Effect of the Physiological Parameters of Different Age Group Workers on Hoe Weeder

Abstract

Research was done on the influence of physiological characteristics of different age groups on the hoe weeder at an agriculture working field (10 x 10 m2). Physiological indicators such as heart rate, oxygen consumption rate, and energy expenditure rate of workers of various ages (21–24, 25-28, 29–32, and 33–36 years) were measured while working on a hoe weeder in an agricultural field. Age-related increases in heart rate, oxygen consumption, and energy expenditure were seen among agricultural laborers in a 10 × 10 m2 field. The heart rate, oxygen consumption rate, and energy expenditure rate of those aged 21 to 24 were found to be the lowest while working on a hoe or weeder in an agricultural field. The physiological characteristics of the age group operator of 33–36 years were determined to be the same.

Keywords:-Hoe weeder, heartbeat, oxygen consumption, energy expenditure, and age groupings.

1. Introduction

Agriculture is a significant part of the Indian economy, and the primary labor force is human. The population dynamics of Indian agricultural workers are expected to reach around 202 million by 2050, with 121 female workers and 81 male workers (Baruah et al., 2006). Weeding is done with indigenous hand tools such as 'Khurapi' and a spade. Weeding hand tools have recently seen significant improvements. Straight blade hoes and triangular blade hoes produced by blacksmiths and local artisans are commonly utilized. The use of rotary tools such as discs and revolving rods is limited. These tools differ in design from location to area. Despite the availability of technologies, farmers continue to practice hand weeding, which is both labor-consuming and costly. Manually operated weeders are uncommon in India, and farmers do not use them since they are either ineffective or require adaptations. A variety of cutting blades are utilized in manually operated weeders. Where weeders are constantly pushed, a V-shape sweep is desired, and the tool geometry of these cutting blades is determined by soil-tool-plant interactions.

Mechanized weeders are not widely used due to fragmented land ownership. Although numerous manually operated weeders are available, farmers believe they are too heavy when compared to standard hoes.

India's agricultural operations are extremely labor-intensive. Farming operations involve engaging with biological and mechanical processes, and farmers must operate in harsh weather conditions, with restricted equipment and machinery, and in ergonomically suboptimal positions (Kathirvel et al., 2003). ERGONOMICS is formed from two Greek words: ERGO (labor) and NOMOS (rules of law). Ergonomics is a scientific field primarily concerned with understanding human interactions, as well as a scientific design profession that utilizes theory, concepts, data, and techniques to develop and enhance work systems that include jobs and people as an integral system. Ergonomics is a medical investigation of the connection between humans and machines in the workplace (Dewangan et al., 2008).

The appropriate, well-designed machine could not provide the expected performance because human labor was not regarded as an integral component of the man-machine system. Ergonomics was once only important in the military but has now spread to the industrial, agricultural, and consumer sectors (Gite and Yadav, 1989). In general, two methodologies are used to measure the impact of ergonomics in agriculture. The first is a concrete approach relating to the cost-benefit ratio, which is regarded as the most important metric. The second way is intangible, and it is determined by the relevance of factors such as human health, comfort, and work safety. The role of biomechanics is to impress both sides for the advantage of agricultural workers. Most agricultural equipment designers prioritize efficiency and durability over workers' comfort and well-being (Ram *et al.,* 2008). The current study was conducted with the goal of evaluating the physiological characteristics of workers of various ages using a hoe weeder in an agricultural working area.

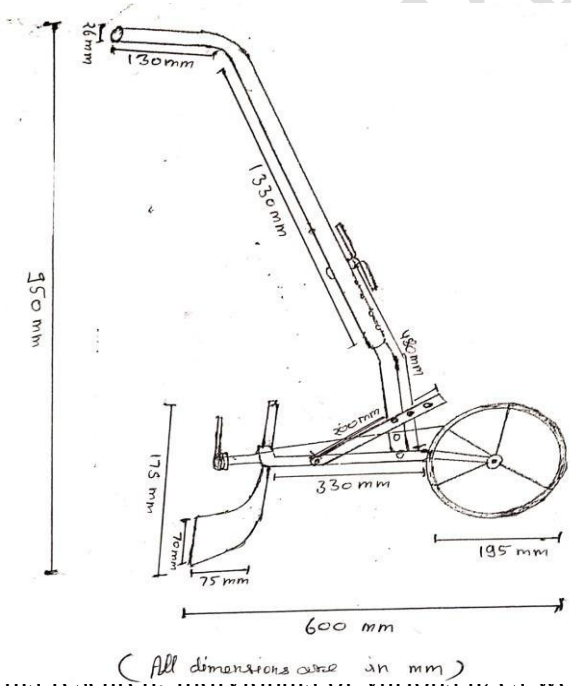
2. MaterialsandMethods

The experimental arrangement for this study was designed to test the ergonomics of a manual hoe weeder. The experimental setup was designed to investigate the physiological and psychological characteristics of workers of various ages using a hoe weeder in the working field area. The experiment was carried out in the agricultural machinery workshop at SHUATS in Prayagraj. **Table 1 provides detailed specifications for the manual hoe weeder.**

Fig.1 Side view of hoe weeder **Fig. 2 View of hoe weeder**

2.1 Selectionofagesubjects

S. No.	Particulars	Specifications
1	Typeof machine	Manualhoeweeder
2	Suitabilyoffield	Vegetablefield
3	OveralldimensionsL×W×H(cm)	184×18×95
4	Type	Singlerow
5	CutterbladeL×W×H(cm)	17.5×7×7.5
6	No.ofgroundwheel	Two
7	Groundwheeldia.	19.5 cm
8	Rimdia.	4.5 cm
9	No.oftine	Singletine
10	Hub length	18 cm
11	Rangeforadjustmentofdepth	5-10cm(hoe)
12	Weightofweeder	4.5 kg
13	Angleofinclinationofhandle	45-65(adjustableaccordingtosuitablyhuman)



It v m certain age categories, were physically healthy, free ging has an effect on maximal aerobic capacity, hea ectional area (Marsh et al, 1999). For the purpose of this research, individuals of various ages were recruited from the available workforce, ranging from 21 to 36 years old.

2.2 Testingofmanualhoeweeder

The work on the farm field area was done with a manually operated hoe weeder. This manually driven hoe weeder, with a working field area of 10 x 10 m2, is mostly utilized by male laborers. It consists of a weeding cutter blade and a wheel that moves the hoe weeder in the desired direction. The operator works in a standing position to weed in the field. It has a handle for manually moving the hoe weeder in the appropriate direction. It is used to trim vegetative sections or uproot and invert weed plants into the soil.

2.2.1 Workingprocedureofworkersonweeding

Workers of various ages (21–24, 25–28, 29–32, and 33–36 years old) were chosen to work on hoe weeders. First and foremost, before operating a manual hoe weeder, ensure that the heart rate of different age groups is constant for 10–15 minutes at rest using a pulse oximeter. Then, a hoe weederwas used to weed an agriculture field (10 × 10 m2) for around 20 minutes. The working heart rate of different age groups was measured at least three times.

2.3 Determinationofvariables

IndependentVariable

1. Differentagegroups=21-24,25-28,29-32,33-36 yrs
2. Agricultureworkingfieldarea=$(10\times10)m^2$

Dependentvariable

1. Heartrate(b/min)
2. Oxygenconsumptionrate(l/min)
3. Energyexpenditurerate(kJ/min)

2.3.1 Hearrate(HR)

The heart rate was monitored and recorded using a heart rate monitor and a pulse oximeter. It was recorded both before and after the weeding operation began.

2.3.2 Oxygenconsumptionrate(OCR)

Singh et al. (2008) provided a generic equation for determining the OCR of workers based on their observed heart rate.

OCR= 0.0114× HR– 0.68..... … (1)

Where,

- OCR refers to oxygen consumption rate in lit/min.
- HR stands for heart rate (beats per minute).

2.3.3 Energyexpenditurerate (EER)

Varghese et al. (1994) provided the following equation, which was used to calculate the EER.

EER=0.159×HR-8.72 ..... … (2)

Where,

- EERstands for energyexpenditurerateinkJ/min.

3. Results and Discussion

The findings of the current inquiry have been described in this chapter. The components included in this research study include analyses and conclusions derived about numerous physical and physiological characteristics. The research concentrates on its aims by delivering findings, and its succinct talks are categorized under the following headings.

3.1 Physiologicaleffectofworkersonhoeweeder

3.1.1 Effect of workers'heart rate while working on a hoe weeder in an agricultural field.

Figure 3 shows the findings of different age groups' heart rates. When individuals' ages increased, their heart rates increased while working on a hoe weeder in an agricultural field. The maximum heart rate of 33-36-year-old workers ranged from 126 beats per minute when working in an agricultural field. Workers aged 21 to 24 had a minimum heart rate of 100 beats per minute under the same settings. Patel and Ram (2020) found similar results.

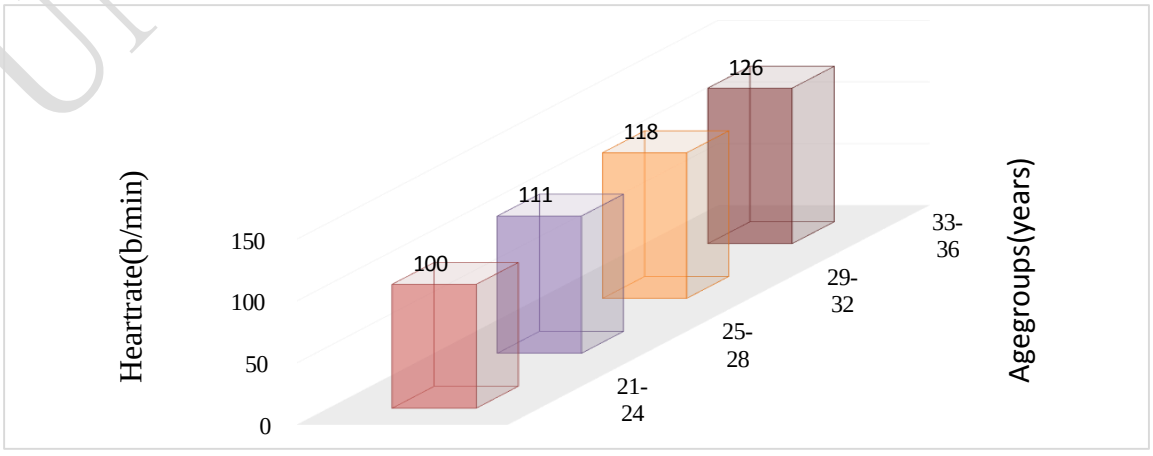


Fig.3Histogram depicting the correlation between age groups and the heart rate of workers while using a hoe weeder in an agricultural field.

3.1.2 Effect of workers' oxygen consumption rate while working on a hoe weeder in an agricultural field.

Figure 4 shows the findings of OCR for different age groups while operating on a hoe weeder. When the respondents' ages grew, there was a rise in OCR while working on a hoe weeder in an agricultural field. The maximum OCR of 33-36-year-old workers varied from 0.76 lit/min when working at different moisture levels in the linseed crop. Workers aged 21 to 24 had a minimum OCR ranging from 0.25 to 0.46 lit/min under the identical conditions. Singh et al. (2008) reported a similar finding.

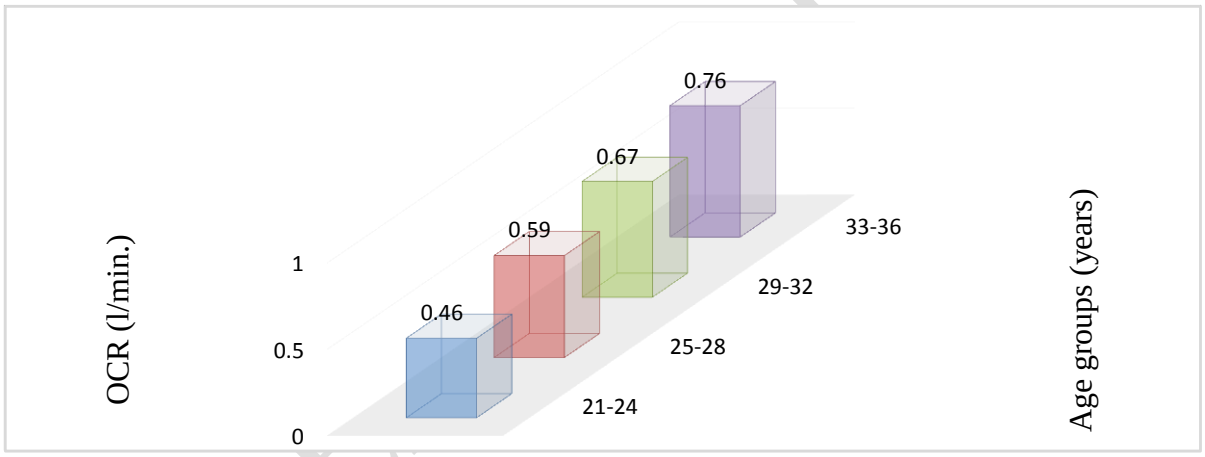


Fig.4 Histogram depicting the correlation between age groups andOCR of workers while using a hoe weeder in an agricultural field.

3.1.3 Effect of workers' energyexpenditurerate while working on a hoe weeder in an agricultural field.

Figure 5 shows the findings of EER for different age groups while operating on a hoe weeder. When the respondents' ages grew, there was an increase in EER while operating on a hoe weeder in an agricultural field. The maximum EER of workers aged 33-36 years varied from 15 kJ/min when working in an agricultural area. The minimum EER of workers aged 21 to 24 years was

9kJ/min under the same conditions. Varghese et al. (1994) reported a similar finding.

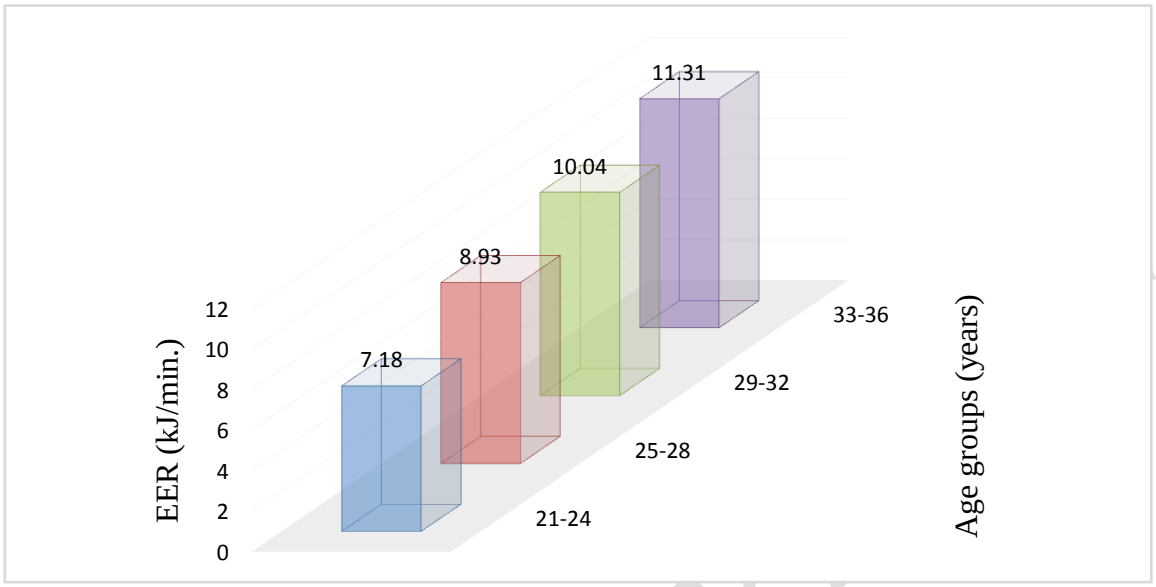


Fig.5Histogram depicting the correlation between age groups andEER of workers while using a hoe weeder in an agricultural field.

4. Conclusions

Hoe weeder was fabricated as parts namely hoe cutter blade, hub, single main frame, handle, V-shape frame, wheels, operational safety, with increasing age groups of subjects, also heart rate increased on hoe weeder during workingon agriculture working field.With increasing age groups of subjects, also oxygen consumption rate increased on hoe weederduring working on agriculture working

field.Withincreasingagegroupsofsubjects,alsoenergyexpenditurerateincreasedonhoeweeder during working on agriculture working field.

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