

Ergonomic assessment of traditional method of cotton picking

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■ **ABSTRACT** : Cotton is one of the most important fibres as it plays a key role in the economic and social affairs of the world. Despite huge production of cotton in India, cotton picking is still practiced manually in India and is a tedious and highly laborious work. Cotton picking is one of the major labour intensive operations in cotton cultivation involving major share of expenditure. Since the varieties used in our country require picking at several stages feasibility of using mechanical cotton picker is remote, hence, the only option left is selective picking method. An adult person can pick about 25-30 kg seed cotton per day. Punjab state, being third in its contribution of cotton crop to the national pool indicates intensive involvement of rural women in this activity. They work intensively during a particular season (Oct.- Nov.) which ranges from 50-60 days and spend approximately, 8-9 hours per day in cotton picking activity and constitute majority of labour. Further, they perform this activity with drudgery prone methods thus, putting large demands on their time and energy. Therefore, All India Coordinated Research Project on Home Science, FRM Component of PAU, Ludhiana have done the ergonomic assessment of existing cotton picking practices being performed by women workers. The parameters for ergonomic assessment were working heart rate, energy expenditure and drudgery scores on five point scale. The results revealed that as no improved technology and methods were used/available for cotton picking, this activity was considered as drudgery prone activity by the women workers.

■ **KEY WORDS** : Ergonomic evaluation, Physiological cost of work, Energy expenditure, Drudgery scores

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Rural women in developing countries like India are potentially involved in farm and allied activities. They are employed mostly in drudgery prone activities which include transplanting, weeding, harvesting, grain cleaning, storage etc (AICRP, 2009). But no mechanization has been introduced for women dominated farm operations to reduce their drudgery at work. Drudgery refers to the dissatisfactory and painful experiences that constraint work performance and also affect the health and productive capacity of women. The tools/ implements available have been primarily developed for male workers and given for use to women workers which result in less efficiency and occupational health problems. This is due to the reason that women have different physical needs than men due to their anthropometric requirements, education, experiences, skills etc. Keeping in view the above criteria, an attempt has been made under All India Coordinated Research

Project (AICRP) on Home Science of Indian Council of Agricultural Research (ICAR) New Delhi is to ergonomically evaluate the traditional cotton picking methods being followed by rural women to know the extent of drudgery involved in the methods of cotton picking followed by rural women.

■ RESEARCH METHODS

Ergonomic assessment of existing cotton picking activity was done by using standard ergonomic techniques given by (Oberoi and Singh, 2007).

A sample of 35 rural women for cotton picking activity in the age group of 21-40 years were taken and the health status of the selected women involved in the experiment was assessed by using the following parameters given by Oberoi and Singh (2007).

Health status :

Health status of farm women (respondents) was assessed by using following parameters.

- Body type/composition
- Body mass index (BMI)
- Physical fitness
- Aerobic capacity (VO_2)

The following parameters were used to do the ergonomic evaluation of cotton picking activity :

Heart rate	Polar heart rate monitor
Energy expenditure	$0.159 \times \text{heart rate (bpm)} - 8.72$
Total cardiac cost of work (TCCW)	$CCW + CCR$ (Cardiac cost of work + Cardiac cost of recovery)

Ergonomic evaluation of selected activities involved the following parameters :

- Heart rate :(resting, working and recovery) Beats /min
- Energy expenditure = $0.159 \times \text{heart rate (bpm)} - 8.72$
- Total cardiac cost of work = $CCW + CCR$
- Cardiac cost of work (CCW) = (Average working heart rate- Average resting heart rate) x Duration of activity
- Cardiac cost of recovery (CCR) = (Average recovery heart rate- Average resting heart rate) x Duration of activity.

$$\text{Physiological cost of cost} = \frac{\text{TCCW}}{\text{Total time of work}}$$

Classification of physiological workload :

It was calculated on the basis of heart rate given by (Varghese *et al.* , 1994):

Very light	Upto 90
Light	91-105
Moderately heavy	106-120
Heavy	121-135
Very heavy	136-150
Extremely heavy	Above 150

Parameters used to assess the drudgery experiences :

Following six parameters were used on five point scale

with 1 score for minimum and 5 for maximum :

- Rating on work demand,
- Rating on feeling of exhaustion,
- Rating on posture assumed in work,
- Rating on manual loads operatives,
- Rating on difficulty perception,
- Rating on work load perception.

Drudgery experiences :

- Very demanding (5), demanding (4), moderate (3), less demanding (2), very less demanding (1)
- Very exhausted (5) exhausted (4), moderately exhausted (3), mildly exhausted (2), no exhaustion (1)
- Very painful (5), painful (4), moderately painful (3), mild pain (2), no pain (1)
- Very heavy loads (5), heavy loads (4), moderately heavy loads (3), light loads (2), no loads (1)
- Very difficult (5), difficult (4), moderately difficult (3), easy (2),very easy (1)
- Very heavy (5), heavy (4), moderately heavy (3), light (2), very light (1)

RESEARCH FINDINGS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Ergonomic assessment of cotton picking with traditional method :

The ergonomic assessment of traditional method being used by rural women for cotton plucking was done by using the standard parameters. The in-depth analysis of work process was done and cotton plucking activity was found as the drudgery prone activity. It was observed that rural women were plucking the cotton bolls with finger tips and collected the same in the cloth tied at the back or were collecting the same in the plastic bag/cloth spread at a distance for which they have to go time and again to put the cotton in that cloth when their hands were full of cotton bolls they had plucked (Fig 1). The results of above assessment have been discussed below.



Fig. 1 : Traditional method of picking of cotton

Data given in the Fig. 2 show that the women involved in cotton picking activity have mean age 38 years; height 156 cms; gross weight 55 kg., Lean Body Mass 46 kg., Body Mass Index 27 and VO₂ (ml/kg x min) 33. On the whole, it was observed that more young women were involved in cotton picking activity as this activity is perceived as tiring and difficult to perform by old women.

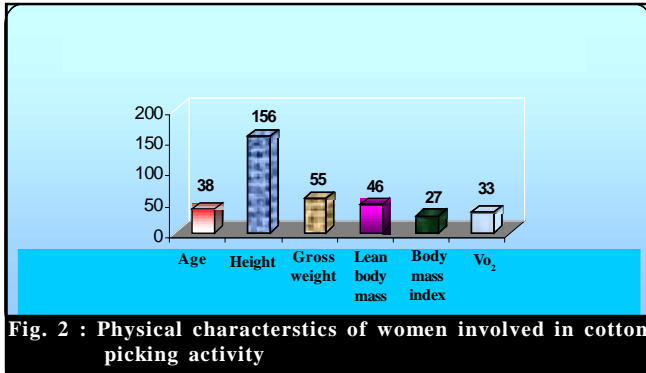


Fig. 2 : Physical characteristics of women involved in cotton picking activity

Health status of respondents :

Health status of the women involved in cotton picking activity was assessed with the help of body type, physical fitness index of the subject, VO₂ and body mass index. The results are highlighted as below:

Fig. 3 shows that maximum of the selected women (75%) had mesomorph body type indicating they had athletic body with well developed musculo-skeletal system.

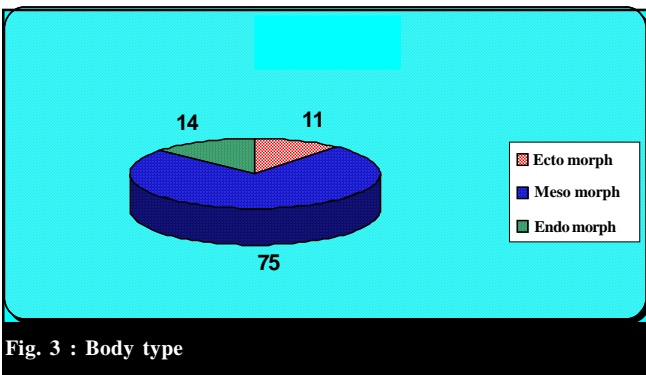


Fig. 3 : Body type

Fig.4 indicates the health status of respondents as per Physical Fitness Index scores given by Varghese *et al.* (1995). It was observed that maximum number of women were having physical fitness of high average category followed by good and low average category.

Physical fitness index :

Fig 5 shows the aerobic capacity of respondents on the basis of Physical Fitness Index VO₂. It was found that maximum number of respondents (31%) were having aerobic capacity of good category followed by high average (24%) and low

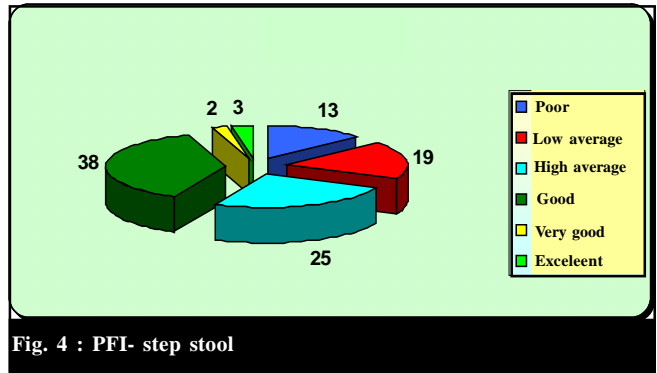


Fig. 4 : PFI- step stool

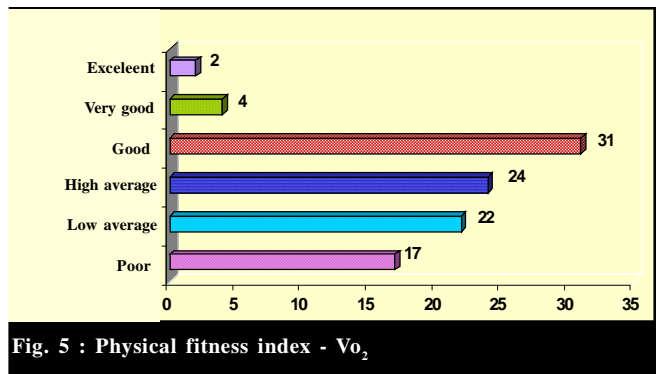


Fig. 5 : Physical fitness index - VO₂

average (22%). Only 2.0 per cent of respondents had excellent aerobic capacity.

Body mass index :

Fig 6 shows that maximum of the rural women belonged to the category of normal body mass followed by obese grade I, critical energy deficiency grade II, critical energy deficiency grade I and low weight. There was no respondent who belonged to the categories of obese grade II and CED grade III..Therefore, it can be concluded that on the whole, the health status of the selected subjects was good and they were not having any major health problem which reduces their work efficiency.

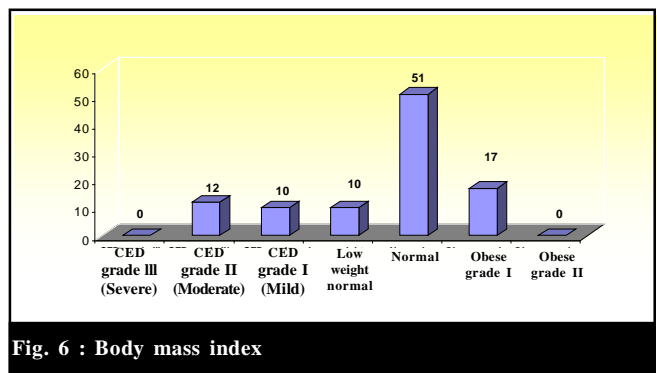


Fig. 6 : Body mass index

Table 1: Ergonomic assessment of existing cotton picking practices followed by rural women

Parameters of ergonomic assessment	Traditional method
Average working heart rate (beats/min.)	96
Average peak heart rate beats/min.)	102
Average energy expenditure (Kj/min.)	6.54
Peak energy expenditure(Kj/min)	7.4
Average TCCW (beats / min.)	480
Average PCW (beats / min.)	8.0
Average work load	Light
Average peak work load	Moderately heavy

Table 2 : Rating on drudgery experience of traditional cotton picking method followed by rural women

Drudgery experience	Traditional method (Scores)
Rating on work demand (Score 1-5)	4
Rating on feeling of exhaustion (Score 1-5)	5
Rating on posture assumed in work (Score 1-5)	4
Rating on manual loads operatives (Score 1-5)	4
Rating on difficulty perception (1-5)	4
Rating on work load perception (1-5)	4

Ergonomic cost of cotton picking activity in terms of average and peak heart rate, were calculated for 35 rural women of Punjab and results for the same have been enclosed in the Table 1. The value of average working heart rate was found to be 96/bpm whereas as value of peak heart rate observed during activity was 102bpm. Average energy expenditure was found to be 6.54Kj/min where as its peak value was 7.4Kj/min. Total cardiac cost of work and physiological cost of work was found to be 480 beats/min and 8.0 beats/min, respectively. On the basis of the value of heart rate, the average and peak work load was found to be within the permissible limits.

Drudgery experience was calculated on the basis of scores gained on different parameters like feeling of exhaustion, posture assumed, perception on manual loads operative, difficulty faced and work load perception. The scores were given to 1-5 indicating very painful/ difficult/ demanding to no pain/ very easy/ very less demanding. It is clear that scores for the drudgery experiences related to all the parameters were found to 4 and more indicating that the activity was really considered as exhaustive, demanding, painful, difficult and heavy in terms of manual work loads by all the women workers. This may be due to the reason that no improved technology and methods were followed by rural women while performing this activity.

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