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Musculo-skeletal disorder of women worker engaged in shelling activity of cashewnut factory

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ABSTRACT : Women are the main working force in cashewnut industry of Meghalaya, which is in North Eastern part of India. Raw cashewnut requires an elaborate process of sun drying, roasting, shelling and peeling of testa to become suitable for human consumption. Shelling of hard outer shell of cashewnut is time and labour intensive which create severe musculoskeletal problem. Twenty women labour were selected purposively for the study and intensity of body pain, perceived joint discomfort, muscular fatigue of hand grip, postural deviation and relationship between demographic factor with dependant variable *i.e.* musculoskeletal problem were recorded. Results show that majority of the women felt severe to very severe pain in fingers, wrist and upper and lower arm of both hands and upper and lower back and they perceived more than intolerable joint discomfort while shelling cashewnut. It was also observed that grip strength of the right hand decreased by 6.59% and left hand is 3.23% after completion of the work and also observed that the deviation of spinal column due to squatting posture is more (11.95%) in the lumber region than the cervical region (3.5%). Further analysis shows that there existed a significant positive correlation in between age and intensity of body pain (r=0.552) of women labour and also in between years of involvement and MSD (r=0.576).

KEY WORDS : Musculo-skeletal disorder (MSDs), Back pain, Hand grip strength, Body ache syndrome and postural deviation

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The trend in India is towards industrialization. As industries develop both in size and complexity, occupational health poses new and more difficult problems. In the world scenario, India occupies a premier position contributing about 43% of the cashewnut production. Meghalaya is one of the states of North East India where cashewnut cultivation and processing is an important new area in case of agro-industrial development. There are many cashewnut factories set up in these areas to process raw cashewnut.

The raw cashew has a very acid content (caustic oil) which can burn the skin and produce noxious fumes when heated and, therefore, it required to undergo an elaborate process of sun drying, roasting, breaking (shelling), heating and peeling to become suitable for consumption (Kanji, Nazneen and Vijfhuizen, Carin 2003). The labour intensive processes are breaking (shelling) and peeling of brown skin (testa) where women are the majority of workers.

They perform extremely tedious time and labour intensive work resulting in fatigue and drudgery. All the time unnatural squatting posture on a fourfold gunny bag are adopted by the women labour while performing these activities which create severe musculo-skeletal disorders (MSDs) such as back pain, knee pain, arthritis, cervical pain, joint pain etc. Due to the adoption of long static sitting posture on the ground, they always suffer from par aesthesia in legs which may lead to many nerve and musculo-skeletal problems. MSDs can affect the body's muscles, joints, tendons, ligaments and nerves. Most work-related MSDs develop over time and are caused either by the work itself or by the worker's working environment. Typically, MSDs affect the back, neck, shoulders and upper limbs; but sometimes it may also affect lower limbs.

So there is a great need to study the musculo-skeletal problems in details, so that some suitable techniques / technologies could be developed to reduce musculoskeletal problem of women worker engaged in cashewnut factories.

METHODOLOGY

Twenty women labour of two age groups (20 – 35 years

and 36 – 50 years) who were involved in shelling activity of cashewnut factory were selected purposively for the study. In order to collect the reliable experimental data, the selected subjects were given enough rest before putting them on selected tasks. Extreme summer months (June to August) were selected for conducting the experiment as it is the season of cashewnut processing.

The subjects who met the following conditions were selected for the experiments:

Body temperature	:	Not above 99º F
Blood pressure	:	120/80 ± 10
Heart rate	:	70 – 90 bpm

Determination of muscular strain:

Muscular strain during the performance of shelling cashewnut was recorded from the intensity of pain from different parts of the body, perceived joint discomfort, muscular fatigue of handgrip and postural deviation.

Intensity of pain in different parts of the body:

To study the resultant chronic effects of selected activities, a suitable body map was used along with questionnaire. The questionnaire was divided into four sections, covering the following regions of the body for measuring the intensity of pain:

– The back: The upper back and lower back.

– The upper extremity: Head, neck, eyes, ears, chest, upper arm and lower arm.

– The lower extremity: Thigh and legs.

– The joints: Shoulder, elbow, wrist, knee and ankle

In order to ascertain the degree of severity of pain, a five point scale (Varghese *et al.,* 1996) was used.

Perceived joint discomfort :

To assess the ratings of perceived joint discomfort a rating scale was developed. In the scale joint discomforts were categorized as no joint discomfort, just noticeable joint discomfort, noticeable joint discomfort, tolerable joint discomfort and intolerable joint discomfort with scores 1 to 5, respectively.

Muscular fatigue of hand grip :

The grip strength of both hands was measured with the help of grip dynamometer. The per cent reduction in grip muscular strength (muscular fatigue) was calculated from the following formula for both the hand before during and after the activity.

$$\text{Per cent reduction in grip muscular strength} = \frac{Sr - Sw}{Sr} \times 100$$

where, S_r = Strength of muscles during rest (kgs)

S_w = Strength of muscles during work (kgs).

Postural deviation during the performance of selected activities :

In order to measure the angle of deviation of normal spine curve and maximum deviated posture, highly adjustable flexicurve was used. The shape adopted by flexicurve was immediately drawn on paper and angle of deviation of normal curve and deviated curve were measured.

Relationship between dependent variable and independent variable :

To find out the relationship of demographic factor (age, years of involvement and BMI of women) and health risk factor (Intensity of body pain), co-efficient of co-relation was used.

Analysis of data :

Simple averages, percentages, standard deviation and weighted mean scores were used to analyze collected data during the experiments. Scoring techniques were used for calculating mean score for intensity of body pain and joint discomfort. The weighted mean score for all the activities were calculated as follows:

$$\text{Weighted mean Score } (i^{th} \text{ factor}) = \frac{\text{Total scores earned by respondents for } i^{th} \text{ factor}}{\text{Total number of respondents}}$$

$$= \frac{\Sigma Xij}{n}$$

where,

X_{ij} = The score earned by the j^{th} respondent for the i^{th} factor

n = Total number of respondents

i = 1, 2, 3 …….k (k = number of factors)

j = 1, 2, 3 …….. n.

To find out the relationship between selected independent variables (age, years of involvement and BMI of women) and dependent variables, *i.e.* intensity of body pain, coefficient of correlation was used. Here coefficient of correlation was used to identify the relationship between independent variables and dependent variables with the following formula:

$$r = \frac{\Sigma Xxy}{\sqrt{\Sigma x^2 \times \Sigma \Sigma^2}}$$

where the coefficient of correlation (r value) lies between -1 and +1, symbolically when,

$r = (-1 \leq R \leq +1)$, then there will be a positive relationship between two variables.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Intensity of body pain while shelling of cashewnut :

Intensity of body pain while performing the selected activity were recorded on a five point scale and results have been given in Table 1. It can be seen from the scores given in the table that most of the women felt severe to very severe pain in the eye (4.05), neck (4.05), shoulder joint (4.5), upper arm (4.75), lower arm (4.5), wrist-RH (4.85), wrist-LH (4.85), fingers-RH (4.95), fingers-LH (4.95), and upper back (4.65), low back (4.6), leg/thigh(4.5) and knee (4.35).

Table 1: Intensity of body pain of subjects while shelling Cashew Nut (mean score)

Different parts of body	Age group		
	20-35 yrs (n=10)	35-50 yrs (n=10)	Total (20-25 yrs) (n=20
Upper extremity			
Eye	4.3	3.8	4.05
Neck	4.4	3.8	4.1
Shoulder joint	4.7	4.3	4.5
Upper arm	4.9	4.6	4.75
Elbow	3.8	3.7	3.75
Lower Arm	4.4	4.6	4.5
Wrist (RH)	4.9	4.8	4.85
Wrist (LH)	4.9	4.8	4.85
Fingers (RH)	4.9	5.0	4.95
Fingers (LH)	4.9	5.0	4.95
Upper back	4.5	4.8	4.65
Lower extremity			
Low back	4.4	4.8	4.6
Buttock	3.3	3.9	3.6
Upper leg/thigh	4.1	4.9	4.5
Knee	4.3	4.4	4.35
Calf muscle	3.5	3.9	3.7
Ankle	3.5	3.9	3.7
Feet / Toe	3.3	3.9	3.6

Rating: 1 – Very Mild, 2 – Mild, 3 – Moderate, 4 – Severe and 5 – Very Severe.

Rating of joint discomfort perceived by the respondents in performance activities :

Women worker felt severe to very severe pain in fingers and wrists and also the upper arm which may be due to more strain in that part of hand because while shelling cashewnut the women workers used one wooden mallet and hit the shell of cashew by using that mallet to break the shell of the nut. All the time they were holding the wooden mallet and hitting the cashew shell simultaneously. Severe to very severe pain was observed in the low back and upper back of the workers due to the adoption of prolonged strenuous sitting posture on gunny bag while shelling of cashewnut and also severe pain in eye as the work demands fine visual attention. In a study done by Eastman – Kodak company (1986) on technicians in sitting posture showed that as the work required fine visual attention, the worker leaned forward to see clearly. This forward bend of the head and trunk put stress on the lower spine and the neck muscles making them fatigued. Prolonged static postures cause ergonomic stresses leading to severe musculoskeletal disorders especially low back pain and other musculoskeletal disorders. Due to static postural operations of prolonged duration, there may exist some unknown ergonomic stresses, which are sole agent for causing such disorders (Pachal and Sashtri, 2000). Standing, sitting, or otherwise remaining in one posture for a long duration while we perform a task, can increase the likelihood of injury. Static exertion combines force, posture, and duration to create a condition that quickly fatigues our muscles which increases the chances of acquiring a cumulative trauma disorder (CTD).

The present study attempted to find out the stressfulness of movement around joint in order to understand their adverse effect on health and well being of the respondents. Body movements were defined around major joints of the body namely wrist, elbow, shoulder, neck, low back, hip, knee and ankle for the activity performed by the women workers.

From the Table 2, it is observed that joint discomfort was perceived by workers while doing shelling of cashew shell was more than tolerable *i.e.* intolerable joint discomfort (4.45) and same results we have been observed in case of peeling cashewnut by women worker (Borah, 2010). Jager and Luttmann (1986) indicated that more the trunk inclined forward, the higher were the stress values at the lumbosacral joint resulting in work related musculoskeletal disorders.

Table 2: Rating of perceived joint discomfort during shelling and peeling activity of cashew nut

Activity	Age groups	Mean	Standard deviation (S.D.)
Shelling	20-35 yrs, n=10	4.4	0.69
	36-50 yrs, n=10	4.5	0.52
	20-50 yrs, n=10	4.45	0.60

Percentage change in the grip strength:

From the Table 3 it was observed that during the shelling activity the strength of the grip decreased due to fatigue of muscles as the activity was carried out for a longer period of time. It was observed that the grip strength of the right hand decreased by 6.59 per cent and that of the left hand decreased by 3.23 per cent after the completion of the work, but the grip strength was increased in both right and left hand 2.85 per cent and 2.34 per cent, respectively during work, which may be due to warming up of muscles. Borah (2002) also observed the same result *i.e.* muscle strength was increased after the milking activity of women which was for

short duration. It may be due to the warming up of muscles at the start of the activity, the grip muscle became more active and the strength of hands increased. Bimla *et al.* (2001) also observed that grip strength increased up to 9.6 per cent in the first cycle of the activity of picking cotton, whereas, it decreased by 14.3 per cent at the end of the activity being done for above five hours.

Postural deviation :

The deviation observed by the respondents involved in the shelling activity of cashewnut is complied in Table 4. The result shows that the deviation of spinal column on an average in lumber region was more (11.95%) than the cervical region (3.5%). It was also found that the percentage deviation of lumber region of rural woman was maximum for working in the sitting type of kitchen and for milking cattle in squatting posture (Verma, 2001 and Borah, 2002). Maiti *et al.* (2007) revealed that there was prevalence of low back problems (93.33%) among women worker involved in post harvesting job, which might be due to heavy workload and awkward posture.

Asymmetric postures increase the load on spine. Postural stress can increase the physiological cost and fatigue during any task and may also lead to injuries to vertebral column in the long run and become evident from the body ache. The posture of the women workers is found to be changed to a certain extent when they perform the activities (Pheasant, 1991). Doomra *et al.* (2007) indicated that while milking cattle by women there was 4.10 and 10 per cent deviation in cervical and lumbar region, respectively.

Relationship between selected independent variables (age, years of involvement and BMI) and dependent variable (intensity of body pain) :

From the analysis of data it was found (Table 5) that there existed a significant positive correlation of intensity of body pain of women labour with age (r = 0.552), with years of involvement in that shelling work (r= 0.576) and with BMI of women labour (r = 0.054). So, it can be said that intensity of body pain increases as age of women, years of involvement in shelling activity of cashewnut industry and BMI of women labour increases towards obesity.

Conclusion:

The activity of shelling cashewnut was found to be very strenuous to the women labour. They have to work for long time without rest and also improper facilities in the working premises lead to their severe musculoskeletal disorder and ill health. The use of improper tools to shell cashewnut gives rise to certain discomforts in the workers body. An advanced technique and technology can be developed to break the hard shell of cashewnut and also ergonomic intervention programme may be implemented to improve the problem of musculoskeletal disorder and other health problem of women worker involved in cashewnut industry and thereby increase their productivity.

Table 3: Percentage change in the grip strength of the subjects during and after the activity of shelling chashew nut

	20-35 yrs (n=10)		36-50 yrs. (n=10)		Total (n=20)	
	RH	LH	RH	LH	RH	LH
During work	+2.50	+2.81	+3.20	+1.86	+2.85	+2.34
After work	-6.81	-3.69	-6.37	-2.76	-6.59	-3.23

*RH – Right hand, LH-Left hand

Table 4: Deviation of spinal column of women worker during shelling of cashew nut

Age group	Cervical			Lumber		
	Normal	White	Deviation (%)	Normal	White	Deviation (%)
20-35 yrs (n=10)	200.3	204.7	4.4	199.1	212.2	13.1
36-50 yrs (n=10)	189.9	201.5	2.6	202.1	212.9	10.8
Total (20-50) n=20	199.6	203.1	3.5	200.6	212.55	11.95

Table 5 : Coefficient of correlation value showing the relationship between independent variables and dependent variables for the women in shelling activities

Dependent variable	Independent variable	r-value		
		20-35 yrs (n=10)	36-50 yrs (n=10)	Total (20-25 yrs) n=20
Intensity of body pain	Age	0.696	0.407	0.552
	Years of involvement	0.737	0.415	0.576
	BIM	-0.310	0.203	-0.054

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