

Ergonomic Evaluation of Hand Pounding Activity Performed by Mishing Community of Assam

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Abstract—*De-husking of rice manually using indigenous tool is still prevalent among the mishing tribe of rural Assam. It is carried out by using large pounding tool (large mortars with wooden mallets). One of its most significant features is that only women are engaged in this post-harvest activity. The tool is generally prepared from the timber obtained from the tree named Mesua ferrea, Family-calophyllacea, (Nahar in Assamese). The womenfolk of mishing community irrespective of their height and weight use the heavy tool to dehusk the paddy grains for their daily consumption. As it is a labour-intensive repetitive activity, severe health problems like work-related musculoskeletal disorders (WMSDs) may occur. Keeping this in view, study was undertaken to assess the postural load and identify the body parts discomfort (BPD) of the respondents. The study was conducted in Lakhimpur district of Assam. A total of 98 samples were selected purposively from three villages with probability proportionate to size sampling (PPS) method. OWAS was used for postural analysis and Nordic Body Map (NBM) was used for the assessment of health hazards of women. According to the technique of OWAS postural analysis it was found that posture assumed by the respondents have a distinctly harmful effect on musculoskeletal system. The working methods involved should be changed as soon as possible and the postures were beyond the acceptable limit Further it was revealed that the respondents perceived discomforts in the upper back, mid-back, lower back, left and right wrist, left and right palm, left knee, and right knee. An ergonomic study regarding this arduous activity and an assessment of the traditional tool may further give a scope on intervention to a women friendly tool, which will help the Mishing women to increase their productivity and work efficiency.*

Keywords: *De-husking, Posture analysis, OWAS, WMSDs, Body Parts Discomfort.*

1. Introduction

The Mishings are the second largest indigenous scheduled tribe (plains) group of Assam after the Bodos. They are playing a significant role in the culture and economy of the greater Assamese society in general and tribal society in particular. They are mainly concentrated in the river side areas of Dhemaji, Lakhimpur, Dibrugarh, Tinsukia, Sibsagar, Jorhat, Golaghat and Sonitpur districts of Assam. The main

occupation of Mishing tribe is agriculture but it is at subsistence level. Brown rice (Bao Dhan), a deep water paddy that produces a particular type of iron-rich, is an integral part of Assam's food habits. The rice having a high content of iron, protein, vitamins, magnesium, phosphorus, selenium, thiamine, niacin, manganese and is high in fibre, mostly grown in Dhemaji, Lakhimpur, Sibsagar, Majuli districts of Upper Assam [1]. Brown rice is mostly consumed rice in mishing community that is preferred to be dehusked manually with the wooden tool as milling polished the brown coating of the rice. Mishing women play an important as well as an active role in the tribal society as compared to men. [2]. De-husking of rice manually with the use of indigenous wooden tool is more prevalent among the rural Mishing community of Assam. Only the womenfolk are involved in this pounding activity. It is carried out by a larger mortar and a pestle usually made of wood. In Assamese, Bengal (West-Bengal, India and Bangladesh), this pounding device is called *Dhenki* and is usually operated using foot. [3] In Mishing community; it is known as 'igi' and is hand-operating. The womenfolk of Mishing community irrespective of their height and weight uses the hand tool in daily basis in order to de-husk the paddy grains for their daily consumption. Though with the advent of technologies, many tools are being modified to automation and user-friendly tools, but the women in rural areas still prefer to work with the indigenous tool, due to certain reasons, may be due to the high cost or may be due to unawareness about the advance factors [4]. Likewise, the Mishing women folks use the tool that is very heavy and this may lead to several musculoskeletal problems. Poor working postures have a great impact, which might likely to cause many health problems in the musculoskeletal system in the long run. The pounding activity requires numerous awkward postures throughout the process, which is a risk factor for the Mishing women. The pounding activity is a heavy activity thus the women spend their physical energy in this particular activity.

This will reduce their work efficiency and productivity. Moreover, it is important to know the comparative discomfort level for combinations of postures so that the potential problems may be eliminated before they arise. Hence, a study is required to comprehend the consequences of this activity. Keeping this in view, a study was undertaken to assess the postural load and to identify the body parts discomfort (BPD) of the respondents.

2. Methodology

The Lakhimpur district of Assam was selected purposively for the study. Lakhimpur is divided into two sub divisions viz., North Lakhimpur and Dhakuakhana. The Dhakuakhana division was selected purposively. Under Dhakuakhana sub-division, one block namely Ghilamara block was randomly selected. Three villages under the Ghilamara block namely:- Patirsuk (Village1), Ayengia bargaon (Village2) and Alimur (Village3) was randomly selected, 43 number of samples were selected from the village no (1) consisting of 221 number of households, 35 number of samples were selected from the village no (2) consisting of 183 households and 20 number of samples were selected from village no (3) consisting of 105 households respectively with probability proportionate to size method. Thus, a total of 98 samples were selected for the study. The study is limited to tribal women (mishing community) of Lakhimpur district, who participate in pounding activity. The postural load, was analyzed during the pounding activity, using the OWAS (Ovako Work Posture Analysis System). OWAS is a simple method to verify safety level which related to work posture, and to evaluate risk level which leads to corrective action (Caputo et al, 2006). Moreover, OWAS method is more suitable to examine manual material handling. Nordic Body Map (NBM) was used as a tool to identify Body parts discomfort of the women respondent. Nordic Body Map (NBM) is a body map that can identify parts of muscle or joint which resulted to complaints from the workers.[3] NBM divided body parts into numbering from 0 to 27 which covering from neck to feet using, five point scale of (Corlett and Bishop, 1976). The procedure to apply the OWAS consisted of making observations of the work tasks, modifying the postures, assigning risk categories and proposing corrective actions.

Table 1: Risk categories and proposing corrective actions.

| OWAS scores | OWAS categories | Description |
|-------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Action category I | Work postures are considered usually with no particular harmful effect on musculoskeletal system No actions are needed to change work postures |
| 2 | Action category II | Work postures have some harmful effect on musculoskeletal system. Light stress, no immediate action is necessary, but changes should be considered in future |

| | | |
|---|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Action category III | Work postures have some harmful effect on musculoskeletal system. Light stress, no immediate action is necessary, but changes should be considered in future |
| 4 | Action category IV | Work postures with an extremely harmful effect on musculoskeletal system. Immediate solution should be found to change these postures |

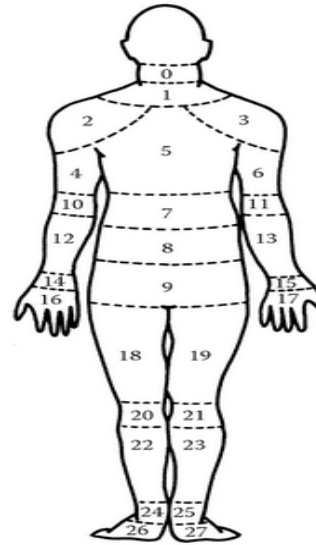


Fig. 1. Nordic Body Map a 5 point rating scale was used

- No discomfort (1)
- Just Noticeable discomfort (2)
- Noticeable discomfort (3)
- Tolerable discomfort (4)
- Intolerable discomfort (5)

3. Results and Discussion

3.1. Details of the activity

It is carried out by a larger mortar and a pestle usually made of wood. There is no uniformity in weight of the hand tool. It was found that majority of the respondents were using the tool of weight 5kg and above. One foot is forwarded to gain a good stance and balance. Both hands are in the middle of the pestle. There should be a balance of strength in both hands and feet. It is lifted light, slightly lean forward and pounded hard. This process must be repeated until the rice comes out completely white. It is a traditional food processing activity of de-husking rice in rural Assam, predominant in the tribal villages. The local people store the paddy grains in jute sacks. Whenever they need rice, the women pound the paddy grains to remove the husk and get rice. The postures involved in carrying the pounding activity are illustrated in the given figures (2, 3, 4).



Fig. 2: The women have to lift the tool, in order to pound the grind the paddy.



Fig. 3. The women holding the tool on one hand and the other hand assuming radial deviation of the palm to collect the grains into the grinding pit.



Fig. 4. The woman adopts the bending posture on her trunk meanwhile, throughout the pounding activity.

3.2. Demographic profile of the respondents

It was clearly revealed that cent per cent respondents were engaged in farming as their main source of income. It was

observed that the Mishing community were highly involved in farming and agriculture. Since they basically involved in farming activities mainly for their family consumption and not for the commercial purpose, their earning in terms of money was found to be less as compared to real income. It was found that majority of the respondents had body weight above 50 kg and height of (165-170cm). Further, it was found that majority of the respondents belonged to the age group of 30-35 years. The study further revealed that majority of the respondents (55.10%) were involved in the pounding activity for more than 10 years and belonged to joint family. It was found that average hours spent in pounding activity was about 2 hours per day. Nearly 52 percent of respondents had rest period for 15-20 minutes, followed by 27.55 percent respondents had rest- break for about 10-15 minutes and 21.42 percent of respondents had rest period of about 20 minutes and above.

3.3 Postural load of the respondents in pounding activity

After keen observation of the activity and understanding the postural load through the OWAS analysis, it was observed that the activity was scored as 3 and the pounding activity falls under the action (category III) shown below. (Table 2), which means work postures have a distinctly harmful effect on musculoskeletal system. The working methods involved should be changed as soon as possible and the postures were beyond the acceptable limit and according to the technique of OWAS postural analysis, the Mishing women assumes combination of awkward posture throughout the activity, awkward posture is the deviation from the natural or neutral position of a body parts. Static postures, manual lifting and carrying, awkward postures during the job are some samples of the risk factors that might result in musculoskeletal illnesses (Meyers, *et al.*, 2001; Nonnenmann, *et al.* 2010).[5] It was observed that two women perform the activity of pounding in a rhythmic manner. For the pounding activity, high forces are required along with assumption of awkward postures. The process consist of different postures like: bending, squatting, standing and stretching. It is possible that over-activation of trunk muscles associated with axial postural tone decreases their responsiveness, which could decrease postural stability. It was observed that the women have to assume a bending posture in pounding activity, which may be a serious risk factor to them. Meanwhile the women bend forward stretching her neck and only one hand to collect the scattered grains to the grinding pit. (Fig.2). Grandjean (1987) reported that the head and neck should be flexed forward by not more than 15 degrees if undue postural stress is to be avoided. There is evidence that frequent or sustained flexion of the head and neck beyond this point is related to chronic neck and shoulder pain.[6]. It was observed that (Fig.3) the back of the respondents are slightly flexed forward during the activity. Lifting the pounding tool in a flexed posture can place unwanted forces on the spine itself. After a while she lift the tool, in order to pound the grain with her maximum force, this goes on in a repetitive, rhythmic manner (Fig.2).

Table 2. Based on OWAS analysis

| Activity | Code | Score | Action category |
|----------|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Pounding | 2241 | 3 | Work postures have a distinctly harmful effect on musculoskeletal system. The working methods involved should be changed as soon as possible |

3.4. Identification of Body Parts Discomfort of respondents in pounding activity

Data revealed that majority of the respondents had tolerable discomfort in the lower back. This may be due to the awkward posture of bending of the trunk portion of the body. From the data presented in the above table (Table II) it was found that the respondents perceived discomforts only in the upper back, mid-back, lower back, left wrist, right wrist, left palm, right palm, left knee, and right knee. This may be due to the awkward posture adopted by the women daily to carry out the pounding activity in their traditional method.

Table 3. Ranking of Body Parts Discomfort faced by respondents in pounding activity

| (N=98) Body parts | No Discomfort (1) | Just Noticeable discomfort (2) | Noticeable discomfort (3) | Tolerable discomfort (4) | Total score | Mean | Rank |
|----------------------|-------------------|--------------------------------|---------------------------|--------------------------|-------------|------|------|
| Mid back | 16 | 28 | 13 | 42 | 279 | 2.84 | VI |
| Lower back | 7 | 14 | 39 | 38 | 304 | 3.10 | III |
| Left wrist | 11 | 22 | 3 | 62 | 312 | 3.18 | II |
| Right wrist | 11 | 7 | 20 | 60 | 325 | 3.31 | I |
| Left palm | 29 | - | 59 | 10 | 246 | 2.51 | VII |
| Right palm | 2 | - | 61 | 10 | 215 | 2.19 | VIII |
| Left knee | 16 | 7 | 31 | 44 | 299 | 3.05 | V |
| Right knee | 16 | 8 | 30 | 45 | 302 | 3.08 | IV |

On the basis of Body Parts Discomfort scale (BPD), discomfort faced by women was ranked accordingly. It was evident from (Table II) that majority of the respondents had right and left wrist pain and had the highest rank (Rank I and II) which might be due to repetitive lifting of the heavy hand tool. The discomfort in the wrist might be due to an inappropriate coupling of the hand tool or different factors like tool circumference may not be an appropriate one. The Mishing women mostly suffered wrist pain that may be a symptom of Carpal Tunnel syndrome, as it is the main form of ergonomic wrist pain that most of the worker suffers if the tool

or the workplace is not compatible with the particular user. The lower back was ranked as (III), it can be concluded that the back pain was due to the awkward posture assumed by the women throughout the activity. The forward bending of the trunk may be the cause of discomfort (Fig.3) as it is known to be poor posture that is likely to contribute in occurring work related musculoskeletal problems. The right knee and the left knee was found to fall under the (Rank IV, V), which comes under the conclusion that knee discomfort may be prevalent due to improper standing. While the discomfort in the mid back (Rank VI) might be due to the poor posture and lastly body parts discomfort was found in the left palm and right palm ranked (VII and VIII) respectively. It can be concluded that it might be due to holding the thick tool tightly and due to high pressure exertion in the hand throughout the activity.

4. Conclusion

It could be concluded that awkward postures result in discomforts in different body parts and are a major factor in the development of pain the mid back, the lower back, left wrist region, the right wrist, left knee, right knee, left palm and right palm. Therefore, findings suggested that further studies in this area can bring contributions in reducing musculoskeletal problems of the forearms and wrist. Ergonomic intervention regarding an appropriate weight of the hand tool for pounding activity is thought to be necessary for the health benefits of the Mishing women. Based on findings, some general recommendations for the ergonomic intervention of the pounding tool may be developed to reduce body parts discomfort and enhance comfort and work efficiency of women in tribal community.

Acknowledgement

The present study was conducted in College of Community Science, AAU, Jorhat-13, Assam, India under the Masters research title, Ergonomic Evaluation of pounding activity with traditional tool (A study in Tribal community) in the Department of Family Resource Management, Faculty of Home Science, Assam Agricultural University.

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