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Physiology

A COMPARATIVE CROSS-SECTIONAL STUDY TO ASSESS MAXIMUM VOLUNTARY VENTILATION (MVV) AND DYSPNOEIC INDEX (DI) OF SWEEPERS AND NON - SWEEPERS INVOLVED IN SWACHH BHARAT ABHIYAN IN INDORE CITY.

Dr. Preeti Shah Bhandari*	Post Graduate Resident III Year Department of Physiology, M.G.M. MEDICAL COLLEGE, INDORE M.P*Corresponding Author
Dr. Vesti Randa	Associate Professor Department of Physiology, M.G.M. MEDICAL COLLEGE, INDORE M.P
Dr. Sunita Solanki	Associate Professor Department of Physiology, M.G.M. MEDICAL COLLEGE, INDORE M.P.
Dr. Ravi Dosi	Associate Professor Department of Pulmonary Medicine and Critical Care, Shri Aurobindo Institute of Medical Sciences, Indore M.P
Dr. S.S. Makode	Demonstrator, Department of Physiology, M.G.M. MEDICAL COLLEGE, INDORE M.P.
Dr. Chhaya Bohare	Post Graduate Resident Department of Community Medicine, M.G.M. MEDICAL COLLEGE, INDORE M.P.
Dr. V.P. Goswami	Assistance Professor Department of Community Medicine, M.G.M. MEDICAL COLLEGE, INDORE M.P.

ABSTRACT This study is a cross sectional study designed to evaluate Pulmonary Function Tests (PFT) focused to evaluate Maximum Voluntary Ventilation (MVV) and Dyspneic Index (DI) in the sweepers and non-sweepers involved in 'Swachh Bharat Abhiyan in Indore City'. It is a study in which after screening of exclusion and inclusion criteria and after taking consent, samples are taken for two groups which includes 91 sweepers and 121 non-sweepers by arranging 4 camps in Nagar Nigam, Indore placed in Rajwada. Conclusion of this study shows that occupational exposure of dust has impact on lungs of sweepers of Nagar Nigam Indore, because all sweepers are diagnosed for having Obstructive Lung Diseases and in sweepers there is significant low value of Maximum Voluntary Ventilation (MVV) and their Dyspneic Index (DI) is on border line for manifesting dyspnoea, as compared to non-sweepers of Nagar Nigam Indore. Both groups are working minimum of at least 1 year in Nagar nigam Indore.

KEYWORDS : Pulmonary Function Tests (PFT), Maximum Voluntary Ventilation (MVV), Dyspneic Index (DI), Swachh Bharat Abhiyan, Obstructive Lung Diseases.

INTRODUCTION

In terms of total population, India is the second-largest nation in the world. India's government has a very challenging task ahead of it: managing this enormously diverse population while maintaining cleanliness. In this regard the Indian government is working hard for cleaning India and trying to make people aware in creating clean environment in the country. India has a made remarkable progress since its independence. It has come a long way on the path of development. Mahatma Gandhi led India's fight for independence as well as on cleanliness.

This study was designed to evaluate the Maximum Voluntary Ventilation (MVV) and Dyspneic Index (DI) in sweepers and non-sweepers which are involved in 'Swachh Bharat Abhiyan in Nagar Nigam Indore City'.

Service Providers of these are playing a major role in keeping the city clean and thereby supporting in winning various prestigious awards.There is exposure of service providers to a variety of pollutants, including soil, dust, bioaerosols with biological origins like pollen, and organic components from plants, which puts them at risk for occupational lung diseases. These service providers work in day and night shift as per government works schedule. That's why I am worried about all our service providers.

In this study honestly, I am trying to find out this temporal association between exposure of dust to worker and manifestations of symptoms, the burden of morbidity of occupational health diseases in this society and also try to find out the severity and the type of lung diseases which they having or may prone to be suffered.

My study is the only study that offers employee's details on potentially harmful agents in their working environment as well as efficacy in personal protective equipment which they are using.

MATERIAL AND METHODS

It is a cross-sectional comparative analytical study of service providers involved in Swachh Bharat Abhiyan in Nagar Nigam, Indore city. After screening of exclusion and inclusion criteria and after taking consent, I have arranged, 4 camps in Main workshop of Nagar Nigam Indore.

I have made two comparative study groups which include 91 sweepers and 121 non-sweepers. Then I have taken anthropometric measurements and physiological variables of all study subjects.Height, Weight, BMI, Blood Pressure, Respiratory rate, Pulse, Temperature and Oxygen saturation by appropriate tools. I have assessed lung functions using RMS Helios 401 Computerized Spirometer and thus determined all the PFT parameters including MVV and from these calculate RMV, BR and DI of sweepers and non-sweepers.

Personal information Data assessment, History taking, General and systemic examination was done to rule out the presence of any illness and detecting illness regarding to cardiovascular disease or respiratory disease. In procedure, after explaining with video and giving demonstration for procedure of PFT, PFT was done in sitting comfortable position on stool. Each test is repeated 3 times, from there the reading with maximum values is taken of MVV and RMV and from these calculate BR and then DI.

I have included in this: Service providers involved in Swachh Bharat Abhiyan of District Indore, doing work for minimum of past 1 year, giving written consent, Age group up to retirement which is 62 years irrespective of sex.

I have excluded in this: Subjects which are not fit in inclusion criteria and Smokers of long duration. Patient Suffering with: Acute Disorders Affecting Test Performance: Nausea, Vomiting, Vertigo. All case of respiratory system required admission, all cases having major surgeries within past 3 months, Acute infective cases, Upper

Respiratory Tract Infection (URTI) for past 15 days, recent MI, Cardiovascular emergencies and bleeding disorders.

RATIONALE

1. Our interest in this study is because Indore has leading role and has won awards for consecutive six years in Swachh Bharat Abhiyan.

2.Service providers of this Abhiyan are exposed to excessive atmospheric pollutants. Hence this study is undertaken to determine their lung functions status as we are worried about their health which mainly involves lung.

3.If Lung Functions will prove to be affected then we will give them proper prevention and treatment at early stage.

AIMS AND OBJECTIVE

Primary Objective-

To determine the Maximum Voluntary Ventilation (MVV) and Dyspneic Index (DI) of Sweepers and Non-Sweepers involved in 'Swachh Bharat Abhiyan in Nagar Nigam, Indore City'.

Secondary Objective-

1.To determine whether dust has an impact on lung functions i.e. on Maximum Voluntary Ventilation (MVV) and Dyspneic Index (DI) of sweepers, involved in Swachh Bharat Abhiyan in Nagar Nigam Indore.

2.If sweepers are proved to be affected of their Pulmonary Function Test (PFT) of Maximum Voluntary Ventilation (MVV) and Dyspneic Index (DI) then we can prevent further deterioration of their lung by early detection and early diagnosis, then suggesting preventive measures and giving proper treatment as earliest as possible.

TABLE- 1. ASSOCIATION BETWEEN SWEEPERS AND NON-SWEEPERS OF AGE, SEX AND SOCIOECONOMIC STATUS

Variable	Category	N	Mean	Std. Deviation	T Test	P Value	Result
BMI (kg/m²)	Sweeper	91	24.32	4.995	0.63	0.527	Non Sig
	Non-Sweeper	121	23.91	4.395			
Pulse (Beats/min)	Sweeper	91	83.18	10.636	-0.49	0.618	Non Sig
	Non-Sweeper	121	83.91	10.546			
RR (Per min)	Sweeper	91	15.6	0.728	1.48	0.139	Non Sig
	Non-Sweeper	121	15.45	0.795			
Temp (Degree Centigrade)	Sweeper	91	36.5	0.312	1.66	0.098	Non Sig
SBP mm of Hg	Sweeper	91	116.1	13.75	-1.21	0.225	Non Sig
	Non-Sweeper	121	118.5	14.695			
DBP mm of Hg	Sweeper	91	71.05	9.13	-0.63	0.529	Non Sig
	Non-Sweeper	121	71.9	10.051			
	Non-Sweeper	121	3.49	1.514			
MVV Lit/Min	Sweeper	91	76.51	27.623	-6.46	0	Sig
	Non-Sweeper	121	105.2	34.989			
RMV (in Lit/ Min)	Sweeper	91	7.8	0.364	1.48	0.139	Non Sig
	Non-Sweeper	121	7.72	0.398			
BR	Sweeper	91	68.71	27.632	-6.48	0	Sig
	Non-Sweeper	121	97.53	35.005			
DI	Sweeper	91	86.51	12.491	-2.98	0.003	Sig
	Non-Sweeper	121	90.94	9.128			

TABLE-2. COMPARISON OF MEAN VALUES BETWEEN SWEEPERS AND NON-SWEEPERS OF FOLLOWING VARIABLES

S. No.	Category		Total Number of Sweepers in %	Total Number of Non – Sweepers in %	P Value	Pearson Chi-Square Test (Values)	Result
1	Age	<30 Years in %	8.8%	19.8%	0.003	15.679	Sig
		>30 Years in %	91.2%	80.2%			
2	Sex	Male	35.2%	89.3%	0.000	67.758	Sig
		Female	64.8%	10.7%			
3	Socio-Economic Status (Kuppuswamy Socio-Economic Scale 2021)	Lower (V)	56.0%	0.0%	0.000	102.55	Sig
		Lower middle (III)	27.5%	33.1%			
		Upper Lower (IV)	16.5%	39.7%			
		Upper middle (II)	0.0%	27.3%			

The Table No 1 Shows:

There is significant association between age group and study groups as ($P<0.05$)

There is significant association between sex group and study groups as ($P<0.05$)

There is significant association between social economic status and study groups. ($P<0.05$)

The Table No 1 Shows:

In Body Mass Index (BMI) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P>0.05$).

In Pulse the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P>0.05$).

In Respiratory Rate (RR) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P>0.05$).

In Temperature (Temp)the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P>0.05$).

In Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P>0.05$).

In Maximum Voluntary Ventilation (MVV) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically significant ($P<0.05$).

In Resting Minute Volume (RMV) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically non-significant ($P<0.05$).

In Breathing Reserve (BR) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically significant ($P<0.05$).

In Dyspnoeic Index (DI) the difference between the mean value of sweeper and non-sweeper categories is found to be statistically significant ($P<0.05$).

RESULT

In our observations and data analysis I have found out that Dyspnoeic Index (DI) of no one in sweepers and non – sweepers is less than 60%. But in sweepers it is on borderline just on appearance of Dyspnoea in non-sweepers it is on upper border.

DISCUSSION

In other studies, on Chronic Exposure to Dust and Lung Function Impairment: A Study on Female Sweepers in India study done by S Smilee Johncy et al. in 2014. The major goal of this study is to evaluate the lung functions and the correlation between lung function parameters and the length of exposure to dust in female sweepers. According to the study, there is a statistically significant decline in FVC, FEV1, PEFR, FEF25-75%, and FEF200–1200, and this impairment grew worse with time spent using sweepers exposed to dust[1].

In other studies, like on A cross-sectional study done by Basavaraj Sangolli et al. in 2018 on pulmonary function tests among the municipal street sweepers of Chitradurga District, Karnataka. This study investigated the effects of long-term exposure to dust on pulmonary function using a spirometry test among municipal sweepers in the Chitradurga district. Additionally, this study examined the effects of smoking and irregular use of face shields, comparing the findings to those of healthy controls. According to this study, non-smoking street sweepers had significantly lower FEV1, FEV1/FVC, PEFR, and FEF 25%–75% than non-smoking controls. These PFT levels were also significantly lower among street sweepers who were smokers and among those who did not wear protective masks when sweeping [2].

In comparison to other study on Maximum Voluntary Ventilation and Its Relationship with Clinical Outcomes in Subjects with COPD study done by Ana Carolina Andrello et al. in 2020. This study aimed to investigate the relationship between MVV and clinical outcomes in COPD and to verify whether MVV predicts these outcomes better than FEV1. This study is reported that that maximum voluntary ventilation (MVV) may be better associated with commonly used outcomes in COPD than FEV1 and may provide information on respiratory mechanics. In the regression models, MVV was a predictor of almost all clinical outcomes, unlike FEV1. Conclusions of this, MVV correlates moderately with clinical outcomes commonly used in the evaluation of individuals with COPD, and MVV is a better predictor of respiratory muscle strength, functional exercise capacity, and patient-reported outcomes than FEV1[3].

In other study on Development and Validation of the Dyspnea Index (DI): A Severity Index for Upper Airway–Related Dyspnea study done by Jackie L. Gartner-Schmidt et al. in 2013. The objective of this study is to (1) develop and validate the Dyspnea Index (DI); (2) quantify severity of symptoms in upper airway dyspnea; and (3) validate the DI as an outcome measure. Conclusion of this study is that the DI is an effective and efficient instrument to quantify patients' symptoms of upper airway dyspnea. It is a statistically robust index, with significant reliability and validity, and can be dependably used as a treatment outcome measure [4].

REVIEW OF LITERATURE

Dyspnoea literally means distressed breathing. Increased respiration without discomfort is called hyperpnoea, depth and rate both are increased. One is not aware of one's respiration till resting pulmonary ventilation becomes more than double. When hyperpnoea becomes four- fivefold to pulmonary ventilation, an unpleasant sensation or discomfort is felt. This type of respiration is called dyspnoea. The word 'air-hunger' is used as synonym to dyspnoea in general language. Thus, desire for air or mental anguish associated with inability to ventilate enough to satisfy the air demand is the essence of dyspnea. Dyspnoea point refers to the height of hyperpnoea at which dyspnoea appears.

Predisposing factors for dyspnoea include [5]:

1.Low vital capacity. People with low vital capacity are more predisposed to get dyspnoea than those with normal or high vital capacity.

2.Maximum ventilatory volume (MVV). Patients with reduced MVV (maximum volume of air that can be taken in or given out per minute, normal value for adult male is 150 L/min and for adult female is 125 L/min) are more predisposed to get dyspnoea.

3.Minute Ventilation or Resting Minute Volume (MV / RMV) This is the volume of air that can breathed in or out of the lung in one minute.

MV = TV x respiratory rate per min.

TV=Tidal Volume

This is also called resting minute volume or pulmonary ventilation (PV). Normal value of MV is 6 liters / min.

4. Breathing Reserve (BR): It is the difference between MVV and Respiratory Minute Volume (RMV). RMV is the volume of air that is taken in or given out per minute (Normal 500 × 12 = 6L/min).

BR=MVV-RMV

5. Dyspnoeic index (DI) refers to breathing reserve percentage of MVV i.e.

$$DI = \frac{BR \times 100}{MVV} = \frac{110 \times 100}{120} = 95\%$$

- Normal value of RMV (MV) ranges from is 6 liters / min.
- BR = MVV – RMV = Ranges from 115 Liters/min to 160 Liters/min
- DI RANGES =60%-90%
- DYSPNOEA OCCURS AT <60% OF DI

Causes of Dyspnea are [5]:

Respiratory disorders such as bronchial asthma, emphysema, pneumonia, pulmonary oedema and penumothorax.

Cardiac failure: It causes dyspnoea by the mechanism explained in Fig 2 Metabolic disorders causing dyspnoea are diabetic acidosis, uraemia, increased H+ concentration.

Metabolic acidosis causes dyspnoea by increasing pulmonary ventilation.

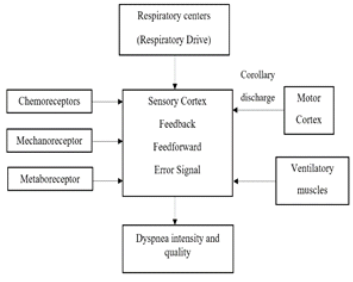

Figure 1: Algorithm for the inputs in dyspnea production [6]

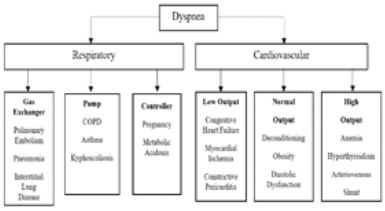

Figure 2: Algorithm for dyspnea pathophysiology [6]

CONCLUSION

1. Occupational exposure of dust has impact on lungs of sweepers of Nagar Nigam Indore.
2. There is significant:

- Low value of Maximum Voluntary Ventilation (MVV),
- Dyspneic Index (DI) is on border line to manifest dyspnea, with significant low level in sweepers of Nagar Nigam Indore as compared to non-sweepers.

3. All the parameters also indicate that sweepers of Nagar Nigam Indore are suffering from obstructive diseases.

4. As Dyspneic Index (DI) is on border line level. Below this level dyspnoea occurs. So, it is necessary to treat these persons for obstructive diseases.

5. In all these sweepers, if there is such type of continuous exposer will go on without protection and without treatment, it will lead to development of severity of lung diseases and development of

restrictive diseases and other complications with permanent lung damages.

6. There should be provision of protective measures for prevention.

SUGGESTIONS, RECOMMENDATIONS & PREVENTIVE MEASURES FOR WORKERS' HEALTH PROTECTION ARE AS FOLLOWING:

A. Sanitation of The Environment:

Protection against Risks: Adequate environmental controls should be in place to shield employees from hazardous fumes, dust, and other hazards.

WHO worldwide suggests seven kinds of protective measures that have been accepted in advanced countries

These 7 suggestions will guide us [7].
a. Protection of the Head: By wearing helmets.
b. Safeguard Our Eyes: By wearing protective glasses.
c. Protection of hearing: Earmuffs are more practical.
d. Maintain Healthy Breathing: Wearing a mask at work.
e. Feet-Specific Protection: Boots are the best option.
f. Put on the appropriate work clothing.: wearing a strong visibility jacket and pair of sturdy pants.

B. Measures in Medicine

The pre-placement test: Thorough physical examination, microbiological and radiographic examinations, such as chest X-rays, electrocardiograms, eye screening, blood and urine examinations, and particular tests.Pulmonary function tests for early lung disease detection.

Regular inspection

Health and medical services -Another recognized service is immunization.

Notification-Reporting of cases and risk
Monitoring the working environment
Upkeep and evaluation of records
Health counselling and education

C. Technical Controls

(I). Dusts can be eliminated at the source by utilizing wet brooms or wet drilling to remove stones.
(II). Safety measures

In order to protect employees from airborne toxins, respiratory protection and gas masks have been among the earliest tools still in use. There are two types of respirators:
Both those that purify the air and
Those that receive fresh air.

D. Environmental Vigilance Periodic environmental surveys

- Occupational health research offers a foundation for investigation that can advance our comprehension of industrial health issues.

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