



## **Work Related Musculoskeletal Disorders in Brick Kiln Workers: A Review**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background:** Musculoskeletal disorders (MSD) have become very common condition. Brick kiln workers are a profession which is not spare from MSDs. The workers in such industries have no knowledge of ergonomics and health problems which add on to the existing MSDs. The aim of this study is to present a summary review of the current state of knowledge about musculoskeletal disorders in brick kiln workers.

**Methodology:** The literatures were searched using various search engines and databases. Search engines were used are Google Scholar, Pub Med, Science Direct and Databases are COCHRANE, CINHAL, MEDLINE, PEDRO etc. The Source of the data has been electronic sources (Databases, Electronic libraries, Electronic Journals, Google Scholar) and print sources (Journals, Textbooks, Hand searching, Follow-up reference).

**Result:** Articles were tabulated revealing their title, author, year, study design. A total of 150 papers and reports were identified from the database search. These papers underwent title and abstract screening. 57 had full text screening, of which 13 articles did not include information on the prevalence of musculoskeletal disorders in brick kiln workers and were therefore excluded. So, total 44 articles were included for the review.

**Conclusion:** Brick making is a multitask activities where specific workers are involved in specific processes. Not to forget that all the brick making manufacturing processes requires time and is a heavy manual work load with repetitive movements in awkward posture due to which MSDs are but

obvious to occur. Also, the workers in such industries are uneducated with almost no knowledge of ergonomics and health problems which add on to the existing MSDs.

**Keywords:** *Brick kiln workers; musculoskeletal disorders; work-related musculoskeletal disorders; prevalence.*

## 1. INTRODUCTION

Work related musculoskeletal disorders (WMDs) were first brought into notice by Bernardino Ramazzini who observed that all those who were working consistently with bad postures for prolong time often resulted in WMDs [1] WMDs have become common in modern world due to stress and overload of work [2]

Musculoskeletal disorders are a broad term in which all the pathologies related to bone, tendon, muscles, ligaments, cartilage and spinal discs are considered provided which occurs due to improper working activities [1,2,3,4]

WRMSDs can be caused not only by static bad postures but repetitive activities like frequent bending, twisting, lifting, pulling, pushing, vibration, etc., at the construction site. [5,6].

India, is also not spared from complains of work-related Musculoskeletal Disorders (WMSDs) as it is not only the agricultural country but also a developing industrial country [7].

In India, workers with different skills are available throughout the year. But the business which is seasonal requires specific skilled workers. Mostly these manual workers come under below poverty line and they come from nearby village and/or migrate to different states as per the requirement of their skilled work. Talking about brick kiln workers, they are off duty during monsoon season as construction sites are closed [7,8].

India is the world's second largest brick producer and has lot of brick kiln worker accounting for over 10% of the global production. In India more than 100,000 brick kilns producing about 250 billion bricks per annum [7-13]. Indian fired clay brick kilns are categorized as unorganized small-scale industries [11] Workers coming to make livelihood from these industries are uneducated and hence has no botheration of their health and ergonomic importance [11,12].

In India, Brick kiln is wide spread small-scale industry. Over last 50 years construction of residential complexes, commercial complexes, corporate sections, roads, dams and factories

are on increasing scale in India. Therefore, the demand of bricks has been increasing many folds. Workers in this industry are poor, ill-literate, unorganized and not covered by occupational health and safety regulations [14] In India Fired clay bricks are produced and about 42,000 small or cottage scale brick kilns and clamps operate seasonally (CPCB, 1996). The most recent estimate annual production of bricks in India is 51,000 million from 45,000 small/cottage scale units distributed throughout the country and there are 2.5 million workers employed in the sector [8].

The history of making bricks in India is almost 5000 years old. The Indus valley civilization was discovered by the archaeologists with the help of old bricks found during the construction of railway track from Karachi to Punjab in mid-19th century [13] In brick kiln industries, male, female and even children are recruited. They work with a temporary contract and are paid very low wages [15].

In brick fields, the job is divided into different categories. As per the work, the workers are termed as brick carriers, brick molders, brick fireman, and brick stackers. These workers have to do heavy manual work like spading, moving the mud, special clay preparation, shifting the clay from one place to another by carrying overhead, molding or giving shape to the bricks, preparation of furnace to burn the raw bricks, loading and unloading, etc [2,5].

Though brick kiln workers are a major part of the unorganized work sector in rural India, they work in very pathetic situations which may be very harmful to their health.

Also, very few studies have targeted health problems and need of these brick kiln workers. Hence our study aims to find the work-related musculoskeletal disorders in brick kiln workers [12].

## 2. AIMS AND OBJECTIVES

### 2.1 Aim

To present a summary review of the current state of knowledge about musculoskeletal disorders in brick kiln workers.

## 2.2 Objectives

To search the literatures using health care databases.

To review the searched literatures using critical appraisal tools.

## 3. MATERIALS AND METHODOLOGY

This narrative review is pertaining of the work-related musculoskeletal disorders in brick kiln workers. The narrative review was carried out from August 2019 to August 2021.

The criteria for inclusion of articles were all the studies done on MSDs in brick kiln workers, published articles in English language and articles published from 2011 onwards were taken into consideration. Articles which included other than brick kiln workers and paper published before 2011 were excluded from the review.

Comprehensive literature search was undertaken in major health databases. The literatures were searched using various search engines and databases. Search engines which were used were Google Scholar, Pub Med, Science Direct and Databases were COCHRANE, CINHAL, MEDLINE, and PEDRO etc. with the help of keyword like work, prevalence, musculoskeletal disorders, and brick kiln workers. All the articles which fulfill the inclusion criteria were filtered. Following this, the included articles were critically appraised. The purpose was to combine the information from the various sources to fulfill the aim of the study. Source of the data were electronic sources (Databases, Electronic libraries, Electronic Journals, Google Scholar) and print sources (Journals, Textbooks, Hand searching, Follow-up reference).

## 4. RESULTS AND DISCUSSION

### 4.1 Results

A total of 150 papers and reports were identified from the database search. These papers underwent title and abstract screening. 57 had full text screening, of which 13 articles did not include information on the prevalence of musculoskeletal disorders in brick kiln workers and were therefore excluded. So, total 44 articles were included for the review. (Fig. 1, Table 1)

## 5. DISCUSSION

### 5.1 Brick Kiln Activities and Musculoskeletal Disorders

The whole process of brick making is multitask and thus different workers are required according to their skills [8].

#### 5.1.1 Brick molders

In this type of brick molding for example, it has been observed that workers are exposed to ergonomic challenges encompassing Manual Material Handling (MMH) activities such as pulling, pushing, lowering, walking, carrying mining, preparation of clay, lifting, bending, stretching, drying bricks, burning bricks etc.

In brick molders, kneeling position was most commonly acquired to do the activities [2] These activities have been observed to expose workers to several ergonomic risk factors such as excessive force, repetition, awkward posture, static postures and heat exhaustion. [16] In a study [2] it was described that as brick molders work on green bricks from the clay, continuous kneel sitting gave pain and problems in lower extremity joints. Similarly, a study [14] conducted to know the incidence of musculoskeletal disorders in Brick kiln workers, and health education of workers regarding importance of good posture and use of personal protective equipment to reduce the incidence of musculoskeletal disorders noticed that workers involved in carrying bricks were reported more of lower back pain and workers involved in molding reported relatively more pain in neck and shoulder region. The possible reason of this variation from other studies may be because of difference in nature of work done by them. Another study [9] pointed out back, shoulders and wrist to be affected in brick molders wherein the back accounting for more illnesses.

Male and female brick molders performed their high hand intensive job, in which wrist, hand and shoulder were affected most. The results of this study showed that the hand is the region which had a significant difference between male and female workers. Female brickfield workers may have less muscle mass, which can lead to significantly more pain in the hands while performing the molding activity. Brick molders perform their work in kneeling and squatting postures for a prolonged period of time, which can lead to low back and knee pain. So, the kneeling and squatting posture in brick molding

activity for long period of time may lead to low back pain and knee pain among brick molders [3].

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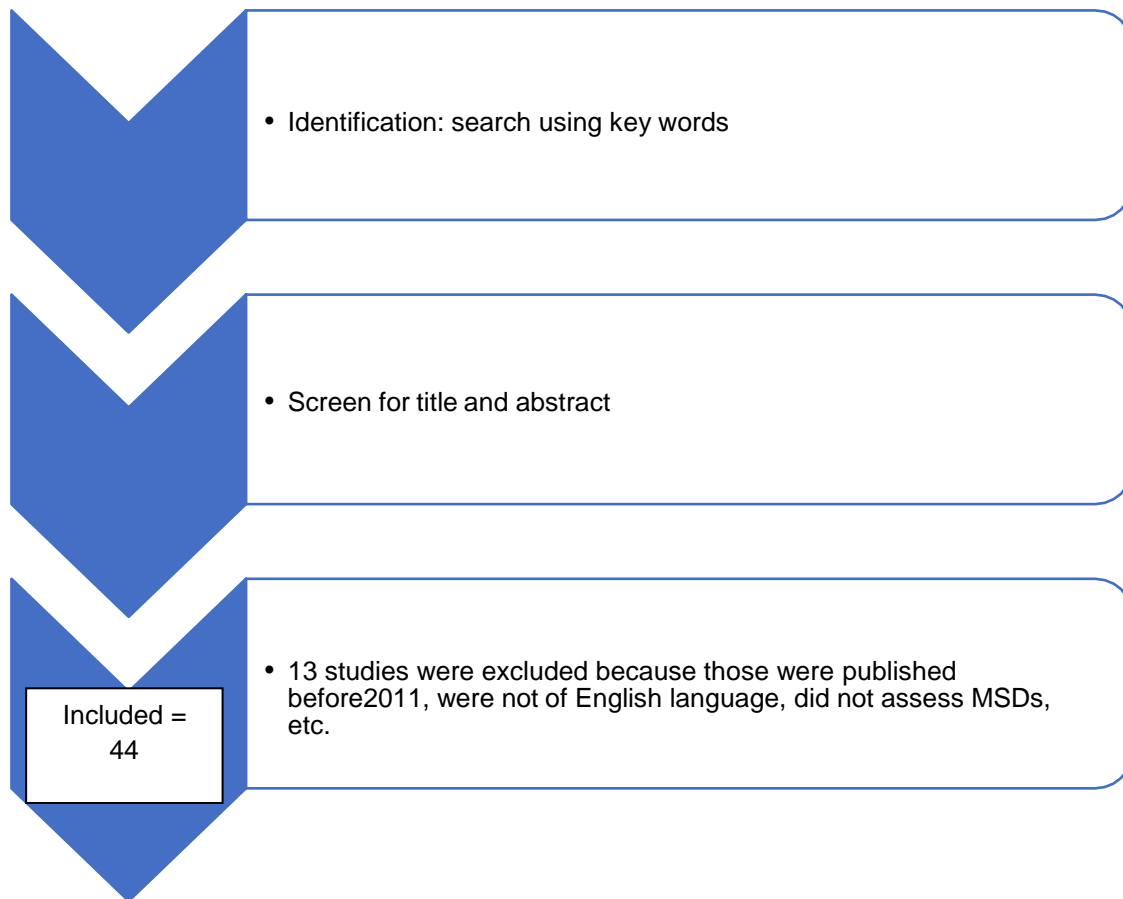


Fig. 1. Flow chart

Table 1. Detail of the articles included in review study

Sr. No	Title	Author and year of Publication	Study Design
1	Status of Brick Kiln Workers in South East Asia	Sourav Halder, UttamKumar Patra	Review study
2	Gender Differences in Prevalence of Musculoskeletal Disorders and Physiological Stress Among the Brick Field Workers of West Bengal, India	Banibrata Das	A Cross-sectional study

3	Health Hazards and Risks for Musculoskeletal Problems Among Child Labourers in the Brick field sector of WestBengal, India	Banibrata Das	A cross-sectional study
4	Occupational Musculoskeletal and Respiratory Illness among Brick Kiln Industry Workers in Bangladesh	AKM Abdul Ahad Biswas	A cross-sectional study
5	Exploring the musculoskeletal problems and associated risk-factors among brick kiln workers	Manoj Kumar Sain	A questionnaire survey
6	Identifying musculoskeletal issues and associated risk factors among clay brick kiln workers	Manoj Kumar SAIN, M. L. MEENA	A Cross-Sectional study
7	Analyzing the occupational health of workers in the brick kilns of Rajasthan	Manoj Kumar SAIN, M. L. MEENA	A questionnaire survey
8	Work-Related Musculoskeletal disorders Among the Head-Load Brickfield Workers	Mst Farzana Rahaman et.al	A Cross Sectional Study
9	Study of Musculo-Skeletal Discomfort in Female Workers of Brick Industry	Irumjahan Khan, Rajan More	A questionnaire survey
10	Evaluation of Work-Related Musculoskeletal Disorder and Postural Stress of Brick Kiln Workers during Performing Different Brick Making Tasks	Maity Payel et.al	A Cross Sectional Study
11	Study of socio-economic status of female workers in some selected brick Kilns in Karad, Maharashtra,	India Irumjahan Khan, Rajan More	A questionnaire survey
12	Prevalence of Work-related Musculoskeletal Disorders Among the Brick Field Workers of West Bengal, India	Banibrata Das	A Cross Sectional Study

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### 5.1.2 Brick carriers/ loading-unloading

Among different task of working in the brick field, the brick carriers had the highest prevalence of musculoskeletal problems [17] In a study [18] it was reported that due to constant weight carrying on head lead to head pain in the workers. They also stated that whether it is

female or male brick carriers, they exceeded the recommended weight limit by statutory authorities. Brick field workers stack bricks loads on head one by one and carrying the bricks on head from stacking area to brick kiln area [2,19] Brick carriers and stackers as their name suggests they have to carry bricks. They carry more than 20 bricks on their head and support the loaded stuffs with both hands which ultimately leads to pain and spasm of head, neck and shoulder muscles [2] Unharmful weight limit to keep on the head is up to 40kg for adult male and up to 25 kg for adult female [1] The load of bricks carried by the male and female workers on their head in this study were crossing the normal weight limits. Also, it was observed that workers performed their work in bending postures during stacking bricks one by one. Thus, the act of loading and unloading, as well as stacking bricks caused the repetitive movement of the trunk and upper limbs of the workers and to work above the shoulder. More than 90% of brick carriers and stackers were suffering from neck pain. <70% of workers had complaints of LBP and upper extremity joint pain. As the cervical spine is in constant compressive load, <12 % of workers had symptoms of nerve impingement [2] Similar results were drawn from other study [20] A study also recommended trolley should be used to shift the bricks instead of carrying on head [2] In another study [21], they stated that use of wheel barrows had very positive effect.

### 5.1.3 Brick layer

In a study it was stated that the job of bricklayers is to pick up bricks and place them in the wall, together with mortar. Therefore, bricklayer has to frequently bend and twist the body, and these movements cause the main physical workload problem. It was identified that on site bricklaying activities are manual handling in squatting and stooping posture, handling of bricks or blocks manually, working on uneven level and manual handling of mortar. Thus, frequent bending and rotation of the body and lifting at work carries a high risk for back pain and cause neck and shoulders disorders. Repetition, force and awkward posture are particularly important work-related factors contributing to disorders of the upper extremities and it was found that in bricklayers musculoskeletal disorder occurs are in neck, shoulder, lower and upper back of the body, knee, wrist and thigh. It was happened when the task is done repetitively for a long period of time [22].

Thomas M. Cook, John C. Rosecrance, and Chris L. Zimmermann held a study in which they included

survey on two major sections, one asking about work- related musculoskeletal disorders and the other asking respondents about job factors which contributed to their musculoskeletal aches and pain. The findings of self- reported musculoskeletal complaints concluded that Low back disorders were clearly the most prevalent musculoskeletal disorders reported by this sample of bricklayer. Frequent lifting of heavy weights, in bent or twisted postures, is generally to be a major risk factor at the workplace and cause higher prevalence of low-back problems is in bricklayers [23,24] Nor Suzila Lop conducted a study [22] aimed to document the critical activities and the risks encountered by trades on site that affect the musculoskeletal disorders, in particular to the bricklayers. Bricklayer does bricklaying (at the floor level) are often in kneeling position when placing the bricks and doing work related activities like bending of the body and twisting the body bend down, straighten up and turn to lay the brick into the position to scoop up mortar and working below knee level (material at feet level). With awkward posture, repetition of activities, these risk factor leads to cause lower back disorder and knee disorder.

### 5.1.4 Brick makers

In a study [25] where MSDs were evaluated using modified Nordic questionnaire and the pain or discomfort was measured using perceived rate of discomfort noticed that these brick makers suffer from pain and discomfort in neck lower back.

It also described that Brick makers other than continuous repetitive bending and twisting activities, have to pay constant attention during brick making process and thus not only it is physically demanding but also more stressful resulting in increased mental fatigue [12] As these workers are not supposed to carry bricks on head, less than 12% of workers had pain in neck and upper limbs. But due to constant standing, knee joint was second most complaining joint in them.

### 5.1.5 Spading activity

Spading is not only done for collecting the mud to prepare bricks but also mixing the wet mud [2,3,5,7] Almost 100% of workers complained of discomfort in this activity [5] As spading demands high force from upper extremity muscles, brick field workers develop MSDs in upper extremity. A

study [26] targeting clay brick kiln workers and WRMDs in them noticed that lower back issues were reported by 62.35% of spading workers. They also reported that those workers who were malnourished had pain complains in shoulder while spading. More than 50% of spading workers had shoulder related discomforts and more than 60% had LBP during spading [27] Poor posture and high prevalence of MSDs were analyzed in spading and molding workers using REBA and RULA [26].

In India, child laborer is not spared from spading in brick kiln small scale industries. In a study [27] on WRMDs in child laborer in West Bengal reported that among the brick-making activities, digging for mud collection is the most strenuous activity and therefore even the child laborer develop musculoskeletal disorders.

### 5.1.6 Fired brick clay

Fired clay brick is one of the ancient building materials used all over India in today's modern world. In such tasks, repetitive process of lifting the raw bricks and arranging for heating purposes are required. So, movements like bending and twisting are more often acquired. Such continuous awkward postures lead to MSDs [28].

### 5.1.7 Brick Packers

We found only 01 literature [29] targeting specifically on brick packers in brick kiln industries. In their study they observed that rates of musculoskeletal trouble were found to be very high, particularly in the wrists/hands and low back and were higher in completely manual system ('hand packing) than in semi-mechanized systems ('monorails). Therefore, are often seen that the strategy of packing adopted has an impact on the musculoskeletal hazards of an employment requiring large amounts of manual handling.

## 5.2 Common Outcome Measures for Physiological Discomfort in Brick Kiln Worker

Following are the common outcome measures used in brick kiln study to assess work related musculoskeletal disorder.

- a. **Physiological discomfort/Pain:** Pain was quantified using modified Body Part Discomfort (BPD) scale. In which five

[2,25,30,31] study used physiological discomfort as VAS and one study used NPRS [32].

- b. **Nordic questionnaire:** Standardized and modified Nordic Questionnaire was employed to get the correlated data including demographic and musculoskeletal health-related data of the workers. Twenty-six studies [1,2,3,7,10,12,17,18,28,20,21,23,26,27,29,30,31,33-39] used either questionnaire or individual Nordic questionnaire (09 out of 26 studies).
- c. **Rapid entire body assessment scale (REBA):** Eleven studies [1,2,3,9,26,27,31,33,34,39] used REBA for postural analysis.
- d. **Rapid upper limb assessment scale (RULA):** RULA is a rapid upper limb assessment which was used for postural analysis more towards upper side of the body. It is best for sedentary and seated works. Six studies [7,9,34,26,27,39] used RULA.
- e. **OWAS (Ovako working posture assessment system):** The degree of postural stress of different tasks in brick making job were analyzed by OVAKO work posture analysis system (OWAS) method. Six studies [9,10,25,29,33,34] used OWAS method.
- f. **Hand grip strength:** Five studies used hand grip strength with the help of hand-held dynamometer [6,7,9,31,38,40].
- g. **10-point Borg Scale:** One study [7] used this scale to detect pain to find out nociceptive or neuropathic component
- h. **NIOSH lifting equation to calculate RWL (recommended weight lifting):** Two studies [7,22] used NIOSH equation.

## 5.3 Female Brick Kiln Workers

A large number of women are involved in brick industry. The reason for including comments especially on female brick kiln workers is they carry work of bearing and rearing of children along with work in brick kiln. Female workers in brick industry are almost equal in number to male workers [41] A molder female worker molds

1000-1200 bricks per day [42] Female worker in loading section has to carry the bricks to form a kiln and also to load and unload the bricks from the vehicle. Female worker carries 12-14 bricks on her head. In a study [25] comparison between genders revealed that female workers were at higher risk for developing MSDs and also repetitive awkward postures lead to develop MSDs in those workers. Also, such postures resulted in frequent episodes of LBP.

The degree of postural stress of different tasks in brick making job were analyzed in different phases. Immediate corrective measures were required because clay cutting was performed in kneeling position whereas other tasks were done in squat position [25] Other study [43] on Uttar Pradesh brick kiln workers, stated that in brick kilns industry large numbers of male and female workers do different type of work such as molding of bricks, lifting bricks, etc. due to which they suffer from musculoskeletal disorders due to repetitive work under unfavorable conditions.

#### 5.4 Child brick kiln workers

All type of works performed by child consist child labor that deprives him from childhood potential, dignity and that is harmful to physical and mental development [44] Of the various reasons, cheap labor of children is the most common reason for child labor [38] One of the studies [38] revealed that the child brickfield workers suffer from MSDs arising from a number of causes of which the most relevant being the adoption of awkward positions like squatting, kneeling or stooping posture for prolonged time periods. These postures require extreme flexion, twisting which leads to LBP. Another study [30] on child labors working in brick industries and workshops aging between 7-14 years concluded that there is a highly significant difference in different body parts of children according to their work because of their work pressure and working pattern. Majority (76.66%) of worker in construction site have high percentage of body discomfort. The children working in workshop (56.66%) and brick kilns (56.66%) have equal percentage of average discomfort in body parts.

#### 5. CONCLUSION

Brick making is multitask activities where specific workers are involved in specific processes. Not to forget that all the brick making manufacturing processes requires time and is a heavy manual work load with repetitive movements in awkward

posture due to which MSDs are but obvious to occur. Also, the workers in such industries are uneducated with almost no knowledge of ergonomics and health problems which add on to the existing MSDs. Use of proper equipment like wheel barrow, trolley etc., frequent breaks, proper ergonomic training and health education are must for them to avoid or reduce the risk of developing WRMSDs in brick kiln workers.

#### 6. LIMITATIONS

- Very few articles targeted female brick kiln workers
- Majority of the literatures did not emphasized on ergonomic aspect in brick kiln workers
- Coping strategies used by the brick kiln workers for MSDs has not been taken into consideration in majority of the studies.

#### DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

#### CONSENT

It's not applicable.

#### ETHICAL APPROVAL

It's not applicable.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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