



RESEARCH ARTICLE

CORRELATION BETWEEN RESPIRATORY SYMPTOMS AND PULMONARY FUNCTION TESTS AMONG CONSTRUCTION WORKERS- A CROSS SECTIONAL SURVEY ACROSS GUJARAT, INDIA

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Manuscript Info

Manuscript History

Received: 22 December 2019

Final Accepted: 25 January 2020

Published: February 2020

Key words:-

Construction Workers, Pulmonary Function Tests, Respiratory Symptoms, St. George Respiratory Questionnaire

Abstract

Background: Construction workers are exposed to multiple risks at working and living places. They are at an increased risk of exposure to high levels of respirable dust, ultimately leading to pulmonary hazards. Currently, there is very limited data on prevalence of morbidities such as musculoskeletal, neurological and respiratory disorders among construction workers in developing countries like India. Purpose of the study was to determine the correlation between respiratory symptoms and pulmonary function tests in construction workers of Gujarat.

Methods: In this cross sectional survey, 457 full time workers construction workers above 20 years, having complaints of respiratory symptoms such as cough, dyspnea, phlegm, chest tightness etc. and having work experience more than 2 years were included. Individuals who were unable to cooperate or unwilling to participate, having BMI > 25 kg/m² or had any pre-existing respiratory or cardiac morbidities were excluded. Demographic details including age, gender, BMI, working experience, working hours per day, literacy, marital status, type of work, native state, addiction, use of personal protective equipment, were also documented. Respiratory symptoms were then correlated with parameters of pulmonary function tests.

Results: A statistically significant and strong negative correlation was found between observed FEV1/ FVC% and the total score of SGRQ ($r=-0.90$, $p=0.01$).

Conclusion: Construction workers reported respiratory symptoms, which significantly correlated with pulmonary function tests suggesting impaired lung function.

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Introduction:-

The World Health Organization (WHO) has envisioned 'Health' as a fundamental right of all citizens that is inclusive of accident prevention and promotion of working conditions in work places. Occupational lung diseases form the majority of the work related morbidity in India, mainly in the form of occupational asthma and Chronic Obstructive Pulmonary Disease (COPD) followed by occupational cancers, cardiovascular diseases, reproductive disorders, neurotoxicity and skin disorders.¹ Based on the sample survey conducted by National Sample Survey Organization (NSSO) in 2011-12, about 5.02 crore workers are employed in construction activities in India and construction workers constitute one of the largest categories of workers in the unorganized sector.²

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Construction workers are exposed to multiple risks at working and living places. They are exposed to physical, chemical, biological, ergonomic hazards and environmental and psychosocial risks. In conjunction with this, respiratory morbidities also comprise another serious health risk in construction workers, due to inhalation of respirable dust mainly. It is widely accepted that construction workers are exposed to pulmonary hazards that produce a variety of symptoms including cough, dyspnea and phlegm. Tasks such as abrasive blasting, emptying bags of cement, cutting wood and masonry, painting, gluing, cleaning with solvents, grinding, polishing, welding, and using diesel-powered heavy equipments like jack-hammering, drilling, sawing, cutting are likely to cause exposure to high levels of respirable dust, ultimately leading to pulmonary hazards.³ Diseases of the lungs and the airways are often manifested by one or more symptoms that can be easily recognized. Thus, the presence of a particular symptom or a group of symptoms can confirm the presence of an underlying disease in the upper or lower airways. There has been major research in the dusty occupations like agriculture, poultry, asbestos industry, quarry, mining but in India very few have been conducted in construction. Due to reasons not known, this sector has been grossly ignored in research. Currently, there is very limited data on prevalence of morbidities such as musculoskeletal, neurological and respiratory disorders among construction workers in developing countries like India. Thus, the purpose of the study was to determine the correlation between respiratory symptoms and pulmonary function tests in construction workers of Gujarat.

Materials and Methods:-

A cross sectional study was conducted over a period of 3 years among construction workers at various sites across different regions of Gujarat state. Study was approved by Medilink Ethics Committee (ECR/344/Inst/GJ/2013/RR-16), as a part of a bigger study. The study was conducted on a sample of 457 participants through simple random sampling, including both males and females. Those above 20 years of age, complaining of respiratory symptoms such as cough, dyspnea, phlegm, chest tightness etc. and those who were full time workers, having work experience more than 2 years were included. Individuals who were unable to cooperate or unwilling to participate, having BMI > 25 kg/m², or had any pre-existing respiratory or cardiac morbidities were excluded. Those with history of trauma, pre-existing medical conditions like diabetes, hypertension, stroke etc. or any obvious musculoskeletal deformities like scoliosis, genu valgum etc. or with history of chest trauma, previous pulmonary surgery or on medications for pulmonary diseases were also excluded. Hence, those participants fulfilling the inclusion and exclusion criteria were recruited only from the 20 work sites. Nature and purpose of the study was explained and written informed consent was obtained in their understandable language. Thumb impression was obtained from illiterates after being explained.

Participants were interviewed and assessed by the principal investigator and were then assessed for the outcome measures, in a personal interview which lasted for 30-40 minutes. Details like age, gender, BMI, working experience, working hours per day, literacy, marital status, type of work, native state, addiction, use of personal protective equipment, were also documented. Initial phase of study interviewed the participants for respiratory symptoms with the use of Hindi and Gujarati version of St. George Respiratory Questionnaire (SGRQ). Those found affected with respiratory symptoms on St. George Respiratory Questionnaire (SGRQ) with a total score > 25, were then assessed for pulmonary function tests with the use of Helios 401 (RMS), a portable PC based spirometer having USB powered system in the later phase. All the tests were demonstrated by the principal investigator before the participants were asked to perform. During the test, adult nose clips were used to prevent air escaping through the nose and disposable mouthpieces were used during all the procedures. Patients were advised not to smoke for at least one hour before testing, not to eat a large meal two hours before testing and not to wear tight fitting clothing as under these circumstances results may be adversely affected. The participants performed pulmonary function tests three times in the sitting position with sufficient rest between repetitions. The best values from all three measurements were then recorded for all lung function parameters.

St. George Respiratory Questionnaire (SGRQ) is a disease-specific instrument designed to measure impact on overall health, daily life, and perceived well-being in patients with obstructive airways disease, and consists of 50 items and two parts (3 components). This questionnaire has been widely used in the general population, different industrial workers and patients with respiratory diseases.⁴ The symptom component (Part 1) has eight items concerning frequency and severity of respiratory symptoms. Part 2 consisting of the activity component has questions that identify physical activities that either lead to, or are limited by, breathlessness. The impact component of Part 2, has 26 questions related to different aspects of social functioning and psychological disturbances resulting from airway disease. A total score is calculated that summarizes the impact on overall respiratory health status. The score is expressed as a percentage of impairment where 100 represents the worst possible respiratory health status

and 0 indicates the best possible respiratory health status. The SGRQ is available in English, Gujarati and Hindi. The internal consistency as assessed using Cronbach's α was > 0.70 for all components, while the intra-class correlations was found to be 0.79 to 0.90.⁵ Helios 401 (RMS) which is a portable PC based spirometer having USB powered system with advanced software, was used. It provides all the details of pulmonary function tests with multiple features including ethnic corrections and Indian predicted equations. Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC), FEV1/FVC Ratio (FEV1/FVC %), FEF25-75% and Maximum Voluntary Ventilation (MVV) were determined.

IBM SPSS version 20.0 and SGRQ calculator were used for analysis and significance level was assigned at 5%. Descriptive statistics were obtained for age, gender, BMI and other measures assessed in self-structured survey questionnaire. Normal distribution was checked using histograms and KS test, and appropriate test of correlation analysis was then applied.

Results:-

Out of the 457 construction workers, 316 were males and 141 were females, among which 208 were married whereas 166 were unmarried/ single and 83 were divorced. Mean age, BMI, work experience in years and working hours per day are shown in table 1. Figure 1 shows the distribution of participants based on their work profile.

Table 1:- Descriptive statistics of demographics.

Variable	Mean $\pm$ SD
Age	37.02 $\pm$ 1.14
BMI	19.93 $\pm$ 3.07
Working experience	10.2 $\pm$ 2.1
Working hours per day	8.5 $\pm$ 2.2

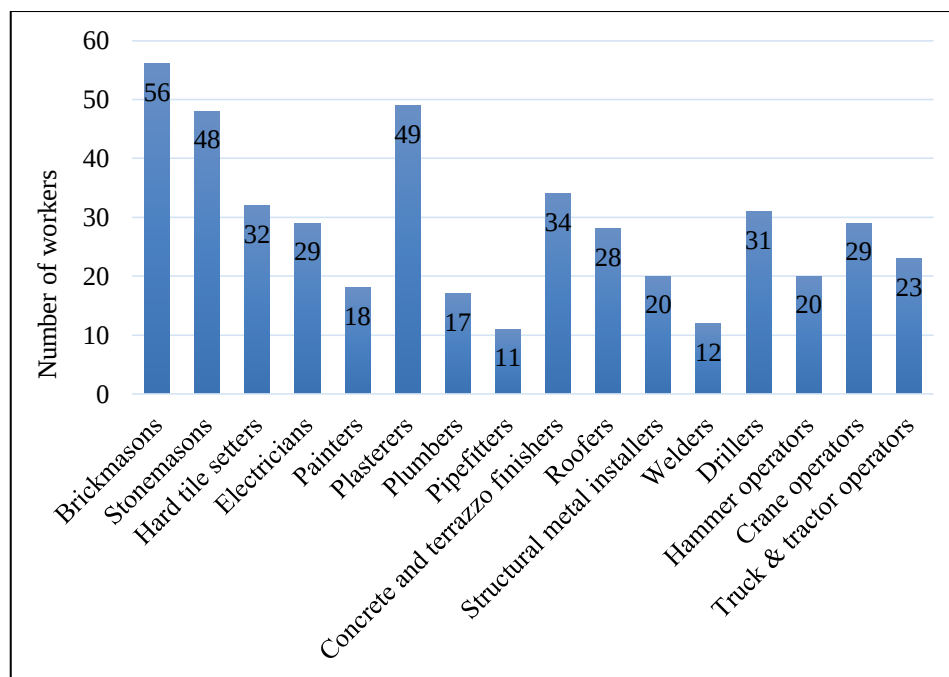


Figure 1:- Stratification of workers according to their work profile.

Table 2 shows the mean and standard deviation, along with 95% confidence interval for each subscale as well as total score of SGRQ. 49% workers had frequency of cough on most of the days a week, 39% workers reported cough complains several days a week. 3% of the workers had cough only for few days a month while only 1.7% workers with chest infection complained of cough symptoms. 5% of the workers did not have any such complains.

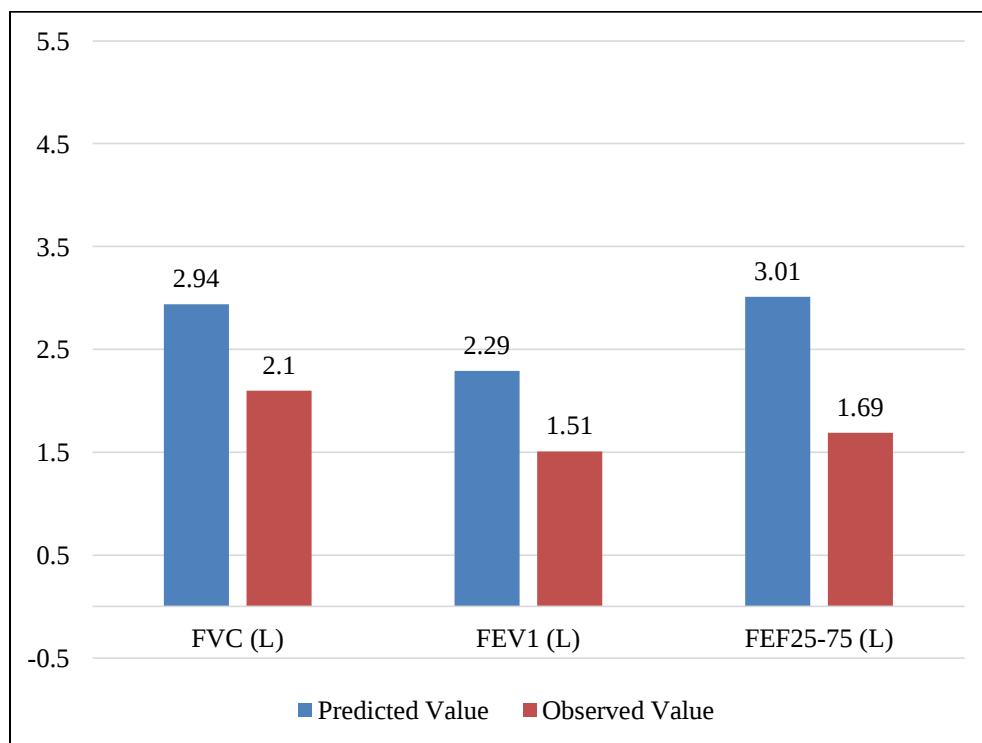
Table 2:- Descriptive statistics of SGRQ.

Variable	Mean	SD	95% CI
Symptom	79.5	1.7	77.9- 81.1
Activity	33.7	7.4	32.07- 34.4
Impact	31.5	1.04	30.5- 32.5
Total	40.2	8.3	38.4- 42.9

Table 3 shows the mean and standard deviation, along with 95% confidence interval for various parameters of Pulmonary Function Tests done among the participants. Figure 3 depicts the comparison of observed and predicted values of FEV1 (L), FVC(L) and FEF25-75 (L). Figure 4 demonstrate the comparison of observed and predicted values of MVV (L/min) and FEV1/FVC % Ratio.

Table 3:- Descriptive statistics of Pulmonary Function Tests.

Parameter	Predicted Values (Mean $\pm$ SD)	95% CI	Observed Values (Mean $\pm$ SD)	95% CI
FVC (L)	2.73 $\pm$ 0.44	2.59- 2.97	1.76 $\pm$ 0.74	1.38- 1.92
FEV1 (L)	2.29 $\pm$ 0.41	2.15- 2.42	1.7 $\pm$ 0.72	1.32- 1.86
FEV1/ FVC % Ratio	77.79 $\pm$ 3.68	74.4- 79.1	71.93 $\pm$ 3.62	70.4- 74.4
FEF25-75 (L)	3.00 $\pm$ 0.77	2.72- 3.1	1.70 $\pm$ 1.01	1.6- 1.8
MVV (L/min)	112.66 $\pm$ 16.84	110.9- 114	37.24 $\pm$ 3.1	34.4- 39.9

**Figure 3:-** Comparison of observed and predicted values of FEV1 (L), FVC (L) and FEF 25-75% (L).

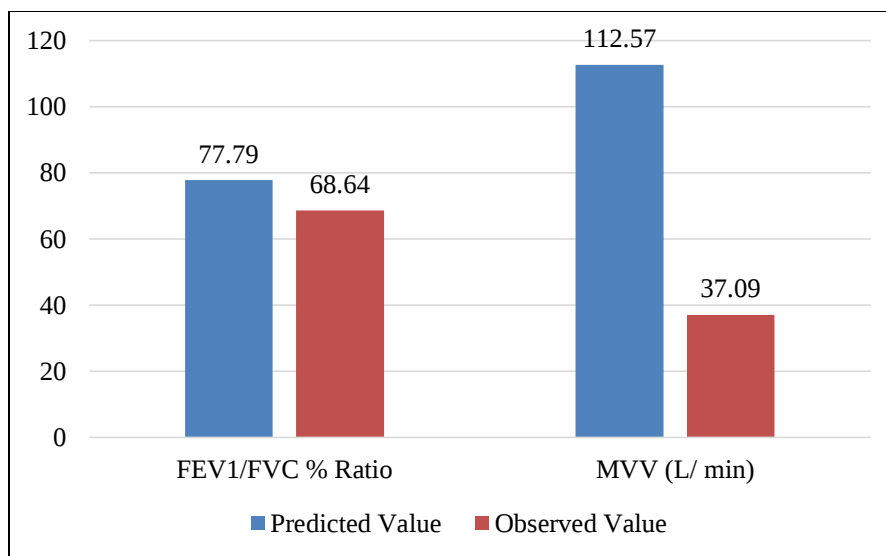


Figure 4:- Comparison of observed and predicted values of MVV (L/ min) and FEV1/ FVC % Ratio.

Pearson's test of correlation was applied to find the correlation between SGRQ and parameters of Pulmonary Function Tests. Table 4 shows the details of correlational analysis such as correlation coefficients and p-values.

Table 4:- Correlational analysis of SGRQ with.

No.	SGRQ	Age	
		r	p
1.	FEV1 (L)	-0.04	0.31
2.	FVC (L)	-0.20*	<0.01
3.	FEV1/ FVC%	0.91*	<0.01
4.	FEF25-75% (L)	-0.10*	0.03
5.	MVV(L/min)	-0.095*	0.04

*Significant at level of significance 0.05

Discussion:-

In the present study, construction workers were by found to have respiratory symptoms in the form of 49% workers having frequency of cough on most of the days a week, 39% workers reported cough complains several days a week. 3% of the workers had cough only for few days a month while only 1.7% workers with chest infection complained of cough symptoms. 5% of the workers did not have any such complains. Also, these symptoms determined using SGRQ showed a significant correlation with FEV1/ FVC %.

These above findings of respiratory symptoms are consistent with the findings of a previous study done by Banerjee et al.⁶ A decline in pulmonary function parameters of the workers was also noted, with observed mean value of FEV1(L/min) as 1.7 ± 0.72 while observed mean value of FVC (L/min) as 1.76 ± 0.74 . The observed mean value of FEV1/ FVC % (L/min) was noted as 71.93 ± 3.62 while that of observed mean value of FEF25-75(L/min) and observed mean value of mean MVV (L/min) was found out to be 1.70 ± 1.01 and 37.24 ± 3.1 respectively. Spirometry was used as an objective measure of lung function to compare with the respiratory questionnaire as it has an added advantage of identifying impaired lung function among those who do not have manifest symptoms and it may not be possible to capture such impairment by use of questionnaire alone.

Another significant finding in the current study was that a statistically significant and negative correlation was found between observed FEV1/ FVC % and the total score of SGRQ ($r=-0.91$, $p<0.01$). Also a weak negative correlation was noticed between the total score of SGRQ and FEF25-75 (L) with $r= -0.10$ ($p=0.03$) and MVV(L/min) with $r= -0.095$ ($p=0.04$). These above correlations of respiratory symptoms and pulmonary function tests of the workers are suggestive that both, subjective tool of measuring respiratory symptom i.e. SGRQ, and objective tool of measuring pulmonary function, i.e. PFT, correlated significantly. Similar to this finding, Aweto H. et al⁷ concluded that the

FVC, FEV1, FEV1/FVC ratio, and PEFR were significantly reduced in the cement-exposed group compared to the unexposed group implying that the pulmonary capacities and functions of the cement factory workers were more compromised than that of unexposed workers. The study has a few limitations. Although SGRQ used for assessing respiratory symptoms is a valid and reliable tool to assess respiratory morbidity, like any other self-reported measure it is still prone to recall bias. Confounding factors such as smoking which could affect the respiratory status were not included in this study, and future studies including the same can be undertaken.

Conclusion:-

Construction workers reported respiratory symptoms, which significantly correlated with pulmonary function tests suggesting impaired lung function. There is a need to detect early signs of any risk and/or illness on such workers so that the sustained intervention actions should be taken to reduce incidents and prevent permanent health damage of work-related sicknesses due to construction works.

Financial support & sponsorship:

None.

Declaration of interest:

Authors declare no conflict of interest.

References:-

1. List of Occupational Diseases (Revised 2010); Identification and recognition of occupational diseases: Criteria for incorporating diseases in the ILO list of occupational diseases. pg. 7
2. Annual report (2018- 19), Ministry of Labour& Employment, Government of India.
3. Borup H et al. Systematic review: chronic obstructive pulmonary disease and construction workers. *Occupational Medicine* 2017; 67:199–204.
4. Jones PW, Quirk FH, Baveystock CM. The St George's respiratory questionnaire. *Respir Med* 1991;85(Suppl B):25–31. doi:10.1016/S0954-6111(06)80166-6
5. AshutoshAggrawal et al. Validation of hindi translation of St. George Respiratory Questionnaire in Indian Patients with Chronic Obstructive Pulmonary Disease. *Indian J Chest Dis Allied Sci* 2007, 49: 87- 92
6. Banerjee et al. Dermatological and respiratory problems in migrant construction workers of Udupi, Karnataka. *Indian J Occup Environ Med* 2015; 19:125-8
7. Aweto HA, et al. Work-related respiratory symptoms and cardiopulmonary function impairment of factory workers in a cement company in South-West Nigeria. *Afr J Med Health Sci* 2018;17: 47-53.