ODR), Responses on musculoskeletal problems and perceived exertion experienced by respondents (RPE)

Transplanting Method	ODR	MSP	RPE
Mechanized Method (Hand Operated Vegetable Transplanter)	3.0	Mild pain in different body region	Moderate
Manual Method (Squatting Posture)	8.0	Very Severe pain in different body region	Heavy

Conclusion

In order to ensure health, safety well being and there by enhancing the productivity of agricultural workers and improving the quality of work, it is necessary that farm workers must have the awareness regarding application and use of modern agriculture machines and tools. Vegetable transplanting is the important labour intensive operations, where maximum percentage of women work force in rural areas is dependent for their livelihood. With the application of mechanized methods of vegetable transplanting, the work and work environment can be improved, physiological workload can be reduced in the agriculture and the efficiency and work out put can be improved. Labour cost, time and rate of energy consumption can also be reduced significantly with improved method.

References

1. Corlett EN, Bishop RP. A technique for assessing postural discomfort. *Ergonomics*. 1976;19:175-182.
2. Gandhi S, Dilbaghi M, Bimla. Ergonomic assessment of bundling activity. *International Ergonomics Conference, HWWE; c2007*. p. 26. (Abstr)
3. Kumar V, Parihar NS. Ergonomic evaluation of manually operated single row manual vegetable transplanter.

Journal of Pharmacognosy and Phytochemistry. 2018;7(3):683-68.

4. Singh SP. Physiological workload of women workers in the operation of manual rice transplanters. *Gender, Technology and Development*. 2009;13(2):271-284.
5. Singh LP. An investigation work posture of workers engaged in casting industry: A study in India. *Asian J Managerial Sci*. 2012;1(1):22-27.