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An assessment of cardiorespiratory function in occupationally exposed petrol pump workers of South Gujarat: A cross-sectional study

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Abstract
Background: Petrol pump workers are routinely exposed to air pollutants such as petrol fumes, particulate matter, and vehicular emissions. Prolonged exposure to these pollutants can negatively affect respiratory health and physical endurance. However, limited research in India, particularly in South Gujarat, has assessed the impact of such occupational exposure on cardiorespiratory function. This study aims to evaluate the respiratory health and physical endurance of petrol pump workers using Peak Expiratory Flow Rate (PEFR), the 2-Minute Walk Test (2MWT), and the St. George's Respiratory Questionnaire (SGRQ).
Method: A cross-sectional study was conducted over six months, involving 250 petrol pump workers aged 19–40 years. Based on inclusion and exclusion criteria, 230 participants were included. Convenient sampling was used. Cardiorespiratory function was assessed using PEFR, 2MWT, and SGRQ. Correlation analysis was performed to assess the relationships among these parameters.
Statistical Analysis: Data were analyzed using Microsoft Excel and *jamovi* (version 2.6). Descriptive and correlational statistics were used.
Results: Among the 230 participants, 77.83% were male and 22.17% female. A strong positive correlation was found between PEFR and 2MWT performance ($r = 0.681$), indicating better lung function is linked to higher physical endurance. Work experience showed a strong negative correlation with PEFR ($r = -0.700$) and a moderate negative correlation with 2MWT ($r = -0.488$), suggesting a decline in function with increasing years of exposure.
Conclusion: The study reveals that longer occupational exposure is associated with reduced lung function and physical capacity. The strong correlation between respiratory health and physical endurance highlights the impact of air pollution on overall fitness. Regular health monitoring and preventive measures are recommended to protect the long-term health of petrol pump workers.

Keywords: PEFR, 2MWT, petrol pump workers, South Gujarat, petroleum fumes, BTEX exposure

Introduction

The study discusses the occupational exposure of petrol pump workers to hazardous chemicals, particularly BTEX compounds, and the consequent risks to respiratory and cardiovascular health.

Petrol pump attendants are at high risk of occupational exposure to hazardous substances, primarily due to continuous contact with petroleum products like petrol and diesel. These fuels contain volatile organic compounds known as BTEX (benzene, toluene, ethylbenzene, and xylene), which are primarily inhaled, although dermal and oral exposure can also occur. The risk is elevated at petrol stations due to the constant release of vapors and vehicular exhaust.

In India, where petrol pumps are usually staffed rather than self-service, attendants often lack access to or do not use personal protective equipment (PPE), and workplace hygiene can be inconsistent. This results in chronic exposure to toxic fumes, increasing the likelihood of respiratory diseases.

Health issues among petrol pump workers range from mild conditions like the common cold to more severe and chronic respiratory diseases such as rhinitis, bronchitis, asthma, chronic obstructive pulmonary disease (COPD), and even lung cancer. Despite the severity of these risks, studies focusing on lung function and respiratory morbidity in this group are limited.

Peak Expiratory Flow Rate (PEFR)

Is a useful and portable lung function test that helps in detecting early signs of respiratory impairment caused by occupational exposure. Although PEFR is effort-dependent and can vary, it remains a reliable and cost-effective tool for field health assessments.

To protect the health of petrol pump workers, it's essential to promote the regular use of PPE, improve hygiene standards at workplaces, and conduct routine health screenings using tools like PEFR.

Need of the Study

Assessing lung and cardiac function in petrol pump workers is important due to their constant exposure to harmful substances like petroleum vapors and air pollution. Regular health checks, especially using tools like Peak Expiratory Flow Rate (PEFR), can help detect early respiratory issues, evaluate protective measures, and guide preventive care.

This study aims to explore the impact of occupational exposure on respiratory health and promote targeted physiotherapy interventions. Unlike previous studies that focused only on male workers in areas like Panjim, Bengaluru, Ahmedabad, and Western Maharashtra, this research includes both male and female workers from South Gujarat.

Aim and Objectives

The aim of this study is to assess the cardiorespiratory function of petrol pump workers in South Gujarat, who are occupationally exposed to hazardous substances such as petroleum vapors and air pollution. The study seeks to evaluate the impact of these hazards on the workers' health by examining their cardiorespiratory function through various methods. Specifically, the study will utilize the St. George's Respiratory Questionnaire (SGRQ) to assess respiratory symptoms, the Mini Wright Peak Flow Meter to measure lung function, and the 2-Minute Walk Distance Test to gauge functional capacity. The findings aim to better understand the effects of occupational exposure on these workers' health and provide insights for preventive measures.

Review of Literature

Summarizes past studies related to respiratory health in petrol pump workers across various Indian cities and internationally.

Methodology

Cross-sectional study conducted over 6 months with a sample size of 230, selected via convenient sampling from South Gujarat.

Materials Used

Includes Mini Wright peak flow meter, pulse oximeter, stopwatch, etc.

Selection Criteria

Inclusion: Non-smoking petrol pump workers aged 19-40 with at least 1 year of experience. Exclusion: Workers with respiratory illnesses, those practicing yoga or involved in athletics.

Procedure Ethical Considerations and Permissions

Ethical clearance for the study was obtained from the Institutional Ethical Committee of M.B. Gohil Institute of Medical Science and Research Center (College of Physiotherapy). Permission for data collection was granted by various petrol pumps in South Gujarat. Participants were screened based on predefined inclusion and exclusion criteria.

Informed Consent and Data Collection

The purpose of the study was explained to all participants, and written informed consent was obtained (Annexure 1). Demographic details were collected from each participant (Annexure 2). Participants then filled out the St. George Respiratory Questionnaire (SGRQ) in Hindi or Gujarati, depending on their language preference (Annexure 3). Vitals were assessed before proceeding with further tests.

2-Minute Walk Test (2MWT)

Participants were instructed to walk at their regular pace for 2 minutes along a marked path. The timer started as they began walking, and if they reached the end of the path, they were instructed to turn around and continue walking until the 2 minutes were completed. The distance covered during the 2 minutes was recorded, and participants were allowed to rest after the test.

Peak Flow Measurement

Using the Mini Wright Peak Flow Meter, participants were instructed to:

1. Stand straight and take a deep breath, filling their lungs completely.
2. Hold their breath, place the device in their mouth, and close their lips around the mouthpiece without inserting their tongue inside the hole.
3. Blow out forcefully for 1–2 seconds.
4. The marker would move, and the number where it stops represents the peak measurement.

Each participant repeated this process three times, with 10 seconds of rest between attempts, and the highest reading was recorded.

Outcome Measures

- **PEFR:** Assessed using Mini Wright Peak Flow Meter
- **SGRQ:** Used to assess respiratory health
- **2MWT:** Evaluates physical endurance

Statistical Analysis

Analysis conducted using JAMOVI software; correlation tests performed to identify relationships between variables.

Results

Table 1: Distribution According To Gender

Gender	Total	Percentage (%)
Female	51	22.17
Male	179	77.83

Table 1: Males make up 77.83% (179), while females account for 22.17% (51) of the total.

Table 2: Distribution According To the Years Of Work Experience

Work Experience (in years)	Participants	Percentage
0-5	116	50.43
6-10	67	29.13
11-15	43	18.70
16-20	4	1.74

Table 2: Most participants (50.43%) have 0–5 years of work experience, followed by 29.13% with 6–10 years, 18.70% with 11–15 years, and only 1.74% has 16–20 years of experience.

Table 3: Distribution According To Working Hours

Working hours	Total	Percentage (%)
12 hours	14	6.08
8 hours	216	93.92

Table 3: The majority (93.92%) work 8 hours, while only 6.08% work 12 hours.

Table 4: Distribution Of According To Pefr

Pefr (liters/min)	Total	Percentage (%)
0-100	0	0
101-200	46	20
201-300	122	53.04
301-400	58	25.22
401-500	04	1.74

Table 4: Most individuals (53.04%) have a peak expiratory flow rate of 201–300 L/min, followed by 25.22% in the 301–400 range. Smaller groups fall into 101–200 (20%) and 401–500 (1.74%), with none in the 0–100 range.

Table 5: The Prevalence of 2mwt

2 Miwt (in meters)	Total	Percentage (%)
0-10	0	0
11-20	0	0
21-30	01	0.43
31-40	15	6.52
41-50	43	18.70
51-60	100	43.48
61-70	65	28.27
71-80	06	2.60
81-90	0	0
Total	230	100

Table 5: Most participants (43.48%) walked 51–60 meters in 2 minutes, followed by 28.27% who walked 61–70 meters. Smaller percentages walked 41–50 meters (18.70%), 31–40 meters (6.52%), and 71–80 meters (2.60%), with very few (0.43%) in the 21–30 range. No one walked below 21 or above 80 meters.

Table 6: The Prevalence of Sgrq

Sgrq	Total	Percentage (%)
0-10	119	51.74
11-20	04	1.74
21-30	14	6.08
31-40	11	4.78
41-50	46	20
51-60	18	7.82
61-70	10	4.36
71-80	08	3.48
81-90	00	0
Total	230	100

Table 6: Most participants (51.74%) scored between 0–10 on the St. George's Respiratory Questionnaire, indicating fewer respiratory issues. The next largest group (20%) scored 41–50. Smaller percentages were spread across other ranges, with no participants scoring above 80.

Table 7: The Mean & SD Of 2mwt & Pefr

Test	Mean	SD
Peak Expiratory Flow Rate (PEFR)	258.70 liters/min	71.71 liters/min
2-Minute Walk Test (2MWT)	55.04 meters	9.35 meters

Table 7: The average PEFR was 258.70 L/min (SD = 71.71), and the average distance in the 2MWT was 55.04 meters (SD = 9.35), indicating moderate respiratory function and walking capacity.

Table 8: Correlation of Pefr & 2mwt

Values	2mwt	Pefr
Mean	57.3	264
N	230	230
Sd	8.79	66.7
Correlation (r)	0.681	

Table 8: The mean 2MWT distance was 57.3 m and PEFR was 264 L/min. With a sample size of 230 and a correlation coefficient (r) of 0.681, there is a strong positive relationship between walking capacity and respiratory function.

Table 9: Correlation between Pefr & Years of Work Experience

Values	Years of work experience	Pefr
Mean	6.16	264
N	230	230
Sd	4.55	66.7
Correlation (r)	-0.700	

Table 9: the average years of work experience was 6.16 (SD = 4.55), and the mean PEFR was 264 L/min (SD = 66.7). A strong negative correlation (r = -0.700) was found between work experience and PEFR, suggesting that longer work exposure is associated with reduced respiratory function.

Table 10: Correlation between 2mwt & Years of Work Experience

Values	Years of work experience	2mwt
Mean	6.16	57.3
N	230	230
Sd	4.55	8.79
Correlation (r)	-0.488	

Table 10: The average work experience was 6.16 years (SD = 4.55), and the mean 2-Minute Walk Test (2MWT) distance was 57.3 meters (SD = 8.79). A moderate negative correlation (r = -0.488) was found between work experience and 2MWT performance, suggesting that greater work experience may be associated with reduced physical endurance.

Discussion

This study evaluated the Peak Expiratory Flow Rate (PEFR), Two-Minute Walk Test (2MWT), and St George's Respiratory Questionnaire (SGRQ) in petrol pump workers of South Gujarat to assess the impact of occupational exposure to petroleum vapors and chemicals on their respiratory and physical health. The study, involving 230 workers from 21 petrol pumps, found that the majority of participants had moderate PEFR values, with an average of 258.7 liters per minute, and a negative correlation between work experience and PEFR (r = -0.700). In the 2MWT, most workers walked between 51–60 meters, and a negative correlation (r = -0.488) was observed between work experience and walking distance. A significant positive correlation (r = 0.681) was found between PEFR and 2MWT performance, suggesting that better lung function was associated with greater physical endurance. These findings underscore the need for preventive measures and health monitoring to protect the respiratory and physical well-being of petrol pump workers, aligning with previous research on the adverse effects of occupational exposure.

Conclusion

The study revealed three key relationships. First, there was a strong positive correlation (r = 0.681) between PEFR and 2MWT, suggesting that better lung function is linked to greater physical endurance. In contrast, both PEFR and 2MWT showed negative correlations with years of work experience—r = -0.700 and r = - 0.488, respectively. This means that as work experience increased, both respiratory function and physical performance tended to decline. Taken together, these findings suggest that longer durations of work, possibly involving physical strain or environmental exposures, may have a gradual impact on both lung health and mobility. At the same time, the strong connection between lung function and walking endurance highlights the importance of monitoring both in maintaining overall functional health, especially in long-term workers.

Limitations

Study limited to South Gujarat, a small sample size, and specific age range.

Further Recommendations

Suggests expanding to other regions, larger samples, and considering additional factors like smoking.

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