Cardio-respiratory status of stone grinders and brick field workers from west Bengal, India

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ABSTRACT

Introduction: Quartz crushing and brick making industry are informal and demands heavy manual labour. They are socio-economically backward and are unable to avail of social security's scheme meant for protection of the health and welfare of Indian workers.
Purpose: To evaluate cardiovascular and respiratory status of stone grinders and brickfield workers and to compare the above parameters with the control group.
Materials and methods: This cross-sectional study was carried out among 94 stone grinders and 82 brick field workers of West Bengal. They are mainly exposed to stone dust particles, silica dust and fumes. Pulmonary function and cardiovascular parameters were measured, and respiratory impairments were assessed by questionnaire.
Results: Pulmonary function parameters, including breath holding time significantly reduced among these occupational groups of workers. But maximum oxygen consumption values were significantly higher than any other industrial workers of West Bengal. Workers of the above mentioned occupation showed restrictive type of lung impairment and prevalence of chest pain, and chronic cough (chronic bronchitis) were much higher than the control group workers. Stone grinders (42.6%) and brick field workers (78%) were in the pre-hypertensive state which is much higher than other industrial workers of West Bengal. BMI and skinfold thickness values of the above mentioned occupational workers were much lower than controls as well as other industrial groups of workers indicating severe nutritional deficiency among them.
Conclusion: Thus the environmental stress and nutritional status of these two occupational groups of workers affect the cardio-respiratory status among them, which can be prevented by use of protective gadgets, use of modern engineering techniques, proper health education and awareness.
Key words: Cardio-respiratory status, stone grinders, brickfield workers

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INTRODUCTION

Occupational exposure to dust is a well-known phenomenon, especially in developing countries [1,2]. The dust emission is quite high in quarries and brick field [3]. The effects of silica and dust on health of workers of stone crushing and brick making industry have been made in different countries as well as in India [4-7].

There are numerous studies supporting the association between respiratory impairment and occupational exposure to dust.

High prevalence of silicosis has been reported among workers engaged in stone grinding and according to Urom et al. [8], major respiratory symptoms among quarry workers includes non-productive cough, chest pain, cataract and dyspnea. Besides, brick making is also a laborious work, including brick molding and brick carrying in hot, humid climate in summer. The environmental impact can create cardiovascular stress on workers [5].

Besides, stone crushing and brick making workers are rural, migrant and unskilled. They are often provided with only seasonal employment (between agricultural seasons). They are not well paid, and most of them are illiterate. They largely suffer from nutritional deficiency.

Again, other environmental stresses like noise, heat and heavy exposure to silica dust along with smoking and alcohol intake produces various cardio-respiratory disorders. Heavy manual labour too can cause low back pain and musculoskeletal disorder among these workers.

Employment in quartz crushing mills and brick making industry is informal and demands heavy manual labour. The workers of these industries are unable to avail of social security schemes meant for protection of the health and welfare of Indian workers.

In our country, very few works have been carried out regarding the cardio-respiratory status of stone grinder and brickfield workers [5,9-11].

In order to fulfill this present study was embarked upon. Therefore, the purpose of the present study is to evaluate: cardiovascular and respiratory status of stone grinders and brickfield workers; anthropometric and body composition pattern of stone grinders and brickfield workers and to compare the above parameters with the control group.

MATERIALS AND METHODS

This cross-sectional study was carried out on 94 male stone grinders of Birbhum district of West Bengal and 82 male Brickfield workers of Hooghly district of West Bengal during October 2009 to April 2010.

A control group of subject (n=156) was selected for assessment of cardiovascular status from office workers, school and college employees. For pulmonary function study of the control group a total of 141 subjects were taken and for anthro-pometric study, 145 subjects were chosen having same socio-economic and demographic criteria, by simple random sampling method i.e.; giving equal chance/probability to every individual the population of being selected.

Age of the subject was recorded by questionnaire, physical parameters like body height; body weight was measured by standard procedure without shoes to the nearest 0.5 cm, and BMI was calculated from body weight/(body height in meter)^2.

Age of the subject, smoking habit, year of smoking, duration of service, uses of personal protective equipment were recorded by questionnaire [12].

Besides, prevalence of chest pain, wheezing, cough, chest tightness, headache, liver or digestive problem, skin irritation, etc., if any were recorded by questionnaire [12].

All the subjects taken for study were working in stone crushing and brick making indu-stries for 8 hours. And all were temporary workers and daily wage laborers. We conducted our work between 8 AM to 3 PM for pulmonary function, cardio-vascular and anthropometric parameters.

Before starting our survey work a written consent was taken from each willing individual worker along with the owner of the industry. Besides, this study protocol was approved by Human Ethical Committee of our Institute.

Exclusion criteria:

1. Unwilling workers.
2. Workers working less than 6 months.
3. Workers with previous exposure to any other occupational agents.
4. Any diagnosed case of asthma or family history of respiratory and other diseases like diabetes mellitus, pulmonary tuberculosis, history of any cardiac diseases.

A) Assessment of strength and cardiovascular parameters

- **Heart rate** - Pre exercise heart rate will be measured from radial pulse by a stop watch but recovery heart rate after exercise will be measured from carotid pulse[13]
- **Blood pressure** - The blood pressure will be measured with the help of sphygmomanometer and stethoscope by Auscultatory method [14]
- **Prediction of maximum O_2 uptake** - The Cardio-respiratory fitness in terms of VO_2 max will be predicted by Queen's College Step test [15]
- **Hand Grip Strength** - By Hand Grip Dynamometer [16]

- **Hand Muscle Endurance** - By Hand Grip Dynamometer and stop watch [16]
- **Waist – hip ratio (WHR)** - Waist circumference (cm)/Hip circumference (cm) [17]
- **Breath holding time** was taken with the help of a stop watch [18]

B) Assessment of pulmonary function - All these pulmonary measurements were made by an automatic Spirometer (Spirovit SP1 model) [19]

- **Forced vital capacity (FVC)(L)** - It was the volume of gas expired after full inspiration, expiration being as rapid and complete as possible (i.e. forced)
- **Forced expiratory volume qualified by time interval used in second-(FEV_T)(L)** - It was the volume of gas exhaled over given time interval during the performance of a forced vital capacity (e.g. FEV_1 is the forced expiratory volume in one second)
- **Percentage of Forced expiratory volume-(FEV_1%)** - It was expressed as the percentage of the forced vital capacity (i.e. FEV_T/FVC X100)
- **Average Flow between 0.2 to 1.2 lit of FVC-($FEF_{0.2\text{-}1.2lit}$)(L/min)** - It was the average flow of air between 0.2-1.2 liters of the forced expiratory vital capacity
- **Forced Mid expiratory flow-($FEF_{25\text{-}75\%}$)(L/min)** - The volume of air per unit of time exhaled during the mid half of the expired volume of the forced expiratory spirogram.
- **Forced End expiratory flow- ($FEF_{75\text{-}85\%}$)(L/min)** - It was the forced expiratory flow at75-85 percent of forced vital capacity.
- **Peak expiratory flow rate-(PEFR)(L/min)**- PEFR was measured by Wright's Peak - Flow Meter [20]

C) Assessment of Anthropometric measurements-

- **Body height (cm)** –by anthropometer.
- **Body weight (kg)**- by standard weighing machine.
- **BMI (kg/m^2)**- Body weight (kg)/Body height (m^2) [21]
- **Waist –hip ratio (WHR)**=Waist circumference (cm) /Hip circumference (cm) [17]
- **Skinfold thickness and % of Body fat**-Triceps and subscapular skinfold were taken by Holtain Skinfold Calliper (Holtain Ltd., UK) with constant tension [22]. Measurements were usually taken on the right side of the body with the subject standing. Body density=1.1043-0.00132(thigh skinfold)-0.00131 (Subscapular skinfold) [23] % Body fat= (4.95/Body density-4.50) x 100 [24]
- **Arm length (cm)-[25]** Distance from the acromion process to the tip of the third finger.
- **Forearm hand length (cm)-[25]** Distance from tip of elbow to tip of longest finger, subject sitting erect, upper arm vertical at side, forearm, hand and fingers extended horizontally.
- **Hand length (cm)-[25]** Distance from the proximal edge of the navicular bone at the wrist to middle finger tip of right hand, held straight and stiff.
- **Hand breadth at thumb (cm)- [25]** Maximum breadth across the palm at right angles to the long axis to the hand, at the proximal knuckle of the thumb(joint between metacarpal bone and 1st phalanges), right hand fingers extended, thumb line along side and in plane of thumb.
- **Hand breadth at metacarpal (cm)-[25]** Maximum breadth across the distant ends of the metacarpal bones (where fingers join palm) of index and little fingers, right hand held straight and stiff, fingers together. Measurement was made with firm pressure.
- **Hand thickness at metacarpal (cm)-[25]** Maximum distance between dorsal and palmar surfaces of the knuckle of the middle finger, the joint between finger and the palm, right hand fingers extended.

Statistical Analysis

Data presented were analysed using SPSS statistical package (version 16.0). Descriptive statistics, i.e. mean, standard deviation. Student '*t*' tests were performed to compare the mean between groups after performing the normality test by histogram, b_1, b_2 method and Q-Q Plot method. Crude Odds ratio with 95% confidence interval was calculated to analyze the risk factors.

RESULTS

Table 1 presents mean ± SD values of different anthropometric parameters among stone grinders and brickfield workers along with the control group.

Stone grinders and brickfield workers were significantly lower in age, body weight, body height and BMI values in comparison to those of the control group. Arm length, forearm hand length, hand length, hand breadth (at metacarpale) and hand thickness were significantly lower in brickfield workers than those of control group.

However, body composition parameters, i.e. skinfold thickness (subscapular and thigh), % of body fat, waist-hip ratio (for stone grinders) were significantly lower in stone grinders and brickfield workers than those of control group. Hand index values of brick field workers and all workers combined are significantly greater than control group. Hand index fall into Dolichocheri category i.e. long finger and narrow small palm.

Table 2 shows mean ± SD values of cardiovascular parameters of stone grinders and brickfield workers along with the control group. It was found that hand strength, hand endurance and

maximum O_2 consumption values were significantly higher than the control group but breath holding time values were significantly lower in brick field workers and stone grinders in comparison to control group. Systolic and diastolic blood pressure values of brickfield workers were significantly higher than the control group. But stone grinders showed significantly lower systolic and insignificantly lower diastolic (except DBP of all stone grinders) pressure values in comparison to control group. Resting heart rate values was insignificantly lower in stone grinders but significantly lower (except lower age group) in brickfield workers than the control group.

Table 1. Mean ± SD values of different anthropometric parameters among different occupational group workers along with a control group.

	CONTROL			**BRICK FIELD WORKERS**			**STONE GRINDERS**		
	ALL (n=145)	**LA (n=52)**	**HA (n=93)**	**ALL (n=82)**	**LA (n=70)**	**HA (n=12)**	**ALL (n=94)**	**LA (n=56)**	**HA (n=38)**
Age (yr.)	39.83 ±11.28	27.56 ±5.50	46.70 ±7.04	26.9**** ±8.26	24.29*** ±5.54	42.17*** ±3.51	33.52**** ±13.42	24.20*** ±7.08	47.26 ±7.26
Weight (kg)	67.18 ±10.82	65.66 ±10.47	68.22 ±10.93	50.6**** ±6.97	50.41**** ±6.29	51.71**** ±10.38	48.15**** ±6.55	48.28**** ±7.0	47.97**** ±5.91
Height(cm.)	167.17 ±6.72	168.10 ±5.73	166.65 ±7.19	159.43**** ±17.15	161.14**** ±6.43	149.48 ±42.20	161.89**** ±6.39	161.61**** ±6.82	162.30**** ±5.78
BMI(kg/m^2)	24.02 ±3.47	23.15 ±3.55	24.51 ±3.34	19.39**** ±1.9	19.37**** ±1.67	19.55**** ±3.02	18.35**** ±2.07	18.48**** ±2.33	18.17**** ±1.63
Arm Length (cm)	73.71 ±3.39	74.08 ±2.70	73.50 ±3.72	71.41**** ±3.77	71.17**** ±3.62	72.8 ±4.49	72.89 ±3.54	72.40*** ±3.61	73.61 ±3.36
Forearm Hand Length (cm)	44.27 ±1.92	44.43 ±1.52	44.19 ±2.12	43.7* ±2.19	43.66* ±2.17	43.98 ±2.35	44.09 ±2.41	43.73 ±2.29	44.61 ±2.51
Hand Length (cm)	19.26 ±0.95	19.43 ±0.84	19.17 ±1.01	18.8*** ±1.06	18.74**** ±1.02	19.16 ±1.24	19.38 ±6.44	19.69 ±8.33	18.93 ±1.20
Hand Breadth at Thumb(cm)	9.74 ±0.56	9.73 ±0.52	9.75 ±0.59	9.7 ±0.55	9.67 ±0.55	9.93 ±0.55	9.51**** ±0.54	9.41*** ±0.54	9.64 ±0.52
Hand Breadth at Metacarpale (cm)	7.84 ±0.38	7.83 ±0.30	7.85 ±0.42	8.07**** ±0.47	8.02*** ±0.45	8.35*** ±0.48	7.84 ±0.37	7.78 ±0.37	7.92 ±0.36
Hand Thickness at Metacarpale (cm)	2.43 ±0.18	2.37 ±0.17	2.46 ±0.18	2.51*** ±0.21	2.49**** ±0.22	2.6*** ±0.13	2.46 ±0.17	2.43* ±0.17	2.51 0.17±
Subscapular Skinfold Thickness (mm)	24.45 ±9.84	23.06 ±9.42	25.23 ±10.03	9.08**** ±2.76	8.84**** ±2.24	10.47**** ±4.69	8.9**** ±3.1	9.0**** ±3.41	8.75**** ±2.62
Thigh Skinfold (mm)	28.61 ±8.7	30.40 ±8.83	27.60 ±8.51	11.27**** ±3.86	11.08**** ±3.58	12.39**** ±5.23	10.92**** ±4.72	11.89**** ±5.04	9.51**** ±3.85
% of Body Fat	28.78 ±10.12	28.40 ±9.53	28.99 ±10.50	10.09**** ±6.73	9.41**** ±4.57	14.05*** ±13.51	9.86**** ±6.34	11.04**** ±7.53	8.13**** ±3.39
Waist Hip Ratio	0.95 ±0.04	0.93 ±0.03	0.96 ±0.03	-	-	-	0.93**** ±0.04	0.91*** ±0.03	0.95 ±0.03
Exposure (yr.)	-	-	-	6.85 ±4.34	5.75 ±3.7	13.25 ±0.75	8.16 ±8.98	4.79 ±6.86	13.82 ±9.38

*=p<0.05, **=p<0.02, ***=p<0.01, ****=p<0.001 LA- lower age group, HA- higher age group

Table 2. Mean±SD values of different cardiovascular parameters among different occupational group workers along with a control group.

	CONTROL			**BRICK FIELD**			**STONE GRINDER**		
	ALL (n=156)	**LA (n=55)**	**HA (n=101)**	**ALL (n=82)**	**LA (n=70)**	**HA (n=12)**	**ALL (n=94)**	**LA (n=56)**	**HA (n=38)**
Age (yr.)	40.1 ±11.23	27.82 ±5.46	46.79 ±7.17	26.9**** ±8.26	24.29**** ±5.54	42.17**** ±3.51	33.52**** ±13.42	24.20*** ±7.08	47.26 ±7.26
Weight (kg.)	66.6 ±10.94	65.36 ±10.49	67.27 ±11.17	50.6**** ±6.97	50.41**** ±6.29	51.71**** ±10.38	48.15**** ±6.55	48.28**** ±7	47.97**** ±5.91
Height (cm.)	167.03 ±6.66	167.86 ±5.75	166.58 ±7.09	159.43**** ±17.15	161.14**** ±6.43	149.48 ±42.20	161.89**** ±6.39	161.61**** ±6.82	162.3**** ±5.78
BMI (kg/m^2)	23.85 ±3.45	23.23 ±3.60	24.18 ±3.34	19.39**** ±1.9	20.23**** ±6.33	19.75**** ±6.58	18.35**** ±2.07	18.48**** ±2.33	18.17**** ±1.63
Heart Rate (beats/min)	77.23 ±9.96	76.87 ±7.88	77.43 ±10.95	73.95** ±10.5	74.73 ±10.95	69.42**** ±5.71	76.26 ±13	73.21 ±12.67	80.74 ±12.30
Systolic Blood Pressure(mm Hg)	125.95 ±14.37	119.38 ±8.37	129.52 ±15.67	126.32 ±8.77	125.29**** ±7.24	132.33 ±13.85	119.98*** ±17.26	119.57 ±14.10	120.58** ±21.27
Diastolic Blood Pressure(mm Hg)	82.7 ±8.95	79.38 ±7.10	84.50 ±9.37	91.12**** ±8.67	90.8**** ±8.25	93.0** ±11.04	78.26*** ±13.04	77.14 ±12.51	79.89 ±13.79
VO_2 (ml/kg/min)	47.33 ±9.56	44.90 ±11.16	49.22 ±7.66	59.04**** ±8.26	58.33**** ±8.66	56.89*** ±6.73	58.08**** ±8.64	60.24**** ±8.52	54.41*** ±7.64
VO_2 (L/min)	3.19 ±0.63	3.08 ±0.50	3.28 ±0.71	2.98 ±1.3	3.12 ±0.97	2.98**** ±0.68	2.93 ±1.26	3.10 ±1.51	2.63**** ±0.55
Hand Grip Strength (Kg)	44.54 ±8.21	46.53 ±8.83	43.46 ±7.68	41.09*** ±10.27	42.09*** ±10.07	35.25** ±9.85	39.22**** ±8.55	40.98**** ±7.75	36.63**** ±9.09
Hand Muscle Endurance (Sec)	109.74 ±98.26	114.65 ±61.61	107.08 ±113.55	164.49**** ±68.61	160.96**** ±67.25	185.13*** ±75.80	152.54**** ±50.47	161.03**** ±50.78	140.03** ±47.95
Breath Holding time(sec)	39.16 ±15.27	36.0 ±14.0	38.4 ±15.6	21.53**** ±7.38	22.07**** ±7.32	18.38**** ±7.28	28.86**** ±12.3	31.41*** ±13.19	25.16**** ±9.90
Exposure (yr.)	-	-	-	6.85 ±4.34	6.78 ±1.32	20.36 ±10.32	8.16 ±8.98	4.79 ±6.86	13.82 ±9.38

*=p<0.05, **=p<0.02, ***=p<0.01, ****=p<0.001

Table 3 presents mean ± SD values of pulmonary function parameters of lower and higher age group and smoker and non-smoker stone grinders and brickfield workers with a control group. All the pulmonary function parameters except FEV_1%, $FEF_{25-75\%}$ and $FEF_{75-85\%}$ (of stone grinders) showed significantly lower values than control group workers. PEFR values were significantly lower in both stone grinder and brickfield workers than control group.

Table 4 shows mean ± SD values of different pulmonary function parameters based on year of exposure. No significant difference in pulmonary function parameters had been found with increase in year of exposure except $FEF_{25-75\%}$, $FEF_{75-85\%}$ and PEFR in stone grinders and only PEFR values for brickfield workers.

Table 5 represents percentage prevalence of different respiratory disorders of stone grinders and brickfield workers as well as control group. It was found that 34.04% stone grinders and 40.82% brickfield workers had restrictive impairment in comparison to 18.44% control group workers.

Table 6 shows effect of smoking and duration of exposure on prevalence of chest tightness, chronic bronchitis and bronchial asthma along with odds ratio among workers. Stone grinders had 5.61 times, 12.4 times and 3.04 times more prone to prevalence of chest tightness, chronic bronchitis and bronchial asthma than control group, whereas brickfield workers had 1.3 times and 1.71 times more prone to occurrence of chronic bronchitis and bronchial asthma. It was observed that smoker stone grinders were 1.15, 1.97 and 1.79 times more prone to chest tightness, chronic bronchitis and bronchial asthma in comparison to non smoker stone grinders. But no such significant association had been found in brickfield workers. It was observed that prevalence of chest tightness and chronic bronchitis increased with the increase in year of exposure. No such association had been found in brickfield workers except in case of chronic bronchitis.

Table7 represents the prevalence of different stages of hypertension among stone grinders and brickfield workers in comparison to control group. It is found that odds ratios are significant only in pre-hypertensive stage.

Table 3. Mean ± SD values of different pulmonary function parameters of different occupational group workers along with a control group.

	STONE GRINDER						**BRICK FIELD WORKER**		**CONTROL**					
	Lower Age Group			**Higher Age Group**			**Lower Age Group**	**Higher Age Group**	**Lower Age Group**			**Higher Age Group**		
	All (n=56)	**moker n=11)**	**Non-smoker (n=45)**	**All (n=38)**	**oker =23)**	**Non-smoker (n=15)**	**ll/ moker n=41)**	**All/ smoker (n=8)**	**l n=60)**	**noker =21)**	**on-noker =39)**	**l n=81)**	**noker =26)**	**on-noker n=55)**
Age(yr.)	24.2 ±7.08	27.09 ±7.02	23.49 ±6.99	47.26 ±7.26	47.7 ±7.04	46.6 ±7.78	21.76 ±4.48 ***	43 ±4.07 *	24.9 ±6.06	26.76 ±6.36	23.9 ±5.72	47.83 ±7.3	47.73 ±7.76	47.87 ±7.14
Wt(kg.)	161.61 ±6.82 ****	163.8 ±5.86 ***	161.08 ±6.98 ****	162.3 ±5.78 ****	161.84 ±6.05 ***	163.0 ±5.46	160.87 ±6.29 ****	142.49 ±51.17	168.43 ±5.95	168.4 ±5.97	168.46 ±6.02	166.4 ±7.35	166.5 ±6.89	166.33 ±7.62
Ht(cm.)	48.28 ±7.0 ****	51.09 ±9.27 *	47.59 ±6.27 ****	47.97 ±5.91 ****	47.59 ±5.93 ****	48.57 ±6.04 ****	49.32 ±5.84 ****	54.19 ±11.14 ***	62.7 ±10.76	63.8 ±12.17	62.13 ±10.03	67.1 ±10.58	67.6 ±11.23	66.9 ±10.35
BMI (kg/m^2)	18.48 ±2.33 ****	19.01 ±3.09 ***	18.35 ±2.14	18.17 ±1.63 ****	18.14 ±1.77 ****	18.22 ±1.44 ****	18.9 ±1.56 ****	19.8 ±1.2 ****	22.10 ±3.65	22.48 ±4.06	21.89 ±3.44	24.21 ±3.18	24.29 ±2.9	24.17 ±3.33
FVC	3.76 ±1.12 ***	3.41 ±0.62 ***	3.85 ±1.2 ***	3.09 ±0.78 ****	2.93 ±0.72 ****	3.32 ±0.83	3.42 ±0.76 ****	3.57 ±0.44	4.30 ±0.61	4.19 ±0.45	4.35 ±0.67	3.69 ±0.61	3.7 ±0.61	3.68 ±0.62
FEV_1	3.45 ±1.02 ***	3.26 ±0.63 **	3.5 ±1.09 **	2.65 ±0.8 ****	2.49 ±0.88 ***	2.9 ±0.61	3.01 ±0.75 ****	3.33 ±0.48	3.91 ±0.64	3.82 ±0.53	3.96 ±0.70	3.17 ±0.56	3.12 ±0.58	3.2 ±0.56
FEV_1%	92.07 ±11.28	95.69 ±4.87 **	91.17 ±12.25	85.35 ±13.93	83.41 ±16.15	88.32 ±9.34	87.24 ±9.95	93.21 ±5.12 **	90.98 ±6.31	90.96 ±5.45	90.99 ±6.8	86.09 ±6.93	84.33 ±7.8	86.92 ±6.39
FEF $_{200-200}$	7.07 ±2.08	7.12 ±1.85	7.06 ±2.16	5.34 ±2.19 ****	4.86 ±2.43 ***	6.07 ±1.57 *	4.47 ±1.52 ****	6.15 ±2.19	7.44 ±1.98	7.44 ±1.84	7.45 ±2.08	6.94 ±1.89	6.65 ±1.94	7.09 ±1.87
FEF $_{25-75\%}$	4.96 ±1.91	4.79 ±1.47	5.0 ±2.01	3.35 ±1.50	3.31 ±1.64	3.42 ±1.3	3.53 ±1.21 ****	4.92 ±1.53 *	5.04 ±1.34	4.92 ±1.2	5.11 ±1.42	3.80 ±1.27	3.54 ±1.16	3.93 ±1.31
FEF $_{75-85\%}$	2.43 ±1.3	2.32 ±0.96	2.46 ±1.34	1.49 ±0.77	1.39±0.81	1.65 ±0.7	1.77 ±0.79	2.23 ±0.96**	2.34 ±0.98	2.16 ±1.04	2.43 ±0.95	1.33 ±0.6	1.2 ±0.48	1.39 ±0.67
PEFR	468.49 ±90.98 ****	504.55 ±36.98	459.68 ±98.14 ****	438.42 ±102.58 ****	423.04 ±110.06 ****	462 ±88.25 *	417.56 ±77.84 ****	361.25 ±45.81 ****	530.5 ±59.96	533.33 ±57.13	528.97 ±62.1	517.04 ±59.13	511.15 ±54.14	519.82 ±61.63
Exposur	4.79 ±6.9	2.59 ±2.44	5.46 ±7.63	13.82 ±9.38	15.74 ±9.83	9.78 ±7.24	6.05 ±2.90	22.88 ±2.53	-	-	-	-	-	-
*=p<0.05, **=p<0.02, ***=p<0.01, ****=p<0.001														

Table 4: Mean ± SD values of different physical parameters and pulmonary functions of paint workers of different duration of exposure.

	STONE GRINDERS			**BRICK FIELD WORKERS**		
	DURATION OF EXPOSURE			**DURATION OF EXPOSURE**		
	<10 yrs. (n=58)	**10-20 yrs. (n=27)**	**>20 yrs. (n=9)**	**<10 yrs. (n=37)**	**10-20 yrs. (n=5)**	**>20 yrs. (n=7)**
Age (Yr.)	29.24±11.71	40.96±13.37****	38.78±13.64	21.76±4.65	24.8±7.26	43.86±3.53****
Body weight (Kg)	48.22±6.72	47.72±6.38	49.06±6.56	49.58±5.83	49.9±8.62	53.07±11.54
Height (cm)	161.56±6.32	161.2±5.81	166.1±7.65	161±6.02	160.32±8.4	139.56±54.54
BMI (Kg/m^2)	18.46±2.23	18.32±1.78	17.78±1.99	18.92±1.57	18.51±1.58	20.09±0.94**
FVC (L)	3.53±1.09	3.53±0.94	3.14±1.11	3.38±0.78	3.78±0.46	3.51±0.44
FEV_1 (L)	3.22±1.04	3.11±0.85	2.58±1.2	3±0.78	3.27±0.52	3.24±0.44
FEV_1%	91.34±13.11	88.37±9.2	79.47±16.06	87.67±10.22	86.54±9.39	92.27±4.72
$FEF_{200-1200}$ (L/min)	6.65±2.2	6.19±1.93	5.16±3.4	4.51±1.59	5±2.13	5.78±2.09
$FEF_{25-75\%}$ (L/min)	4.61±1.95	3.84±1.37*	3.78±2.81	3.57±1.26	3.92±1.68	4.66±1.44
$FEF_{75-85\%}$ (L/min)	2.26±1.2	1.64±0.72***	1.97±1.84	1.8±0.83	1.9±0.89	2.06±0.89
PEFR (L/min)	458.54±98.8	467.41±70.85	408.89±138.87	424.05±77.44	366±54.59	355.71±46.5***
Exposure (Yr.)	2.98±2.52	14.7±3.78	28.67±3.61	5.49±2.43	12.6±3.13	23.57±1.72
*=p<0.05, **=p<0.02, ***=p<0.01, ****=p<0.001						

Table 5. Prevalence of different lung diseases in workers along with a control group.

	STONE GRINDERS						BRICK FIELD WORKERS		CONTROL	
	All (n=94)		Smoker (n=60)		Non-smoker (n=34)		All/Smoker (n=49)		(n=141)	
	No	%	No	%	No	%	No	%	No	%
Normal	56	59.57	37	61.67	19	55.88	29	59.18	112	79.43
Restrictive	32	34.04	23	38.33	9	26.47	20	40.82	26	18.44
Obstructive	2	2.13	2	3.33	-	-	-	-	3	2.13
Combined	4	4.26	2	3.33	2	5.88	-	-	-	-

Table 6. Effect of smoking and duration of exposure on the prevalence of chest tightness, chronic bronchitis and bronchial asthma along with odds ratios among workers.

			No. Examined	Chest Tightness				Chronic Bronchitis				Bronchial Asthma			
Sectors	**Category**	**Group**		**o**	**%**	**OR**	**95% CI**	**o**	**%**	**OR**	**95% CI**	**o**	**%**	**OR**	**95% CI**
Stone grinder (n=94)	**Smoking Habit**	**Smoker**	34	10	29.41	1.15	0.45-2.91	12	35.29	1.97	0.78-5.02	1	2.94	1.79	0.11-29.53
		Non-smoker	60	16	26.67	-	-	13	25	-	-	1	1.67	-	-
	EXPOSURE	**>20 yrs.**	**9**	4	44.44	2.77	0.65-11.83	3	33.33	1.57	0.35-7.12	1	11.11	-	-
		10-20 yrs.	**27**	9	33.33	1.73	0.63-4.75	8	29.63	1.32	0.48-3.68	1	3.7	-	-
		<10yrs.	**58**	13	22.41	1.0	-	14	24.14	1.0	-	-	-	-	-
		ALL	**94**	6	27.66	.61	49-12.64	6	26.6	12.41	4.15-37.07	2	2.13	04	27-34.05
Brick field workers (n=82)	**Smoking Habit**	ALL/ Smoker	82	3	3.66	-	-	3	3.66	-	-	1	1.22	-	-
	EXPOSUR	>20 yrs.	17	2	11.76	-	-	1	5.88	2.25	0.13-38.27	1	5.88	-	-
		10-20 yrs.	28	1	3.57	-	-	1	3.57	1.33	0.08-22.29	-	-	-	-
		<10yrs.	37	-	-	-	-	1	2.7	1.0	-	-	-	-	-
		ALL	**82**		3.66	.56	0.15-2.12		3.66	1.3	0.28-5.96	1	1.22	73	11-28
Control		**ALL**	**141**		6.38		-		2.84	-		1	0.71		-

Table 7. Prevalence of hypertension among different industrial workers along with a control group.

	No. of Subjects Examined	Normal BP<120/80mm Hg				Pre-hypertensive BP=120-139/80-89 mm Hg				Stage 1-Mild BP≥140/90 mm Hg				Stage 2-Moderate BP≥160/95 mm Hg				Severe BP≥180/110 mm Hg			
		No	%	OR	95% CI	No	%	OR	95% CI	No	%	OR	95%CI	No	%	OR	95%CI	No	%	OR	95%CI
Stone grinders	94	44	46.81	--	--	40	42.55	1.29	0.76-2.17	8	8.51	0.16	0.07-0.36	1	1.06	0.32	0.04-2.81	1	1.06	0.2	0.02-1.62
Brick field workers	82	12	14.63	-	-	64	78.05	6.18	3.33-11.44	6	7.32	0.14	0.06-0.33	-	-			-	-	-	-
ALL	**176**	**56**	**31.82**	-	-	**104**	**59.09**	**2.51**	**1.61-3.91**	**14**	**7.95**	**0.15**	**0.08-0.28**	**1**	**0.57**	**0.17**	**0.02-1.45**	**1**	**0.57**	**0.11**	**0.01-0.85**
Control Group	**156**	**68**	**43.59**	-	-	**57**	**36.54**	**1.0**	-	**18**	**11.54**	**1.0**	-	**5**	**3.21**	**1.0**	-	**8**	**5.13**	**1.0**	-

Figure 1 and 2 represents the percentage prevalence of respiratory diseases, liver dysfunction and pain in different parts of the body among stone grinders and brickfield workers.

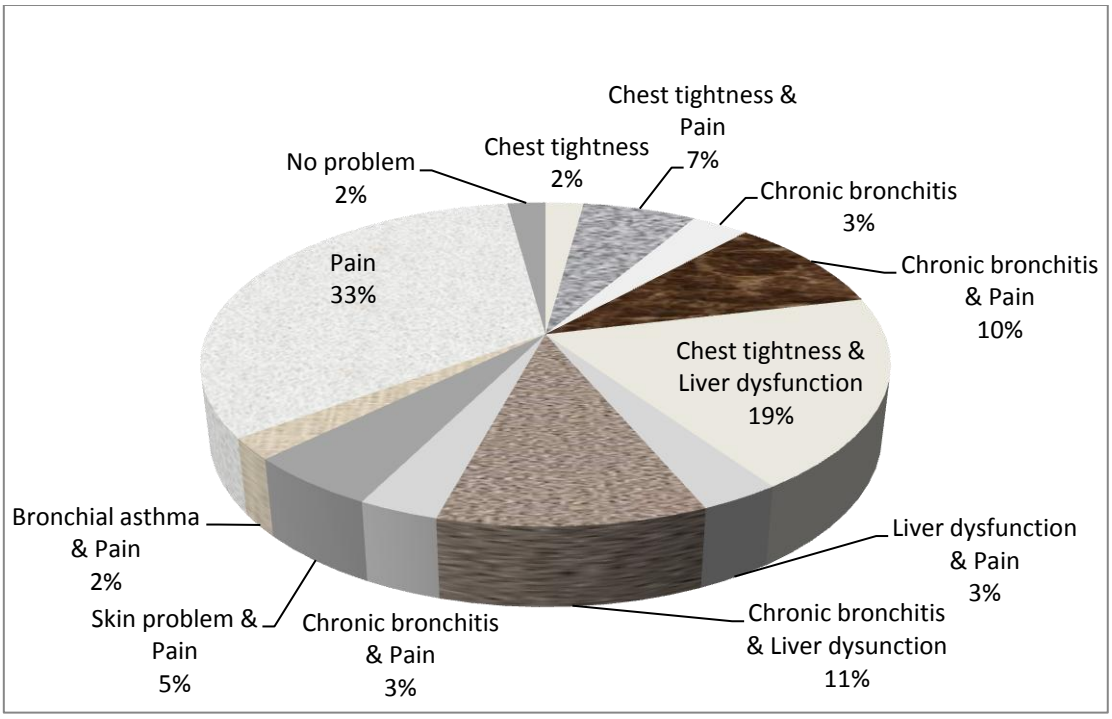

Figure 1. Prevalence of respiratory disorders, liver dysfunction pain and skin problem among stone grinders.

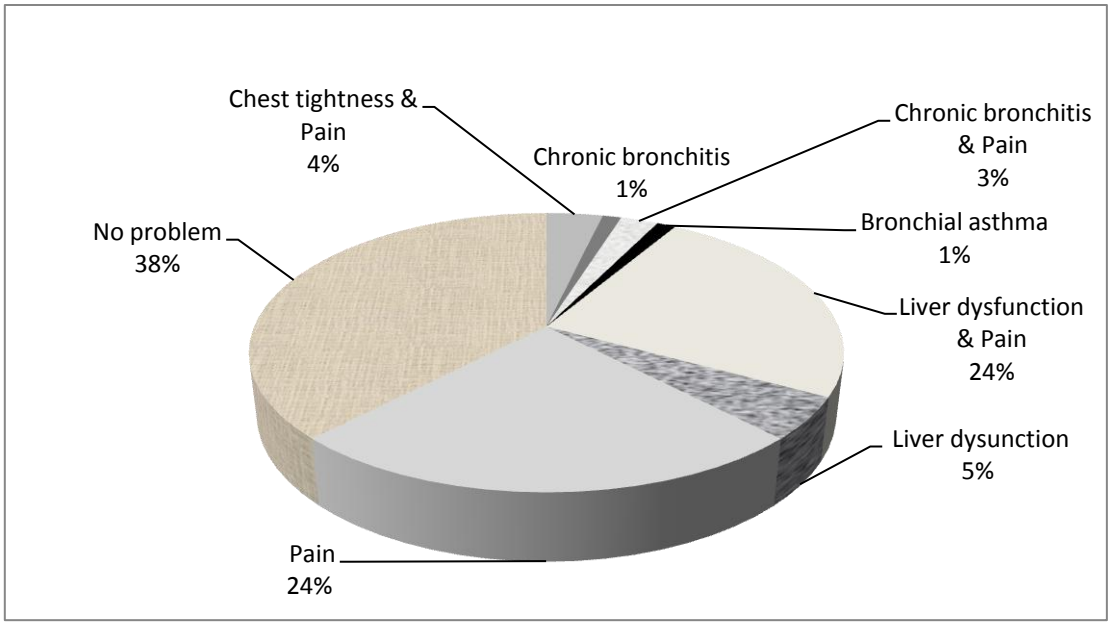

Figure 2. Prevalence of respiratory disorders, liver dysfunction and pain among brick field workers.

DISCUSSION

The present study aims to investigate the differences in selected health traits between two occupational groups, namely brickfield workers and stone grinders as well as the control group. The individuals of both groups were homogenous in terms of ethnic traits, physical environment and socio-economic condition. The health status was measured in terms of few anthropometric parameters, blood pressure, pulse rate and VO_2 max. and pulmonary function parameters.

Body weight, body height, BMI values of stone grinder and brickfield workers were

significantly lower than the control group thereby indicating under-nutrition among brickfield workers and stone grinders. Similar findings were reported by Mandal and Thakur [11] for brickfield workers, fishermen and rickshawpuller. Besides, Bigoniya et al. [26] also reported majority of gardeners of Bhopal city were underweight. Prevalence of underweight is high among the tea garden labourers of Assam [27] and London et al. [28] reported high level of undernutrition, i.e. low BMI among farm workers of Western Cape.

Hand length and hand breadth (at metacarpale) values of brick field workers and stone grinders indicated that they fell into Dolicocheri group, which was very similar to the industrial workers of West Bengal as well as industrial workers of Haryana [29].

The prevalence of underweight and undernutrition of workers of present study might be due to heavy workload, low wage structure, lack of medical facilities, improper work rest cycle, and unhygienic work environment.

Besides, subscapular and thigh skinfold thickness, the percent of body fat and waist/hip ratio values were significantly lower in workers of present study in comparison to control group, which also indicates low nutritional status. Similar findings were observed by Bandyopadhyay [30] for brickfield workers.

Comparison of different hand dimensions of the different occupational group of present study and male industrial workers of different nationalities and India expressed that male brickfield workers and stone grinders of present study had relatively longer hand and narrow hand shape with average hand length 191 mm and hand breadth 79.5 mm, which is similar to that of hand shape of Asian population [29]. These differences in hand dimensions of workers of different occupation and industrial workers of West Bengal might be due to occupation, climate, measurers difference and age group apart from ethnic and genetic variations [31].

Blood pressure values of brickfield workers were significantly higher in comparison to stone grinders and control group. 42.5% stone grinders and 78% brickfield workers were in prehypertensive stage in comparison to 36.54% prehypertensive the control group subject.

Odds ratio values indicate that brickfield workers are 6.18 times, and stone grinders are 1.29 times more prone to hypertension than the control group, but the majority of stone grinders has normal blood pressure. High prevalence of prehypertension was reported by Medhi et al. [32] and Mahanta et al. . [33] among the tea garden labourers of Assam. The underlying reason for these differences in two occupational groups may perhaps be related to high demand of physical activity in such jobs/ occupation. House et al. [34] and Karasek et al. [35] stated that each particular occupation had its own set of demands and rewards that could influence health.

Besides VO_2 max. values (ml/kg/min) are significantly higher in brickfield workers and stone grinders in comparison to control group as well as industrial workers of West Bengal. In contrast, Debray et al. [7] found that stone grinders had lowest VO_2 max. values than agricultural and jute mill workers probably due to fewer numbers of subject in each occupational group. Hand grip strength and endurance values were significantly higher in stone grinders and brickfield workers in comparison to control group. Similar finding was reported by Bandyopadhyay [30]. The higher strength and endurance values of stone grinders and brickfield workers were probably due to extensive use of hand muscles as well as finger muscles for working activities [30].

FVC, FEV_1 and PEFR values of stone grinders and brickfield workers were significantly lower than the control group probably due to free silica dust or dust particles exposure by virtue of their occupation [36]. It was also found that 34% stone grinders and 41% brickfield workers had restrictive type of abnormalities in comparison to control group (18%) as a result of silica dust exposure [37,38]. Although odds ratio of prevalence of respiratory diseases among stone grinders indicated significant association of smoking habit and respiratory impairment (OR range from 1.15-1.97), so smoking is an other etiological factors for prevalence of respiratory diseases in addition to silica dust exposure.

Prevalence of respiratory diseases of stone grinders and brickfield workers when compared to industrial workers of West Bengal [12], it was found that 27.66% and 26.6% stone grinders suffered from chest pain or tightness and chronic cough respectively in comparison to the cement workers (28.9% and 23.3%), cotton workers (32.27% and 33.07%), jute workers (36.96% and 28.4%) and paint industry workers (24.5% and 24%). But only 3.66% brickfield workers suffered from chest pain and chronic cough. But Nwibo et al. [6] reported high prevalence of the above mentioned respiratory problems (47.6% and 40.7%) among Nigerian stone crushing workers. Similar observation was reported by Mashaallah et al. [39] for Iranian stone workers and Lemele et al. [40] for quarry workers of Brazil. The study in Iran reported irritative cough in 75% workers and 31.9% workers of Brazil reported cough with expectoration. These respiratory problems might be due to prolong quarry dust and silica exposure [8].

A significant reduction in mean FVC and FEV_1values with an increase in duration of exposure and increase in odds ratio values for different respiratory diseases might be due to inhalation of dust particles, which are lodged in the

lung causing irritation and inflammatory reactions. It was found that healing of this inflammatory process would cause fibrosis leading to defective oxygen diffusion and impaired lung function [41].

A significant reduction in lung functions among smoker stone grinders observed in the present study was in corroboration with the findings of Rao et al. [42] and Nwibo et al. [6], although Hinzdo [43] and Hinzdo et al. [44] observed significantly higher reduction in lung function among workers with both silica and tobacco exposure than in those of either one. In contrast, no such effect of smoking was found by Ghotkar et al. [45].

In addition to the respiratory problem 33%stone grinders and 29.2% brickfield workers suffered from liver dysfunction, which was supported by Nwibo et al. [6]. Nwibo et al. [6] also indicated that there was a relation between exposure to dust and incidence of hypertension, which was reflected in our study, and it was found that 42.5% stone grinders and 78.05% brickfield workers were in prehypertensive stage.

Fulekar [46] and Sivacoumar et al. [47] reported high concentration of total and respirable dust inside quartz manufacturing in India. Besides, high silica dust exposure among stone grinders as well as brickfield workers, severe unemployment problem forced the people, including women and children to select this job. Besides, widespread illiteracy further impairs the successful implementation of health promoting programme [48].

Thus chronic dust exposure in crushing of rocks and silica may increase susceptibility to respiratory problems, impaired lung function with tobacco smoking and increased length of service as additional risk factors. Therefore, to prevent respiratory impairment and other physiological abnormalities following measured must be taken-

- Use of safety measures like face masks, apron, hand gloves, etc.,
- Discourage tobacco smoking,
- Periodic health check-up,
- Use of modern engineering equipments,
- Proper health education.
- ESI facilities to protect their health

CONCLUSIONS

From the study, it can be concluded that dust exposure in stone crushing, and silica dust exposed workers affects the lung capacity and cardio-vascular parameters of stone grinder and brickfield workers. Besides, stone grinders and brickfield workers also suffer from liver dysfunction and pain in different parts of the body due to prolong silica dust exposure and work related occupational stress.

Thus to protect the health of workers of unorganized sector's implementation of different safety measures and health education is essential for an increase in productivity and economic growth of the country.

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Conflicts of Interest

None

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