



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; SP-11(5): 374-378  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 02-02-2022  
Accepted: 05-03-2022

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## Physiological workload of farm women involved in fetching fodder activities

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### Abstract

Women are not only carriers of human race but civilization and sustainable development rest on them. Their role is quietly appreciated without economic recognition, regard and accountability. The household activities farm women of Uttarakhand do are labour intensive, time consuming, arduous, monotonous, repetitive, manual and within economic return resulting in fatigue and drudgery. This study was conducted to determine the perceived physiological exertion, physiological responses and musculoskeletal problem while doing the activity of fetching fodder collection. The subject included forty farm women of within the age group of 25 to 55 years having the average BMI of 21.87 kg/m<sup>2</sup>, while doing the activity average heart rate, energy expenditure, total cardiac cost of work and physiological cost of work were 129.67 bpm, 11.90 kj/min, 8529.59 beats and 47.92 ppm, respectively. Perceived physical exertion was rated by farm women as “heavy to very heavy”. Incidences of musculoskeletal problem were also very high as farm women reported that they had severe to very severe pain in upper and lower back, neck, head, arm, wrist and fingers.

**Keywords:** Physiological responses; musculoskeletal problem

### Introduction

Women are the lifeline and backbone of every society and if we analyze the women's contribution in history, it is conspicuous that women are the pioneer of all civilization without any recognition. From the dawn of civilization their role is silently appreciated without economic recognition, regard and accountability. Women comprise 50 percent of the population, contribute 75% work hours receive 10% income and 1% share in property (FAO). Women's work remains unrecognized and in unorganized sector of economy despite the fact that their contribution to family is vital. Man received lion's share of income and recognition for their economic contribution, while most of women's work remains unpaid, unrecognized and undervalued because of faulty concept of labour force participation. Household or domestic work is not considered as economic activity, mainly because of its use value than exchange value which indicates reason behind neglect of women's economic contribution to household in particular and society in general. The most striking characteristics of household labour is that, whether employed or not, women continue to do the majority of housework. Women of Meghalaya are not exceptional. The women of this hilly region feel proud of doing agricultural and allied activities along with household chores. Rural women of Uttarakhand make critical contributions to household production and consequently to household and national food security. The majority of rural women take on an increasing share of household labour and their lives are characterized by mounting drudgery. Drudgery of rural women is started at dawn while fetching water from far places in hilly terrain. Their work is labour intensive, monotonous, time consuming, arduous and repetitive which leads to fatigue and drudgery. Drudgery of farm women is an important aspect that has attracted wide attention of researchers. If measured by the extensiveness and intensiveness of their involvement, farm women shoulder much more burden than man. Many of such activities are drudgery prone to varying degree. Even women suffer from different health problems which adversely affect their working efficiency and family welfare. Women have shorter time to rest than men and environmental degradation is increasing women's workload. Considering all the study was envisaged to estimate the physiological workload of hill farm of Uttarakhand, India involved in fetching fodder collection as the activity of firewood collection was considered by hilly farm women as most drudgery prone activity.

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**Material and Methods**

Total of 40 subjects of two age groups (25-35yrs and 36-55 yrs) from Jawahar nagar Udham Singh Nagar district were involved in fetching fodder collection were selected purposively for the study. The subjects who had body temperature not above 99° F, blood pressure 120/80 ± 10, and heart rate 70-90 bpm were selected for the experiments. In order to collect the reliable experimental data, the selected subjects were given enough rest before putting them on selected tasks.

**Methods of Measuring the Physical Characteristics**

Body mass index or Quetlets index was calculated as follows

**Physical fitness or body types were categorized by following Garrow's Scale**

For assessing body composition multiple skin fold anthropometry was used. Measurements of skin fold thickness, the most commonly used technique that determines subcutaneous fat in the body was done at the triceps, biceps, sub scapular and supraeliae skin folds. These measurements were taken to derive body density, per cent body fat, fat weight and lean body mass. The following formulae used to determine the body density, per cent body fat, fat weight and lean body mass

Body density = 1.1599 – (0.0717) x log of sum of 4 skin fold  
 Per cent body fat = (4.95/D – 4.5) x 100  
 Fat weight = Body weight x % fat / 100  
 Lean body mass (kg)= Body weight – Fat weight

**Methods of Measuring the Physiological Parameters**

Heart rate (beats/min) was measured with the help of polar heart rate monitor and recorded at rest, during the entire period of work and recovery thereafter for a period of 5 minutes. Energy expenditure was estimated from average heart rate during rest and during work by using following formula for Indian housewives.

Energy Expenditure (kj/min) = 0.159 X Average heart rate (beats/min) – 8.72

Physiological workload was classified on the basis of working heart rate. Total cardiac cost of work (TCCW) and physiological cost of work (PCW) were determined in this study by using average heart rate during rest and work, recovery heart rate and duration of work and recovery through the following formulas:

Total cardiac cost of work = Cardiac cost of work + Cardiac cost of recovery  
 (TCCW) (CCW) (CCR)

Where, CCW = AHR x Duration of work  
 AHR = (Average working heart rate – Average resting heart rate)  
 CCR = (Avg. recovery heart rate – Avg. resting heart rate) x Duration of recovery

Physiological Cost of work (PCW) =  $\frac{\text{Total Cardiac Cost of Work}}{\text{Total Time of Work}}$

Where, Heart rate maximum = 220 – Age (years)  
 A modified 5-point scale of perceived exertion was used

which is

1. Very light
2. Light
3. Moderately heavy
4. Heavy
5. Very heavy

**Results and Discussion**

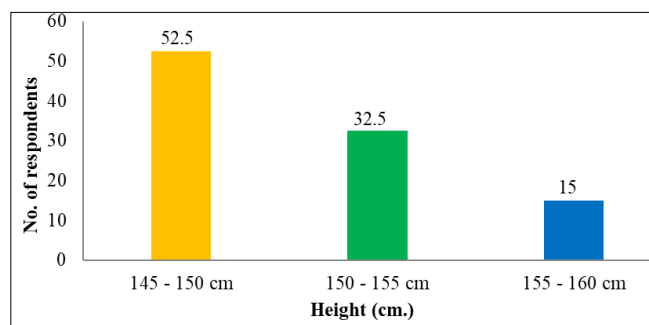
**Table 1:** Physical Characteristics of farm women involved in fetching fodder collection Anthropometric measurement of the respondent (n=40)

S. No.	Anthropometric measurement		Mean	S.D
1.	<b>Height (cm)</b>			
	145 - 150 cm	21 (52.5)	151.1	3.410
	150 - 155 cm	13 (32.5)		
155 - 160 cm	6 (15)			
2.	<b>Weight (Kg)</b>			
	41 - 45 kg	4 (10)	51.525	4.396
	45 - 50 kg	12 (30)		
	50 - 55 kg	18 (45)		
55 - 60 kg	6 (15)			

Figures in parenthesis indicate the percentage

**1. Height (cm)**

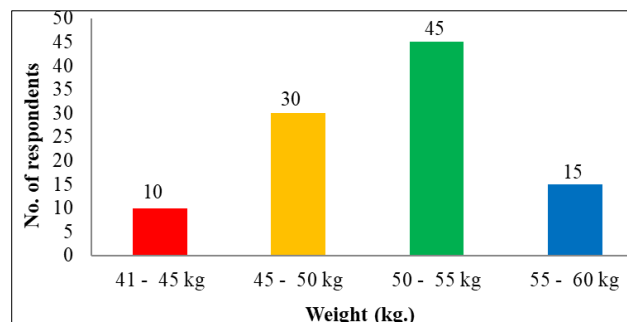
Data revealed that about 52.5 per cent respondents were having height of 145 - 150 cm. It was further stated that nearly (33%) of the farm women were in the category of 150 - 155 m. Only 15 per cent were in the category of 155 - 160 cm. The data showed that maximum respondents had height which ranged from 145 -150 cm.



**Fig 1:** Distribution of the farm women by their height

**2. Weight (kg)**

Data showed that 45 per cent respondents were having the weight of 50 - 55 kg. It was also found that 30 per cent women were having weight of 45 - 50 kg, whereas, 15 per cent were having 55- 60 kg weight. Only 10 per cent of the respondents were having weight 41- 45 kg.



**Fig 2:** Distribution of the farm women by their weight

### 3. Body Mass Index (BMI) of the respondents

The body mass index (BMI) is an attempt to quantify the amount of tissue mass in an individual, and then categorize that person as underweight, normal weight, overweight, or obese based on the value. The BMI scores were interpreted as per the classification given by Garrow (1987). Table - 4.2.1.3 reveals that 67.5 per cent of respondent were in normal healthy weight (18.5 - 25) BMI category, followed by 12.5 per cent of respondents were overweight, whereas 7.5 per cent of the respondents were underweight. Very few i.e. 2.5 per cent respondents were severely underweight. The average BMI was 21.87 kg/m<sup>2</sup>. The findings is supported by Kishtwariya and Rana (2012) which stated that health status of the farm women was ascertained in terms of BMI and the average BMI was reported 22.85 kg/m<sup>2</sup>.

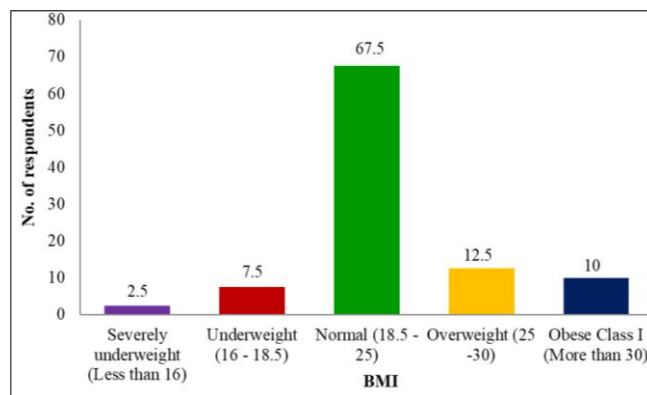
**Table 3:** Distribution of respondents according to Body Mass Index (BMI) (n=40)

BMI category	BMI score	Respondents
Severely underweight	Less than 16	1 (2.5)
Underweight	16-18.5	3 (7.5)
Normal (healthy weight)	18.5-25	27 (67.5)
Overweight	25-30	5 (12.5)
Obese Class I (Moderately obese)	More than 30	4 (10)
Average BMI = 21.87 Kg/m <sup>2</sup>		

Figures in parenthesis indicate the percentage

The activity of firewood collection was studied in details and presented in Table.3. The table revealed that farm women

covered average distance of 4-5 km per trip of Fetching fodder collection. Farm women carried loads of back side on an average 30.88 Kg, but some of them carried up to 40 kg also. But according to ILO Report the permissible limits of lifting and carrying load for women in comfortable outdoor climatic condition in winter is 20 kg and in warm outdoor climatic condition in summer is 15 kg.



**Fig 3:** Distribution of the farm women by their BMI

### 4. Physiological cost of work of farm women in term of energy expenditure rate

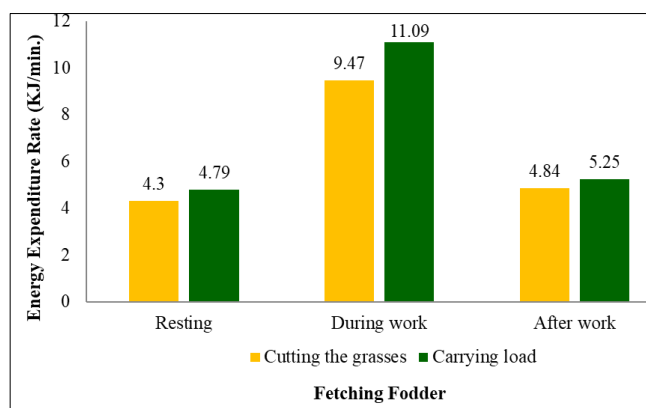
According to the Table - 4.2.4 mean energy expenditure rate (EER) KJ/min and increase in EER from its resting level for various types of activities performed by selected farm women.

**Table 4:** Physiological cost of work of farm women in term of energy expenditure rate (KJ/min) during activities (n=40)

S. No.	Activity profile	Energy Expenditure Rate (KJ/min)			Per cent increase in EER
		Resting	During work	Recovery	
1.	Activity 1 <sup>st</sup> (cutting the grass) n= 40	4.3	9.47	4.84	12.55
2.	Activity 2 <sup>nd</sup> (carrying the load) n= 40	4.79	11.09	5.25	7.14

$$\text{Per cent increase} = \frac{\text{After Activity} - \text{Before Activity}}{\text{Before Activity}} \times 100$$

7.14.



**Fig 4:** Physiological cost of work of farm women in term of energy expenditure rate

Table 4 shows the energy expenditure rate (kJ/min.) of respondents while performing cutting the grasses and carrying load activities.

- In the 1<sup>st</sup> activity per cent increase in energy expenditure rate (EER) found to be 12.55 ranging from 4.3 before work to 9.47 during work.
- For carrying load, the energy expenditure rate (EER) before work was 4.79 Kilojoule/min which increased up to 11.09 KJ/min. during work, with per cent increase of

In the nutshell, it can be concluded that on the basis of energy expenditure of activities (carrying the load) were found to be most strenuous activity, however cutting the grasses, were least exhaustive one.

### 5. Physiological cost of work of farm women in terms of heart rate (beats/minute) during activities

Data enfolded in Table -.5 shows the mean rest, working and recovery heart rate of selected respondents while working. The result of experiments conducted on various farm women (as per activity profile) were analyzed and presented in Table-4.2.5 and figure 4.32 for mean heart rate and per cent increase in heart rate from its resting level. Work performance leads to an increase in the heart rate. The mean resting heart rate ranged as 82 - 85 beats/minutes for various activities. The variations of such responses for different activities are described in Table 4.2.5. Singh and Sarmah (2004) concluded that fetching fuel, fetching of fodder and storing grain, heavy activities in which heart rate was (125 - 150 beats/ min.), light activity like delivering milk (75 - 100 beats/ min.) and light to moderately heavy activity like milling of grains (75 - 125 beats/ min.), it's also dependent upon the distance travelled, time spent, amount of load, posture adopted and mode of carrying load while performing the particular load carrying activity.

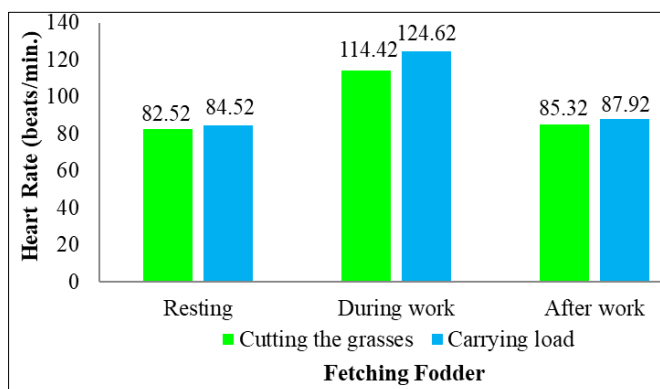
**Table 5:** Physiological cost of work of farm women in terms of heart rate (beats/minute) (n=40)

S. No.	Activity profile	Mean Heart Rate (beats/min)			Per cent increase in heart rate
		Resting	During work	After work	
1	Activity 1 <sup>st</sup> (cutting the grass) n= 40	82.52	114.42	85.32	3.39
2	Activity 2 <sup>nd</sup> (carrying the load) n= 40	84.52	124.62	87.92	4.02

$$\text{Per cent increase} = \frac{\text{After Activity} - \text{Before Activity}}{\text{Before Activity}} \times 100$$

- The cutting the grasses mean heart rate before work, during work and recovery periods was 82.52, 114.42 and 85.32 beats/ minutes, respectively and per cent increase in heart rate was 3.39.

- The mean heart rate at resting level was 84.52 beats/min which increased up to 124.62 beats/minutes during performance, and recovery 87.92 per cent, whereas per cent increase in heart rate was found 4.02 which was maximum in case of carrying the load when all were compared.



**Fig 5:** Physiological cost of work of farm women in terms of heart rate (beats/min.)

Thus on the whole, it can be concluded that there was a marked difference in per cent increase in heart rate for various activities. If farm women who were involved in load carrying activities the per cent increase in heart rate was maximum. On the basis of heart rate it was concluded that the carrying load was more strenuous than cutting the grasses. This finding is supported by Bhagyashri *et al.* (2016) revealed that the average working heart rate during harvesting was observed 107 beats/ min. and average energy expenditure was 8.3

kJ/min.

**6. Physiological cost of work in terms of total cardiac cost of work (TCCW)**

The mean cardiac cost of work, mean cardiac cost of recovery, mean of total cardiac cost of work and physiological cost of work for various types of activities performed by selected respondents.

**Table 6:** Physiological cost of work of in term of total cardiac cost of work (TCCW) during activities (n=40)

S. No.	Activity profile	Cardiac cost of Work (CCW)	Cardiac cost of Recovery (CCR)	Total cardiac cost of work (TCCW) beats/min.	Physiological cost of work (PCW) beats/min
1.	Cutting the grasses	87.3	8.46	287.28	31.92
2.	Carrying the load	110.1	10.2	120.3	13.36

Table-.6 depicts the physiological cost of work on the basis of total cardiac cost of work

- In case of cutting the grasses, mean CCW, mean CCR, and TCCW were 87.3 beats/min, 8.46 beats/ min., and 287.28 beats/min. respectively. Thus the physiological cost faced by the farm women was 33.13 beats.
- For carrying load activities, mean CCW, mean CCR, and TCCW were 110.1 beats/ min, 10.2 beats/min, and 120.3 beats/min. respectively. Thus the physiological cost faced by the farm women was 13.36 beats/min.

In the nutshell, it can be concluded that on the basis of TCCW, activities such as carrying load was found to be most strenuous activity with highest physiological cost of work i.e. 47.46 beats/min, however, activities like cutting the grasses was less exhaustive one.

Thus on the whole it can be concluded from the Table- 4.2.4 to 4.2.6 that in 2<sup>nd</sup> activity which is carrying the load was most strenuous activity with highest physiological cost of

work in term of blood pressure, heart rate, energy expenditure rate and total cardiac cost. The reason behind this may be that carrying load was for long time and that too in awkward posture which resulted in highest physiological cost of work. Borah, R. *et al* (2014) observed that the average and peak working heart rate values were 104 beats/min. and 107 beats/min respectively during parboiling of rice by conventional method. The average resting heart rate value of rural farm women was 76.22 beats/ min. Similarly, the average and peak energy expenditure values were 7.70 KJ / min. and 8.3 KJ/min respectively. Hence, on the basis of working heart rate and energy expenditure, the physiological workload of parboiling of rice was categorized as moderately heavy. The average total cardiac cost of work (TCCW) and physiological cost of work (PCW) were observed to be 1482 (beats/min.) and 39.58 (beats/min), respectively during parboiling activity with conventional tool. The average rating of perceived exertion (RPE) was 3.2 in 5 point modified RPE scale.

## 7. Rate of perceived exertion (RPE)

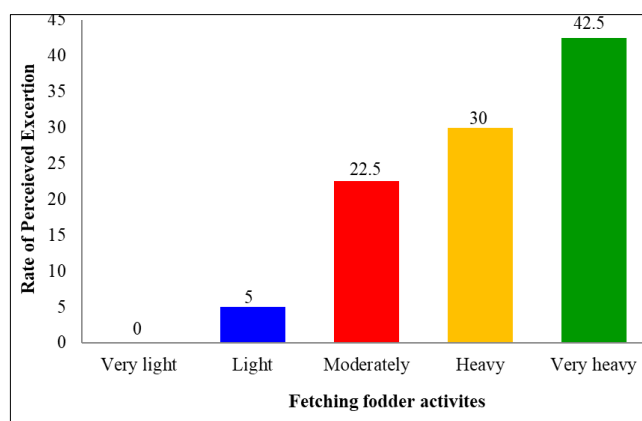
### Perceived exertion rated by respondents

Physical fatigue can be estimated by perceived exertion 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 Rated Perceived Exertion (RPE) scale has been widely used to study physical fatigue. It was perceived that while performing activity of fetching fodder (cutting the grasses and carrying load) was very heavy i.e. 42.5 per cent followed by 30 per cent of the farm women who perceived as heavy. It was also stated that 22.5 per cent perceived moderately heavy and 5 per cent perceived as light.

**Table 7:** Assigned score values for perceived exertion of farm women during activities (n=40)

S. No.	RPE (Variables perceived exertion)	Assigned score	No. of respondents
1.	Very light	5	-
2.	Light	4	2 (5)
3.	Moderately	3	9 (22.5)
4.	Heavy	2	12 (30)
5.	Very heavy	1	17 (42.5)

Figures in parenthesis indicate the percentage values



**Fig 7:** Perceived exertion as rated by respondents

Further, it was concluded that Table- 7 and figure 7 shows that majority of respondent's perceived activity was very heavy with RPE score of 5.

### Conclusion

Studies by different professional groups revealed that women are exploited without any consideration of workload demand, physical fitness, nutritional status and their biological status as they perform a dual role. As a result, the aggregate workload plays on them is so high that it becomes incompatible with their physical fitness leading to fatigue and drudgery and thereby lowering efficiency and impairing health in the long run. Fetching and fodder collection is one of the most drudgery prone activities for women as Cardiovascular Stress Index was higher than many of industrial worker. The body posture can be improved or modified to lessen the drudgery while carrying load. The literature indicates that rural women faced higher risks of morbidity and mortality because of strenuous physical work. Therefore related organizations need to look at the matter and have to form some policies for supplying of alternative for

improving the conditions of farm women.

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