Evaluation of Work Related Musculoskeletal Disorder and Postural Stress of Brick Kiln Workers during Performing Different Brick Making Tasks

Maity Payel, Pal Amitava and *Dhara Prakash C.
Ergonomics and Sports Physiology Division,
Dept. of Human physiology with Community Health, Vidyasagar University,
Midnapore-721102, West Bengal, India
*Email: prakashdhara@rediffmail.com

ABSTRACTS

The presentstudy was aimed to evaluate the musculoskeletal disorder (MSD) and postural stress of brick kiln workers. The study was carried on 111 male and female workers who were engaged in brick kiln work of different villages of some selected districts, e.g., Purba Midnapore, Paschim Midnapore, and Bankura of West Bengal. Modified Nordic questionnaire and body part discomfort (BPD) scale was applied to identify the MSD in different body parts. The postural stress was analyzed by OWAS method. The prevalence of MSD and BPD among the workers was very high and the most affected body parts were neck, shoulder, back and knee. Postural analysis indicated that the workers were subjected to postural stress in all tasks of brick making job and that might be the reason for occurrence of MSD. The squatting posture was the dominating posture in most of the brick making tasks. From the analysis of OWAS it was revealed that among the four action categories (AC 1,2,3, and 4) male and female brick kiln workers showed different distribution of ACs in different phases of tasks. The clay cutting task, which was performed in kneeling posture, showed action category 4, i.e., the task needed corrective measures immediately. Whereas in other tasks, viz, the preparation of clay lump (done in squatting posture with forward bending), filling the dice with clay (done in squatting posture), keeping the raw brick (done in twisted squatting posture), and cleaning the dice with dry sand (done in twisting posture), the action category 2, was found i.e., the task needed corrective measures in the near future. Thus, immediate ergonomic interventions are needed to reduce their work stress by correcting awkward postures.

Key words: Brick kiln workers, MSD, BPD, Posture analysis

INTRODUCTION

Brick kilns are small scale manufacturing units located in the rural area and border of urban areas. The work, which is seasonal, attracts migrant labors from surrounding rural areas .They work in sitting posture especially in squatting, kneeling postures. Work-related Musculoskeletal Disorders (WMSDs) have become a major problem in many industrialized countries including India. Manual brick manufacturing in India is currently an extremely hazardous occupation.

The ergonomics of brick kiln involves the interaction of personal factors such as fatigue, fitness, age and experience and circumstantial factors such as work organization, work

schedule, work load, factory layout, furniture, equipment and psychological support within the work team, which combine to affect the efficiency of work and working life. Analysis of the interaction of these factors influencing physical strain and cognitive strain is essential to improve the working conditions [1]. Much ergonomics research on sitting posture has been conducted with subjects adapted to Western chair sitting postures with the assumption being sitting on the chair are the most suitable way to sit. However, a substantial proportion of the world's population is not habituated to chair sitting suitable in some extends. Due partly to cultural traditions, Asian and African people more frequently adopt sitting on the floor with squatting, crossed legs or on their knees in their works and daily activities. It has been identified that adopting squatting postures without any proper support would gradually cause postural stress.

Back pain problem has been a culprit to many occupational safety and health problems. Lack of ergonomics knowledge and interventions in daily activities of the workers as well as excessive manual material handling are among the many factors contributing to study related disorders [2, 3].

In hand driven cotton spinning operation, awkward postures in different parts of body (i.e. bent back, folded knees, bent neck) are very common. The survey revealed that amongst the operators the disease symptoms on the knees, the back and the shoulder develop over time and were significantly higher than in other areas of the body [4]. This indicated that any interventional program for the improvement of the working condition should focus on eliminating awkward posture of the above mentioned areas of the body. A similar study regarding goldsmith working in awkward posture in India adopts ergonomic intervention to improve workstation design [5].

Musculoskeletal disorder (MSD) refers to conditions that involve the nerves, tendons, muscles and supporting structures of the body [6]. The job related health hazards are very common among the workers. Sitting in the same posture in a forward bending position for a long time puts an extremely undesirable physiological strain on the muscles, ligaments and in particular on the discs.

Musculoskeletal disorders (MSDs) such as low back pain is the most common work related injuries in manual material handling (MMH) tasks. It has been reported in many studies that such diseases are mainly caused from either over-exertion or repetitive poor working postures during performing tasks [7- 9].

Songkham et al [10] investigated occupational hazards and health status on 307 pottery workers in Chiang Mai, Thailand. The study revealed that primary illnesses amongst the sample population was essentially musculoskeletal disorders, including hand-arm-shoulder pain, back pain, neck pain, and leg pain.

Work-related musculoskeletal disorders (WMSDs) affect the muscles, tendons, joints and nerves when they are stressed, or traumatized on a repetitive basis over an extended period of time [11]. In the developed countries some mechanization was introduced but various studies show that the workers working in the brick manufacturing units suffer from musculoskeletal problems [12-19].

In most of the brick kilns India brick making and associated works are done manually. They have to adopt awkward postures during performing different brick making activities. Therefore, an ergonomic study was conducted on brick kiln workers to identify and quantify the postural stress.

MATERIALS AND METHODS

Selection of site and subjects: The study was carried on 111 adult male and female brick kiln worker who were engaged in brick making in different areas of Bankura, Purba and Paschim Medinipur districts in West Bengal. The age range of the subjects was 18-60 yrs. The subjects having at least 4 years of working experience were randomly selected from the present occupation. All of subjects volunteered for the study. The research protocol of the study was approved by the institutional ethical committee.

Evaluation of the musculoskeletal disorder: The musculoskeletal disorder (MSD) of the brick kiln workers was evaluated by modified 'Nordic' questionnaire [20] during performing brick making task.

Perceived rate of discomfort: The intensity of pain or discomfort in different segments of the body was assessed by a 10-point scale (Fig 1), which was a modified pain mapping scale of Wilson and Corlette [21]. The scale was graded from no discomfort at all to maximum discomfort. The discomfort was assessed in the sitting posture adopted by workers in brick making job. Eleven body segments were included in this study. An overall discomfort level of all body parts was computed as the mean values of all the body segments studied. According to the degree of severity, the scores of the 10-point scale were divided into three subgroups, i.e., mild (1– 4), moderate (>4 – <7) and severe (>7).

The 10 point scale arranged in the following way

0 : No pain
1 : Discomfort ness
2 : Very mild pain3 : Mild pain
4 : Numbness
5 : Average pain
6 : Moderate pain
7 : Severe pain
8 : Very much severe pain
9 : Very very much severe pain
10: Intolerable

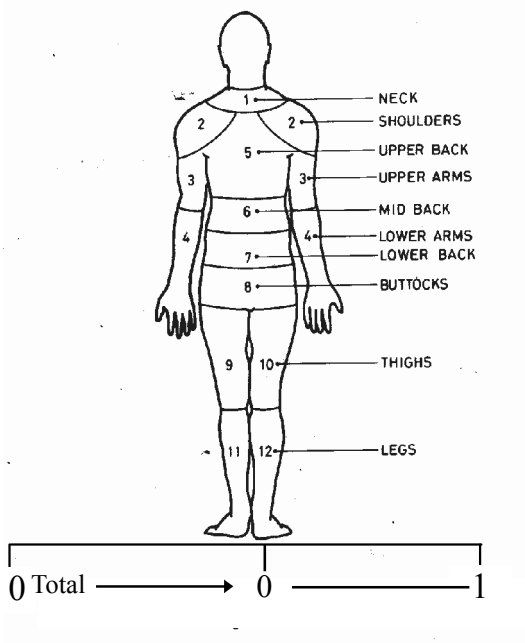

Fig 1: Different segments of the body

OWAS method: The degree of postural stress of different tasks in brick making job (Fig 2) were analyzed by OVAKO work posture analysis system (OWAS) method [22]. The four levels of risk were then related in assessing the remedial actions: no action necessary, action in the near future, action to be taken soon and action to be taken immediately. Different task of brick making were studied on 40 brick kiln workers. The average value of 10 cycles for each subject was recorded. A composite score for different phases of each job of brick making task was determined.

Statistical analysis: Data were summarized into mean and standard deviation values using Microsoft Excel. The Chi square test and Student t-test was employed by the use of ORIGIN 6.1 software.

Clay cutting

Preparation of clay

Falling the dice with

Keeping the raw

Cleaning the dice with dry

Fig 2 Different tasks of brick making job

RESULTS

The results of different parameters were analyzed for different postures, adopted by workers engaged in brick making job and some parameter were compared between male and female workers.

The occurrences of musculoskeletal disorders (MSD) of the male and female subject engaged in brick field have been assessed. From the result it was revealed that the shoulder pain was the most prevalent problem (more than 91% of the respondent) in both sexes (Table-1). The prevalence of MSD in case of lower back was also high (more than 81% of the respondent) in brick kiln workers. Female subjects were prone to have MSDs in upper extremities, knee and feet than that of the male subjects. But the occurrence musculoskeletal problems in lower back and thigh were higher in male than that of females. The results of the Chi square test revealed that there was a significant difference ($P<0.05$) in the occurrence in MSD in neck between male and female workers.

Table 1: Frequency (f) and percentage (%) of musculoskeletal disorders of brick kiln workers

Body Segment	Male (n=52)			Female (n=59)		
	f	%	Grade	f	%	Grade
Neck	24	46.15	3	41	69.49 *	4
Shoulder	48	92.31	1	54	91.53	1
Elbow	13	25.00	6	16	27.12	8
Wrist	8	15.38	7	11	18.64	9
Upper back	21	40.38	4	24	40.68	5
Lower back	48	92.31	1	48	81.36	2
Thigh	20	38.45	5	19	32.20	6
Knee	40	76.92	2	46	77.97	3
Feet	13	25.00	6	18	30.51	7

*$p<0.05$

The quantitative assessment of the perceived rating of discomfort of the brick kiln workers were made with a 10-point subjective scale [21]. The pain mapping has been made by dividing the body into different segments. The results showed that the workers performing brick making tasks reported to suffer from different degrees of perceived exertion (Table 2). It was revealed that moderate to severe degree of discomfort (>4 to =7) was observed in shoulders, mid back, lower back and calf in both sexes (Figure-3). The discomfort rating was the highest in lower back region. No significant difference was observed in discomfort rating between male and female subjects.

Table 2: The perceived rate of discomfort (Mean ±SD) in different segments of the body of brick kiln workers (in a 10 point scale)

Body Region		Brick kiln workers	
		Male (n=52)	Female (n=59)
Neck		2.87±3.21	3.83±3.16
Shoulder	R	5.81±1.99	5.24±2.56
	L	5.81±1.99	5.20±2.52
Upper arm	R	1.40±2.66	1.64±2.88
	L	1.40±2.66	1.64±2.88
Lower arm	R	1.06±2.25	1.15±2.56
	L	1.06±2.25	1.15±2.56
Upper back		2.94±3.42	2.94±3.42
Mid back		4.04±3.48	4.04±3.48
Lower Back		6.48±1.94	5.71±2.95
Buttock		0.40±1.46	0.00±0.00
Thigh	R	2.63±3.18	2.19±3.39
	L	2.62±3.16	2.34±3.49
Cuff	R	4.94±2.73	4.93±3.01
	L	4.94±2.73	5.08±2.98
Feet	R	1.52±2.85	1.90±3.12
	L	1.52±2.85	2.05±3.24
Over all discomfort rating of the body		3.06±1.03	2.92±1.10

The degree of postural stress of different tasks in brick making job (Fig 2) were analyzed by OWAS method [22]. The brick making job was divided into different phases (Table 3) and composite scores for different phases of each job were determined. Then the postures of each job were categorized according to the action category of OWAS method.

Among the four action categories (AC 1,2,3, and 4) male and female brick kiln workers showed different distribution of ACs in different phases of jobs. From them dominating AC was determined. The percentage distribution of ACs in different phases of both sex have been shown in Table 3.

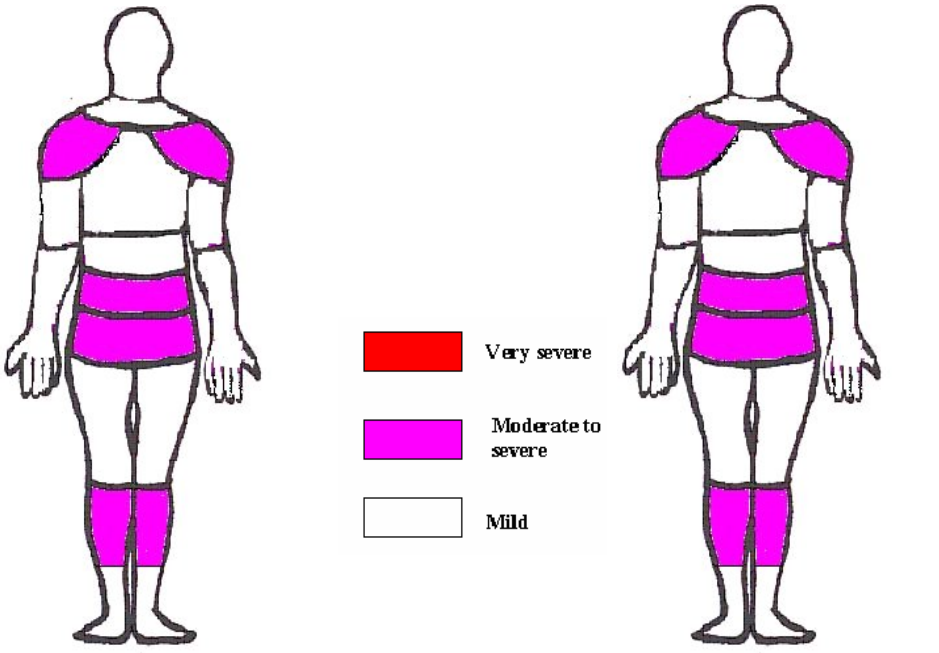

Fig 3: Body part discomfort rating of brick kiln workers

Table 3: Percentage distribution of workers in working postures in different action categories in brick dice making task

Tasks	**Male(n=20)**					**Female(n=20)**				
	Action category				Dominant	Action category				Dominant
	1	**2**	**3**	**4**	categories	**1**	**2**	**3**	**4**	categories
Clay cutting	-	-	-	**100**	**4**	-	-	-	**100**	**4**
Preparation of clay lump	-	**100**	-	-	**2**	-	**100**	-	-	**2**
Filling the dice with clay	-	**100**	-	-	**2**	-	**100**	-	-	**2**
Keeping the raw brick	-	**100**	-	-	**2**	-	**100**	-	-	**2**
Cleaning the dice with dry sand	-	**100**	-	-	**2**	-	**100**	-	-	**2**

DISCUSSION

Manual brick manufacturing in open type of kilns in India is hazardous occupation. There are numerous risks and hazards for adopting awkward postures for prolonged period, high ambient temperature, working with manual load lifting. As the workers ought to work continuously in bent or stressful postures, they suffer from discomfort and pain in different parts of the body [23].

The higher prevalence of work related MSD at different segments of the body of the workers might be due to use of significant force, repetitive movements and longer duration of exposure [24]. A constant repetition of movements imposes a cumulative work load which can cause pain and weakness and impaired function of the muscles and other soft tissues [25]. The physiologic problems that arise from repetitive work or overuse of certain muscles, tendons and soft-tissue structures have been addressed in terms of muscle fatigue, tissue density changes, and tissue strain [26].

The work related musculoskeletal disorders are defined as a musculoskeletal injury that results from work related event. In the present study, the prevalence of MSD was noted in neck, lower back and knee of the workers during performing brick making tasks.

Physiologic evidence shows that the rate and degree of tissue damage depends on the amount of force, repetition and duration of exposure [27]. The prevalence of shoulder problem was very high among the workers. In all tasks of brick making job, workers had to repetitively move their arms. This might evoke shoulder muscular tenderness disorder. This might be due to the static fatigue of the trapezius muscle and multifactorial identification including static and awkward posture and work practices [28].

Some other studies from developing countries like India showed that these workers suffered from assorted health problems due to awkward postures and carrying heavy loads [29, 30]. All these authors concluded that musculoskeletal disorders (MSDs) resulted from frequent trunk bending, twisting and repetitive handling of several bricks at a time. Moreover, some studies reported that women have a higher prevalence rate of work-related MSDs than that of men [31, 32] similar findings were also noted in the present study.

A study was done by Sahu and Sett, [33] on female brick kiln workers and they found that the brick moulders have more pain in the low back and part of the legs. The higher prevalence of MSD in these body segments was occurred because most of the time they had to sit continuously in the same awkward postures to mould the bricks. The results are supported by the subjective assessment of discomfort.

Long term adoption of bend and twist posture was associated with postural stress. Investigation suggested that bending and twisting of back awkwardly and working in same position were both significantly associated with prevalence of lower back problem [34,35] and both were judged by workers to be the most problematic job factors contributing to pain and injury. Goldsheyder et al. [36] reported that there was a significant association of awkward postures

with back pain and the prevalence of lower back problems was significantly increased with work tasks described as "bending or twisting back in awkward way".

The degree of postural stress of different tasks in brick making job were analyzed by OWAS method. A composite score for different phases of each job was determined. The clay cutting task, which was performed in kneeling posture, showed action category 4, i.e., the task needed corrective measures immediately. In other tasks, viz, the preparation of clay lump (done in squatting posture with forward bending), filling the dice with clay (done in squatting posture), keeping the raw brick (done in twisted squatting posture), and cleaning the dice with dry sand (done in twisting posture), the action category 2, was found, i.e., the task needed corrective measures in the near future. Thus, immediate ergonomic interventions are needed to reduce their work stress by correcting awkward postures.

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