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REGULAR ARTICLE

# An evaluation of low back pain among female brick field workers of West Bengal, India

**Banibrata Das**[1,2]

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**Abstract**
*Objectives* The purpose of the study was to determine the prevalence of low back pain (LBP) among brick field workers and to explore attributed causes of LBP, investigate the relationship between LBP and psychophysical and psychosocial factors and measure the impact of LBP.
*Methods* A modified Nordic Musculoskeletal Disorder Questionnaire along with Body Part Discomfort scale were administered to brick field workers ($N = 148$). Working posture of the participants was assessed using Rapid Entire Body Assessment (REBA) method.
*Results* The study showed that 70 % of the female workers reported LBP due to awkward working posture for prolonged period of time. This was mainly reported by brick moulders. 45 % reported LBP due to manual material handling (MMH) and 40 % due to awkward lifting of heavy objects (brick). The study shows that the LBP is more prevalent (OR 1.59 and 95 % CI 0.411–6.207). 78 % of the female workers want the job rotation to relieve from their job monotony.
*Conclusions* LBP occurred among female workers due to awkward posture, repetitive work and MMH. This study also stated that psychosocial cause of LBP is inadequacy income, monotony work, job dissatisfaction. Working posture analysis REBA suggests that all the working postures are high-risk level.

**Keywords** Low back pain · Psychosocial factors · Women · Brick field workers · Psychophysical factors

## Introduction

Women form a significant proportion of the workforce and this proportion has been increased day by day throughout the world. Women in the India, play a major role in shaping the country's economy in the developing countries. A woman takes a vital role in the making of bricks in the brick making industry in West Bengal. In India, female brick field workers coming from low socioeconomic conditions are habituated to heavy physical workload and they performed different types of manual activities which causes low back pain (LBP) among them.

Brick field industries are one of the largest and oldest industries in India, in which millions of skilled and unskilled workers from all over the country make their livelihood [1]. In brick field industry, the female brick field workers have to perform various types of hard and strenuous work that leads to LBP in the body. Studies of the epidemiology of LBP have implicated mechanical risk factors, such as manual handling, carrying heavy loads and work-related posture [2, 3].

Low back problem is a major public health problem with over 80 % of the world population reporting LBP at some point in their life [4]. It is a disorder with much possible etiology, occurring in different groups, and is also a common health condition in working populations. Female brick field workers are at a high risk of suffering from occupational-related LBP because of high-risk activities involved in different activities in brick production. LBP and its associated disability continue to plague the brick field industry. The prevalence of occupational-related LBP

✉ Banibrata Das
dr.banibrata@gmail.com; dr.banibrata@yahoo.com

[1] Department of Physiology, South Calcutta Girls' College, University of Calcutta, Kolkata 700025, India

[2] 100 Biplabi Ganesh Ghosh Sarani, Post-Bhadrakali, Dist Hooghly 712232, West Bengal, India

among manual workers in the brick manufacturing companies is believed to be due to high exposure to awkward postures for long hours, heavy manual work and exposure to whole-body vibration in the work environment [5]. LBP is associated with major costs in terms of health resource usage, work disability and absenteeism [6] and loss of quality of life [7].

The main aim of the present study was to assess the prevalence of LBP among the female brick field workers of the Indian population and to investigate the role of working posture in the reporting of back pain. This study also investigates the relationship between LBP and personal and work-related factors and measures the impact of LBP. Through this study, local awareness regarding occupational safety and health of workers working in unorganized sectors can be increased to improve the present occupational safety and health situation in India.

## Methods

### Study design

For this study 148 female brick field workers were randomly selected from 20 main brick fields of Bhadrakali in Hooghly district, India. This brick field is mainly situated in the river side of Hooghly in Hooghly district of West Bengal, India. Others female brick field workers were not interested in participating in this study and thus their data were excluded from this study. Among the selected female brick field works, some of them are permanent workers ($n = 30$) and some are casual workers ($n = 118$). The inclusion criteria of this study were the workers should have at least 3 years experience in this job.

Before conducting the study, written informed consent was taken from the brick field workers. Prior permission and ethical approval was also obtained from relevant authorities before commencement of the study. Before conducting the survey, a written permission on the project was obtained from Institutional Human Ethical Clearance Committee over the Indian Council of Medical Research Guidelines.

### Job description

There are several activities were performed by the brick field workers. Among these, the below stated activity was performed by the female brick field workers.

(a) Carrying the mud—The mud which was collecting from the river bank is mainly accumulated in the accumulation zone of the brick field by carrying them with basket in the head of the workers. During making the green bricks, the carriers, carries the mud in their head to prepare the clay.
(b) Preparation of raw bricks (moulding)—Preparation of clay is mainly done by the machine with the help of mud, water and several additives. After preparation of clay, inserting of clay in the wooden dice along with sand in squatting posture and particular amount of clay is taken by the workers and put it into the wooden dice; extra clay is removed by wire cutter. Then lifting the wooden dice upward and turning downwards the ground forcefully.
(c) Carrying raw bricks from stacking area to kiln—Generally brick carrier's carry their raw bricks into the kiln for burn. After reaching unloading of raw bricks was done carefully. After unloading, the workers generally used to arrange the bricks for burn.
(d) Loading of burn bricks—After burning the bricks the kiln workers generally take off the burned bricks from kiln. After picking the burns from the dust of kiln, the female workers loaded the burn bricks in their head
(e) Carrying burn bricks—After loading the brick carriers have to cover long distance to store the bricks in the brick field.
(f) Unloading of burn bricks for storage—During storing, the unloading of burn bricks is an important and careful activity which was done by the brick carriers.

### Questionnaire

The modified Nordic questionnaire [8] was used in this study. The questionnaire consists of a series of objective-type questions with multiple choice responses. The questions were grouped into sections dealing with general information of the workers, work organization and work behavior, assessment of stress at work and detailed question on work-related pain. The interview was taken in their local language (Bengali and Hindi). Before conducting the interview the experimental protocol was explained to the brick field workers individually. Interviews were totally confidential, undertaken just after working hours over.

### Repetitiveness of work

Repetitiveness was determined by analyzing time spent in, and motion involved in, the different brick making tasks along with the total time for a particular job. Timing was recorded with a stopwatch repetitive activity was considered to an action that took up more than 50 % of the total time period for that particular job is considered to be a repetitive one [9, 10].

### Discomfort level scale

Discomfort level scale is a 10-point scale for discomfort and pain sensation, where 1 represents just noticeable pain, 5 represents moderate pain and 10 represents intolerable pain (Fig. 1). This scale was used for identifying the discomfort level of the female brick field workers in their different postures. The intensity of pain or discomfort was measured by utilizing the Body Part Discomfort (BPD) scale [11].

### Posture analysis

The working postures were analyzed by the Rapid Entire Body Assessment (REBA) tool [12]. The working postures were recorded with the help of a digital video camera (Sony handycam). Later stick diagrams were drawn from frozen frame video recordings and eventually they were analyzed. The most frequently repeated postures or the postures that were held for the longest amount of time of the work cycles were chosen for assessment.

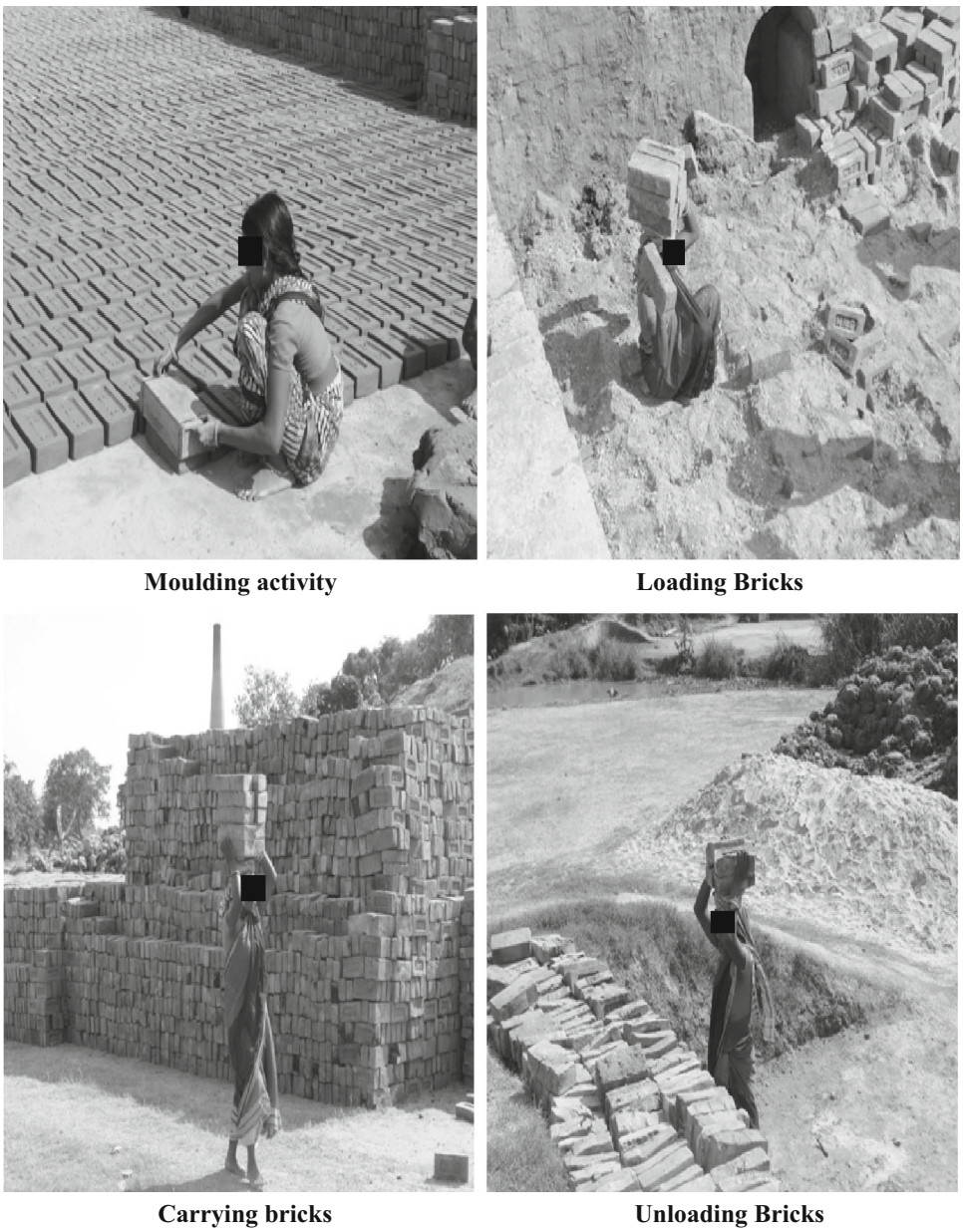


**Fig. 1** Different brick field activities among female brick field workers

### Data analysis

Data were examined using the statistical package PRIMER OF BIOSTATISTICS version 5.0 (Primer of Biostatistics 5.0.msi, Msi Version = 1.20.1827.0, Primer for Windows, Mc-Graw-Hill). Descriptive statistics (frequency and percentage) were used to summarize the data. Cross-tabulations were done to get the frequency and percentages of the subcategories.

Statistical analysis included calculation of mean and standard deviation of the various physical parameters. The association of LBP between two groups of female brick field workers with and without having LBP was examined by $\chi^2$ test and the associations were described by the odds ratio with 95 % confidence interval.

## Results

Demographic factors relating to the study population, including age, years in experience in worker, duration of employment, marital status, education status and types of work are given in Table 1. The mean age of the workers was 30.3 (SD = 10.7) years: age ranged from 21 to 49 years, the mean duration of work was 6.4 h/day. Whereas the years employment was 5.6 years (SD = 8.2) and majority of them were uneducated (56.1 %).

The result of the study shows that the LBP is more prevalent (OR 1.59 and 95 % CI 0.411–6.207) followed by shoulder (OR 0.29 and 95 % CI 0.135–0.650), neck (OR 0.62 and 95 % CI 0.318–1.234), hands (OR 1.95 and 95 % CI 1.011–3.786), knee (OR 7.27 and 95 % CI 3.506–15.083), and leg pain (OR 4.86 and 95 % CI 1.970–11.998) among the both group of female brick field workers (brick moulders and brick carriers).

Table 2 of this study shows the responses to physical and psychosocial attributed factors or causes of LBP at work among female brick field workers. In this study it was observed that 70 % of the female workers reported LBP due to awkward working posture for prolonged period of time; whereas, 61 % of the female stated that LBP due to repetitiveness of work and 55 % reported LBP due to constant sitting static work posture. This was mainly reported by brick moulders. 45 % reported LBP due to manual material handling (MMH) and 40 % due to awkward lifting of heavy objects (brick).

The analysis of questionnaire (Table 2) also showed that 52 % of the female workers performed skilful activity. Most of them (84 %) did not make frequent mistakes at work. As large as 76 % of the female brick field workers stated that they frequently changed their place while at work. 63 % of the workers reported rigidity in work methods and procedure. 84 % of the workers want to work in a group. 93 % of the workers want to accept new jobs/responsibilities and 78 % of the female workers want the job rotation to relieve from their job monotony. About 89.0 % of the workers reported that their job requires repetitive motion of body segments, particularly the movement of the hands. 39 % of the workers reported to take new responsibility that enhanced stress at work. 45 % of the female brick field workers main brick carriers lifting or loading 30–40 kg of bricks at a time with a constant forward bending posture with twisted back and arms. The complaints of LBP can be attributed to the strenuous activities undertaken.

From Table 3, it is evident that the female brick field workers performed various tasks during brick field activities that were highly repetitive, including carrying mud

**Table 1** Demographics of the study population (female brick field workers)

| Variables | Number of subjects ($n$ = 148) | Percentage |
|---|---|---|
| Age (years) | | |
| 21–30 | 93 | 63 |
| 30–39 | 40 | 27 |
| 40–49 | 15 | 10 |
| Years of experience in work | | |
| ≤03 years | 47 | 31.8 |
| 04–05 years | 73 | 49.3 |
| 10–15 years | 24 | 16.2 |
| 16–20 years | 04 | 2.7 |
| Types of workers | | |
| Permanent | 32 | 21.6 |
| Temporary | 116 | 78.4 |
| Marital status | | |
| Single | 27 | 18.2 |
| Married | 121 | 81.8 |
| Education level | | |
| Illiterate | 29 | 19.6 |
| Primary | 73 | 49.3 |
| Junior high school | 46 | 31.1 |
| High school | 00 | 00.0 |
| Duration of work | | |
| ≤5 h/day | 44 | 29.7 |
| 6–7 h/day | 83 | 56.1 |
| 8–8.5 h/day | 21 | 14.2 |
| Types of workers | | |
| Brick moulder | 82 | 55.4 |
| Brick carriers | 66 | 44.6 |
| Number of working days in a week | | |
| Brick moulder | 7 days in a week | – |
| Brick carriers | 7 days in a week | – |

**Table 2** Responses to psychophysical and psychosocial attributed factors or causes of low back pain at work among female brick field workers

| | Response | Number and percentage |
|---|---|---|
| Questionnaire part 1—physical factors | | |
| Low back pain due to manual material handling | Yes | 76 (51 %) |
| Low back pain due to awkward lifting | Yes | 79 (53 %) |
| Low back pain due to constant sitting static posture | Yes | 82 (55 %) |
| Low back pain due to awkward working posture | Yes | 104 (70 %) |
| Low back pain due to repetitive work | Yes | 90 (61 %) |
| Low back pain due to frequent bending and twisting | Yes | 75 (51 %) |
| Questionnaire part 2 (a)—psychosocial factors | | |
| Work organization and work behavior | | |
| Job requires knowledge of skilful activity | Yes | 77 (52 %) |
| Workers make frequent mistakes | Yes | 24 (16 %) |
| Job demands frequent rotation for task and place | Yes | 112 (76 %) |
| Rigidity in work methods and procedure | Yes | 93 (63 %) |
| Work demand targets specific productivity | Yes | 122 (82 %) |
| Like to work in a group | Yes | 125 (84 %) |
| Forced to accept new responsibility | Yes | 58 (39 %) |
| Job demands repetitive motions of body segments | Yes | 132 (89 %) |
| Like to accept new jobs/responsibilities | Yes | 132 (93 %) |
| Favor: job rotation/division of labor | Yes | 115 (78 %) |
| Questionnaire part 2 (b)—psychosocial factors | | |
| Measurement of work stress | | |
| Job dissatisfaction | Yes | 77 (52 %) |
| Monotony at work | Yes | 92 (62 %) |
| Poor relationship with managers of the brick field | Yes | 51 (34 %) |
| Perceived inadequacy of income | Yes | 136 (92 %) |
| Unpleasant work environments | Yes | 27 (18 %) |
| Have you got tired easily | Yes | 21 (14 %) |
| Have you been annoyed and irritated easily | Yes | 10 (07 %) |
| Have you been forgetful? | Yes | 05 (03 %) |
| Do you in your work often have to: Lift, pull or push and carry loads (more than 20 kg) | Lift | 66 (45 %) |
| | Push | 82 (55 %) |
| | Carry | 66 (45 %) |
| Lifting behavior | Alone | 118 (80 %) |
| | With other | 30 (20 %) |
| Do you often have to stand, sit for a prolong time | Stand | 66 (45 %) |
| | Sit | 82 (55 %) |
| Is the discomfort felt during subject in work | Yes | 133 (90 %) |
| Is the discomfort felt during subject in rest | Yes | 101 (68 %) |

(61.44 %), moulding (65.16 %), loading raw bricks (68.01 %), carrying raw bricks to kiln (58.64 %), unloading raw bricks to kiln (78.22 %), picking burn bricks from kiln (66.23 %), Carrying burn bricks from kiln to storage (71.89 %). All these activities involved are performed in an awkward posture and in high repetitive manner which is responsible for acute LBP among female brick field workers.

Figure 2 indicates that 27 % of the brick moulders had complaints of LBP throughout the year which could be suggestive of development of musculoskeletal disorder in their low back region and this pain persists for 24 h among 67 % of the female brick moulders which is responsible from absenteeism from work and 72 % of the workers reported acute pain during work. Whereas in case of brick carriers 25 % had complaints of LBP throughout the year,

**Table 3** Average repetitiveness of different kinds of activities in brick manufacturing units

| Activities | Time taken (s) | | Total time taken in 1 work cycle (s) | | Repetitive/non repetitive |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Carrying mud | 142.5 | ±30.2 | 231.9 | ±37.8 | 61.44 % Repetitive |
| Moulding | 137.3 | ±33.6 | 210.7 | ±38.1 | 65.16 % Repetitive |
| Loading raw bricks | 52.3 | ±15.2 | 76.9 | ±16.7 | 68.01 % Repetitive |
| Carrying raw bricks to kiln | 132.6 | ±26.3 | 226.1 | ±29.5 | 58.64 % Repetitive |
| Unloading raw bricks to kiln | 58.9 | ±17.3 | 75.3 | ±18.5 | 78.22 % Repetitive |
| Picking burn bricks from kiln | 10.2 | ±12.3 | 15.4 | ±14.3 | 66.23 % Repetitive |
| Carrying burn bricks from kiln to storage | 138.4 | ±35.7 | 192.5 | ±33.2 | 71.89 % Repetitive |

Time taken: this means the time required to perform the main activity which is part of a single work cycle

Total time taken in one work cycle: this means the time spent on the completion of a single work

73 % brick carriers had complaints of LBP persists for 24 h and 75 % brick carriers had complaints of LBP suffering during their work.

Figure 2 also represents the assessment of LBP in different body parts according to the BPD scale. The figure shows that most predominant LBP felt among the 71 % of the brick moulders and 72 % brick carriers in BPD scale range of 8-10, which is described as intolerable pain; whereas, 18 % brick moulders and 21 % brick carriers felt LBP in BPD scale range of 6–7, which is described as moderate pain. Figure 3 of the study shows the linear regression between LBP occurred and working days lost among female brick field workers.

From the analysis of working postures (Table 4), it was found that most of the working postures are of risk and high risk and require immediate corrective measures, as indicated by the REBA analysis (by comparing the REBA score with REBA risk level). The stick diagrams, obtained from the still photographs of working postures of the female brick field workers in different brick making activities. These types of working postures are frequently adopted by the brick field workers, and often, they suffer from musculoskeletal complaints in the lower back pain and upper extremities. The posture codes of the REBA indicate that, all the postures in different brick making activities is a high-risk level and it demands immediate attention (i.e., the posture change necessary soon).

## Discussion

The main findings of the study showed that LBP was more prevalent among the females especially brick field sectors where most of the female workers perform heavy and hazardous work for long time in duration. Work-related musculoskeletal disorders (WMSDs) especially LBP continues to present a major challenge to workers and their employers in virtually every industry and every working sector. The relationship between task demands, ergonomics and LBP can become significant as a result of many activities of daily life both at work and elsewhere.

This study showed the prevalence of LBP among the female brick field workers. The results showed that the majority (63 %) of the female workers are in the age group of 21–30 years. This study also showed that most of the female workers are casual workers, because the casual brick field workers are mainly involved in brick making process from October to May in the year. Besides this, they are mainly involved in other activities (construction labor, masonry, etc.) during off season. This study (Table 1) shows that most of the female brick field workers are illiterate (49.3 %) and (31.1 %) have a primary education.

The brick field industry is filled with tasks that require high physical demands. Furthermore, manual lifting and handling of heavy supplies and other material are still commonplace in brick field. A number of risk physical factors for LBP have been identified such as MMH (51 %), awkward lifting (53 %), constant sitting static posture (55 %), awkward working posture (70 %) and repetitive work (61 %) and frequent bending and twisting (51 %). These study was corroborates with the work of Bernard [13]. He stated that few number of risk factors for LBP. These risk factors include manual materials handling, frequent bending and twisting and heavy physical load. These results also echo the findings of a comprehensive review by the National Institute for Occupational Safety and Health (NIOSH), which found strong evidence for a causal relationship between LBP and lifting/forceful movements and evidence for a causal relationship between awkward postures and heavy physical work and LBP. Devereux et al. [14] and Waters et al. [15] stated that the combination of workplace stress and physical work demands increase rates of LBP.

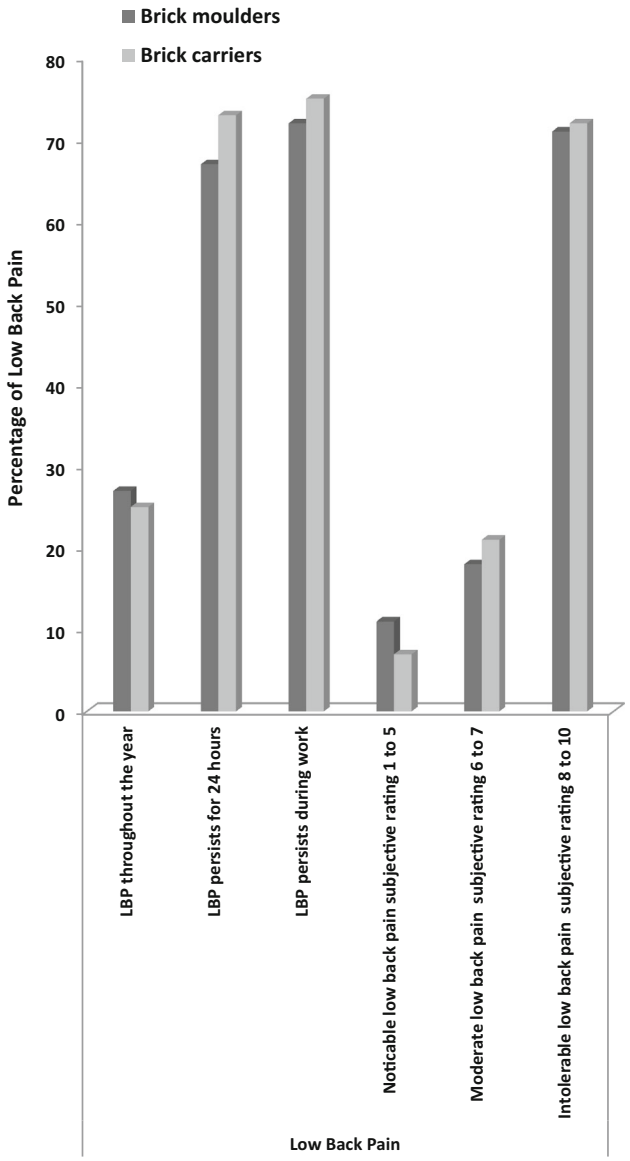


**Fig. 2** Low back pain (*LBP*) according to BPD scale and in different times among female brick field workers

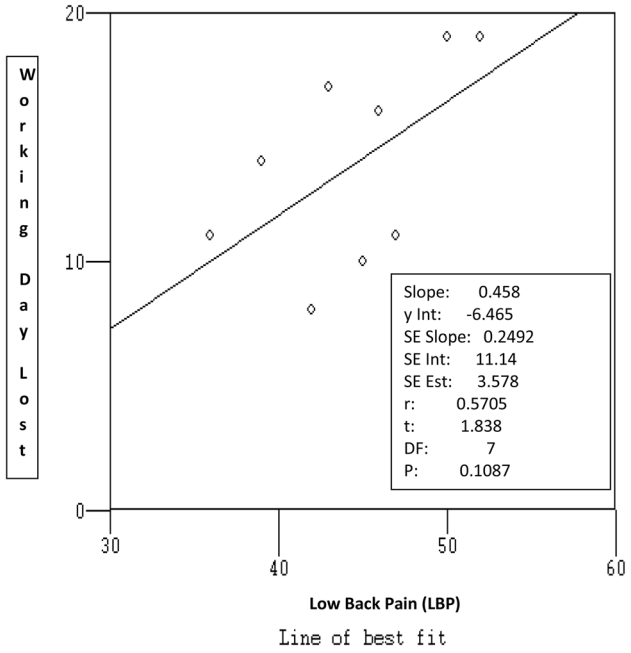


**Fig. 3** Linear regression between low back injuries or pain occurred and working days lost among female brick field workers

This study showed that the some psychosocial factors like job dissatisfaction (52 %), monotony at work (62 %), poor relationship with the managers of the brick field (34 %), perceived inadequacy of income (92 %) and unpleasant work environments (18 %) have a relationship between LBP. These studies have same findings of a study of Snook et al. [16]. They also described that psychosocial factors, such as job dissatisfaction, poor relationship with immediate supervisors, perceived inadequacy of income, lack of control over one's job, and unpleasant work environments seem to have an impact on LBP. Hoogendoorn et al. [17] stated that, one of the consistent findings related to workplace psychosocial stressors is that low job satisfaction is associated with LBP. Monotony at work is also usually associated with higher levels of LBP. Svensson and Andersson [18] stated that monotony was found to have a direct relationship to LBP. Davis and Heaney [19] showed that job dissatisfaction and stress are more consistently and more strongly associated with the development of MSD mainly in lower back. Dissatisfaction with a work situation, a supervisor, or a dead-end job and boredom contribute greatly to the onset and persistence of musculoskeletal disorders.

Carrying heavy loads are the most common human activities in several occupations involving MMH. During brick making, female brick field workers perform several types of MMH that may be causative factors for the development of LBP among them. The present study deals with MMH in which female brick field workers carry, loading and unloading heavy loads (mud, raw bricks and burn bricks) in a repetitive manner is also a causative factor of LBP among them. This study was supported with the result or study of Cole and Grimshaw [20]; they also stated that carrying heavy loads in a repetitive manner is a causative factor of LBP.

Postural analysis can be a powerful technique for assessing work activities. In this posture analysis study (REBA method) it was found that most of the posture adopted by the female workers are high-risk level and change the posture necessary soon. Prolonged working in squatting and kneeling postures is also common in many activities related to brick manufacturing especially moulding, where the female brick field workers mould the

**Table 4** Analysis of working posture by using REBA method for assessing risk level of low back pain

| Sl. no. | Activities | Posture details | REBA score | Risk level | Action categories |
|---|---|---|---|---|---|
| 1. | Carrying mud | Back bent backward, both arms below shoulder level, walking or moving, weight or force needed exceeds 20 kg | 09 | High | Necessary soon |
| 2. | Moulding | Bent forward, both arms below shoulder level, legs bent forward, weight or force needed >20 kg | 08 | High | Necessary soon |
| 3. | Loading raw bricks | Bent forward, both arms above shoulder level, sitting, weight or force exceeds 20 kg | 10 | High | Necessary soon |
| 4. | Carrying raw bricks to kiln | Back bent forward, both arms are above shoulder level, walking or moving, weight or force above 20 kg | 09 | High | Necessary soon |
| 5. | Unloading raw bricks to kiln | Bent forward, one arm is or above shoulder level, sitting, weight or force needed exceeds 20 kg | 10 | High | Necessary soon |
| 6. | Picking burn bricks from kiln | Back bent forward, both arms are below shoulder level, back bent forward, both arms are above shoulder level, weight or force needed is 10 kg or less | 10 | High | Necessary soon |
| 7. | Carrying burn bricks from kiln to storage | Back bent forward, both arms are above shoulder level, walking or moving, weight or force above 20 kg | 09 | High | Necessary soon |

bricks with clay in a squatting posture for prolonged period of time. This study shows that the lower back is the most affected body part among the female brick field workers. Static loading occurs when fixed postures are adopted, often in awkward positions and the muscles remain contracted for extended periods. During moulding activities female brick field workers are engaged in a prolonged forward bent posture without providing any back support, a constant load was maintained in the lumbar region throughout the work. This makes the neck extensor and spinal extensor muscles to get fatigued soon, which in turn leads to neck pain and low back ache among them. In this study, brick carriers mainly carried heavy loads while carrying mud and bricks in their head. Lower back pain has been associated with lifting of heavy objects while in an awkward posture [21]. Posture and the location and weight of a load affect the moment of the force applied in the lumbar region, which in turn affects muscle loading and compressive forces on the internal vertebral disc [22, 23]. Thus, lower back problems appear to be associated with those types of postures that require back flexion, carrying and lifting of heavy loads, and exposure to whole-body vibration [24]. Even nowadays, many physically heavy work phases and a combination of several stress factors, including poor work postures and activities requiring the use of force are common among brick field workers.

The most significant potential risk factors for MSDs in female brick field workers are heavy lifting and carrying and working in stooped or awkward postures [25]. Prolonged extreme trunk flexion is commonly found in farm tasks such as pruning, weeding, labeling and harvesting crops. Female potato cultivators have to carry heavy loads when carrying seeds for planting in grooves in the soil and during harvesting, which may be the causative factor for musculoskeletal disorders [26].

This study showed that female brick field workers suffered from chronic LBP due to carrying heavy loads as well as working in an awkward posture in the brick field which may be the causative factor of musculoskeletal disorder especially LBP. Although it has been widely acknowledged that constrained working postures are one of the important factors of musculoskeletal disorders especially LBP.

This study found that, female brick field workers suffered from acute LBP due to working in an awkward (stooping and kneeling) and static posture in a brick field. One of the main causative factors of LBP is MMH of bricks and loading and unloading of bricks from the kiln. Repetition of work is the main causative factors of LBP and also pain in the upper extremities of the body. REBA posture analysis suggested that, working in an awkward posture for prolonged period of time is one of the leading causative factor for WMSDs among female brick field workers.

Recommendations: The following recommendations are made for reducing the occupational stress of the brickfield workers:

1. Interim rest pauses should be enhanced to avoid excessive physical stress among the female brick field workers.
2. One day break in a week which helps to reduce physical and mainly psychological stress.
3. Careful about posture, try to avoid static work posture.
4. Avoiding long distance travelling that reduces working hour and thus physical stress.

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**Conflict of interest** None declared.

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