



Original Article

Occupational Musculoskeletal and Respiratory Illness among Brick Kiln Industry Workers in Bangladesh



AKM Abdul Ahad Biswas¹, Milton Kumar Saha¹, Irteja Hasan^{2*},
Md. Faisal³, Joy Prokash⁴

¹ Department of Disaster Risk Management, Patuakhali Science and Technology University, Patuakhali, Bangladesh

² Department of GIS and Earth Observation, Patuakhali Science and Technology University, Patuakhali, Bangladesh

³ Department of Disaster Resilience and Engineering, Patuakhali Science and Technology University, Patuakhali, Bangladesh

⁴ Faculty of Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali, Bangladesh

*Corresponding author: Irteja Hasan

Email: irteja07@gmail.com

ABSTRACT

Background: Occupational risk factors are one of the major causes of health-related problems of brickfield workers. The purpose of this study was to assess the occupational health illness of the brickfield workers.

Methods: This cross-sectional study was conducted in the unorganized brick kilns in the south-central part of Bangladesh. Multi-stage probability sampling technique was applied to select brick kilns. A total of 220 workers from 10 brick kilns with one year of working experience were selected. A Standardized Nordic questionnaires and semi-structured respiratory questionnaire was applied for the collection of quantitative information.

Results: The mean age of the workers was 39.01 years and most of them were male. The average working experience was 7 years and about 40% of them worked more than 8 hours in a day without any break of the week. A total of 140 subject (79.5%) had musculoskeletal pain and 140 subject (63.6%) suffered from respiratory problems. Multivariate logistic regression model showed that type of working was the only independent predictor of both musculoskeletal and respiratory problems.

Conclusion: The findings of this study revealed a high prevalence of musculoskeletal and respiratory problems in brick kiln workers. Brick carrying was the most hazardous task among workers at brick kiln industries.

Keywords: Bangladesh, Occupational health, Musculoskeletal pain, Respiratory symptoms

Citation: Ahad Biswas AA, Saha MK, Hasan I, Faisal M, Prokash J. Occupational musculoskeletal and respiratory illness among brick kiln industry workers in Bangladesh. Caspian J Health Res. 2018;3(3):80-85. doi: 10.29252/cjhr.3.3.80

ARTICLE INFO

Received: July 08, 2018

Accepted: September 09, 2018

ePublished: October 01, 2018

Introduction

The brick kiln industry is one of the largest producer in the world. The demand for bricks has been rising over the past decade with the rapid economic and population growth. As a

result, more brick manufacturer industry is rapidly established in an illegal way. The brick kiln workers are engaged in mainly three types of tasks including carriage (transport of clay dust and bricks), moulding (shaping of wet clay into bricks), and

baking (burning of moulded bricks in furnaces). Work-related illnesses are very common among the brick-kiln workers because they are living in a poor environment adjoining brick making units (1). Several studies showed that the labourers working in the brick manufacturing units suffered from acute and chronic musculoskeletal problems due to awkward working postures, heavy workload factors such as force, manual handling, repetitive work and vibration as well as movements (2-6). Previous studies have identified the relationship between highly repetitive work with neck and neck/shoulder musculoskeletal disorders (7). Workers, especially molders, are directly exposed to dust which contains a mixture of inorganic compounds including free silica, iron oxide, etc. Additionally, the workers have to face with 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 (8-12) which places them at the higher risk of developing respiratory diseases (13-17). The workers have to walk on the hot surface while monitoring and regulating the fire. Exposure to heat stress can lead to some physical and psychological health problems. Heat can effect on human health ranging from a mild annoyance, such as heat rash, to death from heat stroke (18-20). Moreover, absence of personal protective equipment makes workers more vulnerable also to injury associated with material handling (12). In Bangladesh, located at Southern Asia, there are at least 7,000 brick kilns, both legal and illegal that are expanding rapidly (21). However, according to the Bangladesh Brick Makers Owners' Association, there are around eight thousand registered and unregistered brick kilns in the country and a significant number of these producers are not formally recognized as an industry and do not equipped with advanced technology (22, 23). There are little information about the occupational illness of brick kiln workers in under-developed countries. Therefore, this study aimed to assess the musculoskeletal and reparatory illness of the workers at brick kiln industries in Bangladesh.

Methods

A cross-sectional study design was conducted in the south-

central coastal district of Bangladesh where many brick industries are available from 1st April to 15th May 2018. Multi-stage probability sampling design was applied to select the brick kilns. At the first stage of the sampling, south-central coastal districts of Bangladesh were selected based on the information of the brick kiln industries in those districts. Then, 10 Upazila (Sub-district) were selected from those districts based on the number of brick industry. Finally, 10 (Ten) Brick Kiln industry was selected from the sub-district based on the information of best and worst condition (Figure 1). From these Brickfields, the workers whose had at least one-year work experience in the brickfield and agreed to participate in the study were selected for interviews and a purposive sampling technique was used for selecting the participants. A total of 220 workers was purposively selected whose main task were to moulding, firing, and carrying bricks for shifting from one place to another. Those workers with known musculoskeletal disease such as osteoarthritis, rheumatoid arthritis, and cervical spondylitis were excluded from the study. The musculoskeletal symptoms and pain was measured using pre-tested Standardized Nordic questionnaires (24). It had questions about discomfort on different parts of the body including neck, shoulder, elbow, wrist/hand, upper back, lower back among the workers. Respiratory illness and symptoms was evaluated using semi-structured questionnaire adopted from American Thoracic Society Division of Lung Disease questionnaire. Chronic Cough was defined as cough occurring 4–6 times per day for most days of the week at least for three months of the year and for two consecutive years. Chronic Phlegm was considered as sputum release at least twice a day for most days of the week for at least three months of the year and for at least two consecutive years. Chronic Bronchitis was defined as occurrence of cough and sputum release for most days of the week for at least three months of the year and for at least two consecutive years. Asthma was defined as difficulty in breathing characterized by attacks of shortness of breath with wheezing (whistling sound on expiration) at least two or more in the past two months with normal breathing between episodes of attack or asthma diagnosed by a physician. Smoking was defined as currently smoking of 1 or more cigarette. Data were described using proportions, mean, and standard deviation according to the type of the variables.

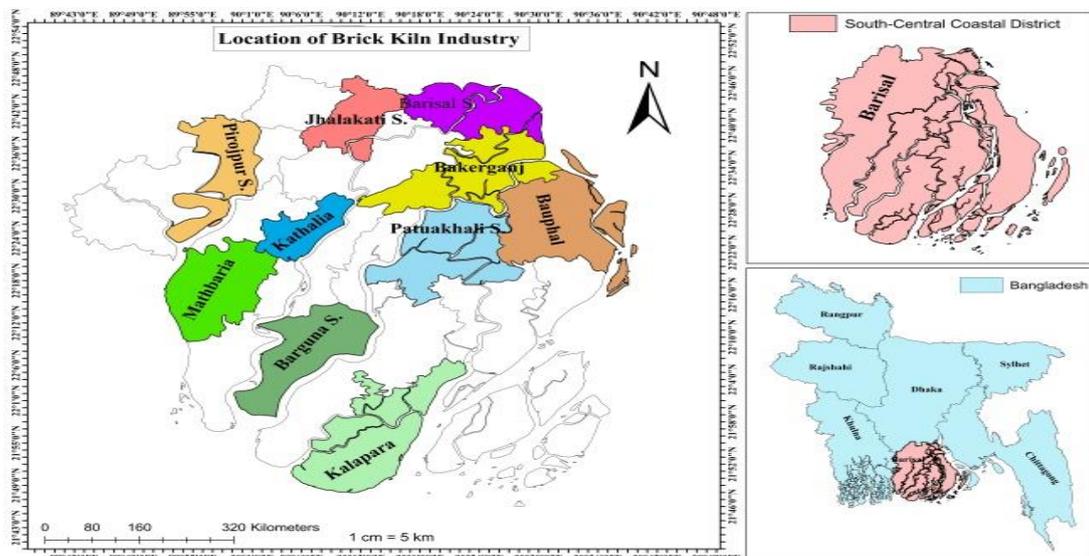


Figure 1. Location of the Brick Industry

Cross-tabulations with chi-square test were done to compare the frequency and percentages of the subcategories. Multivariate logistic regression model was performed to estimate the adjusted odds ratio with 95% confidence interval. All statistical analyses were performed using SPSS version 21. A p-value less than 0.05 was considered significant.

Results

Among 220 respondents, most of them were male (74.5%) and 25.5% were female. The mean age of the participants was 39 years (standard deviation (SD) = 13.2). The majority had education up to primary level (66.4%), were smokers (62.7%), and had a family size of 4 to 7 (88.6%). Regarding to the duration of working, 58.2% were in the brick manufacturing occupation for less than 5 years where the average experience of working was 7.09 years (SD = 5.56 years). Approximately, 42% of the respondents worked in the brick field above 8 hours in a week (Mean = 8.66, SD = 0.94). About two-third of the respondents (64.1%) worked all the day of the week. The average working day of a week was 6 days (SD = 0.55). Regarding to the type of working, most of the respondents were the brick carrier (40%) followed by brisk stackers (28.18%). Table 1 shows demographic characteristics of study participants.

Table 1. Demographic and Socio-Economic Characteristics of the Brick Kiln Workers

Characteristics	Frequency	Present
Gender		
Male	164	74.5
Female	56	25.5
Age group		
Less than 20	22	10
20-40	99	45
More than 40	99	45
Educational status		
Illiterate	30	13.6
Primary	146	66.4
secondary	44	20.0
Family member		
< 4	20	9.1
4-7	195	88.6
> 7	5	2.3
Monthly income		
71.13-106.7\$	14	6.4
106.7-142.3\$	183	83.2
> 142.3\$	23	10.5
Years of work		
≤ 5 years	128	58.2
5-10 years	46	20.9
≥ 10 years	46	20.9
Working hours per day		
Equal to 8 hours	129	58.6
8-12 hours	91	41.4
Working days per week		
5	8	3.6
6	70	31.8
7	142	64.5
Habit of smoking		
Yes	138	62.7
No	82	37.3
Types of works		
Brick moulders	30	13.64
Brick stackers	62	28.18
Bricks fireman	40	18.18
Brick carriers	88	40.00

The majority of study participants (79.5%) experienced musculoskeletal problems. Figure 2 shows the frequency of musculoskeletal pain in different parts of the body. The most prevalent site of pain was hand (79.5%) followed by neck (74%).

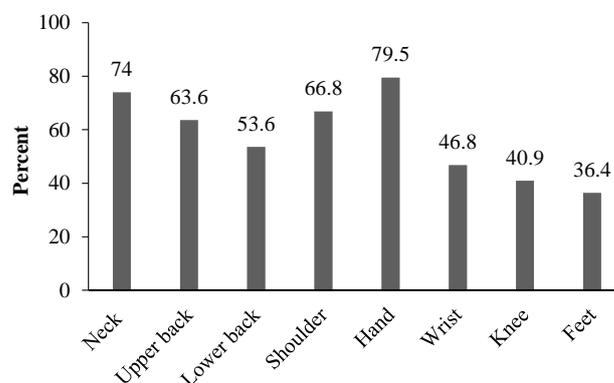


Figure 2. Frequency of Different Musculoskeletal Problems in Brick Kiln Workers

A total of 140 subjects suffered from different kinds of 63.6% respiratory problems. Figure 3 shows the frequency of different types of respiratory problems. Almost one third of the participants (39.1%) had cough among them 6.8% met the criteria of chronic cough. Wheezing and phlegm were the two other prevalent respiratory symptoms in the study participants.

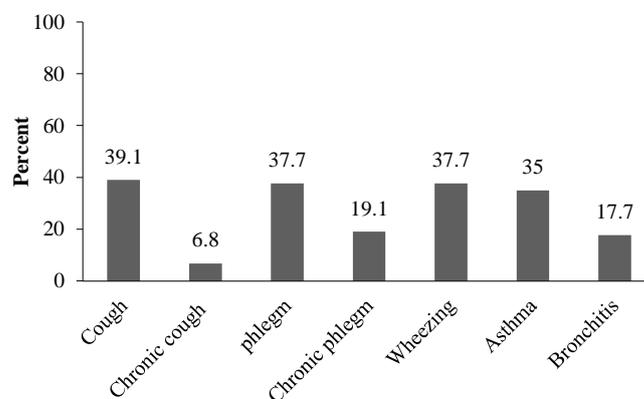


Figure 3. Frequency of Different Respiratory Problems in Brick Kiln Workers

Table 2 shows the distribution of musculoskeletal and respiratory problems according to the respondents' personal characteristics. The frequency of both problems significantly decreased with age. A higher proportion of younger worker suffered from musculoskeletal (90.9%) and respiratory problems (77%) compared to older ages. Among the two sexes, the frequency of respiratory problems in female (75%) was significantly higher than male (59.8%). Regarding to the work experience, workers with less than 5 years work experience in the brick field were significantly more suffered from musculoskeletal (93%) and respiratory illness (73.4%) rather than those who had worked more than 5 years. Regarding to the duration of daily work, the frequency of musculoskeletal pain was significantly higher

Table 2. Distribution of Musculoskeletal and Respiratory Problems according to the Participants' Characteristics

Characteristics	Musculoskeletal Pain			Respiratory problem		
	Yes	No	P-value	Yes	No	P-value
Gender						
Male	128 (78.1)	36 (22)	0.346	98 (59.8)	66 (40.2)	0.028
Female	47 (83.9)	9 (16.1)		42 (75.0)	14 (25.0)	
Age group						
< 20 years	20 (90.9)	2 (9.1)	0.001	17 (77)	5 (22.7)	0.02
20-40 years	87 (87.9)	12 (12.1)		70 (70)	29 (29.3)	
> 40 years	68 (68.7)	31 (31.3)		53 (53)	46 (46.5)	
Educational status						
Illiterate	27 (90)	3 (10)	0.33	19 (63.3)	11 (36.7)	0.20
Primary	115 (78.8)	31 (21.2)		99 (67.8)	47 (32.2)	
secondary	33 (75)	11 (25)		22 (50)	22 (50)	
Family member						
< 4	17 (85)	3 (15)	0.41	12 (60)	8 (40)	0.71
4-7	153 (78.5)	42 (21.5)		124 (64)	71 (36.4)	
> 7	5 (100)	0		4 (80)	1 (20)	
Monthly income						
71.13-106.7\$	10 (71.4)	4 (28.6)	0.11	8 (57.1)	6 (42.9)	0.28
106.7-142.3\$	143 (78.1)	40 (21.9)		114 (62.3)	69 (37.7)	
>142.3\$	22 (95.7)	1 (4.3)		18 (78.3)	5 (21.7)	
Years of work						
≤ 5 years	119 (93.0)	9 (7.0)	0.001	94 (73.4)	34 (26.6)	0.001
5-10 years	34 (73.9)	12 (26.1)		33 (71.7)	13 (28.3)	
≥10 years	22 (47.8)	24 (52.2)		13 (28.3)	33 (71.7)	
Working hours						
Equal to 8 hours	115 (89.1)	14 (10.9)	0.001	87 (67.4)	42 (32.6)	0.105
8-12 hours	60 (65.9)	31 (34.1)		53 (58.2)	38 (41.8)	
Working days per week						
5	8 (100)	0	0.201	6 (75)	2 (25)	0.488
6	58 (83)	12 (17)		41 (58.5)	29 (41.4)	
7	109 (78)	33 (23)		93 (65)	49 (34.5)	
Types of works						
Brick moulders	7 (22.6)	24 (77.4)	0.001	2 (6.5)	29 (93.5)	0.001
Brick stackers	49 (80.3)	12 (19.7)		48 (78.7)	13 (21.3)	
Bricks fireman	38 (95.0)	2 (5.0)		30 (75.0)	10 (25.0)	
Brick carriers	81 (92.0)	7 (8.0)		60 (68.2)	28 (31.8)	
Habit of smoking						
Yes	110 (79.7)	28 (20.3)	0.93	84 (60.9)	54 (39.1)	0.168
No	65 (79.3)	17 (20.7)		56 (68.3)	26 (31.7)	

in those who had worked 8 hours (89%) than who had worked 8 to 12 hours (66%) in a day. Among the various task of the workers, the highest frequency of musculoskeletal problems were among brick fireman (95%) followed by brick carriers (92%). Type of working has also significant relationship with respiratory problems. Brick moulders had the lowest frequency of respiratory problems (6.5%) compared to brick stacker (79%) and brick fireman (75%) (Table 2).

Multivariate adjusted model showed that types of working was the only independent significant predictor of both

musculoskeletal and respiratory problems. In the model, the brick carrier was considered as the reference group because of larger size. The odds of musculoskeletal problems in brick moulder was 93% lower than brick carrier (P-value < 0.001). But, the odds of developing musculoskeletal problems in brick stacker and fireman was not significantly different from brick carriers. The odds ratio of respiratory problems in brick moulders was 0.04 compared to brick carriers. (95%CI:0.006-0.23). The results of multivariate model are shown in table 3.

Table 3. Multivariate Adjusted Estimates of Predictors for Musculoskeletal and Respiratory Problems

	Musculoskeletal illness		Respiratory illness	
	Unadjusted	Adjusted	Unadjusted	Adjusted
	OR (95% CI)		OR (95% CI)	
Age in years	0.93 (0.89-0.96)**	1.002 (0.96-1.05)	0.95 (0.93-0.98)**	0.81 (0.99-1.03)
Sex (female)			2.02 (1.02-3.99)*	2.12 (0.91-4.96)
Years of work				
≤ 5 years	1	1	1	1
5-10 years	0.21 (0.08-0.55)**	0.69 (0.17-2.77)	0.92 (0.43-1.95)	1.77 (0.53-5.91)
≥ 10 years	0.07 (0.03-0.17)**	0.31 (0.08-1.29)	0.14 (0.07-0.30)**	0.38 (0.13-1.09)
Working hours				
Equal to 8 hours	1	1		
8-12 hours	0.67 (0.49-0.93)*	0.58 (0.22-1.55)		
Type of work				
Brick carrier	1	1	1	1
Brick moulder	0.02 (0.01-0.08)**	0.07 (0.01-0.30)**	0.03 (0.06-0.14)**	0.04 (0.006-0.23)**
Brick stacker	0.35 (0.13-0.96)*	0.58 (0.16-2.19)	1.7 (0.81-3.68)	1.24 (0.45-3.41)
Brick fireman	1.64 (0.33-8.28)	1.53 (0.29-7.89)	1.4 (0.6-3.26)	1.36 (0.57-3.24)

Abbreviation: OR, odds ratio; CI, confidence interval, *P-value < 0.05, **P-value < 0.001

Discussion

With the high demand of infrastructure development, brick making industry in Bangladesh is a rapidly growing sector. The brickfield is an informal sector where the workers are recruited on a seasonal basis and they work temporarily for six to eight months during a season (22, 25). In this study it was found that about 58.2% of respondents had been in the brick manufacturing occupation for less than 5 years working experience, however, they did not continue work more than six months in a year.

Several studies had been conducted among the brickfield workers to evaluate their musculoskeletal and respiratory illness (2, 6, 8, 11, 26-28). This study found that more than two third of study participants suffered from different musculoskeletal problems. This finding is in agree with previous reports (8, 12, 27, 28). Working in the brickfield has significant impact on the human body because of manual molding, stacking, firing, and carrying the bricks (4, 29). The brick field workers most often work in awkward postures so naturally, they suffer from various musculoskeletal disorders (4, 30). Among different task of working in the brick field, the brick carriers had the highest prevalence of musculoskeletal problems. Furthermore, neck and upper extremities including hand, wrist and shoulders were the commonest site of pain reported by the workers. Carrying heavy loads above the shoulder is one of the main reasons for pain in the upper extremities of the body. A high frequency of pain was also determined at upper and lower back probably because of bending, carrying, and lifting heavy loads. Previous studies reported that musculoskeletal illness have been significantly associated with constant awkward postures for prolonged period of time (27).

This study found a high prevalence of respiratory problem including asthma, cough, wheezing and phlegm that is in agree with the findings of previous reports (31, 32). Brick kiln is a workplace where dust and smoke exposures are common that may contribute to various respiratory problems. Similar findings also have been seen in previous studies (11, 33, 34). A study was found in Croatia where 31.8% of chronic cough and 26.2% of phlegm was observed on brick kiln workers (35). Due to the high frequency of dust and smoke in the brick kiln which was the main prevailing cause of respiratory symptoms, had been found in earlier research (36-38). In this study there was no relationship between smoking and respiratory problems. In a review on papers published over a period of 35, there was very little to support the view that the risk of occupational asthma is increased in workers who are smokers (39, 40). A study was found in Nepal where the researchers showed that the workers who involved in brick loading/carrying and firing had the significantly higher prevalence of chronic bronchitis (26). In this study the multivariate adjusted model showed that type of working was the only significant independent predictor for both problems. Further investigation revealed that there are significant relationship between types of working and age, sex, years of work and working hours in a day. The frequency of brick moulders was highest among older workers, those who worked more than 8 hours and workers with more than 10 years of work. Brick moulder was as a group of worker who had the lowest frequency of musculoskeletal and respiratory problem. This finding suggest that type of working may play as an

important confounder for the significant univariate association between age, years of work and working hours in a day with musculoskeletal and respiratory problems.

This study suffered from some limitation including small sample size on a non-representative sample that may confined the generalizability of the results. Respiratory findings was evaluated through self-reported questionnaire and the workers did not evaluated using comprehensive respiratory examinations such as spirometry. This limitation may induce some information bias for estimating the prevalence of different respiratory problems.

Conclusion

The findings of this study revealed a high frequency of musculoskeletal and respiratory problems in the brick kiln workers. Type of working was as the main independent predictor for both problems and the probability of developing musculoskeletal and respiratory problems was highest among brick carriers. This study recommends further detailed research on workers health education, as well as implementing the new law and strengthening the existing rules and regulation in this unorganized sectors to reduce the impact of health illness.

Ethical consideration

The Study has been approved by the Research Committee of Faculty of Disaster Management, Patuakhali Science and Technology University.

Conflicts of interests

Authors declared no conflict of interest.

Funding

None.

References

1. Mehta R, Pandit N, Parmar R. Morbidity profile of brick kiln workers around Ahmedabad city, Gujarat. *Healthline*. 2010;1(1):41-44.
2. Heuer H, Klimmer F, Kylian H, Seeber A, Schmidt KH, Hoffmann G, et al. Musculoskeletal problems in bricklayers as a function of length of employment: the role of secondary selection by low-back pain. *Work & Stress*. 1996;10(4):322-335. doi: 10.1080/02678379608256811.
3. Chung MK, Kee D. Evaluation of lifting tasks frequently performed during fire brick manufacturing processes using NIOSH lifting equations. *Int J Ind Ergon*. 2000;25(4):423-433. doi: 10.1016/S0169-8141(99)00041-4.
4. Trevelyan FC, Haslam RA. Musculoskeletal disorders in a handmade brick manufacturing plant. *Int J Ind Ergon*. 2001;27(1):43-55. doi: 10.1016/S0169-8141(00)00036-6.
5. Das S, Bagchi A, Gangopadhyay S, Ghosh S. Comparison of lung related discomforts among female mud molders and brick carriers of brick manufacturing Unit of West Bengal, India. *Int J Health Sci Res*. 2016;6(8):135-141.
6. Thygeson SM, Sanjel S, Johnson S. Occupational and environmental health hazards in the brick manufacturing industry in Kathmandu Valley, Nepal. *Occup Med Health Aff*. 2016;4(5):2-7. doi: 10.4172/2329-6879.1000248.
7. Bernard BP, Putz-Anderson V, Burt SE, Cole LL, Fairfield-Estill C, Grant KA, et al. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for

- Disease Control and Prevention, National Institute for Occupational Safety and Health; 1997 .
8. Das B. Assessment of occupational health problems and physiological stress among the brick field workers of West Bengal, India. *Int J Occup Med Environ Health*. 2014;27(3):413-425. doi: 10.2478/s13382-014-0262-z.
 9. Imran MA, Baten MA, Nahar BS, Morshed N. Carbon dioxide emission from brickfields around Bangladesh. *Int J Agril Res Innov & Tech*. 2014;4(2):70-75. doi:10.3329/ijarit.v4i2.22653.
 10. Iqbal A, Salequzzaman M, Azad AK. Modeling for minimizing the emitted CO₂ from brick kilning through afforestation in Bangladesh. *J Environ Sci (Dhaka)*. 2007;5:45-53.
 11. Shaikh S, Nafees AA, Khetpal V, Jamali AA, Arain AM, Yousuf A. Respiratory symptoms and illnesses among brick kiln workers: a cross sectional study from rural districts of Pakistan. *BMC Public Health*. 2012;12:999. doi: 10.1186/1471-2458-12-999.
 12. Joshi SK, Dahal P, Poudel A, Sherpa H. Work related injuries and musculoskeletal disorders among child workers in the brick kilns of Nepal. *Int J Occup Saf Heal*. 2013;3(2):2-7. doi: 10.3126/ijosh.v3i2.10271.
 13. Joshi SK, Dudani I. Environmental health effects of brick kilns in Kathmandu valley. *Kathmandu Univ Med J (KUMJ)*. 2008;6(1):3-11.
 14. Boschetto P, Quintavalle S, Miotto D, Cascio NL, Zeni E, Mapp CE. Chronic obstructive pulmonary disease (COPD) and occupational exposures. *J Occup Med Toxicol*. 2006;1:11. doi: 10.1186/1745-6673-1-11.
 15. Bharatiya M, Rode M, Phatak M. Study of work related respiratory symptoms and pulmonary functional tests in brick kiln workers. *J Med Sci Clin Res*. 2017;5(1):17179-17184. doi: 10.18535/jmscr/v5i1.152.
 16. Raut AK. Brick Kilns in Kathmandu Valley: Current status, environmental impacts and future options. *Himal J Sci*. 2003;1(1):59-61. doi: 10.3126/hjs.v1i1.189.
 17. Fingerhut M, Nelson DI, Driscoll T, Concha-Barrientos M, Steenland K, Punnett L, et al. The contribution of occupational risks to the global burden of disease: summary and next steps. *Med Lav*. 2006;97(2):313-321.
 18. Golbabaie F, Monazzam MR, Hematjo R, Hosseini M, Fahang-Dehghan S. The assessment of heat stress and heat strain in pardis petrochemical complex, Tehran, Iran. *International Journal of Occupational Hygiene*. 2013;5(1):6-11.
 19. Lin RT, Chan CC. Effects of heat on workers' health and productivity in Taiwan. *Global Health Action*. 2009;2:2024. doi: 10.3402/gha.v2i0.2024.
 20. Parvari RA, Aghaei HA, Dehghan H, Khademi A, Maracy MR, Dehghan SF. The effect of fabric type of common Iranian working clothes on the induced cardiac and physiological strain under heat stress. *Arch Environ Occup Health*. 2015;70(5):272-278. doi: 10.1080/19338244.2014.891965.
 21. Department of Environment. National strategy for sustainable brick production in Bangladesh. Bangladesh: Department of environment ministry of environment and forests government of the people's Republic of Bangladesh; 2017.
 22. Das S, Hasan MSQ, Akhter R, Huque S, Khandaker S, Gorapi MZH, et al. Socioeconomic conditions and health hazards of brick field workers: A case study of Mymensingh brick industrial area of Bangladesh. *J Public Health Epidemiol*. 2017;9(7):198-205. doi: 10.5897/JPHE2017.0927.
 23. Darain K, Rahman ABM, Amimul A, Saiful Islam ABM, Yusuf B. Brick manufacturing practice in Bangladesh: A review of energy efficacy and air pollution scenarios. *J Hydro Environ Res*. 2013;1(1):60-69.
 24. Laura López-Aragón L, López-Liria R, Callejón-Ferre, AJ, Gómez-Galán M. Applications of the standardized nordic questionnaire: a review. *Sustainability*. 2017;9(9):1514. doi: 10.3390/su9091514.
 25. Manandhar UM, Dangol SB. Study on evaluating energy conservation potential of brick production in SAARC countries. Kathmandu, Nepal: Min Energy Initiatives, Nepal and SAARC Energy Center, Islamabad; 2013.
 26. Sanjel S, Khanal SN, Thygerson SM, Carter WS, Johnston JD, Joshi SK. Respiratory symptoms and illnesses related to the concentration of airborne particulate matter among brick kiln workers in Kathmandu valley, Nepal. *Ann Occup Environ Med*. 2017;29:9. doi: 10.1186/s40557-017-0165-0.
 27. Das R. Work related Injuries and Musculoskeletal Disorders among Child Workers in the Brick Kilns of Khejuri of Purba Medipur in West Bengal. *Int J Adv Res*. 2015;3(3):1065-1076.
 28. Inbaraj LR, Haebbar OJ, Saj F, Dawson S, Paul P, Prabhakar AK, et al. Prevalence of musculoskeletal disorders among brick kiln workers in rural Southern India. *Indian J Occup Environ Med*. 2013;17(2):71-75. doi: 10.4103/0019-5278.123170.
 29. Bijetri B, Sen D. Occupational stress among women moulders: A study in manual brick manufacturing industry of West Bengal. *Int J Sci Res Pub*. 2014;4(6):1-7.
 30. Khan R, Vyas H. A study of impact of brick industries on environment and human health in Ujjain City (India). *J Environ Res Dev*. 2008;2(3):421-425.
 31. Laohasirivong W, Srathonghon W, Phajan T, Assana S, Intamat S. Dust exposure and lung function of workers in the brick and clay pottery factories in the Northeast of Thailand. *Int J Environ Stud*. 2017;74(6):1001-1012. doi: 10.1080/00207233.2017.1341738.
 32. Praveena MRR, Clevin RR, Ghattargi CH, Dorla A, Lalitha DH. Effects of occupational dust exposure on the health status of Portland cement factory workers. *Int J Med Public Health*. 2013;3(3):192-196. doi: 10.4103/2230-8598.118963.
 33. Monga V, Singh LP, Bhardwaj A, Singh H. Respiratory health in brick kiln workers. *Int J Phys Soc Sci*. 2012;2(4):226-244.
 34. Sheta SA, El Laithy N. Brick kiln industry and workers' chronic respiratory health problems in mit ghamr district, dakahlia governorate. *Egypt J Occup Med*. 2015;39(1):37-51. doi: 10.21608/ejom.2015.809.
 35. Žuškin E, Mustajbegović J, Schachter EN, Kern J, Doko-Jelinić J, Godnić-Cvar J. Respiratory findings in workers employed in the brick-manufacturing industry. *J Occup Environ Med*. 1998;40(9):814-820. doi: 10.1097/00043764-199809000-00011.
 36. Neghab M, Choobineh A. Work-related respiratory symptoms and ventilatory disorders among employees of a cement industry in Shiraz, Iran. *J Occup Health*. 2007;49(4):273-278. doi: 10.1539/joh.49.273.
 37. Al-Neaimi YI, Gomes J, Lloyd OL. Respiratory illnesses and ventilatory function among workers at a cement factory in a rapidly developing country. *Occup Med (Lond)*. 2001;51(6):367-373.
 38. Salvi SS, Barnes PJ. Chronic obstructive pulmonary disease in non-smokers. *Lancet*. 2009;374(9691):733-743. doi: 10.1016/S0140-6736(09)61303-9.
 39. Vandenplas O. Occupational asthma: etiologies and risk factors. *Allergy Asthma Immunol Res*. 2011;3(3):157-167. doi: 10.4168/aaair.2011.3.3.157.
 40. Tarlo SM, Malo JL; Third Jack Pepys Workshop on Asthma in the Workplace Participants. An official ATS proceedings: asthma in the workplace: the Third Jack Pepys Workshop on Asthma in the Workplace: answered and unanswered questions. *Proc Am Thorac Soc*. 2009;6(4):339-349. doi: 10.1513/pats.200810-119ST.