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**Causes and consequences of Physiological Stress of Women Involved in
Tea Plucking Activity**

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Key Words : Drudgery, Cardiac cost, Physiological stress, Fatigue, Workload

Abstract

The present study was conducted in Kangra district of Himachal Pradesh (India) to study the physiological workload of respondents engaged in plucking tea leaves and identify the major causes and consequences of physiological stress. Majority of the respondents had ectomorph body with average physical fitness. During plucking tea leaves, the body of women workers deviate from natural alignment due to varying height of tea bushes. Hence, a continuous awkward standing posture, adverse environment and working conditions increase drudgery and decrease productivity of women workers. The change in environment temperature caused significantly higher physiological stress to the workers. At average working heart rate values during complete cycle of plucking, the total cardiac cost of work (TCCW=1166.21,108/92.62) and physiological cost of work (PCW=21.43, 21.90 beats) of the respondents in 25-35 and 35-45 years age category showed unacceptable physiological stress of higher workload and fatigue. The regression analysis of physical characteristics that is age, height, weight, body mass index, physical fitness index with heart rate showed that better the physical health lesser is the stress of workload on health of workers.

1.Introduction

Amongst agricultural crops, Kangra is known for tea cultivation in North India, covering about 92 per cent of total area under tea in Himachal Pradesh. The role of women is at forefront as they are deft in tasks related to tea plantation. They spend long hours on wedding, manuring, pruning and especially on plucking from morning till evening. Bhadra (19920 studied the dual role of women in tea plantation society depends on the

complexity of roles, which they perform in socio-economic, cultural, religious and political spheres of life.

The work is being performed in traditional way and in open extreme environment conditions without knowing its impact on health. Due to this back breaking and drudgery prone work, the out put and leisure of the workers decreases and the health is also affected adversely. Thus, keeping in view the most neglected and essentially required aspects of hill women's drudgery due to tea plucking activity the study has been planned with the following specific Objectives;

- 1.To determine the physiological workload of respondents while plucking tea leaves.
- 2.To identify the causes and consequences of physiological stress during plucking tea leaves.

In consonance with specific objectives of the study analogous hypotheses were framed and tested statically:

Ho 1: There is no significant difference in average peak heart rate values of the respondents of both the age groups.

Ho 2: There is no significant relationship between heart rate and environmental parameters for both the age groups

Ho 3:There is no association between heart rate and physical characteristics of the respondents.

Methods

2.1 Sample selection

Multistage random sampling design was adopted to select ten tea growers from two tehsils of Kangra district of Himachal Pradesh. A total sample of 30 women engaged in tea plantation activity was selected in order to achieve the objectives of the present investigation. The observations were recorded with the help of various instruments and scales viz., Polar heart rate monitor, hygrometer, flexi curve, weighing balance, Borg's rating scale, etc.

2.2 Ergonomic analysis of data

2.2.1 Physical fitness index:

PFI = Duration of steeping (seconds) / Sum of 1st + 2nd + 3rd minute recovery pulse count x100

The scores were interpreted for physical fitness using physical fitness index formula by Varghese et al.(1994).

<80 – Poor : 81-100 –Below average : 101-115-High average :116-135-Good
136-150-Very good : >151-Excellent

2.2.2 Total cardiac cost of work (TCCW):

TCCW = Cardiac cost of work +cardiac cost of rest

2.2.3 Physiological cost of work (PCW):

TCCW / Total time taken for activity

2.2.4 Environmental parameters were studied in terms of temperature (⁰C), relative humidity (%) and noise (dB).

2.2.5 Other parameters were postural analysis of lumbo sacral region during the performance of the activity flexicurve and rate of perceived exertion with RPE Scale (1995).

2.3 Statistical analysis

The data were analyzed in terms of frequencies, percentages, mean scores and relational statistics (c²; t-test, correlation and regression and regression) were employed to interpret the data.

Results and Discussion

3.1 Physical characteristics

3.1.1 Age, height and weight

The mean age height and weight of the respondents was 34.63 years , 1.54m and 44.37kg, respectively (Table 1).

Table 1: Physical characteristics of the respondents

S.No.	Variables	Age groups (Years)				Total	
		25-35		35-45		Mean \pm S.E	Range
		Mean \pm S.E	Range	Mean \pm S.E	Range		
1.	Age(Year)	30.13 \pm 3.70	25-35	39.13 \pm 3.01	35-45	34.63 \pm 5.59	25-45
2	Height(m)	1.53 \pm 0.05	1.45-1.6	1.55 \pm 0.05	1.45-1.67	1.54 \pm 0.05	1.45-1.67
3.	Weight(kg)	45.4 \pm 5.652	30-55	43.33 \pm 4.73	34.5-55	44.37 \pm 5.23	30-55
4.	Body mass index (kg/m ²)	19.40	14.27-23.65	18.22	13.82-24.44	18.81	13.82-24.44

3.1.2 Body type

The average body mass index of the respondents was 18.81 kg/m². It was slightly higher (19.40 kg /m²) in case of younger group than elder age group (18.22 kg/ m²). The body type categorized on the basis of body mass index showed that majority of (70 %) the respondents had ectomorph; where as, 30 per cent had mesomorph body types.

3.2 Physical fitness index

The physical fitness of the respondents was assessed on the basis of physical fitness index. Out of total sample, 33.33 per cent belonged to below average physical fitness category. It was followed by 30 per cent in good and 20 per cent in high average category. None of the respondents were found to have excellent physical fitness.

3.3 Physiological stress

Physiological stress of the respondents was determined on the basis of average and peak heart rate, cardiac cost of work, physiological cost of work and rate of perceived exertion while performing the activity.

3.3.1 Heart rate values

The average and peak heart rate value for plucking activity in younger age group was 101.15 and 111.18 b.min⁻¹ and in the elder age group it was 99.99 and 108.40 b.min⁻¹. The peak heart rate for younger age group was 111.18 b. min⁻¹, whereas, for elder group it was 108.40 b. min⁻¹ respectively. The heart rate values for respondents of both age groups were beyond the acceptable limits (Table 2).

Table 2: Average and peak heart rate of the respondents while performing the plucking activity (beats/ minute) (N=30)

S.No	Activity	Age group (years)			
		25- 35		35-45	
		Average	Peak	Average	Peak
1.	Heart rate (b.min ⁻¹)	101.15	111.18	99.99	108.40
2.	Energy Expenditure (kj/min)	7.36	8.96	7.18	8.52

3.3.2 Total cardiac cost and physiological cost of work

The total cardiac cost and physiological cost for complete cycle of plucking was 1166.21 and 23.65 b. min⁻¹. (Younger age group) and 1118.28 and 19.58 b. min⁻¹ for elder age group. These were determined on the basis of heart rate values.

3.4 Causes and consequences of physiological stress

3.4.1 Distance traveled

On an average, the respondents covered a total distance of 1.93 km in the morning and 1.65 km in the evening while plucking. In addition to plucking,

respondents traveled from office to fields and fields to office. Thus, the total distance traveled was 3.11 km in the morning and 2.95 km in the evening.

3.4.2 Postural analysis

All respondents carried out the activity in the standing and bending posture. The angle of bend for younger and elder age group was 195.4° and 190.2° respectively. This might be because while plucking tea leaves respondents had to bend their back according to the height of tea bushes, which varied from bush to bush. They same was reported by AICRP component, Palampur (2001).

3.4.3 Environmental parameters

The mean temperature while performing plucking activity was observed to be 27.97° C to 29.04° C. The mean relative humidity in the environment was found to be 63.013 per cent to 69.21 per cent and the mean noise level in the surroundings varied between 49.45 dB to 50.43 dB.

Ho1: There is no significant difference in average and peak heart rate values of the respondents of both the age groups while plucking tea leaves.

The relationship between age and heart rate value was analyzed with the help of correlation analysis. Data indicated that age and heart rate values of older age group were positively correlated (0.5901*- significant at 5% level). Thus, Ho was rejected for elder age group. Hence, it can be inferred that increase in age affects heart rate while plucking tea leaves during the entire day.

Table 3: Factors affecting average rate of the respondents (Simple linear regression)

S.No	Variables	Equation r^2	25-35yrs. $r^2 \times 100$	Equation r^2	35-45 yrs $r^2 \times 100$
1.	Age(X_1)	$Y_1=94.1105+0.1866X_1$ 0.0094 (0.2512)	0.94	$Y_1=112.1020+0.1217X_1$ 0.0026(0.3125)	0.26
2.	Height(X_2)	$Y_2=69.93335+0.1991X_2$	0.98	$Y_2=41.7447+0.4845X_2$	3.78

		0.0098 (0.2628)		0.0378 (0.3211)	
3.	Weight (X₃)	Y ₃ =125.8128- 0.5689*X ₃ 0.0781* (0.2567)	7.81	Y ₃ =145.7767- 0.6640* X ₃ 0.0692* (0.3198)	6.92
4.	BMI(X₄)	Y ₄ =123.2275- 1.2049*X ₄ 0.0913* (0.4992)	9.13	Y ₄ =146.8510- 1.6232*X ₄ 0.1078* (0.6133)	10.78
5.	PFI(X₅)	Y ₅ =119.4320- 0.1669*X ₅ 0.0720* (0.7887)	7.20	Y ₅ =133.0002- 0.1476*X ₅ 0.0366* (0.0994)	3.66

*- Significant at 5 per cent level Figures in parentheses indicate the standard error.

Ho²: There is no significant relationship between heart rate and environmental parameters for both the age groups during plucking tea leaves.

The effect of environmental parameters on heart rate values for both the age groups was analyzed with help of correlation analysis. Statistically, a positive correlation was observed between heart rate and environmental temperature. The result was found significant for younger age group (0.38657*) at 5% level of significance whereas, elder age group respondents may be more tolerant of it. Thus, it can be inferred that increase in environmental temperature causes more physiological stress in terms of heart rate as well as energy expenditure. Hence, Ho² was rejected. The level of significance for heart rate with relative humidity and noise was found statistically non significant. Thus, Ho was accepted.

Ho³: There is no impact of physical characteristics on heart rate values of tea Plucking respondents.

The effect of various physical characteristics on heart rate values of the respondents was analyzed with the help of regression analysis. Out of all physical characteristics, the maximum variation in heart rate was due to BMI (9.13 %) followed by PFI (7.20%) and weight of the respondents (7.81%) (Table3). The results further

showed that the increase in weight (X3), BMI (X4), and PFI (X5) led to significant decrease in the average heart rate values of the respondents.

4. Conclusion

- The physiological work load of plucking tea leaves was beyond acceptable limits. The various identified causes for this are age, adverse environmental parameters, wrong working habits (improper posture), physical characteristics and physical fitness of the respondents.
- Better the working habits/ conditions for tea plucking activity, lesser will be the physiological stress on women.
- It calls for attention in improvement in working conditions, work habits, better posture and use of simple tools during plucking operation.

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