Occupational Stress among Women Moulders: A Study in Manual Brick Manufacturing Industry of West Bengal

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Abstract- Manual brick manufacturing is an age-old profession practiced all over the world and brick is a very important building material for a developing country, especially like India to improve infrastructure. Women have become an integral part of manpower resources in these unorganized sectors, but unfortunately the female workers here suffer a silent agony. The present study examines the occupational profile, impact of work factor in terms of physiological, biomechanical, musculoskeletal and psychosocial discomforts prevalence among workers in brick kilns. A study was conducted on female moulders engaged in different brick-kiln of West Bengal. Physical parameters such as body weight, height, grip strength; occupational status based on socioeconomic profile; physiological parameters like pulmonary status, biomechanical assessment; and psychosocial assessment were studied. From the result it is seen that 18% of the sample population falls under severe Grade III chronic energy deficiency. More than 90% of body pain is felt in wrists, back, both knees, both thighs and both ankles due to the awkward postures adopted by them. Postural assesment by REBA, RULA and OWAS method shows that most of the posture adopted during work should be corrected immediately. Majority of the workers are in the borderline tending towards development of Chronic Obstructive Pulmonary Disease. The workers worked for more than 8 hours per day, with very less monthly income. Long working hours without adequate rest, low wages, job insecurity and bullying by superiors contribute to various physiological and psychosocial stress which in turn tends workers to various addictive behaviors. Thus, immediate ergonomic interventions are required to improve the quality of life of these workers so that they can continue working for a longer period under the conducive and safe work condition which in turn will influence the social security, health and safety of the workers.

Index Terms- Brick-kiln, women workers, moulders, unorganized sectors, posture.

I. INTRODUCTION

The Indian brick industry is an age old unorganized sectors and the second largest in the world employing large numbers of migrant women workers (Khan & Vyas, 2008). The industry has an annual turnover of more than 10000 crores and it is one of the largest employment generating industries (Khan & Vyas, 2008). In the developed countries some mechanization was introduced but in India the conditions have not improved and human drudgery still prevails. Various studies showed that the workers working in the brick manufacturing units suffered from musculoskeletal problems due to awkward working postures (Heuer et al., 1996; Chung & Kee, 2000; Trevelyan & Haslani, 2001). Studies from developing countries like India, shows that these workers suffer from assorted health problems due to handling of heavy loads without taking adequate rest breaks (Mukhopadhyay, 2008; Sett & Sahu, 2008). Moreover, some studies had reported that women had a higher prevalence rate of work-related musculoskeletal disorders (MSDs) to that of men (Treaster & Burr, 2004; Basu et al., 2008). Work-related MSDs are common causes of pain and functional decline which in turn lead to significant distress and disability (Rempel et al., 1992; Shaw et al., 2002). Various risk factors are involved including biomechanical and environmental conditions such as physical work load, unfavorable body posture, vibration, psychosocial factors such as time, pressure and repetitive or monotonous tasks (Ariens et al., 2000; Bongers et al., 2002; Cromie et al., 2002; Salerno et al., 2002). Although advancement in mechanization has greatly reduced physical stress on the brickfield workers, it still remains the most physically demanding occupation (Gallagher, 1999). Therefore, a field study was conducted on female laborers working in several manual brick manufacturing units of West Bengal, to understand the nature of work, analyze their socio economic status, find out the occupational stress on the workers and to give some suggestive remedial measures for humanizing working condition of brick workers. The process of brick making involves several steps of which, moulding is one of the essential part performed by a group of workers designated as 'moulders'.

II. METHODOLOGY

A. Selection of site and subjects.

The brickfields under study were situated around Uttarpara (District Hooghly) and Dhibdhibi (District South 24 parganas). 55 brick moulders with mean age of 24.4± 4.16 years and having minimum 2 years of working experience was randomly selected for the study. The volunteers were selected with no history of chronic or acute illness, not having hypertension, no acute rheumatic problem, not currently consuming any medicine and not pregnant. The study was done in the month of March and April, as during this time the work go in full swing.

B. Assessment of physical characteristics

The height of the subjects was measured by the Martin type anthropometric rod (mfg by Seiber & Heigner, Switzerland) and weight by a portable, calibrated bathroom weighing machine.

Hand grip strength was determined by using a hand grip dynamometer (Inco, Ambala, India) to test the maximum voluntary contraction (Ravishankar et al., 2005). The best of three trials were accepted with three minutes rest in-between (Chien et al., 2002).

C. Occupational profile of the women workers

An interview schedule was constructed for collecting several data like the nature of employment, duration of employment, daily working hours and monthly income by means of questionnaire.

D. Occurrence of occupational health problems related to Physiological factors.

i). Biomechanical analysis - Work posture assessment

Complete work cycle video were recorded on each subjects by using Sony camera (model no. HDR-XR100E) which was fixed on the tripod.Working postures was then evaluated and analyzed by the following methods:

OWAS method (Ovako Working Posture Analysis System) (Karhu et al., 1977).

RULA method (Rapid Upper Limb Assessment) (McAtamney & Corlett, 1993).

REBA method (Rapid Entire Body Assessment) (Hignett & McAtamney, 2000).

ii). Nordic Questionnaire study and Subjective methods of discomfort

Modified Nordic questionnaire study was done for knowing the occurrence or frequency of pain felt in different parts of their body due to posture at work (Kuorinka et al., 1987). The intensity of pain was measured by modified Body Part Discomfort (BPD) scale. The scale consists of Grade from 0 to 3, with Grade 0 signifies no discomfort at all, Grade 1 signifies just noticeable discomfort, Grade 2 signifies moderate discomfort and Grade 3 signifies intolerable discomfort. As most of the volunteers were illiterate it was very difficult to use 5 point or 10 point scale (Corlett & Bishop, 1976), as they felt difficulty and are very confused in rating their pain in the two extreme points of the scale, as seen in pilot study. So this 3 point scale was used which they feel comfortable.

iii). Assessment of Pulmonary status

To evaluate the lung function capacity, Lung Function test was performed by using automatic Lung function machine & software (Kokko, Finland). Subjects were asked to take a deep inspiration. While breathing out, they were instructed to expire through a connecting tube with maximum effort to continue for 6 sec without any inspiration. From the graph, the Forced vital capacity (FVC) and Forced expiratory volume at 1.0 sec ($FEV_{1.0}$) were collected. The volumes were expressed in terms of Body Temperature, Pressure and Saturated (BTPS) condition.

E. Occurrence of occupational health problems related to psychosocial factors.

This was assessed by means of questionnaire study. Data were collected by using pre tested interview schedule.

III. RESULTS AND DISSCUSSION

Table I: Physical Characteristics of the sample population (n=55)

Variables	**Mean ± SD**
Age (yrs)	24.4± 4.16
Body weight (kg)	39.6±3.44
Height (cm)	149.0± 4.62
Body Mass Index (BMI) kg/m^2	17.9±1.80
Ponderal Index (PI)	12.0±1.43
Maximum grip strength in Left hand (kg)	24.6 ± 3.96
Maximum grip strength in Right hand (kg)	25.0 ± 4.06

The physical characteristics of the brick kiln workers were presented in Table I. The mean body weight of the sample population was found to be less with reference to their age and height (Rao & Balakrishna, 1995). According to the World Health Organization (WHO), there is a very simple relationship between BMI and the risk of the simultaneous presence of two chronic diseases or conditions in a patient (co-morbidity), in which a normal range of BMI is considered to be between 18.5 and 22.9 kg/m^2 in Indian women (Das & Bose 2010). In the present study, the mean BMI for the subjects was found to be 17.9 kg/m^2 which is indicative of the possible high risk for health complications (WHO, 2004).

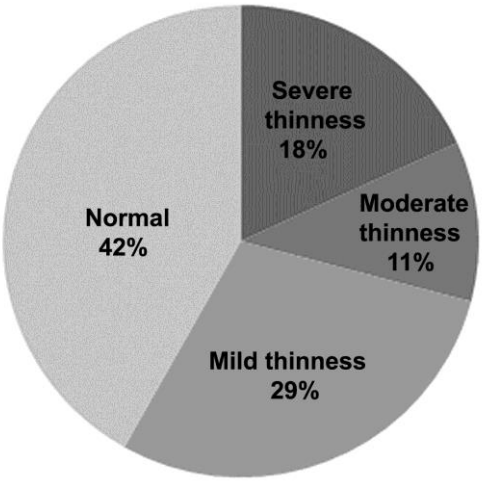

Figure 1: Distribution of women workers according to body types.

It was observed that out of the 55 subjects, 42% fell in the normal category while rest 58% of the women fell in the underweight category, in which 18% of the sample population was under severely thin Grade III chronic energy deficiency with BMI <16 kg/m^2 as recommended by WHO (Figure 1). The risks of being underweight may be due to malnourishment, compromised immune function, respiratory disease, tuberculosis (an infection of the lung), digestive (stomach) disease, cancer, osteoporosis etc. Result from the Ponderal Index showed that the majority of the women belonged to the Ectomorphic group with value < 21.5 and having a thin, linear appearance with narrow waist, hips and shoulders.

Table II. Occupational profile of the women workers (n=55)

Occupational details	Frequency	Percentage (%)
Nature of occupation		
Temporary	55	100.00
Duration of employment		
< 3 years	8	14.55
3-5 years	29	52.73
Above 5 years	18	32.73
Daily working hours		
8 hours or more	55	100.00
Monthly income		
≤ 2000 rupees	51	92.73
≥ 2000 rupees	4	7.27

The occupational profile of the women workers based on socioeconomic profile is shown in Table II. All the women workers engaged in temporary jobs thus it is very clear that the industry did not provide any jobs security. The total duration of the employment is about 3 to 5 years. All the women worked for more than 8 hours per day, with monthly income of less than Rupees 2000. Wages are paid on the basis of the number of bricks made by them.

Table III. Postural assessment of the brick moulders

Postures	OWAS code	Action level	RULA score	Action level	REBA score	Action level
Cutting mud	2,1,6,1 (2)	Corrective measures in near future	7	Investigate and change immediately	12	Very high risk, implement change
Inserting mud in mould	2,1,6,1 (2)	Corrective measures in near future	7	Investigate and change immediately	10	High risk, investigate & implement change
Take out brick from mould	4,1,6,1 (2)	Corrective measures in near future	7	Investigate and change immediately	12	Very high risk, implement

						change

Posture of work is the body positioning required during the performance of work. The entire process of manual brick moulding was divided into certain components for postural assessment as shown in Table III. Different standardized methods were applied for each component to identify the risk factors associated with a particular task. Cutting mud, inserting mud into the mould and take out brick from the mould, were the main task components. Assessment by OWAS method revealed that all the postures were highly risky and corrective measures were required as soon as possible. In every stages of brick moulding, RULA score of 7 with action level 4 suggested interventions and changes are immediately required. REBA score was 10 or more than 10 in all the postures indicating corrective action including further assessment is immediately required. Based on postural evaluation scores from the above table it was clear that adoption of sustained squatting posture and moulding the bricks by forward bending, for hours after hours throughout the day, is very detrimental for the workforce. It was evident from the result that prolonged sitting in squatting posture caused numbness in the lower leg resulting from lack of blood supply due to sustained muscle compression, which in turn leads to MSDs and ultimately injury to different body parts. Changes in work posture by implementing better work station and associated tools need immediate attention.

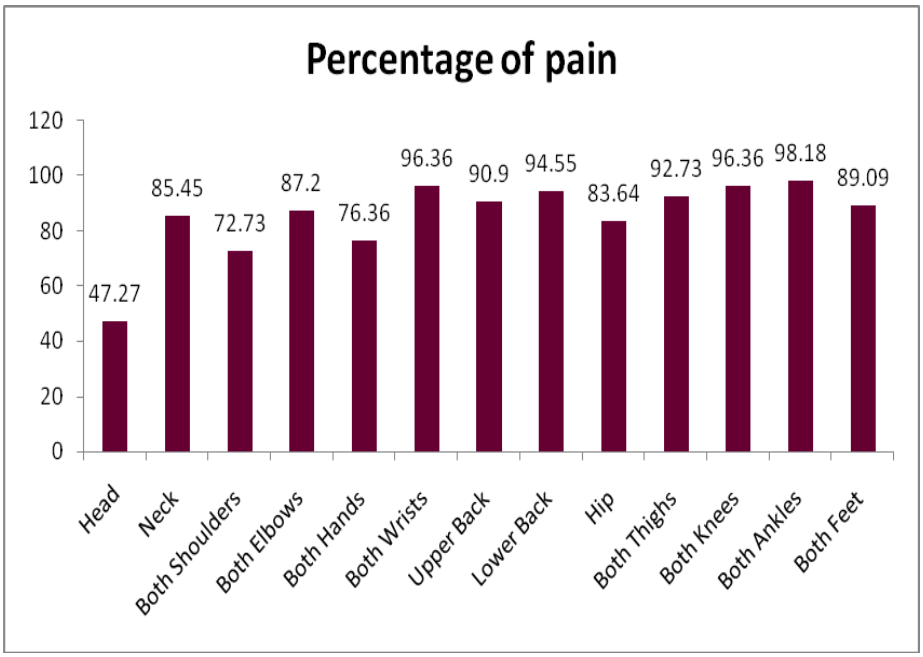

Figure 3: Job related body pain as reported by the volunteer group

Job related body pain by Nordic questionnaire as reported by the volunteer group is given in Figure 3. It was observed that more than 90% of body pain were felt in wrists, upper back and lower back, both knees, both thighs and both ankles. Thus it was seen that the brick moulders had more pain in the wrists and lower part of the body compared to upper part, because most of the time they use to sit continuously in the same awkward squatting posture for long hours to mould the bricks without taking frequent rest interval.

Table IV. Body Part Discomfort Scaling (BPD) Scale (n=55)

Body Parts	No. of subjects	Body Part Discomfort Scaling					
		Grade 0	Grade 1	Grade 2		Grade 3	
				Frequency	Percentage	Frequency	Percentage
Head	26	-	2	17	65.38%	7	26.92%
Neck	47	-	-	15	31.91%	32	68.08%
Both Shoulders	40	-	-	8	20.00%	32	80.00%
Both Elbows	42	-	-	4	9.52%	38	90.47%

Both Hands	46	-	-	4	8.70%	42	91.30%
Both Wrists	52	-	-	3	5.76%	49	94.23%
Upper Back	48	-	-	6	12.50%	42	87.5%
Lower Back	53	-	-	2	3.92%	51	96.23%
Hip	50	-	-	3	4.00%	47	94.00%
Both Thighs	51	-	-	2	3.92%	49	96.08%
Both Knees	53	-	-	2	3.77%	51	96.22%
Both Ankles	54	-	-	1	1.85%	53	98.15%
Both Feet	49	-	-	5	10.20%	44	89.80%
Total	**611**	**0**	**2**	**72**		**537**	
Percentage		**0 %**	**0.35%**	**11.78%**		**87.89%**	

The intensity of pain or discomfort measured by Body Part Discomfort (BPD) scale is shown in Table IV. The result from the present study shows that 87.89% of the women workers experience severe pain and 11.78% workers feel moderate pain due to strenuous posture at work. It was seen that more discomfort zones were concentrated to the whole body especially in the both arms and lower part of the body. Most of the workers suffers pain in intolerable range (grade 3), as the brick moulders go on moulding in the same awkward sitting posture for long hours and their task is designated as repetitive in nature contributing to their major discomfort level.

Table V. The Pulmonary parameters of brick moulder (n=55)

Parameters	**Mean ± SD**
Forced vital capacity FVC (lit)	2.1±0.60
Forced expiratory volume at 1.0 sec FEV1.0 (lit)	1.5±0.41
% FEV1.0 /FVC	74.4±9.85

Physiological strain in the female moulders is expressed in Table V. It was observed that the workers work in a very dusty environment for long hours without taking adequate rest. According to the National Institute of Clinical Excellence, the diagnosis of Chronic Obstructive Pulmonary Disease (COPD) is made when the %FEV_1/FVC ratio is less than 70. The result shows that the mean %FEV_1/FVC is 74, so the workers are in the borderline tending towards development of COPD. The exposure towards dust and smokes in the field area might be the reasons for this.

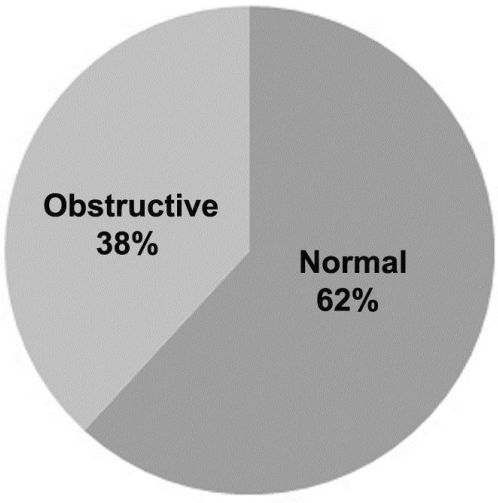

Figure 2: Distribution of women workers according to their lung function test.

Thus, it was found that the % FEV_1/FVC ratio was less than 70 for 38% of the sample population, rest 62% of the workers have % FEV_1/FVC ratio more than 70 (Figure 2). But, it should be noted that pulmonary function tests might seems to be normal initially, however with disease progression; a restrictive and/or obstructive pattern may emerge in the near future (Swanney et al 2008). In some subjects flow parameters altered, that might happened due to the airway obstruction resulting from fibrosis (Sahebjami & Gartside 1996). In few cases, both the FEV1 and FVC value reduced proportionally results in a normal or even increased ratio, which might be a result of decreased lung compliance.

Table VI. Frequency of Occupational Health problems related to psychosocial factors (n=55)

Parameters	**Frequency**	**Percentage (%)**
Headache	32	58.18
Depression	35	63.64
Frustration	37	67.27
Worry	23	41.81
Low self esteem	33	60.00
Boredom	19	34.55
Lack of sleep	25	45.45

Frequency of occurrence of Occupational Health problems related to psychosocial factors is shown in Table VI. From the result it was observed that 58% of the women workers experienced headache due to long working duration in awkward posture. The other problems felt were frustration, lack of sleep and boredom. Upadhayay (1980) reported that the heath and efficiency of the workers depends on the number of hours they have to work. In case of long working hours, the workers are bound to be tired and slacken in their duties. Job security is the

sense of guarantee of not losing the job. Due to temporary nature of the job 60% of women workers always felt that their self-esteem was hurt. The other frequent problems faced were frustration, depression and worry. Selvarani (1992) reported that lack of job security aggravates mental health problems and employers make use of this sort of insecurity to exploit workers.

Table VII. Frequency of different modes of addiction (n=55)

Parameters	Frequency	Percentage (%)
Mode of taking tobacco		
Chewing	52	94.55
Smoking	15	19.35

Long working hours without adequate rest, low wages, job insecurity and bullying by superiors contributed to these various psychosocial stresses. Both physiological and psychosocial stress tends workers to various addictive behaviors like smoking, chewing tobacco etc. as shown in Table VII.

IV. CONCLUSION

Thus the physiological evaluation provided an understanding that the ailments of the women workers are multifactorial and the health problems are positively associated with biomechanical, psychosocial, nutritional, clinical and pulmonary aspects. Biomechanical analysis indicated that the workers are constantly adapting awkward postures, such as, squatting, bending and lifting of load on their hands which resulted in severe back pain and constant aches in the upper and mainly in lower extremities of their body. From the view point of nutritional status, most of the women were thin and skinny. Prevalence of clinical deficiency signs is pronounced in majority of the women. Emphasis needs to be given on improving their eating patterns through dietician's suggestion and nutrition awareness programs which will ultimately improve their physical efficiency. Lung function study revealed that lung efficiency is less than normal in most of the women workers under study. Though at present no supporting clinical evidences was obtained but if the respiratory protection kits are not introduced, this might lead to serious respiratory disorders in the long run. Thus there is also a requirement of awareness program in parallel to the community. It is needless to mention that the importance lies in a systematic intervention between the designer and the users to attain a safer, comfortable work condition. In contrary, the management should stipulate the personal protective equipment required for the specific activity to be performed and ensure that the workers abide by these stipulations. It is important to create awareness of occupational health hazards both to the workers and the management, considering the literacy level and socio-economic condition.

V. RECOMMENDATIONS

Considering most of the workers being illiterate, awareness campaign on safe work practices should be developed for making the workers aware about the impact of the job on personal health. Proper rotation of duty, proper shift system, yoga and physical exercises should be introduced to reduce boredom, frustrations, stress and anxiety. Ergonomics and safe practices to do work have to be established to reduce work related vulnerabilities and thereby increasing over all wellbeing of workers. The workers should be aware how to use the work related tools and protective aids. Organization should be aware of better workplace layout to minimize movements, twisting and asymmetrical lifting or lowering. Re-scheduling of work should be done to allow short breaks for muscle recovery, especially if the workers perform some stretching exercises. Nutritional status of the workers may be related to the prevalence of work related health problems. Nutritional status must be improved by proper counseling of food habits and maintaining hygienic condition to reduce musculoskeletal disorders of the workers. Last but not the least employers must pay attention to the human aspect and promote worker's development by better payment and incentives.

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