Perceived Exertion in Brush Cutter Operation

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Abstract:
Brush cutter is a machine widely used for weeding and clearing fields. While operating brush cutter certain amount of vibration is transmitted to human body. Discomfort will adversely affect work performance, either by decreasing the quantity of work, decreasing the quality of work through increased error rates, or both. The mechanical vibration is directly transferred to the body of subjects through both hands and shoulders. The subject has to stand for longer duration and both hands should be held tightly to the handles of brush cutter during brush cutter operation. In this ergonomic study perceived exertion by brush cutter operators were determined with Overall Discomfort Rating (ODR), Overall Ease of operation rating (OER), Overall Safety Rating, and Body Part Discomfort Score (BPDS) and were analyzed.

Keywords: brush cutter, Overall Discomfort Rating, Overall Ease of operation rating, Overall Safety Rating, and Body Part Discomfort Score.

I. INTRODUCTION

Brush cutter is a power tool worn on a shoulder harness consisting of a rotary head with a small circular saw at the end of a boom, for clearing various kinds of brush woods. Brush cutter is sustained by human operator on his shoulders and in the same time on his right foot and controls it with hands. Human operator’s position for the trimming operation is standing and little bended forward. While operating brush cutters, certain amount of vibration is transmitted to human body. Human spine is exposed to vibrational wave from two directions: from shoulders direction and from the right feet direction.

II. PERCEIVED EXERTION

It was generally accepted that many musculoskeletal injuries begin with the worker experiencing discomfort. Borg (1970) argued that perceived exertion was the ‘single best indicator of the degree of physical strain’. Thus the subjecting rating of operation can be measured in terms of:
- Overall Discomfort Rating (ODR)
- Overall Ease of operation rating (OER)
- Overall Safety Rating (OSR)
- Body Part Discomfort Score (BPDS)

2.1 Overall Discomfort Rating (ODR)

A scale of 70 cm length was fabricated having 0 to 10 digits marked on it equidistantly. For the assessment of overall discomfort rating a 10 – point psychophysical rating scale (0 - no discomfort, 10 - extreme discomfort) was used.

2.2 Overall Safety Rating

A 10 - point psychophysical rating scale (0 – completely secure and no fear, 10 – Totally insecure and extreme fear) was used for the assessment of safety rating. At the end of each trial, subjects were asked to indicate their ease of operation rating on the scale.

2.3 Overall Ease of operation rating (OER)

For the assessment of ease of operation, a 10 - point psychophysical rating scale (0 - very easy, 10 – extremely difficult) was used.

3.4 Body Part Discomfort Score.

After each trial, the subjects were asked if he/she suffered any discomfort. If it so, its location is marked by them by indicating a region of body on a diagram similar to that described by Corlett and Bishop (1976) and to describe the extend of discomfort by giving a rating between 1 and 10, where 1 represented ‘no discomfort’ and 10 represented ‘maximum discomfort’

III. MATERIAL AND METHODS

3.1 Location:

The experiment was conducted in the Instructional Farm, KCAET, Tanur, in Malappuram district, Kerala.

3.2 Brush cutter used:

Two types commonly used brush cutters (4 stroke engine and 2 stroke engine) were selected for the study. They are Honda-GX31 (4 stroke, single cylinder) and Redlands-RBC 2522 (stroke, single cylinder).

3.3 Cutter heads

Four different cutter heads used for clearing grass and brush woods viz. Nylon head, 2-blade type, 3-blade type and circular blades were selected for the study.

3.4. Subjects

Three male and three female subjects were selected randomly who are having experience in brush cutter operation. Experimental data were collected in three replications for both male and female subjects for each type of cutter head and type of brush cutter. The brush cutter is operated at same speed and
the subjects were worn safety measures like gloves, shoes, belt, and goggles. The subject was given all the relevant instructions prior to the measurements. The experiment setup was given table 3.1. Forty eight trials were conducted. In each trial subject was given a rest period of 10 minute after operating brush cutter for 20 minutes in real working condition. After every trial subject is instructed to mark the perceived exertion in the scale.

**Table 3.1 experimental Setup**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cutter heads</td>
</tr>
<tr>
<td></td>
<td>Nylon head</td>
</tr>
<tr>
<td></td>
<td>2-blade type</td>
</tr>
<tr>
<td></td>
<td>3 blade type</td>
</tr>
<tr>
<td></td>
<td>Circular blade type</td>
</tr>
<tr>
<td>2</td>
<td>Brush cutter</td>
</tr>
<tr>
<td></td>
<td>2 stroke engine</td>
</tr>
<tr>
<td>3</td>
<td>Subject</td>
</tr>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
</tbody>
</table>

**IV. RESULTS AND DISCUSSION**

**4.1 Overall Discomfort Rating**

The ODR of male and female subjects for operating in brush cutters are given in Fig.4.1 and Fig.4.2. It was found that subjects having moderate discomfort while using different cutter heads on both machines since they have to carry it on shoulders and mechanical vibration is directly transferred to the body through hands and shoulders. The discomfort rate was found to be increasing for cutter heads in the order nylon head, 2-blade, 3-blade and circular blade respectively for both male and female subjects. Also the discomfort rate was found to be higher in brush cutter with 2 stroke engine that of 4 stroke engine.

**Figure 4.1 ODR of male subjects while operating brush cutter**

**4.2 Overall Safety Rating**

The OSR of male subjects while operating brush cutter is presented in Fig.4.3 and for female subjects it is given Fig.4.4. The OSR is similar for brush cutters with 4 stroke and 2 stroke engines. OSR is varying from the range of ‘secure and meager fear’ to ‘moderately secure and less fear’ for male subjects and ‘secure and meager fear’ to ‘slightly secure and moderate fear’ for female subjects. This implies that female workers give more cautiousness in operating machine whereas male workers take it as lighter as possible. Also using nylon heads for brush cutters give more safe feeling for both categories of subjects.

**Figure 4.3 OSR of male subjects for brush cutter operation**

**Figure 4.4 OSR of female subjects for brush cutter operation**
4.3 Overall Ease of operation Rating

Brush cutter with 4 stroke engine and 2 stroke engine has not shown much difference in ease of operation for both subjects. But it is clear that the ease of operation varying for different cutter heads. It varies in the order of nylon head, 2 blade, 3 blade and circular blade. Cutter heads with 3 blade and circular blade shows slight difficulty for both subjects. This may be because of the increase in cutting points for 3 blade and circular blade compared to others. As the number of cutting points increased the force transmitted to the body has also increasing in unit time. The OER of male subjects are presented in Fig 4.5 and for female subjects are presented in Fig 4.6.

![Figure 4.5 OER of male subjects for brush cutter operation](image1)

![Figure 4.6 OER of female subjects for brush cutter operation](image2)

4.4 Body part Discomfort rating

<table>
<thead>
<tr>
<th>Brush cutter</th>
<th>BPDS</th>
<th>Body part experiencing pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 stroke</td>
<td>42.33</td>
<td>Moderate pain in shoulders, neck, right thigh, right wrist and right palm</td>
</tr>
<tr>
<td>4 stroke</td>
<td>38.67</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brush cutter</th>
<th>BPDS</th>
<th>Body part experiencing pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 stroke</td>
<td>47.33</td>
<td>Moderate pain in shoulders, neck, right thigh, right hand buttock and lower back</td>
</tr>
<tr>
<td>4 stroke</td>
<td>44.00</td>
<td></td>
</tr>
</tbody>
</table>

The mean BPDS value for 2 stroke brush cutter was found to be 42.33 and 47.33 for male and female subjects respectively. The mean BPDS values for 4 stroke brush cutter were 38.67 and 44.00 respectively for male and female subjects which are less than that of 2 stroke engine. The subject has to carry whole brush cutter with cutter head in one shoulder and engine is held near to the right thigh. The mechanical vibration is directly transferred to the body of subjects through both hands and shoulders. The subject has to stand for longer duration and both hands should be held tightly to the handles of brush cutter during brush cutter operation.

V. CONCLUSION

Ergonomic studies of two commonly used brush cutter were done at K.C.A.E.T., Tavanur. Four different cutter heads used in the study were nylon head, 2 blade, 3 blade and circular blade. The results are It was found that subjects having moderate discomfort while using different cutter heads on both machines since they have to carry it on shoulders and mechanical vibration is directly transferred to the body through hands and shoulders.

- OSR is varying from the range of ‘secure and meager fear’ to ‘moderately secure and less fear’ for male subjects and ‘secure and meager fear’ to ‘slightly secure and moderate fear’ for female subjects.
- Female workers give more cautiousness in operating machine whereas male workers take it as lighter as possible.
- Brush cutter with 4 stroke engine and 2 stroke engine has not shown much difference in ease of operation for both subjects.
- The ease of operation varying for different cutter heads in the order of nylon head, 2 blade, 3 blade and circular blade.
- The subject has to carry whole brush cutter with cutter head in one shoulder and engine is held near to the right thigh invites some difficulty for the operators.
- The mechanical vibration is directly transferred to the body of subjects through both hands and shoulders. The subject has to stand for longer duration and both hands should be held tightly to the handles of brush cutter during brush cutter operation.

VI. REFERENCES


