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Original Research Article

Comparison of Lung Related Discomforts among Female Mud Molders and Brick Carriers of Brick Manufacturing Unit of West Bengal, India

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ABSTRACT

Background: Manual brick manufacturing units in West Bengal, especially in the unorganized sectors, employ a large number of female workers. Repetitive exposure to free silica, iron oxide, lime, magnesium carbonate, alkalis, calcium carbonate, calcium sulfate, sodium chloride causes respiratory problems amongst mud molders.
Objective: This study aims to compare the lung related discomforts among female mud molders and brick carriers of brick manufacturing unit. It also recommends some preventive measures like use of personal protective equipment (PPE) during daily work.
Materials & Methods: A cross sectional study was conducted in Dhibdhibi (District South 24 parganas) brick field. 90 adult female mud molders (Experimental group A) with at-least five years of work experience were randomly chosen from manual brick manufacturing units. The same parameters were assessed and compared among 90 brick carrier subjects (Experimental group B) who too had a work experience for equal number of days. All general physical parameters, dynamic lung function parameters were assessed by standardized procedure.
Result: The value of all the Lung function parameters individual mud molders subjects were found to be lower in the mud molders as compared to those of the brick carriers.
Conclusion: Due to the direct and repetitive exposure to chemical substances in daily mud molding there was a deterioration of the lung function among the mud molders. Daily inhalation of chemical substances like silica, mica proved to be hazardous for the individuals. It required wearing musk, gloves during mud molding. Results further indicated that the brick carriers were less exposed to chemical substances.

Key words: Brick kiln, mud molders, brick carriers, lung function, silica, Personal protective equipment.

INTRODUCTION

Brick is one of the most important building materials or Unit of construction in India. Fired clay bricks are produced in India and about 42,000 small or cottage scale brick kilns and clamps operate seasonally (CPCB, 1996). As per the latest 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. [(1)] Manual brick-manufacturing units in India engage a large number of female workers on a daily-wage basis for a period of 8 months per year. There are two groups of female workers in the brickfields: the brick molders

and the brick carriers. These brickfields are mostly unorganized. [(2)]

Brick field workers perform several types of strenuous activity, such as: i) cutting the mud with a spade, ii) carrying the mud, iii) preparation of clay, iv) carrying the clay, v) molding, vi) stacking (loading and unloading the bricks), vii) carrying the bricks (green & burn bricks), and viii) burning the bricks in kiln. During this process, brick field workers have to face a lot of problems.

Work related musculoskeletal disorders (WMSD) are a common cause of pain in female workers in brick manufacturing industries involved in sorting and stacking process. They not only cause human suffering but are economically costly as well due to reduced working capacity and lessened production. WMSDs are a range of inflammatory and degenerative diseases resulting from forceful, repetitive and long duration jobs resulting in pain/discomfort and functional impairment and may affect body's soft tissues, tendons, tendon sheaths, and muscles, nerves of hands, wrists, elbow, shoulder, neck and low back. Among such disorders pain of neck, shoulders and low back cause long periods of disability and sick leave. WMSD exacerbate due to the nature of the job but is not the sole causation effect of the job like force, repetitiveness, duration and psychosocial factors. [(3)] The present study concentrated on female mud molders of West Bengal, India to find out the prevalence of lungs related difficulties compared with the brick carriers.

For instance, molders are directly exposed to dust which contains a mixture of inorganic compounds including free silica, iron oxide, etc. On the other hand, brick kiln workers (firemen) have to face very high temperature along with more proximal exposure to smoke and some toxic gases like sulfur dioxide, hydrogen sulfide, carbon dioxide and carbon monoxide, as well as particulate air pollutants while burning biomass fuels. Adverse environmental and physical conditions affect the health status of brick field workers who perform also other types of activities, e.g. they have to walk on a hot surface (top of the furnace) while monitoring and regulating the fire. Physiological responses to such activities mainly involve the musculoskeletal and cardiovascular systems. Since the environment is unfriendly, it hinders excess heat elimination by the circulatory system, making the heart work harder to transport energy to the muscles for a successful completion of the job. An increase in age concurrently deteriorates the functional capacity. [(4)]

Mud Molders

Clay dust contains a mixture of inorganic compounds including free silica, iron oxide, lime, magnesium carbonate, alkalis, calcium carbonate, calcium sulfate, sodium chloride and varying amounts of organic materials while burning of biomass fuels increase the exposure to gases including sulphur dioxide, hydrogen sulphide, carbon dioxide and carbon monoxide and particulate air pollutants. Next to smoking, occupational risk factors are a major cause of chronic respiratory illnesses and account for 13% of COPD, 11% of asthma and almost all cases of silicosis, asbestosis and pneumoconiosis worldwide. [(5)] A review of the literature shows that workers from different occupations exposed to dust and smoke including brick kiln workers are at a higher risk of developing chronic respiratory symptoms and illnesses. [(6)] Besides environmental exposures, occupational factors also play an important role in

affecting the health of the employees. Evidence suggests that factors like length of job, lack of protective equipment, type of work and type of burning fuel is associated with respiratory illnesses in different occupations. [(7)]

Brick carriers

Little information is available regarding respiratory health of brick kiln workers in developing countries. A study done on brick manufacturing workers in Croatia shows that there is a significantly higher prevalence of respiratory symptoms such as chronic cough (31.8%), chronic phlegm (26.2%) and chest tightness (24%) in exposed workers as compared to control workers (20.1%, 18.1%, 0%) respectively. [(8)]

This study was designed to

- Analyze the lungs condition of the mud molders compared to the brick carriers.
- Recommend some preventive measures to avoid the prevalence of the chronic lungs diseases and use of personal protective equipment to reduce the inhalation.

MATERIALS AND METHODS

Study design and population: It was a cross-sectional survey conducted in the Dhibdhibi (District South 24 parganas) brick field. The study was conducted on 180 female workers engaged in brick manufacturing unit especially in mud molding activity and brick carrying activity. Adult female mud molders and brick carriers with at least five years of work experience were randomly chosen from manual brick manufacturing units.

Inclusion criteria:

- Healthy adults in mean age group of 31 years.
- Willing to actively participate in the study.

Exclusion criteria:

- Subjects with prior history of lungs diseases.
- Subjects with history of smoking, alcohol consumption.
- Subjects with chronic illness.

Ethical clearance was procured from Institutional Ethics Committee (IEC-H) from Calcutta University.

90 subjects were randomly assigned for experimental group A, who were involved with mud molding activity for more than 5 years un-interrupted, whereas experimental group-B consisted of another 90 randomly assigned samples, who are involved in brick carrying activities for equal days belonging to the same socio economic status.

Standardized and modified Nordic Questionnaire was employed to get the correlated data including socio-economic backgrounds, health status, activity profile, time spent, frequency of performance, total number of days performed in a year etc, for performing the mud molding and brick carrying activities.

Procedure

Different physical parameters like height (by *Anthropometric Rod*), weight (by *Weighing Machine),* BMI (calculated from the anthropometric data, Poskitt, 2000), waist/hip ratio (by *measuring tape*) were measured in both groups using standardized methods. Lungs function test was measured with Computerized Spirometry (Kokko made by Finland) and was computed by standardized software.

Statistical analysis

Data was analyzed using software of Minitab 16. Descriptive statistics of socio-demographic variables were computed as mean, standard deviation. Student t-test was calculated with those data.

RESULTS

Table 1: Comparison of the different parameters between the two experimental groups

Sl no	Parameters	Experimental Group A (mean value± sd)	Experimental Group B (mean value± sd)	p-value <0.05
1.	Height(cm)	155.20±1.01	155.61± 1.03	0.644
2.	Weight(kg)	57.30±1.23	58.70 ±1.57	0.536
3.	B.M.I(kg/m^2)	23.84±1.21	24.0 ± 1.15	0.617
4.	W/H ratio	0.8±0.06	0.7±0.04	0.743
5.	FVC(L)	1.861±0.868	3.989±0.837	**0.00***
6.	FEV1(L/sec)	1.365±0.620	3.229±0.551	**0.00***
7.	FEV1/FVC	0.753±0.134	2.330±0.205	**0.00***
8.	FEF 25-75%(L/sec)	1.325±0.728	3.632±0.80	**0.00***
9.	PEFR(L/min)	1.850±0.983	3.799±0.730	**0.00***
10.	MVV(L/min)	47.4±1.7	61.53±1.9	**0.00***

(*p<0.05 values are significant)

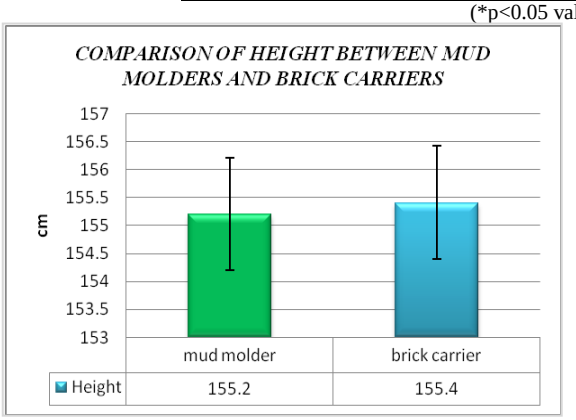

Fig 1: Bar diagram comparing height of mud molders and brick carriers (p<0.05).

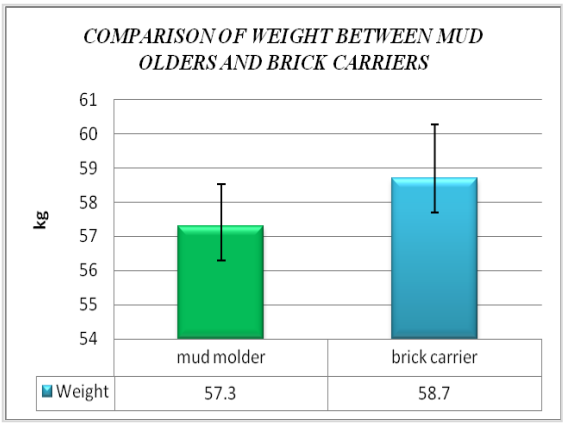

Fig 2: Bar diagram represent comparison of weight between mud molder groups and brick carriers (p<0.05).

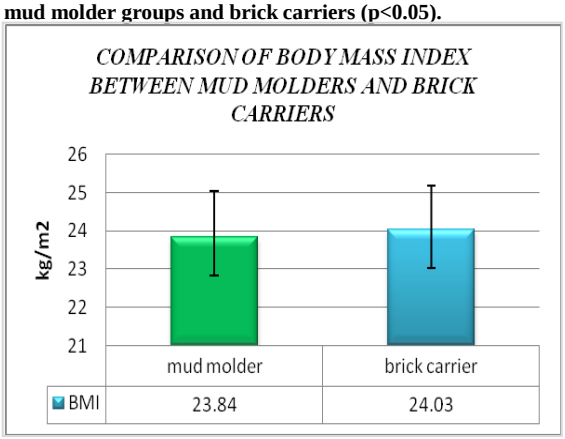

Fig 3: Bar diagram comparing of body mass index between mud molders and brick carriers (p<0.05).

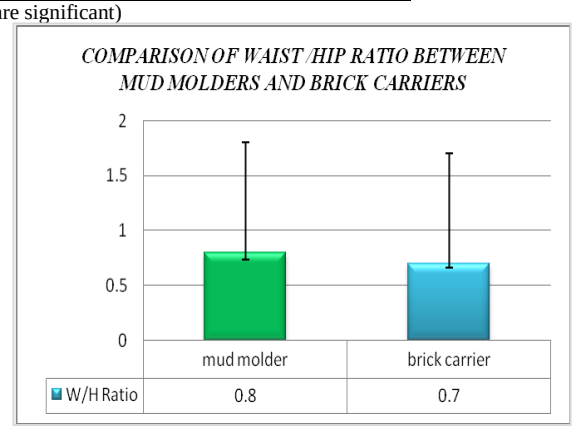

Fig 4: Bar diagram comparing waist/hip ratio between mud molders and brick carriers (p<0.05).

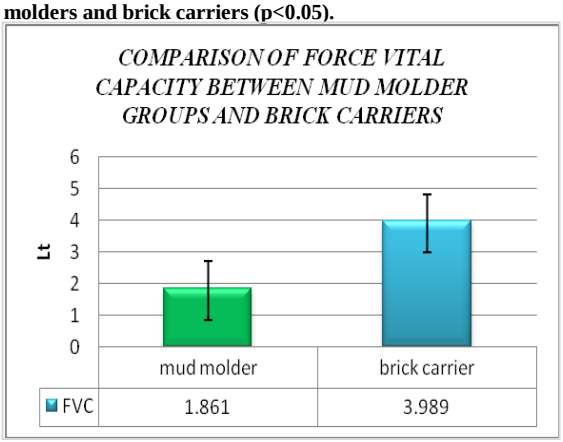

Fig 5: Bar diagram comparing forced vital capacity between mud molders and brick carriers (p<0.05).

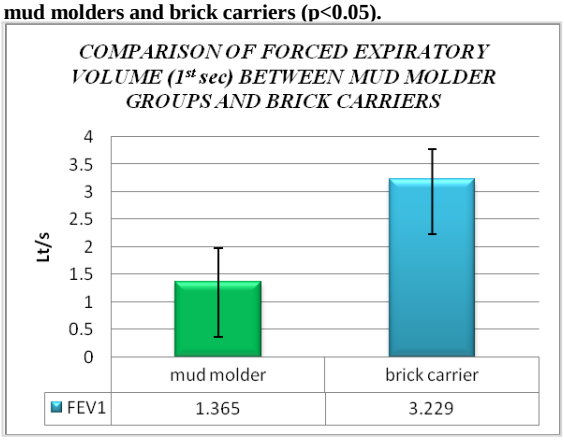

Fig 6: Bar diagram comparing forced expiratory volume (1st sec) between mud molders and brick carriers (p<0.05).

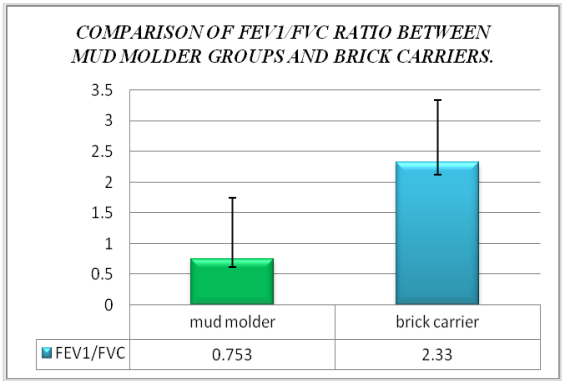

Fig 7: Bar diagram comparing fev1/fvc ratio between mud molders and brick carriers (p<0.05).

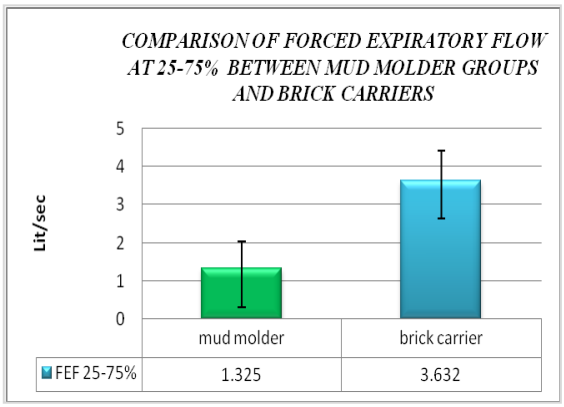

Fig 8: Bar diagram comparing forced expiratory flow at *25-75%* between mud molders and brick carriers (p<0.05).

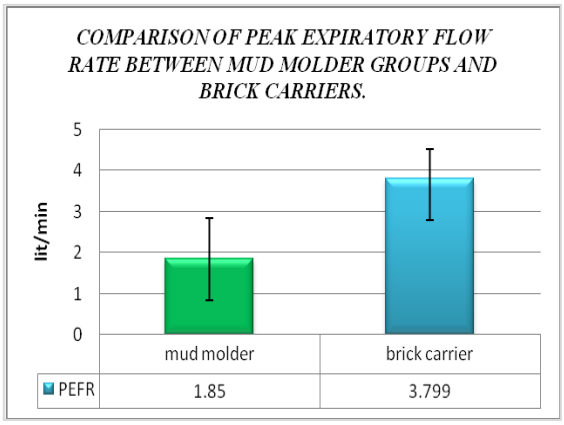

Fig 9: Bar diagram comparing peak expiratory flow rate between mud molders and brick carriers (p<0.05).

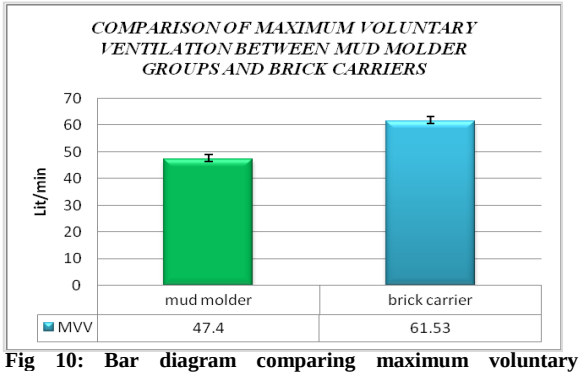

Fig 10: Bar diagram comparing maximum voluntary ventilation between mud molders and brick carriers (p<0.05).

The mean age of the workers was 31years. Both groups had insignificant anthropometric value like height, weight; B.M.I, waist hip ratio. But the present study revealed that the different lung functions parameters like FVC (Force Vital capacity), FEV1 (Forced Expiratory Volume in the first second), FEV1/FVC ratio, FEF 25-75% (Forced Expiratory Flow at *25-75*%), PEFR (peak expiratory flow rate), MVV (maximum voluntary ventilation) were lower in experimental group A than the experimental group B (p<0.05). (Table 1), (Bar Diagrams 1-10).

DISCUSSION

The present cross sectional study revealed that 80% of the brick manufacturing workers were women, at least in this part of the world. From earlier studies it appears that due to low socio economic level they are suffering from malnutrition. As a result of malnutrition status and highly stressful physical activities in untoward environmental conditions (extreme hot and humid conditions) these workers are compelled to suffer additional burden of occupational hazards. Earlier studies confirmed that the brick manufacturing women are suffering from different body part discomfort and pain, probably as manifested occupational hazard. This study further confirms that the migrant female brick manufacturing workers (as evident from our questionnaire), especially mud molders, and is suffering from lung related discomfort. This is probably one of the unique studies where classified workers performing specific work within the brick field work station have been taken into account in West Bengal.

In this particular study, a comparison among different lung function parameters was performed between two different classes of female brick field workers namely mud molders and brick carriers. In spite of all the physical parameters amongst two classes of workers show insignificant differences of mean, ensuring that both classes represent the similar socio-economic

strata, dynamic lung function parameters showed significant differences. Different dynamic lung function parameters namely FVC (Forced Vital capacity), FEV1 (Forced Expiratory Volume in the first second), FEV1/FVC ratio, FEF 25-75% (Forced Expiratory Flow at *25-75*%), PEFR (peak expiratory flow rate) and MVV (maximum voluntary ventilation) were found to be significantly lower in the mud molders as compared to those of the brick carriers. Since addition of water in dry soil is essential for required mud preparation, the mud molders are compelled to be exposed to higher densities of suspended particulate matter and respiratory particulate matter. However, there is another stress factor that is evident among the mud molders, which is awkward working posture for considerably long periods, but this part of the study has not been accounted for here.

On the other hand, the female brick carriers are compelled to carry much higher load on their head (50 kg or more, which is beyond the NIOSH Recommended Weight Limit of 23.5 kg), imposing a different kind of threat for probable musculoskeletal disorders. But that part of the study has not been represented here; only dynamic lung function parameters have been taken into account for comparative studies.

Repetitive exposure to silica, mica, iron, magnesium and other chemical substances causes poor lung functions. Continue exposure to these chemical substances for 5 to 10 years, it blocks movement of air in and out of lungs. Dust deposits in the lungs, damages lung tissue, and causes scarring. Lungs become inflamed and filled with fluid, causing severe shortness of breath and low blood oxygen. Ultimately this leads to development of Chronic Obstructive Pulmonary Disease (COPD), Bronchitis, emphysema, silicosis. [9]

The present study indicates that the female migrant mud molders were suffering from multiple respiratory symptoms. There is no provision of pre-employment and periodic medical examination for these workers and none of the workers had social security such as health insurance. Workers work in odd environmental conditions throughout the year and all seasons, thus predisposing them to develop multiple respiratory diseases. [10]

Role of women in brick industry is increasingly understood and recognized in brick manufacturing field. There is need to initiate women oriented researches in manufacturing industry. As discussed earlier, ergonomic characteristics of women are different from men, hence design of women friendly tools and equipment is required. Work station should be adjustable to make it comfortable for women during performing their activities.

CONCLUSION

The study concludes that due to continued dust exposure mud molders are highly affected in their lung functions. Dynamic lung function parametric changes among mud molders showed a peculiar indication representing some of the vivid characteristics of both obstructive pulmonary disorders as well as restrictive pulmonary diseases, in comparison to their brick carriers' counterpart. Thus, the emerging multiple respiratory disorders amongst female mud molders in brick kilns of West Bengal is found to be a unique characteristic of occupational hazard in West Bengal.

Practice of recommended industrial hygiene ensures that proper engineering control may be used to reduce environmental stress to a permissible limit. Proper personal protective equipments (PPE) like masks and gloves may be used during their working time.

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Conflict of interest: There is no conflict of interest amongst authors.

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