

Cardiovascular Stress and Work Productivity among Brickfield Workers

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ABSTRACT

Background: One of South-East Asia's oldest chaotic, labor-intensive informal sectors is the brickfield industry. Many individuals working in this sector; are illiterate, deprived, and backward. The brickfield workers were exposed to cardiovascular stress while doing different brick manufacturing operations. The aim of the study is to assess cardiovascular stress and work productivity of the 284 brick field workers.

Materials and methods: A cross-sectional study was carried of on the 284 workers working in brickfields of Faridpur sadar, Faridpur, Bangladesh from January 2022 to December 2022. The Cardiac Stress Index (CSI) was used for measuring stress and work productivity was measured by semi structured questionnaire.

Results: The mean age of the 284 workers was 38.1±9.5 years. The mean average family income was 12,919.0±2,111.0 taka. One out of three workers (35.2%) had above normal CSI. CSI was significantly associated with worker's average monthly family income ($p=0.001$) and was above normal among the workers who had monthly family income >15,000 takas (61.3%). CSI was also significantly associated with the working station, working hours, resting hours, and duration of working hours by brick carrier in a day ($p<0.05$). CSI was above normal among the workers who were working as a brick carrier (55.0%), working >6 hours daily (41.1%), taking rest >1 hour (59.3%), and working >6 hours as a brick carrier daily (64.8%).

Conclusion: This study might be helpful for brick-field workers to increase their working productivity and also help to reduce the risk of the cardiovascular event during working environments.

Key words: Brickfields; CSI; Cardiovascular stress; Work productivity.

Introduction

Bangladesh is a highly populated country, where approximately 4.0 million new residences are required annually to accommodate the growing population.^{1,2} The country's rapid urbanization has sparked an upstart building industry that produces 8.6 billion bricks annually, with demand increasing at a rate of around 5.28% per year.³ Brickfields are a raising industry in both urban and rural areas in our country.⁴ According to government statistics, Bangladesh has at least 4,234

brick kilns, both legal and illicit.⁵ Almost all brickfields produce bricks by using traditional manual techniques.^{6,7} Molders, carriers, and stackers are the three types of labor in the brickfield. They were exposed to adverse surroundings while working, which had an impact on their work productivity and cardiac stress. This industry demands substantial manual labor with significantly different workloads.⁸ The socio-economical values of brickfield workers were significantly poor in our country.⁹

Cardiac stress has a significant impact on the ability to do work in brickfields.¹⁰ The workers worked on a wide range of physically demanding tasks, including spading mud, hauling mud, preparing clay, moving clay, shaping, stacking, carrying bricks, and kiln-firing bricks.^{11,12} The cardiovascular system is one of the most effective physiological responses experienced by workers during brick manufacturing. It is most prevalent among brick carriers.^{10,13} Dehydration and heat are two significant factors that affect the cardiovascular system and the heart rate predominantly.¹⁴ Continuous work in the heat causes the cutaneous blood vessels to dilate while the central nervous blood volume declines. To maintain the cardiac output, the heart rate increases but the stroke volume decreases.^{4,15} Performance, efficiency, production, and work quality all are impacted by heat stress.¹⁶

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The health of the employees is significantly impacted by occupational concerns as well. Evidence reveals a relationship between factors like the duration of the work, the absence of safety equipment, the nature of the work, and the type of fuel used.¹⁷ The Cardiac Stress Index (CSI) is a modified measure of Heart Rate Variability (HRV) which is a particular parameter of cardiac assessment due to variations in the heart rate (HR). It is a risk factor for morbidity and mortality like myocardial infarction, left ventricular dysfunction, etc.^{18,19} Workers in the brick industry face a variety of challenges that have an impact on their health.¹⁷ These factors influence the productivity of the workers. The aim of the study is to assess the cardiovascular stress and work productivity of the 284 brick field workers.

Materials and methods

This cross-sectional study was to assess cardiovascular stress and work productivity among brickfield workers working in brickfields named TNT brickfield, AKL brick field, Mondol Brick, MZM brick kilns, and T & T MWM brickfield, Faridpur 7800, Faridpur, Bangladesh.

Participants conveniently selected 284 workers aged ≥ 18 years and who had at least 3 months of working experience selected in the purposively selected brickfields.

The studied participants were interviewed by a pretested semi-structured questionnaire through the face-to-face interview from January to December 2022. The questionnaire consists of socio-demographic characteristics and factors related to work productivity among brickfield workers. The Cardiac Stress Index (CSI) was categorized as normal and above normal. The normal range of CSI was within 0.5-9.25 and above the normal limit (>9.25) was considered as an increased chance of risk factors.¹⁹ CSI of brickfields workers was measured from the radial pulse in terms of Working Heart Rate (WHR), resting heart rate (HR rest) and Heart Rate maximum (HR max). $CSI = 100 \frac{(HR \text{ work} - HR \text{ rest})}{(HR \text{ max} - HR \text{ rest})}$.

Collected data were checked, edited, coded, and recoded by using SPSS version 25. Descriptive statistics such as mean, standard deviation and percent were computed for continuous variables of the participants. Chi-square was used to assess the significance of associations between two nominal variables and a p-value of <0.05 at a 95% confidence interval was taken as significant. The results were presented in tables and chart.

Informed written consent was obtained from each participant. Ethical approval was obtained from the Institutional Review Board (IRB) of the National Institute of Preventive and Social Medicine (NIPSOM), Dhaka 1212, Bangladesh. (NIPSOM/IRB/2017/09).

Results

Table I depicts the particulars of the Brickfield workers. The mean age of the 284 workers was 38.1 ± 9.5 years with an age range of 20-60 years. About three-fourths of the workers (71.5%) were from the age group 26-45 years and a few (4.9%) were from >55 years. Most of the respondents 234 (82.4%) were male and married (90.5%). Regarding educational qualification, half of the participants were illiterate (50.0%), 39.0% had no formal education and only 10.2% studied primary and above levels. Above half of the workers came from the nuclear family (53.5%). The mean average family income was Tk. $12,919.0 \pm 2,111.0$ and above three-fourths of the worker's (77.8%) income was Tk. 10,001-15,000.

Table I Socio-demographic outlines of the workers (n=284)

Outlines		Frequency (n)	Percent (%)
Age groups (Years)	≤ 25	20	7.0
	26-35	105	37.0
	36-45	98	34.5
	46-55	47	16.5
	>55	14	4.9
	Mean \pm SD	38.1 \pm 9.5	
Sex	Male	234	82.4
	Female	50	17.6
Marital state	Married	257	90.5
	Single	27	9.5
Education	Illiterate	142	50.0
	No formal education	113	39.8
	Primary and above	29	10.2
Family type	Nuclear	152	53.5
	Extended	132	46.5
Monthly family income (BDT)	$\leq 10,000$	32	11.3
	10,001-15,000	221	77.8
	$>15,000$	31	10.9
	Mean \pm SD	12,919.0 \pm 2,111.0	

Figure 1 portrays that most of the workers had a smoking history (71.5%) and 28.5% had no smoking history.

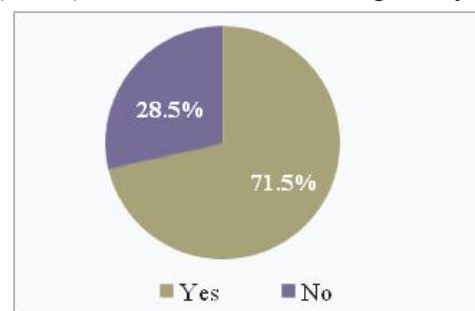


Figure 1 Smoking habit of the workers (n=284)

Table II Factors related to cardiovascular stress and work productivity of the workers

Factors		Frequency (n)	Percent (%)
Working station (n=284)	Brick molder	80	28.2
	Brick carrier	120	42.3
	Brick stacker	84	29.6
Working experiences (n=284)	≤10 years	182	64.1
	>10 years	102	35.9
	Mean±SD	10.1±4.8	
Working hours (n=284)	≤6 hours	82	28.9
	>6 hours	202	71.1
	Mean±SD	7.2±2.3	
Resting hours(n=284)	≤1 hour	198	69.7
	>1 hours	86	30.3
	Mean±SD	1.3±0.5	
Number of bricks laid by brick molder in a hour (n=80)	≤100	24	30.0
	>100	56	70.0
	Mean±SD	117.4±21.7	
Duration of working hours by brick carrier in a day (n=120)	≤6 hours	32	26.7
	>6 hours	88	73.3
	Mean±SD	8.0±1.5	
Number of bricks dried by brick stacker in a day (n=84)	≤1,000	74	88.8
	>1,000	10	11.2
	Mean±SD	860.8±136.0	

Table II describes the factors related to cardiovascular stress and work productivity of the workers. Most of the workers were brick carriers (42.3%). The mean working experience of the workers was 10.1±4.8 years and two-thirds had ≤10 years of experience. The majority of the workers were working >6 hours daily (71.1%) with the mean of 7.2±2.3 hours and took rest ≤1 hour daily with the mean of 1.3±0.5 hours. More than two-thirds of the brick molders lay >100 bricks in an hour (70.0%) with the mean of 117.4±21.7 bricks. About three-fourths of the brick carriers work >6 hours daily (73.3%) with the mean of 8.0±1.5 hours. The majority of the brick stacker dried ≤1,000 bricks in a day (88.8%) with the mean of 860.8±136.0 bricks.

Table III Cardiac stress index scores of the workers (n=284)

Components of CSI	n(%)	Scores
		Mean±SD
HR parameters	During working	89.1±13.3
	During resting	80.1±11.1
	Maximum HR	182.0±9.5
	Recovery phase	84.8±12.5
Levels of CSI	Normal	184(64.8)
	Above normal	100(35.2)

Table III evaluates the cardiac stress index of the brickfield workers. Among them, nearly two-thirds (64.8%) had normal CSI and the remaining one-third (35.2%) had above than normal CSI. The mean CSI score was 9.1±6.0.

Table IV Association within socio-demographic outlines and cardiac stress index

Outlines	Cardiac stress index		χ ² value	p-value
	Normal	Above normal		
	n(%)	n(%)	Total	
	n(%)	n(%)	n(%)	
Age groups (Years)				
≤25	13(65.0)	7(35.0)	20(100)	1.776 0.777
26-35	73(69.5)	32(30.5)	105(100)	
36-45	60(61.2)	38(38.8)	98(100)	
46-55	29(61.7)	18(38.3)	47(100)	
>55	9(64.3)	5(35.7)	14(100)	
Gender				
Male	146(62.4)	88(37.6)	234(100)	3.343 0.074
Female	38(76.0)	12(24.0)	50(100)	
Marital state				
Married	167(65.0)	90(35.0)	257(100)	0.044 0.835
Unmarried	17(63.0)	10(37.0)	27(100)	
Education				
Illiterate	97(68.3)	45(31.7)	142(100)	1.655 0.437
No formal education	70(61.9)	43(38.1)	113(100)	
Primary and above	17(58.6)	12(41.4)	29(100)	
Family type				
Nuclear	106(69.7)	46(30.3)	152(100)	3.510 0.061
Extended	78(59.1)	54(40.9)	132(100)	
Monthly family income (BDT)				
≤10,000	26(81.3)	6(18.8)	32(100)	13.200 *0.001
10,001-15,000	146(66.1)	75(33.9)	221(100)	
>15,000	12(64.8)	19(61.3)	31(100)	

*Statistically significant value.

Table IV interprets the association between socio-demographic outlines and the cardiac stress index of the brickfield workers. The CSI was significantly associated with worker's average monthly family income (p=0.001). The CSI was above normal among the workers who had a monthly family income > Tk.15,000 (61.3%).

Table V interprets the association of cardiac stress index with the factors related to cardiovascular stress and work productivity of the brickfield workers. The CSI was significantly associated with the working station (p=0.000), working hours (p=0.001), resting hours (p=0.000) and duration of working hours by brick carrier in a day (p=0.000). The CSI was above normal among the workers who were working as a brick carrier (55.0%), working >6 hours daily (41.1%), taking rest >1 hour (59.3%) and working >6 hours as a brick carrier daily (64.8%).

Table V Association of cardiac stress index with the factors related to cardiovascular stress and work productivity

Factors	Cardiac stress index		Total	χ^2 value	p-value
	Normal	Above normal			
Smoking habit (n=284)					
Yes	129(63.5)	74(36.5)	203(100)	0.481	0.496
No	55(67.9)	26(32.1)	81(100)		
Working station (n=284)					
Brick molder	54(67.5)	26(32.5)	80(100)	45.153	*0.000
Brick carrier	54(45.0)	66(55.0)	120(100)		
Brick stacker	76(90.5)	8(9.5)	84(100)		
Working experiences (n=284)					
≤10 years	126(69.2)	56(30.8)	182(100)	4.383	0.036
>10 years	58(56.9)	44(43.1)	102(100)		
Working hours (n=284)					
≤6 hours	65(79.3)	17(20.7)	82(100)	0.595	*0.001
>6 hours	119(58.9)	83(41.1)	202(100)		
Resting hours (n=284)					
≤1 hour	149(75.3)	49(24.7)	198(100)	31.382	*0.000
>1 hours	35(40.7)	51(59.3)	86(100)		
Number of bricks laid by brick molder in a hour (n=80)					
≤100	14(58.3)	10(41.7)	24(100)	1.313	0.252
>100	40(71.4)	16(28.6)	56(100)		
Duration of working hours by brick carrier in a day (n=120)					
≤6 hours	23(71.9)	9(28.1)	32(100)	2.734	*0.000
>6 hours	31(35.2)	57(64.8)	88(100)		
Number of bricks dried by brick stacker in a day (n=84)					
≤1000	68(91.9)	6(8.1)	74(100)	1.446	0.229
>1000	8(80.0)	2(20.0)	10(100)		

*Statistically significant value.

Discussion

One of the major factors contributing to the increase in brick production is the rapid urbanization.¹⁵ The brickfield workers changed their posture frequently during different stages of production, which enforced extra load on their cardiovascular system.¹⁰

In the current study, the mean age of the 284 workers was 38.1±9.5 years with an age range of 20-60 years. About three-fourths of the workers (71.5%) were from the age group 26-45 years and a few (4.9%) were from >55 years. Most of the respondents 234 (82.4%) were male and married (90.5%). Almost similar findings were found in the studies conducted in Bangladesh.^{4,11}

Regarding educational qualification, half of the participants were illiterate (50.0%), 39.0% had no formal education and only 10.2% studied primary and above levels. Among this group of workers, 38% of the respondents were illiterate found in the study.⁴ The mean average family income was Tk. 12,919.0±2,111.0 and above three-fourths of the worker's (77.8%) income was Tk. 10,001-15,000 which was similar to the study.¹¹

To assess work productivity and work related factors among brickfield workers they were divided into 3 groups: brick molder, brick carrier, and brick stacker. In this study, most of the workers were brick carriers (42.3%) which were moderately similar to the study in India.¹⁰ The mean working experience of the workers was 10.1±4.8 years and two-thirds had ≤10 years of experience. The majority of the workers were working >6 hours daily (71.1%) with the mean of 7.2±2.3 hours and took rest ≤1 hour daily with the mean of 1.3±0.5 hours. More than two-thirds of the brick molders lay >100 bricks in an hour (70.0%) with the mean of 117.4±21.7 bricks. About three-fourths of the brick carriers work >6 hours daily (73.3%) with the mean of 8.0±1.5 hours. The majority of the brick stacker dried ≤1,000 bricks in a day (88.8%) with the mean of 860.8±136.0 bricks. These findings were almost similar to studies done in Bangladesh, India and Nepal.^{1,4,6,20}

The study revealed that among the brickfield workers, nearly two-thirds (64.8%) had normal CSI and the remaining one-third (35.2%) had above than normal CSI. This result was almost similar to the studies.^{18,19}

Regarding the association of Cardiac stress index with different studied variables, CSI was significantly associated with worker's average monthly family income (p=0.001). The CSI was above normal among the workers who had monthly family income > Tk. 15,000 (61.3%). The CSI was also significantly associated with the working station (p=0.000), working hours (p=0.001), resting hours (p=0.000) and duration of working hours by brick carrier in a day (p=0.000). The CSI was above normal among the workers who were working as a brick carrier (55.0%), working >6 hours daily (41.1%), taking rest >1 hour (59.3%) and working >6 hours as a brick carrier daily (64.8%).

Conclusion

The study showed one out of three workers had above normal CSI. The CSI was significantly associated with their socio-demographic and work related factors which are modifiable. By reducing their risk factors for cardiac events and increasing productivity at work, this information can help. In addition to these public health regulations, programs for intervention and health promotion must be more inclusive of these brickfield employees and reduce their risk of cardiovascular events.

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Disclosure

All the authors declared no competing interest.

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