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Assessment of musculoskeletal disorders among workers of Chhattisgarh engaged in harvesting of lotus rhizome

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Abstract
At present the farmers don't use any types of harvesting tools believing that it may damage the rhizomes. The lotus rhizome was under the mud at a depth of about 15-30 cm under 30-40 cm depth of water. The traditional harvesting method consists of farmers feeling for the rhizomes using their toes and then digging them out by their hands. The process of harvesting was very tedious, hazardous and drudgery involve. The test was conducted to know various physical problems and pain on body parts of the labour engaged for harvesting of lotus rhizomes in Dhamtari districts among the farmer producer group in 2018-19. The main aim of this study was to investigate postures adopted by agricultural workers during harvesting of lotus rhizome in muddy field and to analyze the causes of discomfort related to those postures. 20 male workers in age group 20-45 were randomly chosen. They were screened for normal with medical investigation. These subjects were used for the traditional harvesting of lotus rhizome. Musculoskeletal disorders (MSD's) are common among the workers. Analysis of MSD's indicates that the workers engaged in lotus rhizome harvesting had exposed that discomfort level was very severe in neck (95%), clavicle (75%), shoulder (90%), fingers (90%), lower back (80%), thigh (75%), foot (75%) and toes (85%) was high when compared with seven other parts. These discomforts may be due to prolonged standing in muddy field and necessitated bending posture.

Keywords: Lotus rhizome, harvesting, traditional method, Musculo skeletal disorder (MSD's), overall discomfort rate (ODR), body part discomfort score (BPDS)

Introduction
Lotus (*Nelumbo nucifera* G.) is a perennial rhizomatous aquatic plant, which is very popular and used as non-conventional vegetable in India, China, Japan and Australia (Wang and Zhang, 2004) [6]. Lotus plant is grown for use as food, medicine and also for cultural and religious activities. Lotus root is the edible rhizome of the lotus plant. Lotus is generally grown in the waterlogged field, and pond. All the parts of the lotus plant like flower, leaves, stem, seeds and rhizomes are thought to have multiple medicinal properties.

The lotus plant is a perennial aquatic plant. In many places of India as well as in Chhattisgarh, lotus cultivation is popular in wetlands like small rivers, ponds, reservoir and lakes due to higher income. In Chhattisgarh rhizome of the lotus plants is called as *"Dhens"* and at some parts of state it is also known *as Kamalgatta* or *Kamal kakdi*. It is very popular and high priced vegetable crop. The major lotus rhizome producing districts of the Chhattisgarh are Raipur, Dhamtari, and Durg but at present the area have been extended to Kabirdham, kanker, Gariyaband, Mahasamund and Balod, where most of the farmers of are cultivating lotus rhizome (Parmanand *et al.* 2019) [3].

According to the International Labour Organization (ILO), the agricultural sector is one of the most hazardous sectors to health worldwide. Agriculture work possesses several characteristics that are risky for health: exposure to the weathers, close contact with the animals and plants, extensive use of chemicals and biological products, difficult working postures and lengthy hours, and use of hazardous agricultural tools and machinery (Donald, 2006) [2]. Agricultural workers involve several strenuous activities like ploughing, spading, carrying, uprooting, planting, weeding, cutting, shafting, threshing, sweeping, etc (Das and Gangopadhyay, 2011) [1].

At present the farmers don't use any types of harvesting tools believing that it may damage the rhizomes. The lotus rhizome was under the mud at a depth of about 15-30 cm under 30-40 cm depth of water. The traditional harvesting method consists of farmers feeling for the rhizomes using their toes and then digging them out by their hands. To know the exact node inside the muddy water the farmers engaged in harvesting uses their toes tip to detect the exact point by experiences. It was again risky and tedious job viewing a chance of snake bite and leech (Jonk) bite inside the muddy soils.

Materials and Methods

Selection of area and sample

Lotus cultivation is the major occupation with 100-150 ha area in *Dheemar* community of the Dhamtari district. Ratnabandha, Mujgahan and Panchvati colony of Dhamtari district were selected for the study. This area was chosen due to the easy accessibility and cooperation rendered by the respondents. Thirty male workers in age group 20-50 were randomly chosen have been selected for the study by random sampling method. They were screened for normal with medical investigation. A well-structured interview scheduled was prepared for testing. The data about their socio economic, occupational status, occupational status, musculoskeletal disorder and recovery pattern was mentioned in questionnaire. The QEC checklist or assessment sheet was prepared which included by questions that need to be answered by the workers. These questions are designed to quantify the exposure risk for the different parts of the body. The posture-related discomfort of the labour engaged in harvesting of lotus rhizome, two methods was used as Follows: (Corlett and Bishop, 1976).

1. Overall Discomfort Rating (ODR) and
2. Body Part Discomfort Score (BPDS)

The body part discomfort score (BPDS) was obtained using "Human graphic" (Fig.1). In this method the body was divided into 16 regions. The intensity of pain perceived in each reported body part was determined on a 5-point continuum. The total BPDS of the subject was the rating multiplied by the number of body parts corresponding to each category. It was the sum of all the scores of the body parts assigned by the subject. Finally, QEC provides 5 categories for estimating the risk level as gives in Table 1.

During the survey from field observation and discussion with farmers and laborers, information was collected regarding traditional harvesting of rhizome. It was observed that those workers worked continuously in awkward postures during certain agricultural activities. They suffered from musculoskeletal disorders (MSDs) in different parts of their body. Analysis of comfort indicates that the workers engaged in lotus rhizome harvesting had exposed that discomfort in neck, clavicle, shoulder, fingers, lower back, thigh, foot and toes was high when compared with other parts. The degree of discomforts varied from moderate to very severe discomfort and more than almost three fourth of the workers report very severe pain in neck, clavicle, shoulder, fingers, lower back, thigh, foot and toes since the activities performed by these workers necessitated frequent bending and long hours of standing in muddy field.

Table 1: Classification of risks level to severity scale

Severity scale	Very low	Low	Moderate	Severe	Very Severe
Action level (Risk level)	1	2	3	4	5

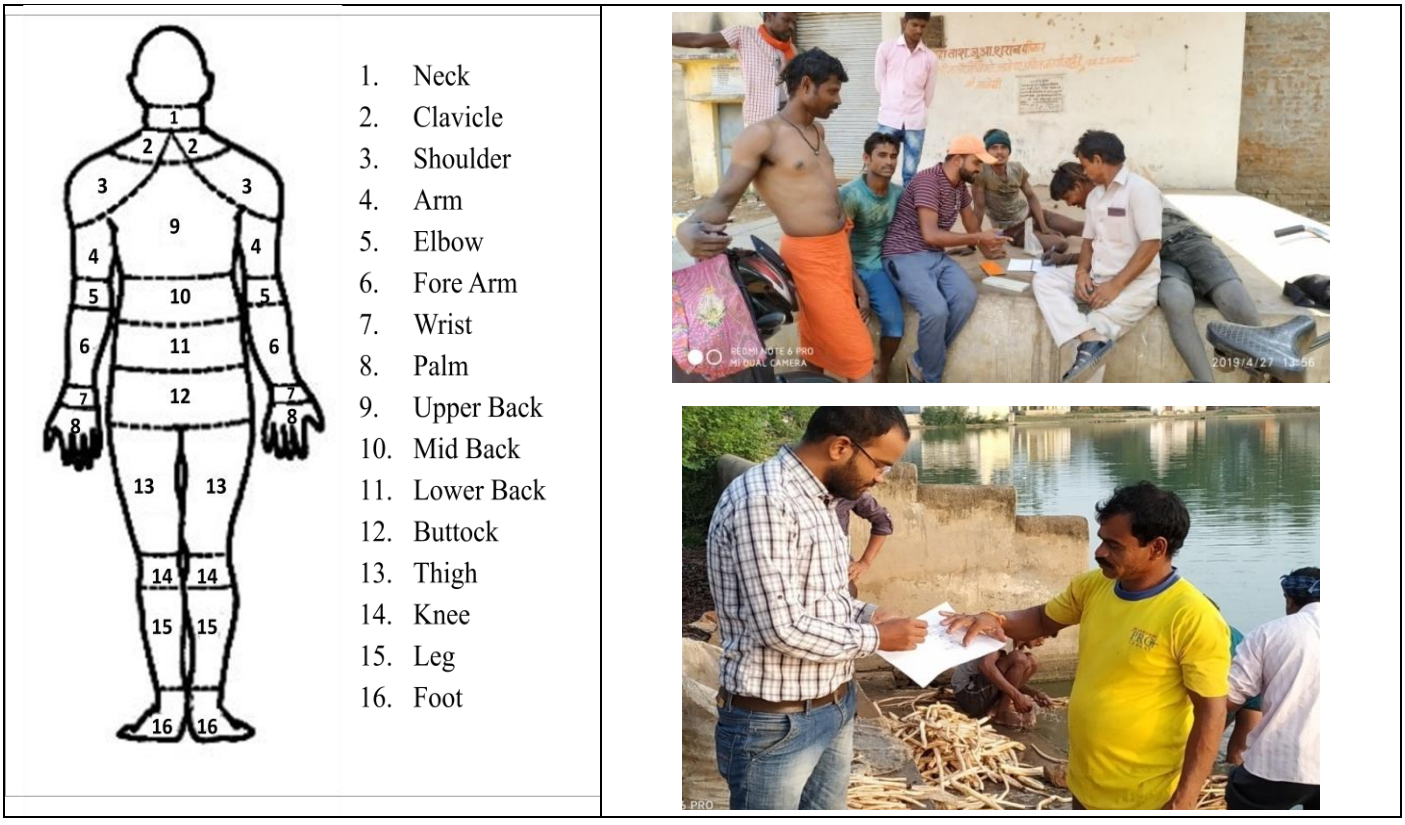

Fig 1: Body map technique for determining musculoskeletal problems and discomfort on body part.

Results and Discussions

The details of the socio economic status of the workers out of the twenty respondent 40% were in the age group of 40-50. The entire respondents were male. Only 10% were illiterate. 75% respondents have working experience of more than 5 year in harvesting of lotus rhizome. All the subjects were right handed, physically fit and were not suffering from any physical anamalities to perform the harvesting of lotus rhizome.

The details of the incidences of pain in their body parts of these subjects along with frequency in parentheses are depicted in Table 3. BPDS (Body Parts Discomfort Score)

were calculated by wattage of for traditional harvesting of lotus rhizome. It was noted that BPDS was found 5 i.e. very severe pains in most of the body parts such as neck (95%), clavicle (75%), shoulder (90%), fingers (90%), lower back (80%), thigh (75%), foot (75%) and toes (85%) was high when compared with seven other body parts. Thus more than 75% workers were responded to the severe pain on the above mentioned body parts.

Table 2: Socio economic status of the workers

S. No.	Particulars		No. of Workers (N=20)	Percentage
1	Age (in years)	< 30	4	20
		30-40	5	25
		40-50	8	40
		50-60	3	15
		> 60	0	0
2	Gender	Male	20	100
		Female	0	0
3	Education Status	Illiterate	2	10
		Primary School	10	50
		Secondary	5	25
		High School	3	15
4	Experience (in years)	< 5	5	25
		> 5	15	75

Table 3: Distribution of workers according to their incidences of pain in their body parts (N=20) by traditional lotus rhizome harvesting method.

S. No	MSD in various body parts	5	4	3	2	1	BPDS
		f (%)	f (%)	f (%)	f (%)	f (%)	
1	Neck*	19 (95)	1 (5)	0	0	0	6.60
2	Clavicle*	15 (75)	5 (25)	0	0	0	6.33
3	Shoulder*	18 (90)	2 (10)	0	0	0	6.53
4	Arm	7 (35)	9 (45)	4 (20)	0	0	5.53
5	Elbow	9 (45)	5 (25)	6 (30)	0	0	5.53
6	Fore arm	7 (35)	7 (35)	6 (30)	0	0	5.40
7	Wrist	12 (60)	5 (25)	3 (15)	0	0	5.93
8	Palm	14 (70)	4 (20)	4 (20)	0	0	5.87
9	Fingers*	18 (90)	2 (10)	0	0	0	6.53
10	Upper back	3 (15)	2 (10)	2 (10)	13(65)	0	3.67
11	Mid back	4 (20)	8 (40)	5 (25)	3(15)	0	4.87
12	Lower back*	16 (80)	4 (20)	0	0	0	6.40
13	Buttock	1 (5)	1 (5)	2 (10)	16 (80)	0	3.13
14	Thigh*	15 (75)	5 (25)	0	0	0	6.33
15	Knee	2 (10)	12 (60)	6 (30)	0	0	5.07
16	Leg	8 (40)	7 (35)	5 (25)	0	0	5.53
17	Foot*	15 (75)	5 (25)	0	0	0	6.33
18	Toes*	17 (85)	3 (15)	0	0	0	6.47

5-Very Severe, 4-Severe, 3-Moderate, 2-Low, 1-Very Low
Note: Parentheses data are given in % of total subjects

Table 4: Recovery pattern for very severe pain

S. No.	Recovery	Neck	Clavicle	Shoulder	Fingers	Lower back	Thigh	Foot	Toes
1.	Short break	1 (5%)	1 (5%)	8 (40%)	5 (25%)	7 (35%)	4 (20%)	1 (5%)	1 (5%)
2.	Overnight rest	6 (30%)	6 (30%)	3 (15%)	6 (30%)	2 (10%)	6 (30%)	6 (30%)	6 (30%)
3.	Medical consent	3 (15%)	6 (30%)	3 (15%)	4 (20%)	1 (5%)	3 (15%)	2 (10%)	2 (10%)
4.	Pain balm	7 (35%)	2 (10%)	4 (20%)	5 (25%)	8 (40%)	5 (25%)	8 (40%)	9 (45%)
5.	Taking pain reliving pills	3 (15%)	5 (25%)	2 (10%)	0 (0%)	2 (10%)	2 (10%)	3 (15%)	2 (10%)

The recovery pattern of pain in their body parts of these subjects along with frequency in parentheses are depicted in Table 4. It was found that they are compelled to carry out a considerable number of manual, rigorous tasks in fields. The recovery patterns used by the workers for very severe discomfort in different regions of the body are short break during harvesting. Sometimes they had to rest overnight or pain balm and pills were also used by the workers.

It was found that body posture was one of the major factor which causes muscular fatigue and discomfort in the body. Uncomfortable body posture in different activities reduces work efficiency, capacity and safety of operator. ODR (Overall Discomfort rate) and BPDS (Body Part Discomfort Score) indicates the effect of awkward posture on body parts. Skin diseases, etching in body, leach (Jonk) bites, snake bites were also noted in different part of the body study (Fig: 2).

Fig 2: Injuries on body parts of labours during traditional harvesting of rhizome.

Conclusions

The major problems among the workers engage for lotus rhizome harvesting was musculoskeletal disorders. Farmers handle heavy workload in muddy fields and awkward postures during excavation of soil and digging of lotus rhizomes which leads to musculoskeletal disorders as well as various skin problems. The above resulted problems may be eradicated by use of appropriate power operated harvester.

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