

*Full Length Research Paper*

## Socioeconomic conditions and health hazards of brick field workers: A case study of Mymensingh brick industrial area of Bangladesh

Sajan Das<sup>1</sup>, Md. Shamim Quamrul Hasan<sup>2</sup>, Rumana Akhter<sup>1</sup>, Sumaiya Huque<sup>1</sup>, Sumana Khandaker<sup>1</sup>, Md. Zobayer Hossain Gorapi<sup>1</sup> and Mohammad Shahriar<sup>1\*</sup>

<sup>1</sup>Department of Pharmacy, University of Asia Pacific, Dhaka-1215, Bangladesh.

<sup>2</sup>Department of Public Health, State University of Bangladesh, Dhaka, Bangladesh.

Received 16 February, 2017; Accepted 12 May, 2017

The purpose of the study was to determine the impact of brick kilns on socioeconomic conditions working environment, hazards and risk associated with each of the tasks as well as the negative effect of hazardous work of brick field workers. A semi-structured survey has been served as the main data collection method from the different 9 brick fields of Gouripur and Ishwargonj sub district under the Mymensingh district (n=402). Descriptive statistics (frequency and percentage) were used to summarize the data. The socioeconomic condition of the brick kiln workers indicated that the majority of the workers are male respondents at the brick kiln with low education level, 91.79% of workers receiving monthly income less than 15000 BDT, as well as facing major health and environmental difficulties. 42.29% of the workers are current smokers, the majority of the workers claimed that they didn't get proper sanitation (90.8%) and drinking water (98.01%) and having some locomotion problems. A high frequency of respiratory problem, gastrointestinal illnesses, eye and ear problem as well as having some site injuries during work, more commonly in legs and hands were observed in the brick kiln workers and sometime more than that. A sustainable approach should be taken to minimize environmental and health hazards inherent in brick kilns at the right time.

**Key words:** Brick kilns, Bangladesh, socioeconomic status, occupational hazards.

### INTRODUCTION

Brick making is a significant activity in Bangladesh, albeit not formally recognized as an industry. The brick kilns of Bangladesh are expanding rapidly as it is the primary construction material in Bangladesh because of lack of stone aggregate. Therefore the demand for bricks has

been rising over the past decade. Government statistics indicate that there are at least 4,234 brick kilns, both legal and illegal, in Bangladesh. However, the Bangladesh Brick Makers Owners' Association estimates that there are around eight thousand registered and unregistered

\*Corresponding author. E-mail: shahriar@uap-bd.edu. Tel: +88-1841844259.

brick kilns in the country (ILO, 2014).

Occupational health is defined by the International Labor Organization (ILO) and the WHO, as 'the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations (Koh and Jeyaratnam, 2001).

Brick kilns are situated both in urban and rural areas of Bangladesh, where a large number of workers, including men and women and even children work in the kiln on a temporary contract and low wages. Workers working in the brick manufacturing units suffered from musculoskeletal problems due to awkward working postures (Trevelyan and Haslam, 2001; Chung and Kee, 2000) and also suffer from assorted health problems due to handling of heavy loads without taking adequate rest breaks (Mukhopadhyay, 2008). 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). Despite advancement in mechanization has greatly reduced physical stress on the brick field workers, it still remains the most physically demanding occupations (Gallagher, 1999).

The nature of the work exposes the workers to a dangerous environment and working conditions (Fidan et al., 2005; Imran et al., 2014; Shewale et al., 2013; Forey et al., 2011; Torres-Duque et al., 2008; Shaikh et al., 2012). Brick manufacturing plant uses many different raw materials and produces many intermediates, by-products and products. Among these, there are many substances potentially harmful to the health of brick kiln workers. Brick kilns in Bangladesh burn not only wood and coal but also plastic and tires, which causes the emission of fine dust particles, hydrocarbons, sulfur dioxide, oxides of nitrogen, fluoride compounds, carbon monoxide and small amount of carcinogenic dioxins (Imran et al., 2014; Iqbal and Hasan, 2007; Shaikh et al., 2012). It has been previously estimated that exposure to wood smoke is associated with a 70% increased risk of having chronic obstructive pulmonary disease (Sood et al., 2009). It is a well-known physiological fact that human performance is limited by excessive environmental heat exposure and humidity (Parsons, 2003; Bridger, 2003) condensing the world's economic productivity and particularly affecting the developing countries in the tropical climate zone (Kjellstrom, 2009; Kjellstrom et al., 2009; Lundgren et al., 2013). Brick workers are exposed to the sun for long hours as well as high concentration of dust while manual breaking of coal. There is also a risk of exposure to gas/dust (from bottom ash spread on the kiln) and open fire during manual coal feeding and the workers have to walk on hot surfaces (top of the furnace) while monitoring and regulating the fire (Vaidya et al., 2015).

Work exposure to the high temperature and the high density dust and particulate matter over a long time can

result in occupational health problems, including serious disease such as lung cancer (Monga et al., 2012). Occupations exposed to dust and smokes, including brick kiln workers are at a higher risk of developing chronic respiratory symptoms (Boschetto et al., 2006) and illnesses. 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 (Shahzad et al., 2006; Shrestha and Shrestha, 2005; Wang et al., 2003).

The main objective of this research study was to assess the impact of brick kilns on socioeconomic conditions, working environment, hazards and risk associated with each of the tasks and negative effect of hazardous work of brick kiln workers.

## MATERIALS AND METHODS

In the present research, the methodology is designed as selection of the study area and population, sampling technique and sample size, survey instrument, the construction of the questionnaire, data collection procedure, data processing and analysis are further stated.

### Selection of the study area and population

Brick making industry is one of the fastest growing sectors in Bangladesh which has an estimated annual production of around 8 billion units of bricks. Government statistics, for instance, anticipates approximately 4,234 brick kilns in Bangladesh whereas the other sources indicate the number between 5,000 and 8,000. In the present study, Gouripur and Ishwargonj sub districts under Mymensingh district had been identified as the study area. Nine brick kilns were selected randomly from an updated list of fourteen registered brick kilns from the selected two sub district. In this study, population consisted of the worker, both male and female who works directly in the brick kilns.

### Sampling technique and sample size

Sample size was determined randomly from the respondents who are available during the survey. Though there was a defined target population, but the researcher was not able to carry out a research using probability sampling technique. A semi-structured survey was served as the main data collection method for this study (Rana and Das, 2014). A total 402 brick kiln workers have been interviewed from the nine different brick kilns of Mymensingh district. 370 brick kiln workers were interviewed in the Gouripur sub district, in more than 6 brick kilns and 132 brick kiln workers were interviewed in 3 brick kilns in the Ishwargonj sub district.

### Survey instrument

The survey is the main data collection method of this study. A semi-structured survey was conducted to collect necessary primary data from the target population. For conducting a survey, a semi-structured questionnaire was used.

**Table 1.** Distribution of respondents by age and sex.

Age (years)	Male		Female		Total	
	Frequency	%	Frequency	%	Frequency	%
20 – 25	15	5.58	8	6.02	23	5.72
26 – 30	72	26.77	55	41.35	127	31.59
31-35	119	44.24	49	36.84	168	41.79
36-40	56	20.82	21	15.79	77	19.15
>40	7	2.60	0	0	7	1.74
<b>Total</b>	<b>269</b>	<b>66.92</b>	<b>133</b>	<b>33.08</b>	<b>402</b>	<b>100</b>

### Construction of the questionnaire

Twenty questionnaires were conducted to find out the vulnerability and present condition of workers in the study area based on socioeconomic conditions and health hazard risks of brick field workers.

The questionnaire is finally drafted based on a compromise between the requirement and the ability of the respondents to furnish the data, while designing the questionnaire certain statistical and operational factors among which the terms of data sought, the method of collection, the respondents units processing and tabulating requirement also considered. All the questionnaires were conducted by face to face interview.

### Data collection procedures

Semi-structured interviews are rational for this study because workers are always busy, and they are controlled by supervisors, senior workers for these reasons, a semi structured and a self-employed questionnaire has been used containing pertinent questions in relation to the objectives of the study.

### Data processing and analysis

Data were analyzed using the SPSS (Version 18.0) and MS Excel (Version 2007). 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 were done in case of smoking characteristic.

## RESULTS

### Socioeconomic condition of brick kiln workers

To assess the socioeconomic condition of the workers different parameters are considered in the present study, namely; age, gender, religion, marital status, family member, the type of house, education, working designation, working experience, working hour per day and monthly income of the workers in the study area. Of the 402 respondents analyzed, 269 (66.92%) were performed on males and 133 (33.08%) on females, with an age range of 20 to >40 years. The distribution respondents working in the brick kilns by age and sex, represents that the highest number of respondents (n=

168, 41.79%) were belonged to the age of group 31-35 years, followed by the age group of 26-30 (31.59%), 36-40 (19.15%), 20-25 (5.72%) and only 1.74% of male respondents were more than 40 years (Table 1).

Among the respondents majority of them were Islamic religion (86.32%) and 90.05% were married person (Table 2). It was evident that most of the workers (56.47%) have more than 5 to 6 family members followed by more than 7 (25.87%) and less than or equal to 4 (17.66%) family members. It was observed from the survey that most of the houses (81.59%) of the brick kiln workers were tin-fence and followed by 16.42% houses is building and 1.99% houses were semi-building (Table 2). It may be stated from the present study that most of the workers are living in poor housing with unhealthy environment.

The analysis of the data obtained from Table 2 reveals that 9.7% of the sampled workers are illiterate followed by primary (72.64%) and secondary (17.66%) level in the study area.

From Table 2, it is evident that the brick field workers performed various tasks during brick field activities according to their job responsibilities or designation that were highly repetitive, where 18.16% people working designation were found as rubbish man followed by 17.66% mud, brick carrier and loader, 17.16% coalman, 16.67% mud carrier and brick maker, 15.67% molder and 14.68% fireman in the present study. On the other hand, the majority of the workers (60.45%) worked in the brick kiln were less than or equal to 6 years. The majority of the workers had more than or equal to 6 years of working experience (Table 2).

In Bangladesh, brick making is carried out during November to June while people return to their homeland during rainy season. The study found that about 39.3% of the workers usually worked 7-8 h in a day, 33.08% of them worked 8-9 h and about 27.61% worked more than 10 h daily (Table 2). Working hour was based on their age as demonstrated by the workers.

It was observed from the survey that 60.95% of the workers get (10,000-15,000) BDT per month, about 30.85% get less than 10,000 BDT, about 6.97% get (15,001-20,000) BDT and only 1.24% get more than 20000 BDT (Table 2).

**Table 2.** Distribution of respondents by religion, marital status, family member, the type of house, education, working designation, working experience, working hour per day and monthly income (n=402).

Variables		Frequency	%
Religion	Islam	347	86.32
	Hinduism	53	13.18
	Christianity	2	0.50
Marital status	Unmarried	31	7.71
	Married	362	90.05
	Divorced	9	2.24
Family member	≤4	71	17.66
	5-6	227	56.47
	>7	104	25.87
Type of house	Tin-fence made	328	81.59
	Semi building	8	1.99
	Building	66	16.42
Education	Illiterate	39	9.70
	Primary Level	292	72.64
	Secondary Level	71	17.66
Working Designation	Mud cutter and brick maker	67	16.67
	Molder	63	15.67
	Mud, Brick Carrier and Loader	71	17.66
	Rubbish man	73	18.16
	Coalman	69	17.16
	Fireman	59	14.68
Working experience (years)	≤6	243	60.45
	>6	159	39.55
Working hour per day	7-8	158	39.30
	8-9	133	33.08
	≥10	111	27.61
Monthly income (BDT)	<10000	124	30.85
	10000-15000	245	60.95
	15001-20000	28	6.97
	>20000	5	1.24

### Health hazard risks with vulnerability to health of brick field workers

There are many responsible factors of health hazard risks are found in the brick kiln due to risky environment round the clock in the study area. Unsanitary environment, air pollution and extremely hot environment are most common factor of health hazard risks of the present study (Table 3). It was observed that more than 95.52% of body pain was felt due to repetitive movement of hands. Lists of common difficulties due to locomotion among brick kiln workers are cited in the following Table 3.

It is observed from the Table 4 that, 11.19% had ever smoked more than 1 cigarette a day for one year while 42.29% among them were current smokers. Almost 17.2% workers coughed more than 6 times a day at the time of the survey. A high frequency of respiratory symptoms and illnesses was observed in the brick kiln workers. Among them, 31.8% had respiratory distress

such as shortness of breath with wheezing, chronic bronchitis and asthmatic problem and most of them had GIT problem, eye and ear problem (Table 5).

Different types of site of injury were identified in the present study as the majority of the workers were not aware about safety measures and none was practicing such measures, as well as no monitoring and supervision of safety and working condition of brick kilns were conducted by the responsible person, stated by the participants (Table 6). Most of them take treatment from the Government hospitals (37.31%) followed by village doctors (35.07%) due to free medication and low visiting cost (Table 7).

### DISCUSSION

It is observed from the present study, that the male respondents are dominated on the survey. The present

**Table 3.** Distribution of respondents by major problems and limitations as well as by their locomotion problems.

Variables		Frequency	%
Major problems and limitations	Very hard work and risky	377	93.78
	Low salary	223	55.47
	Lack of pure drinking water	394	98.01
	Lack of sanitation systems	365	90.80
	Bricks falling on workers	128	31.84
	Flying dusts	359	89.30
	Extremely hot	384	95.52
	No first-aid kits	313	77.86
	No job security	302	75.12
	Absence of life insurance	348	86.57
Locomotion problems	Repetitive gesture	382	95.02
	Sitting posture	299	74.38
	Standing posture	344	85.57
	Bent trunk	383	95.27
	Lifting weights	367	91.29
	Walking	325	80.85
	Arms above the height of the shoulders	328	81.59
	Repetitive movements with the hands	384	95.52
	Twisting	371	92.29
	Mechanical pressure with the hands on the object of work	239	59.45

\* Multiple answers are considered.

**Table 4.** Distribution of respondents by smoking status and characteristics of smokers.

Smoking status		Characteristics of Smokers	
Variables	Frequency (%)	Variables	Mean (Standard Deviation)
Non- smoker	187 (46.52)	Age at Starting Smoking	20.09 (3.47)
Ever smoker	45 (11.19)	Cigarettes per day	11.59 (3.88)
Current smoker	170 (42.29)		

study is not in accordance with the study done in India, where the female respondents were highly dominated on the survey (Vikrant et al., 2016; Shewale et al., 2013). Moreover the patterns of work in brick kilns require male (Patil et al., 2017). The majority of respondents were belonged to the age of group 31-35 years (n= 168, 41.79%). This is similar to the previous study finding among brick kiln workers (Inbaraj et al., 2013). The tasks like driving a van for transferring soil and bricks, carrying bricks and other goods are more suitable for male as in the socioeconomic context of Bangladesh, female are traditionally less involved in outside works.

The majority of the workers appear to drop out during or just after primary school. In the present study majority of the workers are not highly educated which was also observed in other countries (Shaikh et al., 2012; Vikrant et al., 2016; Shewale et al., 2013; Patil et al., 2017; Das, 2015a, c). The key reason behind this is that maximum

workers work in brick kilns for a particular duration of the year and leaves the area when the brick making season finishes. Moreover, the parents are not able to give them school expenditure, although cost is very low. The main reason for such level of education was their parents are unable to afford the education expenses as well as their labor is essential for household work.

The majority of the workers in the present study worked 7 to 8 h per day. 33.08% of the workers were working above 8 h against limits of 48 h per week, which was also observed in India (Vikrant et al., 2016; Patil et al., 2017; Bijetri and Sen, 2014; Das, 2015b, Das, 2015c). The workers stated that they have to spend even more time in working due to the continuous demand to meet the target number of bricks (Patil et al., 2017; Zia-ur-Rahman et al., 2012; Inbaraj et al., 2013). The work is performed mostly during the day, but the bakers/firemen said that their work is evenly divided across the day and night. Most of the

**Table 5.** Distribution of respondents by respiratory, gastrointestinal, eye and ear problem.

Variables		Frequency	%
Respiratory problem	Respiratory distress	128	31.8
	Continued cough	69	17.2
	Some time cough	192	47.8
Gastrointestinal problem	Constipation	142	35.3
	Diarrhea	117	29.1
	Diarrhea and Constipation	118	29.4
Eye and ear	Blurred vision	235	58.5
	Eye injury	63	15.7
	Hearing loss	189	47.0

\* Multiple answers are considered

**Table 6.** Distribution of respondents by site of injury.

Site of Injury	Type of Injury			Total
	Sharp Cutting (%)	Lacerated Injury (%)	Fracture Bone (%)	
Hand	59 (50)	53 (44.92)	6 (5.08)	118
Leg	53 (55.21)	34 (35.42)	9 (9.38)	96
Shoulder	3 (75)	1 (25)	0 (0)	4
Neck	12 (75)	3 (18.75)	1 (6.25)	16
Knee	19 (43.18)	19 (43.18)	6 (13.64)	44
Wrist	6 (26.09)	11 (47.83)	6 (26.09)	23
Finger	6 (28.57)	15 (71.43)	5 (23.81)	21
Ear	4 (44.44)	5 (55.56)	0 (0)	9
Hip	3 (100)	0 (0)	0 (0)	3
Elbow	15 (75)	4 (20)	1 (5)	20
Back	5 (71.43)	1 (14.29)	1 (14.29)	7
Ankle	14 (40)	21 (60)	0 (0)	35

\* Multiple answers are considered.

**Table 7.** Distribution of respondents having health care in terms of any health related problems (n=402).

Health Care Provider	Frequency	%
Chemist shop	54	13.43
Village doctor	141	35.07
MBBS doctor	3	0.75
Private hospital	16	3.98
Government hospital	150	37.31
Homeopathic	38	9.45

workers stated that they get the monthly salary, according to their experience and working skills.

The results of the study show that 98.01% people facing difficulties in getting pure drinking water, followed

by extremely hot 95.52%, 93.78 % people feel this type of works is very hard and risky, sanitation problem (90.8%), flying dust (89.3%), absence of life insurance (86.57%), no first-aid kits (77.86%), no job security (75.12%), low

salary (55.47%) according to their working activity, bricks falling on workers (31.84%) during transportation, respectively (Table 3). Selvarani (1992) reported that lack of job security aggravates mental health problems and employers make use of this sort of insecurity to exploit workers. Workers also indicated that the employer does not provide them any shelter to shield from the strong sun in the summers. The estimates of the problems mentioned above are also quite similar to the previous studies done on workers of brick kilns (Das, 2015b; Rana and Das, 2014). According to the workers, they would prefer improvements in their working environment.

Brick making includes several steps and various types of activities and requires a variety of skills, within two main categories as follows; preparing the green brick and burning the bricks. The legs and hands are the main part of the body of these workers, both youth and adult workers are likely to have locomotion difficulties. 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 (Chaffin and Anderson, 1987; McGill and Norman, 1985). Prolonged sitting in squatting posture, mixing of clay, carrying in a trolley and pushing the trolley are the main causes of have such kind of locomotion difficulties, which are similar to the study finding among brick kiln workers (Trevelyan and Haslam, 2001; Qutubuddin et al., 2013; Bijetri and Sen, 2014; Vikrant et al., 2016; Inbaraj et al., 2013; Shewale et al., 2013; Patil et al., 2017; Das, 2015c).

Age, working environment, mainly poor quality fuel in inefficient and outdated technology, flying dusts in air, nature of work and smoking are strong predictors of developing symptoms of respiratory problem (Torres-Duque et al., 2008; Forey et al., 2011; Bijetri and Sen, 2014; Shaikh et al., 2012). The estimates of the symptoms observed in the present study are also quite similar to the previous studies done on workers exposed to dust and smoke in brick kilns and other occupations (Neghab and Choobineh, 2007; Fidan et al., 2005; Croitoru and Sarraf, 2012; Rafeemanesh et al., 2015; Al-Neaimi et al., 2001; Vikrant et al., 2016; Shewale et al., 2013; Das, 2015b; Patil et al., 2017; Inbaraj et al., 2013). Majority of brick kilns in Bangladesh burns not only wood and coal but also plastic and tires for baking the bricks which makes the brick kiln workers susceptible to high exposure of air pollution and health related problems. Prevalence of asthma has ranged from 6 to 14% in other studies done in occupational settings where dust and smoke exposures are common (Friis et al., 1999; Shaikh et al., 2012). It is a well established fact that smoking is a major risk factor for chronic bronchitis (Shaikh et al., 2012; Salvi and Barnes, 2009); however, 46.52% of these patients do not have a history of smoking (Table 5). The results of the study show that 17.2% had continued cough and 47.8% of the respondents coughed sometimes (Table 5).

They also suffered from constipation (35.3%), diarrhea

(29.1%) and both (29.4%) which is similar to other studies (Shewale et al., 2013; Das, 2015b; Vikrant et al., 2016; Patil et al., 2017). Gastrointestinal problems may be due to unhygienic food and unhealthy toilet, polluted environment and consumption of contaminated pond water. Improvement in sanitation and water supply systems has been suggested as a method to control epidemics of water born diseases, as these factors are the tip of the iceberg (Das et al., 2016; Ferdousi et al., 2015). In addition, it was observed from the present study that 10, 58.5% of the workers had blurred vision followed by hearing loss (47%) and eye injury (15.7%), respectively (Table 5). Similar findings were observed by Vikrant et al. (2016), Shewale et al. (2013) and Das (2015b). Effect on the eye and ear could be due to continuous exposure to relatively low concentrations of fine particles, heavy noise from pug machine, the pump machine, excavators and the generator.

The result of the present study shows that 118% of the workers experience hand injury and 96% workers experience leg injury at work (Table 6). Special safety should be taken using moving vehicles and pug machine which is the most risky equipment having a higher probability of trapping hands, leg and clothes (Das, 2015b). In terms of any health related problem majority of the workers visited on different health care facilities, although they have very little opportunity to get proper treatment because quality of service provided by these doctors for them was low (Table 7). They have superstitions and it is 'almighty having for poor people'.

## Conclusion

The brick making is treated as a profitable business activity in Bangladesh. Finally, the study tries to identify the overall impact of workers in brick kilns and assesses the condition of brick kiln industries as the workers in the brick kiln are suffering from various health hazards and their living condition is not even sub-standard. All the workers forced to do their work manually a short time, which causes major or minor accidents very often. As a result, they suffer from various injuries and major health problem and it is hampering physically and mentally. There is no better arrangement for pure drinking water, healthy food, hygienic toilet and living place for workers. Preventive measures against environmental and health hazards inherent in brick kilns should be undertaken at the right time, before it is too late.

## CONFLICT OF INTEREST

The authors have not declared any conflict of interest

## REFERENCES

- Al-Neaimi YI, Gomes J, Lloyd OL (2001). Respiratory illnesses and ventilatory function among workers at a cement factory in a rapidly developing country. *Occup. Med.* 51(6):367-373.

- Ariens GA, Mechelen WV, Bongers PM, Bouter LM, Wal GVD (2000). Physical risk factors for neck pain. *Scand. J. Work Environ. Health* 26:7-19.
- Bijetri B, Sen D (2014). Occupational Stress among Women Moulders: A Study in Manual Brick Manufacturing Industry of West Bengal. *IJSRP* 4(6):1-7.
- Bongers PM, Kremer AM, ter Laak J (2002). Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist? A review of the epidemiological literature. *Am. J. Ind. Med.* 41(5):315-342.
- Boschetto P, Quintavalle S, Miotto D, Lo-Cascio N, Zeni E, Mapp CE (2006). Chronic obstructive pulmonary disease and Occupational exposures. *J. Med. Toxicol.* 1:11.
- Bridger RS (2003). Introduction to ergonomics. 2nd ed. London: Taylor and Francis.
- Chaffin DB, Anderson G (1987). Occupational biomechanics. New York: Wiley.
- Chung MK, Kee D (2000). 'Evaluation of lifting tasks frequently performed during brick manufacturing processes using NIOH lifting equations'. *Int. J. Ind. Ergonom.* 25(2):423-433.
- Croitoru L, Sarraf M (2012). Benefits and costs of the informal sector: the case of brick kilns in Bangladesh. *J. Environ. Prot.* 3:476-484.
- Cromie JE, Robertson VJ, Best MO (2002). Work-related musculoskeletal disorders and the culture of physical therapy. *Phys. Ther.* 82(5):459-472.
- Das R (2015a). Socio-economic conditions of female workers in brick kilns— An exploitation to healthy social structure: a case study on Khejuri CD blocks in Purba Medinipur, West Bengal. *IJSR* 4(1):95-102.
- Das R (2015b). Causes and consequences of child workers in the brick fields of Khejuri CD blocks in Purba Medinipur District, West Bengal. *IJHS* 4(2):28-42.
- Das B (2015c). An evaluation of low back pain among female brick field workers of West Bengal, India. *Environ. Health Prev. Med.* 20:360-368.
- Das S, Shahriar M, Narjish SN, Akhter R (2016). *In Vitro* investigation on antimicrobial sensitivity pattern of enteric fever causing bacteria isolated from different clinical sources in Dhaka City, Bangladesh. *Int. J. Med. Health Res.* 2(5):33-37.
- Ferdousi R, Narjish SN, Chowdhury D, Shahriar M (2015). Antimicrobial resistance pattern of bacteria isolated from ICU patients with urinary tract infections. *Int. J. Pharm.* 5(4):1079-1086.
- Fidan F, Unlu M, Koken T, Tetik L, Akoun S, Demrel R, Serteser M (2005). Oxidant-anti oxidant status and pulmonary function in welding workers. *J. Occup. Health* 47:286-292.
- Forey BA, Thornton AJ, Lee PN (2011). Systematic review with meta-analysis of the epidemiological evidence relating smoking to COPD, chronic bronchitis and emphysema. *BMC Publ. Med.* 11(36):1-64.
- Friis L, Norback L, Edling C (1999). Self-reported asthma and respiratory symptoms in sewage workers. *J. Occup. Health.* 41:87-90
- Gallagher S (1999). Ergonomics issues in mining. In: Karwowski W, Marras WS ed. *The Occupational Ergonomics Handbook*. CRC Press LLS, New York. pp 1893-1915.
- Imran MA, Baten MA, Nahar BS, N Morshed N (2014). Carbon dioxide emission from brickfields around Bangladesh. *Int. J. Agric. Res. Innov. Tech.* 4(2):70-75.
- Inbaraj LR, Haebbar OJ, Saj F, Dawson S, Paul P, Prabhakar AKP, Mohan VR, Alex RG (2013). Prevalence of musculoskeletal disorders among brick kiln workers in rural Southern India. *Indian J. Occup. Environ. Med.* 17(2):71-75.
- International Labour Office, International Programme on the Elimination of Child Labour (IPEC) (2014). Health hazards of child labour in brick kilns of Bangladesh. Geneva: ILO. Available at: file:///C:/Users/Raj/Downloads/Bangladesh\_Country\_Report.pdf.
- Iqbal A, Hasan I (2007). Modeling for minimizing the emitted CO<sub>2</sub> from brick kilning through afforestation in Bangladesh. *J. Environ. Sci.* 5(11):21-29.
- Kjellstrom T (2009). Climate change, direct heat exposure, health and well-being in low and middle-income countries. *Glob. Health Action.* 2.
- Kjellstrom T, Holmer I, Lemke B (2009). Workplace heat stress, health and productivity an increase change for low and middle income countries during climate change. *Glob. Health Action.* 2.
- Koh D, Jeyaratnam J (2001). *Work and Health: Textbook of Occupational Medicine Practice*. 2<sup>nd</sup> ed. Singapore: World Scientific.
- Lundgren K, Kuklane K, Gao C, Holme'r I (2013). Effects of heat stress on working populations when facing climate change. *Ind. Health* 51:315.
- McGill SM, Norman RW (1985). Dynamically and statistically determined low back moments during lifting. *J. Biomech.* 18:877-885.
- Monga V, Singh LP, Bhardwaj A, Singh H (2012). Respiratory health in brick kiln workers. *Int. J. Phys. Soc. Sci.* 2(4):226-244.
- Mukhopadhyay P (2008). Risk factors in manual brick manufacturing in India. *HFESA J. Ergon. Austr.* 22(1):16-25.
- Neghab M, Choobineh A (2007). Work related respiratory symptoms and ventilatory disorders among employees of a cement industry in Shiraz, Iran. *J. Occup. Health* 49:273-278.
- Parsons KC (2003). Human thermal environments: the effects of hot, moderate and cold environments on human health, comfort and performance. London: Taylor and Francis. 22:4260.
- Patil DS, Durgawale DP, Gordhanbhal SR (2017). A Cross Sectional Study of Socio-Demographic and Morbidity Profile of Brick Kiln Workers in Rural Area of Karad, in Satara District. *JMSRC* 5(1):15313-15321.
- Qutubuddin SM, Hebbal SS, Kuma ACS (2013). Ergonomic evaluation of tasks performed by workers in manual brick kilns in Karnataka, India. *GJRE* 13(4):35-42.
- Rafeemanesh E, Alizadeh A, Saleh LA, Zakeri H (2015). A study on respiratory problems and pulmonary function indexes among cement industry workers in mashhad, Iran. *Med. Pr.* 66(4):471-477.
- Rana A, Das A (2014). Causes and Consequences of Child work in Brick Field: A Study on the Selected Brick Fields in Char Bhadrans under Faridpur District. *IOSR-JBM* 16(3):24-26.
- Salerno DF, Copley-Merriman C, Taylor TN, Shinogle J, Schulz RM (2002). A review of functional status measures for workers with upper extremity disorders. *Occup. Environ. Med.* 59:664-670.
- Salvi SS, Barnes PJ (2009). Chronic obstructive pulmonary disease in nonsmokers. *Lancet* 374:733-743.
- Selvarani S (1992). Handling workplace stress. *Health Action* 5:4-9.
- Shahzad K, Akhtar S, Mahmud S (2006). Prevalence and determinants of asthma in adult male leather tannery workers in Karachi, Pakistan: A cross sectional study. *BMC Publ Health* 6:292.
- Shaikh S, Nafees AA, Khetpal V, Jamali AA, Arain AM, Yousuf A (2012). Respiratory symptoms and illnesses among brick kiln workers: a cross sectional study from rural districts of Pakistan. *BMC Publ. Health* 12:999.
- Shewale A, Acharya S, Shinde RR (2013). Nutritional and morbidity profile of brick kiln workers in Sakwar, Tribal area of Thane district. *Med. J. West India* 41(1):27-29.
- Shrestha IL, Shrestha SL (2005). Indoor air pollution from biomass fuels and respiratory health of the exposed population in Nepalese households. *Int. J. Occup. Environ. Health* 11(2):150-160.
- Sood A, Petersen H, Blanchette C, Meek P, Belinsky S, Picchi M, Tesfaigzi Y (2009). Wood smoke-associated chronic obstructive pulmonary disease (COPD)-underappreciated in the United States? *Am. J. Respir. Crit. Care Med.* 179:A4742.
- Torres-Duque C, Maldonado D, Pérez-Padilla R, Ezzati M, Viegi G (2008). Biomass fuels and respiratory diseases a review of the evidence. *Proc. Am. Thorac. Soc.* 5:577-590.
- Trevelyan FC, Haslam RA (2001). Musculoskeletal disorders in a handmade brick manufacturing plant. *Int. J. Ind. Ergonom.* 27:43-55.
- Vaidya VG, Mamulwar MS, Ray SB, Beena R, Bhatlawande PV, Ubale S (2015). Occupational health hazards of women working in brick kiln and construction industry. *JKIMSU* 4(1):45-54.
- Vikrant DP, Mukesh DBS, Parth DVH, Shinde DRR (2016). Epidemiological study of health hazards & working conditions of brick kiln workers in rural area of North Maharashtra. *WJPMR* 2(6):86-89.
- Wang XR, Eisen EA, Zhang HX, Sun BX, Dai HL, Pan LD (2003). Respiratory symptoms and cotton dust exposure; results of a 15 year follow up observation. *Occup. Environ. Med.* 60:935-941.
- Zia-ur-Rahman AN, Khan T, Khan DA (2012). Status of occupational health and safety in brick kiln industries at hatter industrial estate Haripur, Pakistan. *JE* 1(2):56-63.