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Assessment of drudgery of hill farm women through ergonomic considerations

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Abstract
Women play a major role in shaping the economy of the country in rural India. Himachal Pradesh is a small hill state of India in north western Himalaya, where agriculture is the mainstay of population due to low level of industrialization. It is due to small landholdings and men's migration for more lucrative jobs leaving all responsibilities including agriculture on women. Women are normally employed in those operations which are either not mechanized or are least mechanized and these operations involve lot of drudgery. The farm women perform almost each and every agriculture activity right from land preparation, sowing, transplanting, weeding, harvesting and till the post-harvest handling. In vegetable farming women provides the major share of labour for land preparation, weeding and harvesting. The present study was undertaken with the objectives to prepare a drudgery scale of vegetable cultivation and to determine the health status of farm women involved in vegetable cultivation through body mass index (BMI). Weeding was found to be the most drudgery prone activity with maximum physical fatigue with score value of 2.2. Further, mean Rapid Entire Body Assessment score (REBA score - 9.13) also revealed that there was a high risk in the working posture which led to physical fatigue and musculo-skeletal disorders. The average heart rate during all the farming operations i.e. land preparation, weeding activity and harvesting was same and was 107.54 b/min. Thus, knowledge and awareness generation regarding the available tools and technologies among farm worker would be of great help to reduce drudgery and augment productivity.

Keywords: ergonomic, drudgery, weeding, BMI, intervention, Musculo skeletal

Introduction
Himachal Pradesh is a small hill state of India in north western Himalayas. Agriculture is the mainstay of population of this state due to low level of Industrialization. It is due to small landholdings and men's migration for more lucrative jobs leaving all responsibilities including agriculture on women. Thus, rural India is witnessing a process which could be described as feminization of agriculture. India is the second largest producer of vegetables after China. In India about 8.9 million hectare area is under vegetable cultivation with the total production of 156.3 million.

Cultivating vegetables in the traditional way is a hard job and require considerable amount of physical effort through the use of appropriate agricultural equipment and tools. The enhanced production efficiency contributes to the viability of vegetable cultivation. Equipment and tools are necessary for plant propagation, soil preparation, planting, pest and weed control, irrigation, harvesting, postharvest handling, storage, and distribution. In addition, land preparation, weeding and harvesting of vegetable by conventional method, would be hard as they involves a considerable amount of drudgery which in turn results in rise of physiological as well as psychological stresses. These factors show the need for mechanization of vegetable cultivation method (Javidan *et al*. 2012) [5]. Human energy measurement is important because whenever the physical capacity of a person is exceeded, it is bound to cause considerable fatigue and reduction in the efficiency of operation with repetitive work with their bodies in fixed and static positions that are even more susceptible to getting work related health problems. Women spend long hours with much labour in respective farming operation resulting in fatigue and drudgery. Thus, there is a need to consider the ergonomic parameters in detail to assess the activity of vegetable cultivation with the following objectives.

- To determine the health status of women involved in vegetable cultivation
- Ergonomic assessment of hill farm women involved in the vegetable cultivation

Methodology

The present study was conducted in two villages i.e. Ghad and Pantehar of Panchrukhi block of Kangra district of Himachal Pradesh, because most of the women were involved in the vegetable cultivation activity in the selected areas. Random sampling technique was used for selecting the locale of the study, while proportional allocation method was used for selecting the sample size of women who were involved in vegetable cultivation. For collecting the relevant data as per the objectives of the study, an interview schedule was prepared. Interview schedule consisted of general information regarding age, occupation and socio-economic status of the respondents, profile of the agricultural work, along with questions/ observations regarding the physiological parameters of the respondents in existing working conditions in terms of heart rate, energy expenditure, rated perceived exertion (RPE Scale), total cardiac cost of work (TCCW), physiological cost of work (PCW) and their musculoskeletal problems while carrying out the various farm operations involved in vegetable cultivation.

Result and Discussion

Tools used in vegetable cultivation operations

Data pertaining to traditional tools/methods and improved tools used in the vegetable cultivation is given in Table 1 and the data revealed that cent percent respondents used traditional tools/methods for preparatory tillage, manuring, sowing, transplanting, harvesting and storage. Majority of the respondents (60.00%) used traditional tool for weeding as compared to 40.00 per cent of the respondents who were using the improved tool. These results are in the congruence with Singh and Rathore (2007) [9] who revealed in his study that adoption of improved tools by the farm women is comparatively low as compared to men farm workers due to the rigid attitude of the women farm workers and lack of knowledge regarding the appropriate use and availability of new tools in the market.

Table 1: Distribution of respondents according to traditional/improved tools used in vegetable cultivation operations

N=30

Sr. No	Type of work	Traditional tool		Improved tool	
		Number	Percentage	Number	Percentage
1	Preparatory tillage	30	100.00	-	
2	Manuring	30	100.00	-	
3.	Sowing	30	100.00	-	
4.	Transplanting	30	100.00	-	
5.	Weeding	18	60.00	12	40.00
6.	Harvesting	30	100.00		
7.	Storage	30	100.00		

Type of tools used for vegetable cultivation practices

Table 2 shows that fawda and kudal were being used for preparing land before sowing by cent percent of the respondents who also carried out the manuring, sowing and transplanting activity manually. The traditional sickle and khurpi were being used by cent percent respondents for harvest and post-harvesting operations. The kudali and traditional sickle was used by 60.00 per cent of respondents for weeding operation while 40.00 per cent respondents were using improved tools i.e. hand fork for weeding operation. The reason being that new improved tool being light in weight will enhance their production in less time thereby helping them to save their energy and maintaining good health. These findings are in line with Kishtwaria *et al*. (2017) [7] that working with improved tools not only enhance the work output but also ensure safety of the women.

Table 2: Distribution of the respondents according to the tools used for vegetable cultivation

N=30

S. No	Type of Activity	Tools used	No of users	Percentage
1.	Land preparation	Fawda and Kudal	30	100.00
2.	Manuring	By hand	30	100.00
3.	Sowing	By hand	30	100.00
4.	Transplanting	By hand	30	100.00
5.	Weeding	Kudali, Sickle Hand fork	18 12	60.00 40.00
6.	Harvesting	Khurpi	30	100.00
7.	Post-harvest	Sickle	30	100.00
8	Storage of harvest	Open	30	100.00

Body Mass Index (BMI) as a health parameter

The Body Mass Index (BMI) is a parameter to quantify the amount of tissue mass in an individual based on which the individual is categorized as underweight, normal weight, overweight, or obese. The BMI scores were interpreted as per the classification given by Garrow (1987).Table 3 reveals that 58.34 per cent of respondents were in normal (18.5-25) BMI category followed by 18.33 per cent of respondents who were overweight, whereas very few i.e. 3.33 per cent respondents were severely underweight. The average BMI was 21.89kg/m^2.This finding is supported by Kishtwaria and Rana (2012) [6]. Health status of the farm women can be ascertained in terms of BMI and the average BMI of sampled hill women was reported as 22.85kg/m^2.

Table 3: Distribution of respondents according to Body Mass Index (BMI)

N=30

Sr. No	BMI category	BMI score	Respondents	Percentage
1.	Severely underweight	Less than 16	1	3.33
2.	Underweight	16-18.5	4	13.33
3.	Normal (healthy weight)	18.5-25	18	58.34
4.	Overweight	25-30	6	18.33
5.	Obese Class I (Moderately obese)	More than 30	2	6.67
Average BMI		21.89kg/m^2		

Cardiovascular responses for weeding operation

Cardiovascular responses such as heart rate and energy expenditure during the activity with respect to working on existing conditions have been depicted in Table 4. It is clear from the table that the resting mean heart rate was 74 b.min^{-1} which increased up to 107 b.min^{-1} during the activity, indicating increase over base as 33 b.min^{-1}. Thus, the per cent increase was 30.84 b.min^{-1}. "t" test was carried out to test the significant increase in heart rate values between rest and during activity and the results was found to be significant (7.06*) at 5% level of significance. Energy expenditure being an derivative of the heart rate showed similar results. The percent increase in the energy expended while carrying out the task was 45.16 kj/min. Further, 't' test carried out to test the significant change in energy expenditure was found to be 7.029* (Significant at 5% level). These results are in line with the results of Aware *et al*. (2016) [1] that the average working heart rate during weeding was 106.97 b.min^{-1}, and the average expenditure was 8.28 kj/min.

Table 4: Distribution of respondents according to their cardiovascular responses during work

N=30

Sr. No	Parameters to measure cardiovascular responses (b.min^{-1})	Cardiovascular responses				't' value
		Existing working conditions				
		At rest	During activity	Increase over base	Per cent increase	
1.	Heart Rate (b.min^{-1})	74	107	33	30.84	7.06*
2.	Energy Expenditure(kj/min)	4.59	8.37	3.78	45.16	7.029*

Note*: Significant at 5% level

Physiological stresses and Physical fatigue

Data enfolded in table 5 shows the total cardiac cost of work, physiological cost of work and physical fatigue of selected respondents while working.

It can be seen that while working average TCCW was 786.24 beats and average PCW was 39.31 b.min^{-1}. Further, the table also shows the average blood pressure during work was 143.23 mmHg (systolic) and 100.7 mmHg (diastolic). The results are in line with the study of Dahiya (2015) [2] on polyhouse farming and found that the average blood pressure during the activity was high with 149.3 mmHg (systolic) and 100.7 (diastolic).

Physical fatigue was estimated by perceived exertion which a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. Although this is a subjective measure, a person's exertion rating may provide a fairly good estimate of the actual heart rate during physical activity. The Varghese RPE (Rated Perceived Exertion) scale has been widely used to study physical fatigue. Table 5 shows that while working average physical fatigue was 2.2. This finding is supported by Gupta *et al*. (2002) [4] who revealed that weeding was the maximum drudgery prone activity with a RPE scale value of 2.1.

Table 5: Distribution of respondents according to their physiological stresses while on existing working condition

N=30

Parameters (Physiological stresses)	Existing working conditions		
	Mean	S.D	S.E
Total cardiac cost of work (TCCW) (beats)	786.24	28.58	±5.22
Physiological Cost of Work (PCW) (b.min^{-1})	39.31	1.42	±.24
Physical Fatigue (based on RPE value)	2.2		
Blood pressure	**At rest**		**During work**
Systolic (mmHg)	120		143.23
Diastolic (mmHg)	80.2		100.7

Distribution of Rapid Entire Body Assessment (REBA) score for existing working conditions

Rapid entire body assessment (REBA) developed by McAtamney and Hignett in 1995 [8] is a tool to analyze the posture that leads to musculoskeletal risks involved in variety of tasks which the women perform.

The mean scores given in the Table 6 shows overall final REBA mean score as 9.13 for existing working condition. On comparing the score in the REBA score sheet, it was found that there was high risk in the working posture of the respondents. Thus change in posture was recommended. These findings are supported by the study on paddy transplanting activity conducted by Devi Laxmi (2011) [3] whose research showed a REBA score of 9.10, which indicated high risk of musculoskeletal disorders.

Table 6: Distribution of Rapid Entire Body Assessment (REBA) score of respondents during weeding

N=30

S. No	Postures	Existing working conditions
		Mean score
1	Final upper arm score	2.53
2	Final lower arm score	1.96
3	Final wrist score	1.96
4	Final wrist and arm score	5
5	Final neck score	2.13
6	Final trunk score	3.36
7	Final leg score	1.9
8	Final neck, trunk, and leg score	6.76
9	Final score	9.13

Note: High risk, investigate and implement change

Conclusion

- Vegetable cultivation in selected area is mainly done by women with traditional tools and methods. After ergonomic interventions the weeding activity was found to be the most drudgery prone work with a high drudgery score.
- Except for the improved hand fork, cent percent of the respondents were using the traditional tools for carrying out the activity of vegetable cultivation.
- Significant percent increase in physiological stresses *viz*. heart rate and energy expenditure were recorded.
- Mean REBA score was found maximum in weeding operation with a value of 9.13 which indicated high risk of the traditional method of activity.
- Thus, the women farmers were imparted awareness trainings right postures to be adopted while performing farm activities and use of improved tools, which were both available in the market and at the block offices.
- The farmers were motivated to use the modified improved new tools

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