



Musculoskeletal Disorder Faced by Women Workers in Cashew Nut Processing Industries of North-East India

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ABSTRACT In the cashew nut industries, women are mainly involved in cashew nut shelling and peeling activities. The objective of this study was to investigate the occupational health hazards and risk of injury faced by the women workers employed in the cashew nut processing industry. The study was conducted in four cashew nut processing industries: two each in Selsella and Mankachar blocks of Meghalaya and Assam, respectively. Ten female workers from each industry comprising a total of 40 workers, who have normal physiological characteristics, were selected randomly. RULA and QEC tools were used for the assessment of health hazards of the women workers. Discomfort survey was done to investigate the intensity of pain in different body parts. The results of the study showed that the workers of cashew nut industries were exposed to high occupational health and safety risk due to poor working environment, awkward working posture, repetitive and tedious job.

INTRODUCTION

Cashew nut (*Anacardium Occidentale* L.) is an evergreen plant which grows up to 12 meters high and has a spread of about 25 meters. It is a popular cash crop worldwide, and is often known as 'poor man's crop and rich man's food'. In India, cashew nut was initially introduced in Goa, and later expanded to western states of India and southern region of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (Kumar et al. 2012). In the North-Eastern states of India, cultivation of cashew nut is commonly found in Meghalaya, some parts of Assam, and Tripura. The geoclimatic phenomenon of these regions such as sandy loam soil, heavy rainfall along with hilly topography, makes the area suitable for cashew nut cultivation.

Indian cashew nut industries are capable of providing several employment opportunities and support the livelihood of the cashew farmers as the processing of cashew nut needs a huge labor force (Karthickumar et al. 2014). The Indian

cashew nut processing industries have an extensive history of employing an immense number of workers with more than 95 percent of them being women (DCCD 2014; Anonymous 2009). The processing of cashew nut requires passing through a complex procedure of sun drying, roasting, shelling (breaking the outer layer), heating, and peeling of testa to become appropriate for human consumption. However, in parts of India like in Maharashtra stream roasting process is followed in small scale cashew nut processing industries (Mohod et al. 2010). After roasting of the raw cashew, it releases caustic acid which can burn the skin, mouth and tongue if anybody consumes it directly. Therefore, elaborate processes are required to remove the caustic acid from the nut.

In the cashew nut processing industries of Meghalaya and Assam, women are mainly involved in cashew nut shelling and peeling of brown testa for a total of 12 hours from 6 am to 6 pm. The workers get a mere half-an-hour as lunch break, and the monotonous repetitive work usu-

ally results in severe musculoskeletal problems and drudgery. To carry out these activities, the workers have adopted a very unnatural squatting posture. They remain in this position for the entire day seated on a fourfold gunny bag. The unnatural posture makes them suffer from paraesthesia (tingling sensation) in their legs that may gradually lead to many neuro and musculoskeletal problems in the muscles, joints, tendons, ligaments, nerves, and eventually cause back pain, knee pain, arthritis, cervical pain, joint pain, etc. The long static posture of the worker demands high physiological cost and low productivity.

Objective of the Study

To investigate the occupational health hazards and risks of injuries faced by the women workers employed in shelling activity in the cashew nut processing industry.

METHODOLOGY

A total of four cashew nut processing industries, two each from Selsella and Mankachar block of Meghalaya and Assam, respectively were selected purposively. In order to determine the samples for this study, 10 female workers from each industry comprising a total of 40 workers, whose maximum body temperature was 99° F, blood pressure and heart rate within the maximum range of 120/80±10 and 70-90 bpm, respectively were randomly selected. The study was limited to only shelling activity as the shelling activity is found to be more hazardous due to its repetitive and tedious nature and excessive visual demand (Borah and Baruah 2013a).

To analyze the musculoskeletal injury risks, Rapid Upper Limb Assessment (RULA), Quick Exposure Check (QEC), and Discomfort Survey were done. RULA scores were drawn with the help of "ErgoMaster" software. The ultimate assessment of work-related musculoskeletal disorders at workplace was achieved by comparing the assessment scores from both methods. Brown and Li (2003) found that a QEC score could be described as equivalent to a RULA score as presented in Table 1.

Table 1: Action level of RULA and QEC given by Brown and Li (2003)

| <i>QEC score</i> | <i>Action</i> | <i>Equivalent RULA score</i> |
|------------------|-------------------------------------|------------------------------|
| <40% | Acceptable | 1-2 |
| 40%-49% | Investigate further | 3-4 |
| 50%-69% | Investigate further and change soon | 5-6 |
| >70% | Investigate and change immediately | >7 |

Assessment of Physical Characteristics

The physical fitness of the women workers was assessed by taking the measurement of Age, Weight, Height and Body Mass Index (BMI) or Quetlets Index. The BMI was examined by using following formula (Deurenberg et al. 1991):

$$BMI = \frac{\text{Body weight (in kg)}}{\text{Height}^2 \text{ (Square meter)}}$$

RULA Assessment Method

Rapid Upper Limb Assessment (RULA) is an inspection method developed by McAtamney and Corlett in 1993 which is used in ergonomic investigations of work-related upper limb disorders in workplaces. Musculoskeletal workload on the entire body with special attention to the neck, upper limbs and trunk can be examined by RULA method. An action level is formed by a "Final Score" produced by the method. The action level specified the level of intervention essential to decrease the risk of injury of the worker due to the current task. RULA method was formed to distinguish risky working posture to conduct improvement (Yusuf et al. 2016).

QEC Tool

Work related musculoskeletal disorders (WMSDs) can be quickly assessed by the Quick Exposure Checklist (QEC). The reliability of this method can be obtained from a checklist/score sheet that merge observational evaluation of the researchers and self-report by the respondents. The assessment tool was introduced in late 90's, but in 2008, David et al. further improved the validity and usability of the tool and published a reviewed version of the QEC based on test

results obtained by Li and Buckle (1998). QEC is found to be a delicate tool for an ergonomic intervention of before and after changes in exposure and to compare the exposure level between two or more workers accomplishing the same task, or between the people accomplishing variety of tasks. It emphasises the unnatural postures of different body parts, movements with repetition, manual materials handling, work duration, manual force exertion, visual demand, driving and use of vibrating tools, and the risks associated with these by using assessment questionnaire for both workers and observers. The final score obtained by QEC indicated the risk exposure level of the given task such as Low, Medium, High, Very High, etc. (Table 2).

Table 2: Distribution of risk level for QEC on the basis of final score

| Score | Low | Medium | High | Very high |
|---------------|-------|--------|-------|-----------|
| Back (static) | 8-15 | 16-22 | 23-29 | 29-40 |
| Shoulder/arm | 10-20 | 21-30 | 31-40 | 41-56 |
| Wrist/hand | 10-20 | 21-30 | 31-40 | 41-46 |
| Neck | 4-6 | 8-10 | 12-14 | 16-18 |
| Driving | 1 | 4 | 9 | - |
| Vibration | 1 | 4 | 9 | - |
| Work pace | 1 | 4 | 9 | - |
| Stress | 1 | 4 | 9 | 16 |

Source: Author

The total load can be assessed by combining the scores of the researcher and workers. Exposure level (E) is estimated based on the percentage by dividing the total actual score exposure (X) with total maximum score (X_{max}) (Brown and Li 2003).

$$E(\%) = \frac{X}{X_{max}} \times 100$$

Where, X= Total score, originated from the investigation of posture (shoulder/arm + back + neck + wrists/hand)

X_{max} = Maximum total score for working posture (shoulder/arm + back + neck + wrists/hand)

X_{max} is persistent for certain type of tasks. The minimum score (X_{min} = 162) indicates static body position, sit or stand with or without repetition and comparatively lower load. The maximum score (X_{max} = 176) indicate pushing, pulling, lifting, carrying loads and other type of manual handling tasks.

Discomfort Survey

The body discomfort scale was initially introduced by Corlett and Bishop in 1976 which is a subjective symptom survey tool that analyses the discomfort in different human body parts by means of subject's direct experience to discomfort. The survey scale involves users to respond to their direct physical sensations by asking them to rate the intensity of discomfort for each specific body part. The present study individually examined body discomfort of 40 respondents using this tool, and distributed the respondents in frequencies in accordance to a five-scale rating, that is, Very Severe, Severe, Moderate, Mild and No Pain.

RESULTS AND DISCUSSION

Physical Characteristics

The results revealed that the mean age of the women workers engaged in cashew nut shelling activity was 34.60 years; mean weight was 51.65 kg and 159.95 cm was the mean height. Correspondingly, the mean Body Mass Index (BMI) of the respondents was found to be 20.20, belonging to normal category (Table 3).

Table 3: Physical characteristics of respondents involved in cashew nut industry

| Parameters | Mankachar Average | Selsella Average | Mean |
|-------------|-------------------|------------------|--------|
| Age (years) | 36.65 | 32.55 | 34.60 |
| Weight (kg) | 47.75 | 55.54 | 51.65 |
| Height (cm) | 151.60 | 168.30 | 159.95 |
| BMI | 20.67 | 19.74 | 20.20 |

Source: Author

Assessment of Musculoskeletal Disorders by Using RULA

Results of the RULA assessment scores (Fig. 1 and Table 4) show that the scores of all the respondents of both Selsella and Mankachar block were on five and above five, which indicates the risk of musculoskeletal injuries, and that there is a need for further investigation and change. Further, it was observed that 20 per cent of the respondents were counted above the score of 6, indicating the association of higher

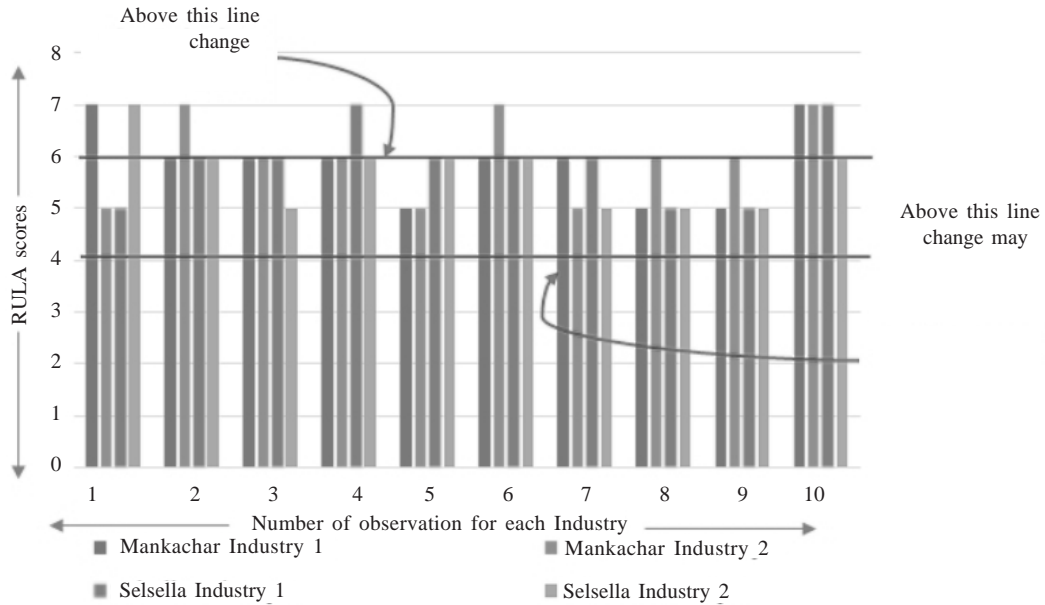


Fig. 1. RULA scores of the workers engaged in cashew nut shelling activity

Source: Author

level of risk, therefore further suggesting a high demand of investigation and implementation of change as soon as possible. The force/ load and awkward working posture of head, arm, shoulder, wrist, trunk, neck, legs, etc. may be the reason for the higher risk associated with the task (Ansari and Sheikh 2014; Yusuf et al. 2016).

Assessment of Musculoskeletal Disorders Using QEC

Table 5 represents the number of subjects suffering from level of pain associated with cashew nut shelling activity (in frequencies) along with the average score. From the analysis of data,

Table 4: Distribution of the RULA scores of the workers engaged in cashew nut shelling activity

| S. No. | Mankachar (N=20) | | | Selsella (N=20) | | |
|---------|--------------------|--------------------|-------------|--------------------|--------------------|-------------|
| | Industry 1 n=10 | Industry 2 n=10 | Mean scores | Industry 1 n=10 | Industry 2 n=10 | Mean scores |
| 1 | 7 | 5 | 6 | 5 | 7 | 6 |
| 2 | 6 | 7 | 6.5 | 6 | 6 | 6 |
| 3 | 6 | 6 | 6 | 6 | 5 | 5.5 |
| 4 | 6 | 6 | 6 | 7 | 6 | 6.5 |
| 5 | 5 | 5 | 5 | 6 | 6 | 6 |
| 6 | 6 | 7 | 6.5 | 6 | 6 | 6 |
| 7 | 6 | 5 | 5.5 | 6 | 5 | 5.5 |
| 8 | 5 | 6 | 5.5 | 5 | 5 | 5 |
| 9 | 5 | 6 | 5.5 | 5 | 5 | 5 |
| 10 | 7 | 7 | 7 | 7 | 6 | 6.5 |
| Average | 5.90 | 6.00 | 5.95 | 5.90 | 5.70 | 5.80 |

Source: Author

Table 5: Result of QEC assessment of the respondents engaged in shelling of cashew nut

| Risk factors | Mankachar (n=20) | | | | | Selsella (n=20) | | | | | Total Av. Score N=40 |
|---------------|------------------|----|----|-----|-----------|-----------------|----|----|-----|-----------|-------------------------|
| | L | M | H | V.H | Av. Score | L | M | H | V.H | Av. Score | |
| Back | - | 5 | 8 | 7 | 28.90 | - | - | 4 | 16 | 28.40 | 28.65 |
| Shoulder/ arm | - | 8 | 12 | - | 32.90 | - | 5 | 15 | - | 32.80 | 32.85 |
| Wrist | - | 2 | 18 | - | 32.00 | - | 1 | 19 | - | 32.20 | 32.10 |
| Neck | - | - | - | 20 | 17.40 | - | - | - | 20 | 17.50 | 17.45 |
| Vibration | 20 | - | - | - | 1.00 | 20 | - | - | - | 1.00 | 1.00 |
| Driving | 20 | - | - | - | 1.00 | 20 | - | - | - | 1.00 | 1.00 |
| Work pace | 1 | 5 | 14 | - | 7.60 | - | 4 | 16 | - | 7.35 | 7.48 |
| Stress | 1 | 12 | 7 | - | 4.00 | 1 | 14 | 5 | - | 4.80 | 4.4 |

Source: Author

it is revealed that the entire group of respondents was found suffering from excessive level of pain in the neck due to forward bending for a prolonged period (Fig. 3a). Back, shoulders/ arms, wrist pain symptoms were observed to be the usual problems among the shelling workers (Gangopadhyay et al. 2005; Borah and Baruah 2013b). It is noteworthy to mention that workers in cashew nut industries get their earning as per the amount (in kg) of cashew nut they shell in a day. To make more money, the workers have to work faster and this increase in pace leads to a more vigorous and repetitive muscle movement.

Table 6 reveals the exposure score percentage of QEC assessment using the equation $E(\%) = X/X_{max} \times 100$ (Li and Buckle, 1998). A maximum possible score 162 (X_{max}) can be gained from QEC score table as the selected task is considered as static, sited, or standing, with or without repetition and relatively low exertion of load/force (Brown and Li 2003; Mirmohammadia et al. 2015). The results revealed that the risk exposure on back, shoulder/ arm, wrist/ hand was relatively high and exposure on neck was very high as the task needs constant visual demand, thereby compelling the subject to bend the head/

neck in a static position for prolonged period of time. The resulting action level indicates that the task needs to be investigated further, and that there is a need to change the working posture as soon as possible.

Assessment of Physical Discomfort Survey

The association of pain and postural discomfort, forced static exertions, and repetitive motion is an extensively accepted indicator of poor job design (Corlett and Bishop 1976; Stuart-Buttle 1994). Therefore, a body discomfort survey is a vital part of the job analysis to find out the drawbacks of a job design and risk factors at different body parts. According to the findings of this study presented in Figure 2, the incidences of the postural discomfort caused by cashew nut shelling task was almost the same in all the body regions. As per the workers' statement, most often severe to very severe pain occurred in the neck and back area. In their response, the respondents did not report mild pain and no pain in any body parts. The study is in conformity with Girish et al. (2012) who found back pain as the second most reportedly painful

Table 6: Summary of QEC action levels with comparison to RULA for shelling activity

| Block | Back | Shoul- der | Wrist | Neck | Exposure score (%) | RULA Action level | Remarks |
|----------------|-------|---------------|-------|-------|-----------------------|-------------------------|-------------------------------------|
| Mankachar n=20 | 28.90 | 32.90 | 32.00 | 17.40 | 68.64 | 5-6 | Investigate further and change soon |
| Selsella n=20 | 28.40 | 32.80 | 32.20 | 17.50 | 68.45 | 5-6 | Investigate further and change soon |
| Total N=40 | 28.65 | 32.40 | 32.55 | 17.45 | 68.54 | 5-6 | Investigate further and change soon |

Source: Author

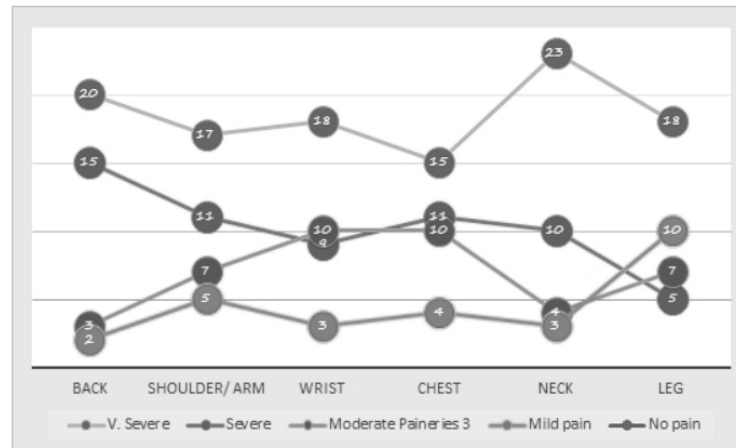


Fig. 2. Distribution of the respondents according to the level of physical discomfort associated with different body regions

Source: Author

area as experienced area by the workers. They also stated that this could be a result of continuous forward leaning positions, occasional rotations, and crouching during their work. Further, Grooten et al. (2007) also stated that sustained and monotonous work was a strong risk factor for musculoskeletal problems.

CONCLUSION

The results of RULA, QEC and Discomfort Survey showed that high level of risk exposure

is associated with the shelling task in the cashew nut processing industries. The outcome of the assessment tools recommends further investigation of the case. Implementing the change to reduce the risk of occupational health and safety of the women workers engaged in the cashew nut processing industries of North-East region of India is eminent. The study revealed that the women workers do not have any knowledge of correct body posture, health and hygiene, musculoskeletal disorders, and consequences of prevalent risk factors. Moreover, the workplace



Fig. 3a. Posture of the subject while shelling
Source: Author



Fig. 3b. Working area of shelling



Fig. 3c. Tool used by the workers for shelling

was found lacking of natural as well as artificial lighting, fan, ventilation etc. (Fig. 3b). Industrialization plays a great role in the development of a nation, but it should not be at the cost of human health and safety. As one of the largest producers in the world, Indian cashew nut industry has a high potential to support the livelihood and economic growth of the nation. However, women in cashew nut industries suffer from various health risks and injuries which can lead to severe musculoskeletal and nervous system disorders. Thus, the study demands intervention with improved tools and technologies as they were using only wooden mallet for shelling cashew nut (Fig. 3c), and some elaborate awareness programme on significance of correct working posture, hygiene and sanitation, proper indoor climate, musculoskeletal disorders and its prevention.

RECOMMENDATIONS

The study recommends an ergonomically designed workstation along with improved tools and technology for shelling cashew nut and use of Personal Protective Equipment (PPE) to implement safety of the women workers at the workplace. Training with improved tools and technologies and awareness programme on occupation health and safety are also recommended.

LIMITATIONS

This study is limited only to women workers engaged in cashew nut shelling activity.

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