

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Comparative Study Of Assessment Of Pulmonary Function Tests In Sugarcane Workers.

CL Shinde¹, and Mohit Manik Malge^{2*}.

¹Assistant Professor, Department of Physiology, Dr. Vitthalrao Vikhe Patil Medical College Ahmednagar, Maharashtra, India.

²Associate Professor, Department of Physiology, FH Medical College and hospital, Etamdapur, Agra, Uttar Pradesh, India.

ABSTRACT

Sugarcane workers are often exposed to airborne dust, plant residues, and chemicals that may negatively affect their pulmonary function. This study aimed to compare the pulmonary function of sugarcane workers with non-exposed individuals using pulmonary function tests (PFTs). A cross-sectional comparative study was conducted over one year, involving 80 participants (40 sugarcane workers and 40 controls). Pulmonary function tests, including forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and FEV₁/FVC ratio, were measured using spirometry. Statistical analysis was performed using the unpaired t-test to compare the groups, with a p-value < 0.05 considered significant. Sugarcane workers exhibited significantly lower FVC (2.8 ± 0.5 L) and FEV₁ (2.1 ± 0.4 L) compared to the control group (FVC: 3.2 ± 0.4 L, FEV₁: 2.7 ± 0.3 L), with p-values of 0.02 and 0.01, respectively. The FEV₁/FVC ratio was also reduced (75% vs. 85%, p=0.03). A higher prevalence of respiratory symptoms, including chronic cough and shortness of breath, was noted in sugarcane workers. Sugarcane workers show a decline in pulmonary function, likely due to occupational exposure. Regular screening and protective measures are recommended to prevent long-term respiratory impairment.

Keywords: Pulmonary function, Sugarcane workers, Occupational exposure

<https://doi.org/10.33887/rjpbcs/2024.15.4.47>

**Corresponding author*

INTRODUCTION

The sugarcane industry is one of the largest agricultural sectors, employing millions worldwide, particularly in developing countries [1]. Despite its economic importance, sugarcane cultivation and processing expose workers to various occupational hazards, including respiratory issues caused by airborne dust, plant residues, and chemicals. Prolonged exposure to such irritants can impair lung function, leading to chronic respiratory disorders such as bronchitis, asthma, and chronic obstructive pulmonary disease (COPD). Pulmonary function tests (PFTs) are essential tools in assessing respiratory health, measuring vital parameters like forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) [2, 3].

This comparative study aims to evaluate the pulmonary function of sugarcane workers by conducting PFTs and comparing the results with non-exposed individuals. The study hypothesizes that sugarcane workers are at an increased risk of developing respiratory impairments due to their prolonged exposure to environmental pollutants. Identifying these risks through PFTs can provide valuable insights into occupational health challenges and inform preventative strategies to protect workers from long-term health consequences. The study's findings may contribute to better workplace safety regulations and the implementation of effective interventions to mitigate respiratory hazards in the sugarcane industry [4, 5].

STUDY METHODOLOGY

The present study was a cross-sectional comparative analysis conducted over a period of one year at Department of Physiology at Ahmednagar Medical College. Our study population comprised 80 participants, divided into two groups: 40 sugarcane workers and 40 individuals with no exposure to the sugarcane industry, serving as the control group.

The sugarcane workers were selected from various plantations, ensuring they had been employed in the industry for at least five years. The control group was matched for age, gender, and socio-economic background to eliminate confounding variables. Informed consent was obtained from all participants prior to their inclusion in the study.

Pulmonary function tests (PFTs) were performed on all participants using a spirometer to measure key respiratory parameters, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the FEV1/FVC ratio. The tests were conducted in accordance with standardized guidelines, ensuring accurate and reliable measurements. Each participant was assessed in a controlled environment to avoid any external factors influencing the results. Additionally, detailed questionnaires were administered to gather information on smoking habits, respiratory symptoms, and occupational exposure.

The data collected from the PFTs were then analyzed to compare the pulmonary function of sugarcane workers with that of the control group. Statistical analysis was performed using appropriate tests such as the unpaired t-test to determine the significance of differences between the groups. The analysis focused on detecting any decline in pulmonary function among sugarcane workers compared to the control group, with a p-value of less than 0.05 considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of the Study Population

Characteristic	Sugarcane Workers (n=40)	Control Group (n=40)	p-value
Age (mean \pm SD)	42.6 \pm 7.5 years	43.1 \pm 6.8 years	0.68
Gender (Male/Female)	28/12	29/11	0.82
Smoking History (%)	22 (55%)	18 (45%)	0.39
Duration of Exposure (years)	8.2 \pm 2.5 years	N/A	N/A

Table 2: Comparison of Pulmonary Function Test Results between Sugarcane Workers and Control Group

Parameter	Sugarcane Workers (Mean ± SD)	Control Group (Mean ± SD)	p-value
FVC (L)	2.8 ± 0.5	3.2 ± 0.4	0.02
FEV1 (L)	2.1 ± 0.4	2.7 ± 0.3	0.01
FEV1/FVC Ratio (%)	75 ± 6	85 ± 5	0.03
Peak Expiratory Flow (L/s)	5.6 ± 1.2	6.4 ± 1.1	0.05

Table 3: Prevalence of Respiratory Symptoms among Sugarcane Workers and Control Group

Symptom	Sugarcane Workers (n=40)	Control Group (n=40)	p-value
Chronic Cough (%)	16 (40%)	6 (15%)	0.01
Shortness of Breath (%)	12 (30%)	4 (10%)	0.03
Wheezing (%)	10 (25%)	3 (7.5%)	0.02
Chest Tightness (%)	14 (35%)	5 (12.5%)	0.02

Table 4: Comparison of Pulmonary Function in Smokers vs. Non-Smokers among Sugarcane Workers

Parameter	Smokers (n=22)	Non-Smokers (n=18)	p-value
FVC (L)	2.5 ± 0.4	3.0 ± 0.5	0.03
FEV1 (L)	1.9 ± 0.3	2.3 ± 0.4	0.04
FEV1/FVC Ratio (%)	73 ± 5	78 ± 6	0.05

DISCUSSION

The findings of our study provide significant insight into the pulmonary health of sugarcane workers compared to a control group, indicating that occupational exposure to dust and other environmental factors associated with sugarcane farming can negatively impact lung function. Pulmonary function tests (PFTs), including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio, showed marked differences between sugarcane workers and individuals not exposed to such occupational hazards. These results are consistent with other studies that have demonstrated respiratory impairments among workers in agriculture and similar industries [6].

The demographic characteristics of the study population, as summarized in Table 1, reveal that the two groups were similar in terms of age, gender distribution, and smoking history. The similarity in these variables is crucial, as it minimizes confounding factors that could otherwise influence the results. The comparable age and gender distribution across the groups indicates that the observed differences in pulmonary function are more likely attributable to occupational exposure rather than demographic factors [7, 8].

While smoking history was slightly more prevalent among sugarcane workers (55%) compared to the control group (45%), the difference was not statistically significant. This suggests that the impact of occupational exposure on lung function in sugarcane workers is distinct from the effects of smoking, although the influence of smoking on respiratory health remains a relevant factor. Further analysis of the results, as seen in Table 4, highlights the exacerbation of respiratory impairments among smokers within the sugarcane worker population, which is discussed later in the section [9].

Table 2 presents a clear distinction between the pulmonary function of sugarcane workers and the control group. The sugarcane workers exhibited lower values for all key parameters, including FVC, FEV1, and the FEV1/FVC ratio, with statistically significant differences observed in each. The reduced FVC and FEV1 values suggest a restrictive and obstructive pattern of lung impairment among sugarcane workers, which could be attributed to long-term exposure to dust, particulate matter, and chemical residues in their work environment.

The average FVC for sugarcane workers was 2.8 L, significantly lower than the control group's average of 3.2 L ($p=0.02$). This reduction in FVC points to a restrictive ventilatory defect, which may indicate reduced lung expansion due to fibrosis or other chronic lung diseases linked to occupational exposure. Similarly, FEV1 was significantly reduced among sugarcane workers (2.1 L) compared to the control group (2.7 L), suggesting an obstructive airway condition commonly associated with exposure to dust and other airborne irritants.

The FEV1/FVC ratio, which is an essential measure for diagnosing obstructive lung diseases, was also lower in sugarcane workers (75%) than in the control group (85%). This lower ratio further suggests that sugarcane workers are at a heightened risk of developing obstructive lung conditions, including chronic bronchitis and chronic obstructive pulmonary disease (COPD). The results are consistent with previous studies showing that agricultural workers, particularly those involved in sugarcane harvesting, often experience a decline in lung function due to the inhalation of fine particulate matter.

The results from Table 3 highlight the prevalence of respiratory symptoms among sugarcane workers, which were significantly higher compared to the control group. Chronic cough, shortness of breath, wheezing, and chest tightness were more frequently reported by sugarcane workers, with statistically significant differences in all categories. For example, 40% of sugarcane workers reported chronic cough, compared to just 15% of the control group ($p=0.01$), and 30% reported shortness of breath, compared to 10% of the control group ($p=0.03$). These symptoms correlate with the reduced lung function observed in the PFTs and further support the conclusion that occupational exposure is detrimental to respiratory health.

The high prevalence of respiratory symptoms among sugarcane workers underscores the need for improved workplace safety measures. The chronic cough, likely a result of chronic irritation from dust inhalation, may evolve into more severe respiratory conditions if preventive measures are not taken. Furthermore, the increased prevalence of wheezing and chest tightness suggests that many sugarcane workers may be experiencing airway inflammation and narrowing, conditions often seen in asthma or bronchitis. These findings align with similar studies conducted in agricultural settings, where exposure to organic and inorganic dust has been shown to increase the risk of respiratory illness.

As seen in Table 4, the impact of smoking on lung function among sugarcane workers is significant, with smokers demonstrating even lower PFT values than non-smokers. The FVC and FEV1 were both notably reduced among smokers, with values of 2.5 L and 1.9 L, respectively, compared to 3.0 L and 2.3 L among non-smokers. This highlights the compounding effect of smoking on already compromised respiratory function due to occupational exposure.

The FEV1/FVC ratio was also lower in smokers (73%) compared to non-smokers (78%), indicating that smoking exacerbates the obstructive nature of lung impairments. This finding suggests that sugarcane workers who smoke are at an even higher risk of developing chronic respiratory diseases, further highlighting the need for smoking cessation programs in this population. It is well-established that smoking increases the risk of COPD and other respiratory disorders, and when combined with occupational exposure to dust, the risk is likely to increase substantially.

The findings from this study have important implications for occupational health, particularly in agricultural industries like sugarcane farming, where workers are exposed to hazardous environmental conditions. The significant decline in lung function among sugarcane workers, as well as the high prevalence of respiratory symptoms, underscores the need for stricter regulations and better protective measures in the workplace.

Regular health check-ups, including pulmonary function testing, should be mandatory for sugarcane workers to detect early signs of respiratory impairment. Additionally, providing workers with appropriate personal protective equipment (PPE), such as masks or respirators, may help reduce the inhalation of dust and other airborne irritants. Public health initiatives aimed at reducing smoking among sugarcane workers could also be beneficial in mitigating the combined effects of occupational exposure and smoking on lung function.

CONCLUSION

In conclusion, this study provides compelling evidence that sugarcane workers are at increased risk for both restrictive and obstructive lung diseases due to prolonged occupational exposure. The significant reduction in PFT values and the high prevalence of respiratory symptoms call for immediate interventions to improve working conditions and safeguard the respiratory health of sugarcane workers. Future studies should continue to explore the long-term effects of such occupational exposures and assess the efficacy of protective measures in preventing respiratory diseases in this vulnerable population.

REFERENCES

- [1] Viswanathan R, De Monte AJH, Shivpuri, DN& Venkitasubramoni TA. Bagassosis- A study of pulmonary function. *Ind J Med Res* 1963; 51: 563 – 693.
- [2] Nair KV and Das KV. Bagassosis. A case report. *Jr Ass Physc India* 1970;18(6): 573- 75. 10.
- [3] Patil SN, Somade PM, Joshi AG. Pulmonary function tests in sugar factory workers of Western Maharashtra (India). *J Basic Clin Physiol Pharmacol* 2008; 19(2):159-66. 11.
- [4] Miller GJ. and Hearn CED. Pulmonary function at rest and during exercise following bagassosis. *British Journal of Industrial Medicine* 1971; 28: 152-158.
- [5] Kishor Jugal. Designing questionnaire for occupational and environmental studies. *Ind J of Occup & Environ Med* 2000; 4:183-90
- [6] Govan ADT. Respiratory System, In: Alasdair D. T. Govan, Peter S. Macfarlane, Robin Callander, eds. *Pathology illustrated*, 4 edition, Singapore: ELBS with Churchill Livingstone, Singapore Publishers Pvt Ltd 1994:342.
- [7] Ganong FW. Respiratory adjustments in health and disease, In:William F Ganong, *Review of Medical Physiology*. 22 editions, Singapore: McGraw –Hill; 2005:688.
- [8] Vishwanath P. Kurup. Farmers lung and related hypersensitivity pneumonitis. *Indian J Chest Dis Alli-Sci* 1984;26 (4):242-255.
- [9] Virendra Singh JN. Pande GC. Khilnani. Tests for ventilatory function, In: PS. Shankar, *Pulmonary function tests in health and disease*, 1 edition. Indian College of Physicians 1998;39: 46-59.