Original Research Article

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Prevalence of respiratory abnormalities and spirometric disparities among construction workers in Tangail, Bangladesh

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ABSTRACT

Background: Occupational exposure is a significant factor for having respiratory symptoms and impairment of lung function in the working population. Construction workers impose a great risk of respiratory diseases since they continuously expose to construction hazards at their working place. The objective of this study was to explore the status of respiratory health of construction workers as well as correlation of blood parameters with it.

Methods: This cross-sectional study was conducted among construction workers along with the control group (university staffs) by randomly selecting 50 individuals in each group from September 2019 to February 2020 in Tangail, Bangladesh. Questionaries' survey was executed followed by spirometry and oximetry. After confirming abnormalities of lung function, blood was drawn for further IgE, ESR, and CRP analysis.

Results: Significantly (p<0.05) higher percentage of respiratory symptoms such as dyspnea (24%), coughing (30%), sneezing (40%), discomfort of chest (18%) were found in construction workers. In addition, lung function (FVC, FEV1, FEV1%, PEF, PEF%, FEF25, and FEF2575) was significantly (p<0.05) lower in construction workers compared with control. Furthermore, both IgE (353.57±25.41) and ESR (17.87±5.25) also reported a marked rise in the number of construction workers (p<0.05).

Conclusions: It can be concluded from our study that construction hazards might the cause of prevalent respiratory symptoms, decreased lung function, and increased inflammatory markers such as IgE and ESR.

Keywords: Construction workers, ESR, IgE, Oximetry, Respiratory diseases, Spirometry

INTRODUCTION

Occupational demises and injuries are the global burdens in the au courant world. It has been estimated that 2.34 million people occupational death each year, only 321,000 are due to accidents and 2.02 million from work-related diseases. The cost of the death of workers is not only on individual worker families but also on the world economy, an estimated 4% loss of global gross domestic production. According to the National Institute for Occupational Safety and Health (NIOSH), work-related deaths from respiratory diseases and cancers account for

almost 70 percent of all occupational disease deaths.² Among all work-related diseases, respiratory diseases are the leading cause of morbidity. More than 50 million people are reported to be dealing with occupational lung diseases.³

Construction is one of the most hazardous places that provides a congenial environment having respiratory diseases. The hazards in construction sites are 8 times more risker than any other manufacturing company.⁴ Silica, wood dust, lead dust, cement, stone dust, and chemicals are the most common hazards in construction

sites that are holding responsible for causing serious respiratory diseases, including silicosis, chronic obstructive pulmonary disease (COPD), asthma and lung cancer. About 2 million construction workers are exposed to silica dust during their workplace.⁵ High mortality rates, in silicosis, were observed in construction workers than in other industries from 1990-1999.⁶ Besides, Construction workers impose a high mortality rate due to COPD, even without smoking.⁷

High range of respiratory symptoms, for examples, coughing, phlegm, breathlessness, chest tightness, watering eyes, and wheezing have been documented in several studies, associating with construction hazards. 8-12 These symptoms cause the potentiality of construction workers at their working places to be impaired. Moreover, exposure to hazard at the construction site may trigger abnormal immune response associated with an augmented level of inflammation in the body, subsequently might be a great marker to detect a person having respiratory diseases. However, spirometry is the most trustworthy method, until now, to prognosticate abnormal lung function as well as the pattern of respiratory diseases. Important parameters of spirometry are Forced vital capacity (FVC), Forced expiratory volume in one second (FEV1), The ratio of FEV1/FVC (FEV1%), Peak expiratory flow (FEF), 25% flow of the FVC (FEF25), 75% flow of the FVC (FEF75) and Average flow between 25% and 75% of the FVC (FEF2575).

Bangladesh is a highly dense populated country, therefore, providing high accommodation system required here. As a result, significant numbers of people, 3.5 million, are involved in the construction sector. Lacking proper mechanization, still now construction site is laborintensive in Bangladesh. But, a large number of workers have apathy to accustom to personal protective equipment. A study reported, total 806, average 135, construction workers lost their lives during 2008-2013 in Bangladesh, which was the highest in the world. Bangladesh Occupational Safety, Health and Environment Foundation (OSHE), 179 construction workers lost their lives which was the second-largest accident figure in the year of 2017.

While construction workers play an important role in the gross domestic product (GDP) in the country, there are limited studies about construction hazards role on respiratory health in Bangladesh. The aims of this study were to assess lung function of construction workers by spirometry, to find the prevalence of respiratory symptoms among construction workers, and to investigate the correlation of blood parameters with abnormal lung function.

METHODS

Study design: This cross-sectional study was performed among the construction workers by randomly selecting 50

individuals from September 2019 to February 2020, in Tangail, Bangladesh. University staff, consisting 50 individuals, matched with ages, having same criteria that were for construction workers and who had no history working on construction sites were recruited as control group. Letters were posted to the relevant construction site managers in order to gain an agreement to undertake the study from Biochemistry and Molecular Biology department in Mawlana Bhashani Science and Technology University.

Sampling technique: Probability simple random sampling technique was used for sample selection.

Inclusion criteria

Male workers, age ranged between 18-50 years, no any diagnosed respiratory diseases, worked at least 1 year in construction site and those who gave oral consent were included in this study.

Exclusion criteria

Workers aged less than 18 years and more than 50 years, female workers, managers or supervisors and those who were not willing to participate in the study were excluded.

Preparation of questions and data collection

Questions related to occupational respiratory health were customized with the American Thoracic Society (ATS) and NHLI Division of Lung Diseases (DLD) questionnaire (ATS-DLD-78 questionnaire) standard.¹⁷ It ascribes questions on demographic characteristics (age, BMI, and education), smoking habits, respiratory problems (dyspnea, coughing, sneezing, discomfort of chest, conjunctivitis), family history, mask usage habit, revealing years.

Data were gathered at their workplace by going to individual construction employees. They were caught on the purpose of our study and given the choice to take an interest in this study. Then construction workers were asked questions, face to face, by our expert members, and responses were assiduously written on documents.

Oximetry and spirometry

The individual worker was asked to perform the oximetry test as well as the spirometry test, who had already completed a part of the questionnaire. In the oximetry test, the person was asked to position one of the fingers in an oximeter (AiQURA AD805 Finger pulse oximeter, Zhehjiang, China) to obtain both heart rate and blood oxygen saturation.

On the other hand, for the calculation of lung power, a portable spirometer (SP 10 spirometer, Contec medical system Co. Ltd., China) was brought to construction workers and tested. Before performing Spirometry, the

pros and cons of the spirometry methods were evinced by our expert. In our research, the spirometry test was performed in a standing position, as spirometry can be performed both in a sitting position and in a standing position. Test execution was repeated three times to get precise lung function capability and results were automatically saved in the spirometer. The measurement parameters of the spirometer were: FVC, FEV1, The ratio of FEV1/FVC (FEV1%), FEF, FEF25, FEF75, and FEF2575.

Blood collection and serum separation

The workers were persuaded, having an irregular lung function capability, to supply blood for further analysis of ESR, CRP, and IgE. Although maximum workers had abnormal lung function capacities, we could manage to get blood from 15 workers due to having trepidation of blood draw. Likely, for the comfort of measurable investigation, blood was also drawn from 15 controls. From 5 ml drawn blood, 1.6 ml was kept in the ESR test tube to determine the amount of ESR and the remainder of the blood was kept in a serum test tube to conduct both CRP and IgE tests. In addition, serum test tubes were kept outside before being placed in an icebox but ESR test tubes were kept in the icebox immediately to hold them properly in the laboratory.

Both test tubes, serum, and ESR, were held outside the icebox in the laboratory to reach normal temperature. After that, the serum was separated at 1000 rpm, using a tabletop centrifuge (DSC-200 T, DIGISyatem, Taiwan). Separated serum was stored in freezer at -80°C with proper labelling.

Erythrocyte sedimentation rate (ESR) test

Westergren procedure for calculating blood ESR levels was adopted in our study. In this process, blood was drawn from the ESR test tube into the westergren tube (2.55 mm in diameter, 200 mm in length) and then placed vertically at room temperature for 60 minutes in the westergren stand. ESR values were measured in mm/hr. after one hour later, having seen the volume of the coagulated erythrocyte.

C-reactive protein (CRP) test

The CRP test was performed using the latex agglutination method, while the CRP Latex kit (Lab21 Health Care Ltd, Biotec, UK) was used. The latex suspension was combined with the serum on a slide and moved for one minute in a rotational machine at 100 rpm. The presence or absence of noticeable agglutination indicates whether or not CRP is present in the specimen. Displaying the agglutination, serum was weakened for 2, 4, 8 and, 16 times and the sum of CRP level calculated, watching agglutination, by $6\times$ number of diluting time condition. Total CRP levels were represented as mg/l.

Immunoglobin E (IgE) test

Using the human IgE ELISA kit (AMEDA Labordiagnostik GmbH Krenngasse12, 8010 Graz, Austria), total IgE levels from serum were measured quantitatively. The IgE level detection procedure was followed prudently from the supplier's user manual. Thermo Scientific Well washer and Thermo Scientific Multiskan FC were treated for wall washing and absorbance, respectively. In addition, a standard curve was developed using Microsoft Excel-2013.

Statistical analysis

Software Statistical Packages for Social Sciences (SPSS for Windows, version 20, IBM Corp, Armonk, New York, USA) was chosen for statistical analysis. Chisquare test was performed on respiratory symptoms, smoking status, amount of cigarette per day, alcohol consumption, and family history of respiratory problems and not using masks to get a significant difference between construction workers and control. On the other hand, t-tests were performed to determine the mean difference in parameters of spirometry, oximetry, and biochemical tests. The corresponding graph was developed using Microsoft Excel-13.

RESULTS

General characteristic of study subjects

General characteristic of the study subjects is presented in Table 1.

Table 1: General characteristic of study groups.

Parameters	Construction N (%) or M±SD	on Control N (%) or M±SD	P value		
\mathbf{Age}^{ϵ}	28.68±9.15	30.40±3.92	0.158		
BMI [€]	21.03±3.06	22.11±1.73	0.032*		
Education [¥]					
Uneducated	38 (76)				
Elementary school	7 (14)				
Secondary school	4 (8)				
University	1 (2)	50 (100)			
Smoking habit¥					
Yes	19 (38)	13 (26)	0.198		
No	31 (62)	37 (74)			
Alcohol taking¥	1 (2)	0 (0)	0.315		
Genetic history of lung diseases [¥]	3 (6)	7 (14)	0.203		
Protective mask use [¥]					
Yes	4 (8)	31 (62)	0.000*		
No	46 (92)	19 (38)	0.000*		
*P value is significant at <0.05 €: t_test ¥: Chi_square test					

^{*}P value is significant at <0.05. €: t-test. ¥: Chi-square test

The mean age of construction workers was 28.68±9.15 and the control group was 30.40±3.92 which means that construction workers were about same ages as like as the

control group. Unlikely, body mass index (BMI) was found significantly (p<0.05) lower in construction workers (21.03±3.06) compared to control (22.11±1.73). Most (76%) of the construction workers had no educational attachment rest 14%,8% and 2% had elementary school, secondary school, and university education respectively. Moreover, parameters, such as smoking habit, alcohol taking and genetic history of lung diseases showed congruity between the construction and control group. However, a significant (p<0.05) number of construction workers (92%) were not used to mask (Table 1).

Prevalence of respiratory symptoms

Respiratory symptoms, dyspnea (24%), coughing (30%), sneezing (40%), and discomfort of chest (18%), were significantly (p<0.05), expect conjunctivitis (22%), prevalent in construction workers (Table 2). Notably, among respiratory symptoms, higher numbers (40%) of construction workers had sneezing (Table 2). Furthermore, morning is the critical moment, when construction workers were superfluously suffering from dyspnea (10%), coughing (18%), and sneezing (26%) (Figure 1). In contrast, conjunctivitis was high at night, but feeling discomfort in chest was equally the same in morning, night, and working place (Figure 1).

Table 2: Prevalence of respiratory symptoms.

Symptoms	Construction N (%)	Control N (%)	χ^2	P value
Dyspnea	12 (24)	4 (8)	4.76	0.029*
Coughing	15 (30)	5 (10)	6.25	0.012*
Sneezing	20 (40)	5 (10)	12.00	0.001*
Discomfort of chest	9 (18)	2 (4)	5.01	0.025*
Conjunctivitis	11 (22)	12 (24)	0.06	0.812

^{*}P value is significant at < 0.05

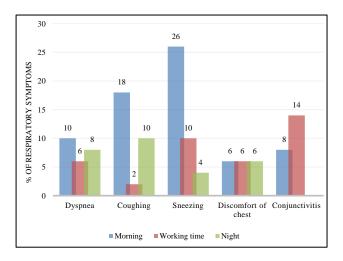


Figure 1: Respiratory symptoms according to diverse time.

Lung function parameters

The independent sample t-test for the spirometer and oximeter parameters of the construction and control group is shown in Table 3. Due to exposing to hazards at their working place, significant (p<0.05) lower level of FVC $(2.76\pm0.62),$ FEV1 $(2.49\pm0.75),$ FEV1 (79.06 ± 13.17) , PEF (7.37 ± 2.10) , PEF (%) (89.84 ± 12.24) , FEF25 (6.06 ± 1.84) and FEF2575 (3.98 ± 1.19) , except FVC (%) (72.74±15.81), FEV1/FVC (%) (91.50±9.75) and FEF75 (2.47±0.95), were obtained in construction workers as shown in Table 3. On the other hand, heart rate (84.32±14.36) was significantly (p<0.05) higher in construction worker but oxygen saturation level (97.88±1.88) was not (Table 3).

Table 3: Contrasts of spirometer and oximeter values between construction and control.

Parameters	Construction (Mean±SD)	Control (Mean±SD)	t-test	P value
FVC (L)	2.76±0.62	3.31±0.32	-5.53	0.000*
FVC (%)	72.74±15.81	77.64±9.43	-1.88	0.063
FEV1 (L)	2.49±0.75	3.12±0.30	-5.53	0.000*
FEV1 (%)	79.06±13.17	85.00±9.75	-2.56	0.012*
PEF (L/s)	7.37±2.10	9.18±1.28	-5.18	0.000*
PEF (%)	89.84±12.24	109.20±16.81	-6.58	0.000*
FEV1/FVC (%)	91.50±9.75	94.36±4.23	-1.90	0.060
FEF25 (L/s)	6.06±1.84	7.53 ± 1.34	-4.58	0.000*
FEF75 (L/s)	2.47±0.95	2.61±0.60	-0.92	0.361
FEF2575 (L/s)	3.98±1.19	4.56±0.97	-2.70	0.008*
Heart rate (BPM)	84.32±14.36	75.68±12.11	3.25	0.002*
Oxygen saturation (%)	97.88±1.88	98.26±1.10	-1.23	0.221

^{*}P value is significant at <0.05

Blood parameters

In Table 4, blood parameters such as IgE, ESR, and CRP outcomes are shown. The construction worker had significantly (p<0.05) higher level of IgE (353.57±25.41) compared to the control (142.37±29.93) as well as a higher level of ESR (17.87±5.25) relative to control (8.87±4.32). However, all individuals displayed a lower level (<6 mg) of CRP during this study, both in construction and control group (Table 4).

Table 4: Comparison of blood parameters between construction and control.

Parame	eters	Construction (Mean±SD)		t-test	P value
IgE (IU	J/ml)	353.57±25.41	117.51±22.74	-26.81	0.000*
ESR (mm/h))	17.87±5.25	8.87±4.32	5.13	0.000*
CRP (n	ng/l)	All<6	All<6		

^{*}P value is significant at <0.001

DISCUSSION

This research shows that construction workers are more likely to have respiratory problems, even having same ages with control, where most of the workers were illiterate and they were not used to smoke significantly. Our study also reveals higher numbers (92%) of workers not accustomed to face masks during their working hours that shows congruence with a research on ceramic workers in Dhaka where 68% of ceramic workers were not inclined to use personal protective equipment.¹⁸

Continuous exposure to pithy particles from construction sites can cause symptoms of respiratory disease. Respiratory symptoms including dyspnea (24%), coughing (30%), sneezing (40%), discomfort of chest (18%), and conjunctivitis (22%) were found to be substantially greater in construction workers than control. Studies carried out by Al-Neaimi et al on the cement factory found cough, phlegm, wheeze, dyspnea, sinusitis, bronchitis and asthma to be about 20%, 17%, 5%, 14%, 18%, 9% and 4% respectively. During a study of construction workers, Ranganathan showed migrant construction workers suffering from dry cough (16.8%), productive cough (23.9%), breathlessness (7%), chest congestion (3.5%), and running nose and sneezing (7%).

Spirometry is regarded as an integral component of any respiratory medical surveillance program as well as occupational respiratory diseases.¹⁹ Studies construction, flour mill, and rice mill have found the attenuated level of spirometer parameters and it is regarded that exposing to dust particles at the respective type of working places are responsible for lowering lung function in the working group. 20-22 Likely, construction workers, in this study, showed decreased levels of FVC, FEV1, FEV1 (%), PEF, PEF (%), FEF25, and FEF2575. Mariammal et al reported, for both actual and predicted value, significantly lower level of FVC, FEV1, PEFR, and FEF25-75% during the study on both construction and sanitary workers.9 Besides, another study, by Mahmood et al, on the cement factory, also pointed that the unexposed community substantially had a higher level of FEV1% and PEF.23

Inflammation is the natural response of the body to remove foreign particles. Construction workers might have inflammation, since them constantly exposed to construction hazards. This study disclosed the incremented level of IgE and ESR in construction workers compare with the control that was consent with gosh et al study, where rice mill workers had increased both IgE and ESR level.²² Purdue et al premised, inflammation in the lung may be an independent risk factor for lung cancer, as restrictive lung disease is weakly linked to tobacco.²⁴

It is obvious from our study that construction hazards cause respiratory abnormalities to some extent. However, in our study we could not measure the level and types of hazards, which would convey more risk of having respiratory abnormalities among construction workers.

CONCLUSION

This study concludes that working in construction site imposes prevalent of respiratory symptoms as well as decreased level of lung function with higher level of IgE and ESR among construction workers. The Construction Company and government should arrange awareness program to disseminate knowledge about the harmful effects of construction hazards among the construction workers. Such workers should be encouraged to use protective equipment to prevent the burden of respiratory diseases.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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