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Causes and Consequences of Physiological Load of Workers in Grape Cultivation Activities

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ABSTRACT

The aim of this study was to find out the causes and consequences of physiological load of workers in grape cultivation activities. The study was conducted with 15 respondents who were engaged on grapes cultivation activities. Physical fitness was determined by calculating the physical parameters i.e. height, weight, BMI, Ectomorphic, Mesomorphic type body. Maximum respondents were in grape group of above 26 years. Hence, a continuous awkward standing posture and adverse environmental and working conditions increase and decrease productivity of grape orchard workers. The change in environmental temperature and physiological load greatly affect the workers. The physical characteristics comprising age, height, weight, body mass index, physical fitness index play a major role for the physical health and workload of the health of grape orchard workers. The physiological load was found highest for pruning followed by harvesting. The least physiological load was for plant protection.

Keywords: Environment condition, Fatigue, Grape cultivation, Physiological load, Workload

INTRODUCTION

Grape (*Vitis vinifera* L.) is an important fruit crop in India. Grapes are the third most widely cultivated fruit after citrus and banana. Major grape-growing states are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu and the north-western region covering Punjab, Haryana, Delhi, western, Uttar Pradesh, Rajasthan and Madhya Pradesh (Singh, 2010). Agricultural workers carry out several strenuous activities like ploughing, spading, carrying, uprooting, planting, weeding, cutting, shafting, threshing, sweeping, etc. Women also perform such activities especially perform planting, weeding and harvesting (Ponnusamy *et al.*, 2013). Musculoskeletal disorders were common among farmers. Farmers handle heavy workloads often in awkward posture and experiencing some work related problems. They experience high rates of low back, shoulder, hand, knee and upper extremity disorders (Donald, 2006). Grape production is very labour intensive operation i.e. Grape vineyard workers faces high stress on the hands during pruning of the grapevines under highly repetitive conditions (8 to 10 week period of intense and fast-paced work) and also the cumulated duration of exposure over the entire day was high, i.e. approximately 8 to 10 hours per day over a 4-month period. Many tasks such as dormant pruning, shoot suckering and crop harvesting were done repetitively by hand and could result in musculoskeletal disorders (MSD) among the workers. Pruning had also been associated with increased risk of developing cumulative trauma disorder of the wrist among workers. Vineyard rows (about 30 feet long each) was planted 8 to 12 feet apart, with about five vines per row. Pruning one vine takes about 60 seconds. Pruning is carried out by shifts with 8 hours, performing approximately 2400 cuts per hour i.e., about 60 vines per hour, or 480 vines per day (Roquelaure *et al.*, 2002). So keeping in mind the working pattern and working

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conditions the present study was undertaken to assess the causes and consequences of physiological load of workers in grape cultivation activities.

METHODOLOGY

A sample of 32 respondents was selected purposively for the work profile and working condition of workers. A sample of 15 respondents was selected purposively from the randomly selected 2 grape orchards. Out of the six grape orchards selected in phase I Respondents who were physically fit and willing to cooperate and engaged in grape cultivation activity were selected. Physical fitness of the workers involved in grapes cultivation activity was ascertained by measuring the parameters i.e. height, weight, BMI, Ectomorphic and Mesomorphic type body. The height was measured using a stadiometer. A stadiometer is a piece of medical equipment used for measuring height. The stadiometer has a measuring range. Body weight: An accurate portable weighing machine was used for the study to take the weight of the orchards workers. The subject was asked to stand straight on the balance and the weight was recorded in kg with an accuracy of 0.1 kg. BODY MASS INDEX: The condition of the workers was assessed by specifying the different degrees of the underweight expressed as the body mass index (BMI), the weight and height measures was used to calculate the BMI of respondents. Weight in (kg)/ height in (m^2) (Garrow, 1981). The Body mass index was calculated using the standard formula. Accordingly, the health status was defined as follows: i) BMI 20–24.9 (normal); ii) BMI 25–29.9 (overweight); and iii) BMI $\geq$ 30 (obesity). Body Type Quetelet's Index Score Description, Ectomorph 20 Slender, very thin body Mesomorph 20-25 Athletic type body, Endomorph 25 Abdominal physical type. Occupational risk was assessed through physiological parameters. Physiological load was assessed on the basis of (AICRP, 2013). Score sheet was used to assess through the physiological load and time load (Table 4 and 6).

RESULTS AND DISCUSSION

Background profile of the workers of grape orchard

Age: Majority of the respondents (59.3%) in pooled sample belonged to late young age and similar trend was also observed in study districts *viz*., Hisar, Sirsa and Fatehabad.

Physical characteristics of workers in grape cultivation

Mean height and weight of grape workers involved in grape cultivation was 159.9 cm and 64.2 kg respectively. Body mass Index (BMI) was observed as 21.8 kg/m^2 exhibiting that the subjects were having good health.

Table 2: Personal profile and health status of the selected respondents (n=15)

Physical Characteristics	Mean ± SD
Height (cm)	159.9± 8.8
Weight (kg)	64.2±4.7
BMI (kg/m^2)	21.8±1.1

Body type: Majority of the workers (80%) had mesomorphic (Athletic type body) which is considered as the perfect type body type followed by 20 per cent with ectomorphic (cylindrical type thin body).

Table 3: Body type of the selected respondents (n=15)

Body Type	Q.I	F	%
Ectomorphic (Cylindrical very thin body)	<20	3	20
Mesomorphic (Athletic type body)	20-25	12	80

Table 1: Background profile of the workers of grape orchard (n=32)

Variables	Hisar (n=18)	Sirsa (n=8)	Fatehabad (n=6)	Total (N=32)
Age				
Below 18 years (adolescents)	2(11.1)	-	-	2(6.25)
19-25 years (young)	7(38.8)	2(25.0)	2(33.3)	11(34.3)
Above 25 years (late young)	9(50.0)	6(75.0)	4(66.6)	19(59.3)

Physiological load of workers in grape cultivation activities

The physiological load of workers in grape cultivation was assessed and presented in Table 4.

***Land preparation**:* Physiological load factor during various activities land preparation was 4 for the removing of stalks and stubbles and unwanted plants and 2.47 for ploughing by country plough. Mean physiological load factor for land preparation was 3.2.

Table 4: Physiological load of workers in grapes cultivation activities (n=15)

Farm activity	Physio-logical load rating	Physiolo-logical load factor	Mean physio-logical load factor
Land preparation			
Removing of stalks & stubbles unwanted plants	4.00	4.00	3.2
Ploughing	2.47	2.47	
Pruning			
Cutting of undesirable vines	5.00	5.00	5
Manuring			
Transportation of manure	2.4	2.4	2.9
Mixing of manure	2.70	2.70	
Spreading of manure	3.83	3.83	
Irrigation			
Preparation of irrigation channels	4.00	4.00	4
Plant protection			
Covering with net	3.00	3.00	2.3
Spraying	2.00	2.00	
Topping	2.00	2.00	
Harvesting			
Fruit picking	4.27	4.27	3.5
Gathering and heaping	3.00	3.00	
Packaging in polythene	3.33	3.33	
Trimming	3.63	3.63	
Handling and transportation			
Loading of the product	3.67	3.67	3.67

Physiological work load rating: Very light-1, light-2, Moderately heavy- 3, Heavy-4, Very heavy-5

***Pruning**:* Physiological load factor during pruning for cutting of undesirable vines was 5.

***Manuring**:* During manuring transportation of manure got physiological load factor was 2.4 and mixing of manure got 2.70, spreading of manure got 3.83. The mean physiological load factor manuring was 2.9.

***Irrigation**:* Physiological load factor during irrigation for preparation of irrigation channels was 4.

***Plant protection**:* Activities among plant protection include spraying and topping, which got physiological load factor of 2 each. Mean physiological load factor of plant protection was 2.

Harvesting: Fruit picking got physiological load factor of 4.27, gathering and heaping got 3, packaging in polythene got 3.33 and trimming got physiological load factor of 3.63 and Mean physiological load factor of harvesting was 3.5.

***Handling and transportation**:* Physiological load factor in handling and transportation for loading of the product was 3.67. Hannihen (1995) unfolded that excessive musculoskeletal stress at work, specially with static load, as it plays a major role in low back pain, neck and shoulder disorders. Electromyography recording during working conditions has been used to quantify muscular stresses, allowing better designing of work environment to reduce low back pain and neck shoulder tensions. Wrists and neck, shoulder, lower arms and upper back was the frequently used body part in grapes cultivation activities. Pain felt in the other body parts were 'buttocks due to adoption of poor posture for prolonged period.

Occupational risks of workers in grapes cultivation terms of physiological load

Table 5 presents the occupational risks of workers in terms of physiological load. According to physiological load, pruning got first rank and harvesting secured IInd rank. Land preparation obtained IIIrd rank followed by Irrigation which got IVth rank. Handling and transportation got (V) rank followed by manuring with VI rank. Last rank was secured by plant protection (VII rank). Hildebrandt *et al.* (1995) reported that 75 per cent of

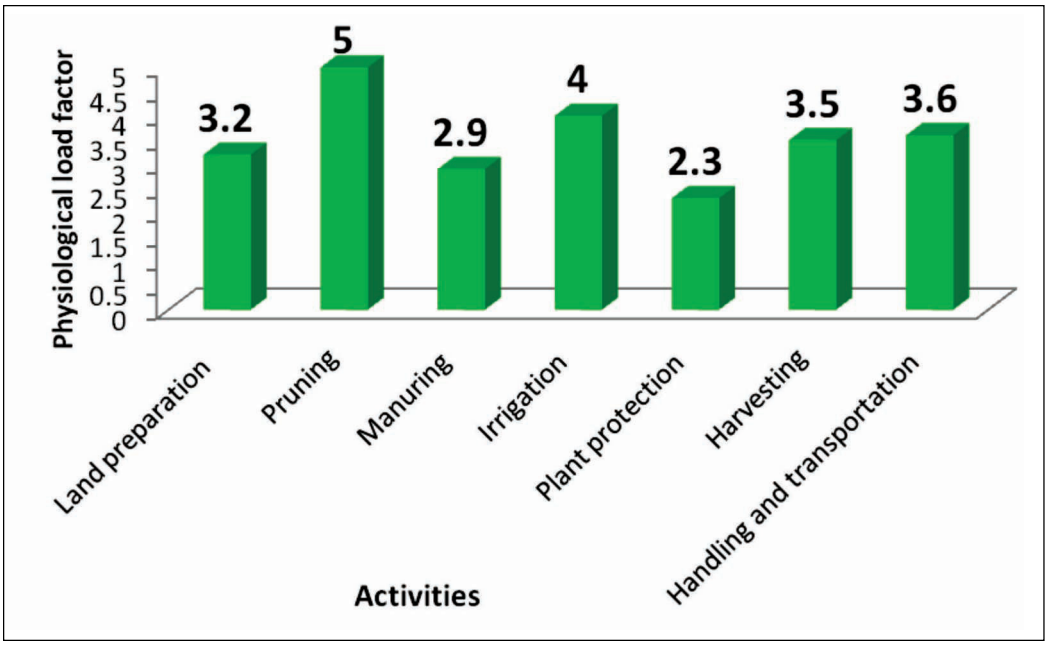

Figure 1: Physiological load of workers in grapes cultivation activities

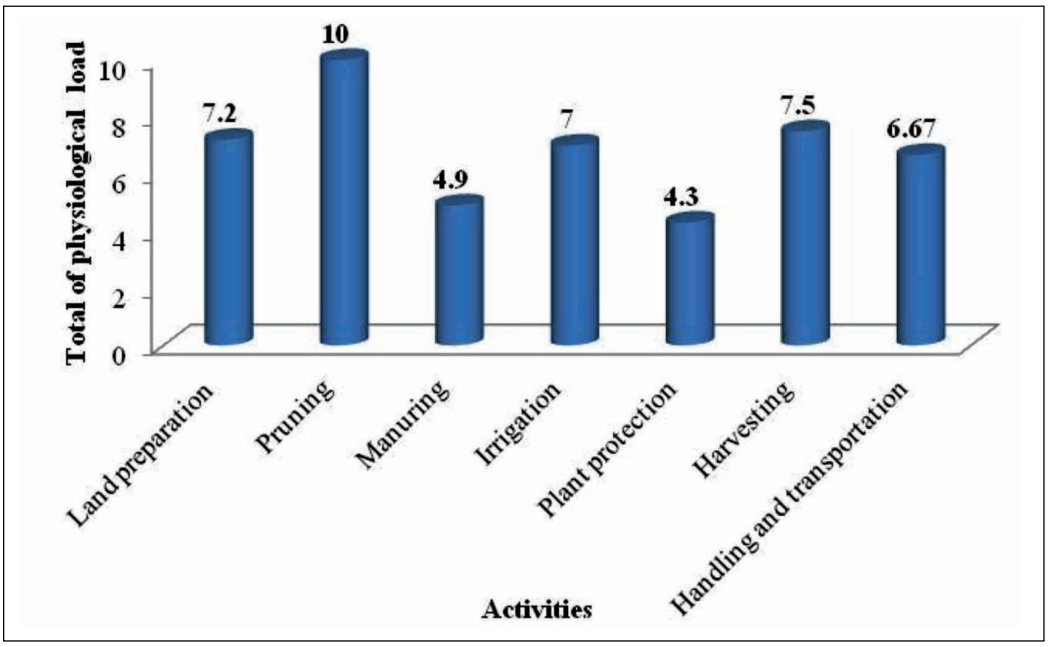

Figure 2: Occupational risks of workers in terms of physiological load

farm workers reported experiencing musculoskeletal symptoms during the previous 12 months.

Time load of workers in grape cultivation

Table 6 presents the time load factor of workers in grape cultivation activities.

***Land preparation**:* Time load factor during various activities of land preparation was 26.5, for removing of stalks and stubbles and unwanted plants and 14 for ploughing by country plough. Mean Time load factor for land preparation was 20.2.

***Pruning**:* Time load factor during pruning for cutting of undersirable vines was 89.

***Manuring**:* During manuring transportation of manure got time load factor was 11 and mixing of manure got 20, spreading of manure got 15. The Mean time load factor for manuring was 15.3.

Table 5: Occupational risks of workers in terms of physiological load

Activities	Physiological load		
	Time Load	Physiological load factor	Total
Land preparation	20.2	3.2	23.4
Pruning	89	5	94
Manuring	15.3	2.9	18.2
Irrigation	25	4	29
Plant protection	34.7	2.3	37
Harvesting	87.8	3.5	91.3
Handling and transportation	58.6	3.67	62.27

Irrigation: Time load factor during irrigation for preparation of irrigation channels was 25.

Plant protection: Activities among plant protection includes spraying and topping which got time load factor of 32.25 and 58 respectively. Mean time load factor of plant protection was 34.7.

Harvesting: Fruit picking got time load factor of 112, gathering and heaping got 65.6, packaging in polythene got 62.6 and trimming got time load factor of 111 and mean time load factor of harvesting was 87.8.

Handling & transportation: Time load factor in handling and transportation for loading of the product was 58.6.

Table 6: Time load of workers in grapes cultivation (n=15)

Farm Activity	Duration / Time						Mean
	Hours/ day	No. of days	No. of man days/ season	No. of labour employed	Work load as per time	Time load Factor (Total score)	Time load factor
Land preparation							
Removing of stalks and stubbles unwanted plants	8	7	3.5	5	3	**26.5**	**20.2**
Ploughing	8	1	1	2	2	**14**	
Pruning							
Cutting of undesirable vines	8	31	31	15	4	**89**	**89**
Manuring							
Transpiration of manure	2	4	1	2	2	**11**	**15.3**
Mixing of manure	4	8	4	2	2	**20**	
Spreading of manure	1	8	1	2	3	**15**	
Irrigation							
Preparation of irrigation channels	8	4	4	5	4	**25**	**25**
Plant protection							
Covering with net	4	2	1	4	3	**14**	**34.7**
Spraying	5	10	6.25	7	4	**32.25**	
Topping	8	20	20	6	4	**58**	
Harvesting							
Fruit picking	8	45	45	10	4	**112**	**87.8**
Gathering and heaping	1	45	5.6	10	4	**65.6**	
Packaging in polythene	1	45	5.6	8	3	**62.6**	
Trimming	8	45	45	10	3	**111**	
Handling and transportation							
Loading of the product	1	45	5.6	4	3	**58.6**	**58.6**

No. of man days: 8 hrs =1 man day

Work load as per time- Very high duration-5, High duration- 4, Moderate- 3, Less duration- 2, Very less duration-1

Conclusively, Pruning was most time consuming activity followed by harvesting Carruth (2002) reported that working on the farms and the size of the farm has found to influence injury rates. Stueland (1997) reported that injuries increased as hours worked per week increased, about 3 percent for every hour worked. Injuries are almost three-times as likely to occur when farm hires work long hours (more than 60 hrs/week) or on farms with large acreage (greater than 30 acres under tillage. Similarly Janowitz *et al.* (2000) reported that vineyard workers face high stress on the hands during pruning of the grapevines under highly repetitive conditions (8 to 10 week period of intense and fast-paced work.

CONCLUSION

Mean height and weight of grape workers in grape cultivation as assessed in three districts of Haryana were 159.9 cm and 64.2 kg respectively. Body mass Index (BMI) was observed as 21.8 kg/m^2. Mean height and weight of grape workers involved in grape cultivation was 159.9 cm and 64.2 kg respectively. The occupational risks of workers in terms of physiological load were highest for pruning followed by harvesting. The least physiological load was for plant protection. Accordingly, appropriate extension interventions should be deployed to increase the work efficiency of workers of grape cultivation.

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