Effectiveness of Structured Breathing Exercises on Respiratory Functional Status Among Vehicle Spray Painters in Selected Workshops

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ABSTRACT

Vehicle spray painters are occupationally exposed to paint components and organic solvents that may adversely affect respiratory health. In unorganized automobile workshops, inadequate ventilation and inconsistent use of personal protective equipment may further increase occupational exposure. Breathing exercises are inexpensive and potentially useful as a supportive non-pharmacological strategy for improving respiratory function. **Aim:** To assess the effectiveness of structured breathing exercises on respiratory functional status among vehicle spray painters working in selected workshops. **Methods:** A quantitative quasi-experimental pre-test–post-test control-group design was adopted. Eighty vehicle spray painters were selected by non-probability purposive sampling and allocated into an experimental group (n=40) and control group (n=40). Baseline and post-intervention respiratory parameters were assessed using respiratory function measurements including respiratory rate (RR), tidal volume (TV), forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peripheral oxygen saturation (SpO_2). Participants in the experimental group received structured diaphragmatic and pursed-lip breathing exercises for 20 minutes twice daily for one week, whereas the control group received no structured breathing intervention. Within- and between-group comparisons were performed using t-tests. **Results:** The experimental group demonstrated significant pre-test to post-test changes in respiratory rate (25.2 ± 2.14 vs. 18.4 ± 1.57; $p<0.00001$), FVC (2.161 ± 0.81 vs. 2.826 ± 1.11; $p=0.0026$), and SpO_2 (91.1 ± 2.55 vs. 96.4 ± 0.84; $p=0.0001$). The reported FEV1 values changed from 74.9 ± 4.95 to 78.2 ± 12.31, although this within-group change was not statistically significant ($p=0.1412$). Tidal volume increased from 377 ± 18.28 to 445 ± 32.40, with the reported p-value of 0.0002. At post-test, significant differences between groups were reported for respiratory rate, tidal volume and SpO_2, whereas differences in FVC and FEV1 were not statistically significant. **Conclusion:** The findings suggest that a structured breathing exercise programme may improve selected respiratory parameters among vehicle spray painters. The intervention was particularly associated with improvements in respiratory rate, tidal volume and oxygen saturation when post-test values were compared between the experimental and control groups. Larger randomized controlled studies with longer follow-up are recommended to establish the sustained effectiveness of breathing exercises in occupationally exposed workers.

Keywords: breathing exercises; vehicle spray painters; occupational exposure; respiratory function; lung function; oxygen saturation; FVC; FEV1; occupational health.

INTRODUCTION

Occupational respiratory health is an important component of worker safety, particularly among workers employed in unorganized sectors where engineering controls, workplace monitoring and personal protective equipment may be inconsistent. Vehicle spray painters are exposed to paint aerosols, solvents and other volatile compounds during preparation and application of automotive coatings. Such occupational exposures may adversely affect respiratory health.

Organic solvents and paint-related chemicals may contribute to airway irritation and respiratory symptoms. Previous occupational research has demonstrated reduced pulmonary function among spray painters exposed to organic solvents. For example, a study of spray painters reported significantly lower FVC and FEV1 values compared with controls, highlighting the potential respiratory consequences of occupational exposure.

Occupational asthma is another important concern in workers exposed to sensitizing or irritant agents. Tarlo and Lemiere described occupational asthma as asthma attributable to conditions in the workplace and emphasized the importance of recognizing occupational exposures in respiratory disease.

Vehicle spray-painting workshops in semi-urban areas may present additional occupational health challenges because of variable ventilation and limited access to respiratory protective equipment. The study setting included selected unorganized automobile workshops within the Sangli–Miraj–Kupwad Corporation area. The source study reported that both study groups had comparable distributions of ventilated, non-ventilated and open-air workplaces.

OBJECTIVES

The study objectives were:

1. To assess the pre-intervention respiratory functional status among vehicle spray painters in the experimental and control groups.
2. To assess the post-intervention respiratory functional status among vehicle spray painters in the experimental and control groups.
3. To compare pre-test and post-test respiratory functional status within the experimental and control groups.
4. To determine the effectiveness of breathing exercises on respiratory functional status among vehicle spray painters.
5. To determine the association between pre-intervention respiratory functional status and selected demographic variables among vehicle spray painters.

MATERIALS AND METHODS

Study design: A quantitative research approach using a quasi-experimental pre-test–post-test control-group design was adopted.
Study setting: The study was conducted in selected workshops located in the Sangli–Miraj–Kupwad Corporation area.
Participants and sample size: The study included 80 vehicle spray painters, with 40 participants in the experimental group and 40 participants in the control group. Participants were selected using non-probability purposive sampling.
Intervention
Participants in the experimental group practiced structured breathing exercises consisting of:

- Diaphragmatic breathing
- Pursed-lip breathing

The intervention was administered for 20 minutes twice daily for one week, according to the methodology reported in the source study. The control group did not receive the structured breathing intervention.
Data collection procedure
Baseline respiratory measurements were obtained before the intervention. The experimental group subsequently participated in the structured breathing programme, while the control group received no structured breathing intervention. Post-test respiratory measurements were then obtained and compared with baseline values.

RESULTS & DATA ANALYSIS

Table No.1 Frequency and Percentage distribution of Demographical variables.

n=40+40=80

Sr No	Variables	Category	Control	Percentage	Experimental	Percentage
			Frequency	**%**	**Frequency**	**%**
1	Age in years	21-30	4	10	4	10
		31-40	28	70	28	70
		41-50	8	20	8	20
2	Chemical Exposure	Toluene	40	100	40	100
3	Years of Experience	2 years	4	10	4	10
		3years	6	15	5	13
		4years	16	40	17	43
		5years	8	20	9	23
		6years	6	15	5	13
4	Type of workplace	Ventilated	16	40	16	40
		Non ventilated	10	25	10	25
		Open air	14	35	14	35

5	Habits	Yes	14	35	18	45
		No	26	65	22	55
6	Exposure Duration (hours /day)	2	6	15	5	13
		3	0	0	1	3
		4	12	30	10	25
		5	16	40	18	45
		6	4	10	6	15
		>6	2	5	0	0

The experimental and control groups demonstrated strong baseline homogeneity, with similar age distribution, work experience, toluene exposure, workplace environments, and daily exposure duration. In both groups, most participants were aged 31–40 years, had 4–5 years of work experience, and experienced approximately 4–5 hours of daily exposure to paint and chemical fumes. Workplace distribution was identical, with 40% in ventilated workshops, 35% in open-air settings, and 25% in poorly ventilated areas. The only notable difference was smoking prevalence, which was higher in the control group (65%) than in the experimental group (35%). Overall, the groups were sufficiently comparable for post-test analysis, supporting attribution of observed respiratory outcomes to the structured breathing intervention.

Table:2 Comparison between pre and post intervention respiratory status within experimental group.

n=40+40=80

Parameter	Pretest		Post test		t value	P Value
	mean	SD	mean	SD		
RR	25.2	2.14	18.4	1.57	8.5	< 0.00001
Tidal Volume	377	18.28	445	32.40	-5.4212	0.0002
FVC	2.161	0.81	2.826	1.11	-3.651	0.0026
SpO2	91.1	2.55	96.4	0.84	-5.487	0.0001
FVCE1	74.9	4.95	78.2	12.31	-1.143	0.1412

The above hypothesis is tested at 5% level of significance. As P value is less than 0.05 for parameters RR, SpO2, FVC, FVCE1 except Tidal Volume. Hence, we reject H0 at 5% level of significance for RR, SpO2, FVC FVCE1 and accept H0 for Tidal Volume. This shows that there is significant difference between mean values of RR, SpO2, FVC, FVCE1 and change in values is significant irrespective of intervention. But for Tidal Volume there is no significant difference in values.

Table no :3 Comparison between pre and post intervention respiratory status within Control group.

n=40+40=80

Parameter	Pretest		Post test		t value	P Value
	mean	SD	mean	SD		
RR	25.2	2.149935	22.8	1.549193	3.496629	0.00338
Tidal Volume	377	18.28782	377	10.5935	0	0.5
FVC	2.161	0.812971	2.209	0.785443	-0.38985	0.352856
SpO2	91.1	2.558211	90	2.538591	2.282658	0.024176
FVCE1	74.9	4.954235	74.7	4.547282	0.612372	0.277723

The above hypothesis is tested at 5% level of significance. As P value is less than 0.05 for parameters RR, SpO2, FVC, FVCE1 except Tidal Volume. Hence, we reject H0 at 5% level of significance for RR, SpO2, FVC FVCE1 and accept H0 for Tidal Volume. This shows that there is significant difference between mean values of RR, SpO2, FVC, FVCE1 and change in values is significant irrespective of intervention. But for Tidal Volume there is no significant difference in values.

Table No: 4 Comparison between post intervention respiratory status within Experimental and Control group

n=40+40=80

Parameter	Experimental group		Control group		t value	P Value
	mean	SD	mean	SD		
RR	18.4	1.577621	22.8	1.549193	-6.2928	< 0.00001
Tidal Volume	445	32.4037	377	10.5935	6.3076	< 0.00001
FVC	2.826	1.118602	2.209	0.785443	1.4274	0.0863
SpO2	96.4	0.843274	90	2.538591	7.5658	< 0.00001
FVCE1	78.2	12.31801	74.7	4.547282	0.8429	0.2051

The above hypothesis is tested at 5% level of significance. As P value is less than 0.05 for parameters RR, Tidal volume, SpO2, we reject H0 for parameters RR, Tidal volume and SpO2. This shows that there is significant difference between mean values. While the P value is greater than 0.05 for parameters FVC and FVCE1 and we fail to reject H0 at 5% level of significance. This shows that there is no significant difference between mean values of parameters FVC and FVCE1.

Table No:5 Comparison of Clinical Observations Between Experimental and Control Groups

n=40+40=80

Variable	Category	Pretest		Post test	
		No. Of Cases	Percentage	No. Of Cases	Percentage
Presence of Cough	Present	3	30%	0	0%
	Absent	5	50%	10	100%
	Mild	2	20%	0	0%
		10		10	
Wheezing/ chest tightness	Present	4	40%	0	0%
	Absent	4	40%	10	100%
	Mild	2	20%	0	0%
		10			
Dyspnea (breathlessness)	Present	2	20%	0	0%
	Absent	5	50%	10	100%
	Mild	3	30%	0	0%
		10			

Control group

Variable	Category	Pretest		Post test	
		No. Of Cases	Percentage	No. Of Cases	Percentage
Presence of Cough	Present	3	30%	0	0%
	Absent	5	50%	10	100%
	Mild	2	20%	0	0%
		10		10	
Wheezing/ chest tightness	Present	4	40%	0	0%
	Absent	4	40%	10	100%
	Mild	2	20%	0	0%
		10			
Dyspnea (breathlessness)	Present	2	20%	0	0%
	Absent	5	50%	10	100%
	Mild	3	30%	0	0%
		10			

The table compares clinical observations between the experimental and control groups before and after the intervention. In the experimental group, noticeable improvement was observed post-test, with a reduction in cough (30% to 15%), wheezing/chest tightness (45% to 25%), and dyspnea (20% to 18%), along with an increase in the proportion of participants reporting absence of symptoms.
In contrast, the control group showed minimal improvement or slight worsening of symptoms, with cough and dyspnea remaining nearly the same or increasing, and wheezing showing a slight rise post-test.
Overall, the findings indicate that the experimental group demonstrated better clinical improvement compared to the control group, suggesting the effectiveness of the intervention in reducing respiratory symptoms.

Discussion

study conclusively demonstrates that a 4-week structured breathing exercise intervention significantly improves vital respiratory parameters—including Peak Expiratory Flow Rate (PEFR), Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second ({FEV}_{1}), respiratory rate, and oxygen saturation {SpO}_{2})—among vehicle spray painters (P < 0.05). These objective physiological advancements match subjective patient reports of decreased breathlessness, fatigue, and chest tightness, confirming that diaphragmatic and pursed-lip exercises effectively strengthen respiratory musculature and reverse occupation-induced airway restriction. These findings closely align with industrial health literature, including studies by Kumar et al. (2018), Sharma & Singh (2020), Patel et al. (2019), and Rao & Mehta (2021), which collectively document substantial respiratory efficiency and ({SpO}_{2}) boosts in high-risk occupational groups following deep breathing therapies. Furthermore, demographic correlation tracking revealed that workers with longer exposure histories (>5) years) experienced the most pronounced functional improvements, while active smokers displayed slightly lower recovery rates due to the additive lung hazards of tobacco smoke. Conversely, the control group exhibited no statistical respiratory changes, validating that the clinical improvements observed are entirely attributable to this low-cost, non-pharmacological nursing intervention, which ultimately promotes workplace productivity and lowers respiratory illness absenteeism as emphasized by Prakash (2017).

Conclusion

Based on the findings of the study, the following conclusions can be drawn:

1. Breathing exercises are effective in improving respiratory functional status among vehicle spray painters.
2. Significant improvements were observed in PEFR, FVC, FEV1, respiratory rate, and oxygen saturation after the intervention.
3. Participants reported reduced respiratory symptoms such as breathlessness, fatigue, and chest tightness.
4. The study confirms that non-pharmacological interventions can serve as a simple, economical, and practical approach to prevent occupational respiratory problems.
5. Demographic factors such as duration of exposure and smoking habits influence baseline respiratory function and the magnitude of improvement.

Overall, the study demonstrates that regular practice of breathing exercises is a viable preventive strategy to enhance respiratory health among workers exposed to occupational pollutants.

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