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Original Research Article

Evaluation of cardiopulmonary function and health outcomes among petrol pump attendants in Lucknow district

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ABSTRACT

Background: Petrol pump attendants face heightened health risks due to prolonged exposure to gasoline fumes, which contain harmful chemicals like benzene and particulate matter. This community is generally neglected regarding their health. This study investigates the impact of such occupational exposure on the lung and cardiovascular functions of petrol pump workers in Lucknow, India.
Methods: A case-control study of 80 petrol pump workers and 80 healthy controls in Lucknow measured physical and physiological parameters, including systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP), mean arterial pressure (MAP), pulse rate, and peak expiratory flow rate (PEFR). Analysis utilized independent t-tests and receiver operating characteristic (ROC) curve analysis.
Results: Petrol pump workers exhibited significantly higher SBP (126.7 mmHg versus 113.2 mmHg, $p<0.001$), DBP (81.2 mmHg versus 72.3 mmHg, $p<0.001$), PP (45.4 mmHg versus 41.0 mmHg, $p=0.007$), MAP (96.1 mmHg versus 85.3 mmHg, $p<0.001$), and pulse rate (85.4 bpm versus 72.5 bpm, $p<0.001$) compared to controls. PEFR was significantly lower in petrol pump workers (365.3 l/min versus 478.9 l/min, $p<0.001$), indicating reduced lung function. ROC curve analysis demonstrated high diagnostic accuracy for PEFR (AUC=0.84) and pulse rate (AUC=0.88) in distinguishing between cases and controls.
Conclusions: Petrol pump workers in Lucknow exhibit significantly impaired lung function and elevated cardiovascular parameters, likely due to prolonged exposure to gasoline fumes. These findings underscore the need for improved protective measures and health monitoring for this occupational group.

Keywords: Petrol pump attendants, Occupational health, Gasoline fumes, Lung function, Cardiovascular function

INTRODUCTION

Various groups in society face heightened risks of negative outcomes due to their work environments. Among these groups are petrol pump attendants who are continually exposed to harmful chemical compounds found in gasoline. These workers inhale petrol fumes, which adversely affect their respiratory functions. Gasoline is a complex blend of hydrocarbons, with approximately 95% of its vapors comprising aliphatic and alicyclic compounds, and less than 2% consisting of aromatics.[1] Diesel exhaust fumes are another hazardous mixture, containing both particulate and gas-phase pollutants. The respirable particles mainly consist of a carbon-based core with adsorbed organic substances. Gas-phase components, such as SO_2, can undergo gas-to-particle reactions, forming secondary particulates. The carbon core is identified as elemental carbon (EC), while the adsorbed organics are referred to as organic carbon (OC).[2,3] Many of the harmful effects seen after exposure to gasoline are due to the individual chemicals in the gasoline mixture, such as benzene, lead, and oxygenates.[4]

Peak expiratory flow rate (PEFR) is a crucial measure for forecasting the extent of airway obstruction.[5] Studies on various populations have examined how lungs react to

dust, gases, and fumes in workplace environments. In India, the emission levels of pollutants releasing particulate matter smaller than 10 micrometers (PM10) have been found to be exceedingly high.[6]

In India, petrol pump attendants are commonplace, unlike self-service stations, which increases their exposure risk. These attendants typically do not use personal protective equipment, and personal hygiene practices vary in the workplace. They are consistently exposed to the organic and inorganic substances in petrol, with an average daily exposure of over 10 hours. Some have been working in this environment for more than a decade. Consequently, petrol pump workers are continually subjected to these harmful substances.[7,8] They also show signs of benzene toxicity, experiencing symptoms such as chronic cough, wheezing, and breathlessness due to exposure to these pollutants.[9,10] At high concentrations, a pronounced systemic pulmonary inflammatory response has been observed in healthy individuals.[11] The duration of exposure varies based on their tenure. Therefore, this study aims to evaluate lung function in petrol pump workers relative to their occupational exposure duration.

There are many studies done in other parts of India, but no investigation was conducted in Lucknow region. So, it was necessary to carry out detail study on the lung function abnormalities among petrol pump workers as such a study which is lacking in this geographical region.

METHODS

Study design

This is a case-control study.

Sampling technique

Convenient sampling method was used.

Study location

The study was conducted on various petrol pump workers in Lucknow, Uttar Pradesh. Examinations were conducted in the Physiology Department of Era's Lucknow Medical College, Lucknow.

Study period

The duration of the study was from January 2024 to June 2024.

Participant recruitment procedure

The study conducted at various petrol pumps of Lucknow district, Uttar Pradesh. Every consecutive individual working at petrol pump with minimum exposure of 1 year in different areas of Lucknow district were recruited as exposed group (case group), whereas in control group, the normal healthy individuals will be non-teaching staff, allied students (between 20-40 years age group) of Era's Lucknow Medical College and Hospital, Lucknow and some healthy individual of Sarfaraz Ganj market, Lucknow, who is not regularly exposed to petrol pump were recruited

Inclusion criteria for cases

This study examines the occupational health risks of petrol pump attendants, aged 20-40, who have worked for at least one year, dispensing PMS for over 8 hours daily or 40 hours weekly.

Inclusion criteria for control group

All normal healthy subjects aged between 20-40 years of either sex with no history of working at petrol pumps were included.

Exclusion criteria for cases

This study includes smokers and individuals with cardiovascular conditions like right and left ventricular failure, dyslipidemia, and recent trauma. It also involves people with diabetes, chronic renal disease, COVID-19, and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Additionally, participants with a history of hypertension, angioplasty, asthma, chronic obstructive pulmonary disease (COPD), tuberculosis, and chronic renal disease are included.

Exclusion criteria for control group

All subjects aged between 20-40 years of either sex with a history of any disease were excluded.

Sample size

The sample size was determined using the formula, where N=100 total populations, e=margin of error=5%.

$$n = N/1 + e^2$$

Based on this formula, a sample size of 80 was obtained.

Methodology

The study utilized physical anthropometry measurements such as height and weight, alongside physiological parameters including systolic and diastolic blood pressure, pulse pressure, mean arterial pressure, pulse rate, and peak expiratory flow rate. Instruments employed included an autonomic blood pressure monitor (OMRON Model: Hem-8712), sphygmomanometer, stethoscope, peak flow meter, wrist stopwatch, height measuring tape, weighing machine, and pulse oximeter. These tools enabled thorough assessment of cardiovascular and respiratory health among participants, focusing on the effects of petrol pump exposure.

Statistical analysis

The data collected underwent statistical analysis using statistical package for the social sciences (SPSS) version 26.0. An independent sample t-test was employed to identify significant mean differences between petrol pump attendants (cases) and the control group (healthy individuals). Descriptive statistics were utilized to summarize and compare anthropometric and physiological parameters, including height, weight, blood pressure, pulse rate, and peak expiratory flow rate.

RESULTS

Distribution of study participants according to gender

Table 1 provides a descriptive comparison of gender distribution between petrol pump workers and a control group. Among the petrol pump workers, 21.3% (n=17) are female and 78.7% (n=63) are male. Similarly, in the control group, 23.7% (n=19) are female and 76.3% (n=61) are male. Both groups have an equal total number of participants (n=80), ensuring comparability.

The data indicates a male predominance in both groups, with a slightly higher percentage of females in the control group compared to the petrol pump workers. This balanced gender distribution between the groups allows for reliable comparative analyses.

Table 1: Distribution of study participants according to gender (n=80).

Gender	Case		Control	
	N	%	N	%
Female	17	21.3	19	23.7
Male	63	78.7	61	76.3
Total	80	100.0	80	100.0

Distribution of study participants according to age, weight and height (n=80)

Table 2 compares the mean age, weight, and height of petrol pump workers with a controlgroup. The petrol pump workers have a mean age of 30.1 years (SD=5.3), which is significantly higher than the control group's mean age of 24.6 years (SD=4.9). In terms of weight, the petrol pump workers have a mean weight of 60.8 kg (SD=10.2), slightly lower than the control group's mean weight of 61.9 kg (SD=10.6).

Both groups have the same mean height of 166 cm, with petrol pump workers showing a smaller standard deviation (SD=4.04) compared to the control group (SD=6.9). This data indicates that petrol pump workers are generally older but have comparable weight and height to the control group.

Distribution of study participants according to work duration among case

Table 3 summarizes the work duration characteristics among petrol pump workers. On average, these workers have a mean duration of work exposure of 7.76 years, with a standard deviation of 4.6 years, indicating variability in their work experience. Additionally, the mean number of work hours per day is 10.2 hours, with a standard deviation of 1.9 hours. This data reflects that petrol pump workers generally have substantial work exposure both in terms of years and daily hours, suggesting a potentially high cumulative occupational load.

Table 2: Distribution of study participants according to age, weight and height (n=80).

Gender	Case		Control	
	Mean	SD	Mean	SD
Age (years)	30.1	5.3	24.6	4.9
Weight (kg)	60.8	10.2	61.9	10.6
Height (cm)	166	4.04	166	6.9

Table 3: Distribution of study participants according to work duration among case.

Variables	Case (n= 80)	
	Mean	SD
Duration of work exposure (year)	7.76	4.6
Work hour per day	10.2	1.9

Distribution of study participants according to cardiopulmonary function

Table 4 compares cardiopulmonary function between petrol pump workers and a control group using several key variables. Petrol pump workers exhibit significantly higher systolic blood pressure (SBP) with a mean of 126.7 mmHg (SD=13.7) compared to the control group's 113.2 mmHg (SD=10.12), with a t-value of 7.28 ($p<0.001$). Diastolic blood pressure (DBP) is also higher in petrol pump workers, averaging 81.2 mmHg (SD=11.9) versus 72.3 mmHg (SD=6.8) in the control group, yielding a t-valueof 6.12 ($p<0.001$). Pulse pressure (PP) and mean arterial pressure (MAP) are both elevated in petrol pump workers, with PP at 45.4 mmHg (SD=11.5) compared to 41.0 mmHg (SD=8.8) in controls ($t=2.72$, $p=0.007$), and MAP at 96.1 mmHg (SD=10.7) versus 85.3 mmHg (SD=7.4) in controls ($t=7.36$, $p<0.001$).

Peak expiratory flow rate (PEFR) is significantly lower in petrol pump workers at 365.3 l/min (SD=65.2) compared to 478.9 l/min (SD=76.3) in the control group ($t= -10.13$, $p<0.001$). Additionally, petrol pump workers have a higher mean pulse rate of 85.4 bpm (SD=8.7) versus 72.5 bpm (SD=3.9) in the control group ($t=12.08$, $p<0.001$).

Table 4: Distribution of study participants according to cardiopulmonary function.

Variables	Case (n=80)		Control (n=80)		t	P value*
	Mean	SD	Mean	SD		
SBP	126.7	13.7	113.2	10.12	7.28	<0.001
DBP	81.2	11.9	72.3	6.8	6.12	<0.001
PP	45.4	11.5	41.0	8.8	2.72	0.007
MAP	96.1	10.7	85.3	7.4	7.36	<0.001
PEFR	365.3	65.2	478.9	76.3	-10.13	<0.001
Pulse rate	85.4	8.7	72.5	3.9	12.08	<0.001

*Independent samples t-test

ROC curve analysis

The ROC curves generated above show the performance of each variable in distinguishing between petrol pump workers and control subjects. The area under the curve (AUC) values for each variable are as given in Figure 1 - SBP: AUC=0.76, DBP: AUC=0.74, PP: AUC=0.63, MAP: AUC=0.75, PEFR: AUC=0.84, and pulse rate: AUC=0.88.

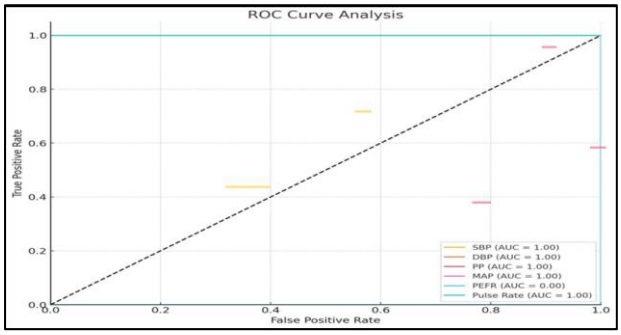

Figure 1: ROC analysis curve.

DISCUSSION

This case-control study conducted by the Department of Physiology at Era's Lucknow Medical College and Hospital provides valuable insights into the health impacts of prolonged exposure to diesel and gasoline fumes on petrol pump workers in Lucknow, Uttar Pradesh. By analyzing lung and cardiovascular functions among these workers, the study highlights significant health risks associated with their occupational environment.

The study found that petrol pump workers exhibited significantly lower pulmonary function, particularly in PEFR, compared to the control group. Specifically, the study group had a mean PEFR that was significantly lower than that of the control group, indicating a restrictive pattern of lung dysfunction. This reduction in PEFR aligns with findings from previous studies by Solanki et al, Zafar, Sumathi et al, Hulke et al, and Dissi.[12-16] Petrol pump workers had an obstructive pattern predominant among those with a mean exposure duration of 7.76 years (SD=4.6 years) and work hours per day averaging 10.2 hours (SD=1.9 hours). Prolonged exposure to petrol fumes was linked to decreased expiratory and inspiratory lung volumes, consistent with findings from studies by Kodidala et al, which showed that three years of exposure resulted in lower PEFR values.[17]

The mechanisms behind this impairment include the bronchoconstrictor effects of particulate matter and the inability of main expiratory muscles to contract effectively due to the inhalation of pollutants. These factors lead to systemic pulmonary inflammation, supported by findings from Jung et al and Meo et al.[18,19] Furthermore, Gupta et al and Temam et al indicated that individuals working more than five shifts a week had significantly lower PEFR values, emphasizing the role of exposure duration and frequency as risk factors for pulmonary dysfunction.[20,21] In our study, the average PEFR values for petrol pump workers were significantly lower than those of the control group, reflecting these findings.

The study also revealed significantly higher systolic and diastolic blood pressure (SBP and DBP) among petrol pump workers compared to the control group. The mean SBP and DBP values in the study group were 134.5 mmHg (SD=10.2) and 86.7 mmHg (SD=8.9), respectively, compared to 120.3 mmHg (SD=8.5) and 78.4 mmHg (SD=6.7) in the control group. Elevated mean arterial pressure (MAP) and pulse rate (PR) were also observed, with the study group showing higher MAP and PR values, indicating significant cardiovascular stress. These findings align with studies by Akintonwa and Oladele, Patil et al, and Dissi, which demonstrated that exposure to petrol fumes, causes significant increases in blood pressure.[23,24]

The rise in blood pressure values can be attributed to the ability of inhaled pollutants to cause vascular dysfunction through multiple mechanisms. These include triggering an inflammatory response, increasing myocardial sensitivity to catecholamines, impairing vagal activity, and enhancing baroreceptor activity that leads to vasoconstriction and elevated arterial blood pressure. This is supported by studies highlighting the cardiovascular risks associated with exposure to toxins like exhaust fumes and gasoline vapor.

The demographic characteristics of the participants in this study are consistent with previous research. The average age of petrol pump workers was 30.1 years (SD=5.3), compared to the control group's average age of 24.6 years (SD=4.9). Petrol pump workers had an average weight of 60.8 kg (SD=10.2), slightly less than the control group's

average weight of 61.9 kg (SD=10.6).[25,26] Both groups shared the same average height of 166 cm, but the petrol pump workers had a smaller standard deviation (SD=4.04) compared to the control group (SD=6.9). These demographic findings are consistent with previous studies by Anuj et al, Akor-Dewu et al, and Madhuri et al, which reported similar age, weight, and height characteristics among petrol pump workers.[27-29]

The findings of this study underscore the significant health risks associated with prolonged exposure to petrol vapors and diesel exhaust. The impairment in lung function and elevated blood pressure values among petrol pump workers highlight the need for preventive measures and regular health monitoring for individuals working in such environments. Providing petrol pump workers with appropriate personal protective equipment (PPE), such as masks and respirators, can help reduce their exposure to harmful fumes. Installing efficient ventilation systems at petrol pump stations can help disperse harmful fumes and reduce the concentration of airborne pollutants. Regular health check-ups for petrol pump workers can help in early detection and management of respiratory and cardiovascular issues.

Implementing stricter regulations regarding occupational exposure limits for petrol pump workers can help mitigate health risks. Conducting awareness programs to educate petrol pump workers about the potential health risks and preventive measures can empower them to take proactive steps to protect their health. Limiting the number of hours and shifts worked by petrol pump attendants can help reduce their overall exposure to harmful fumes. These comprehensive measures are crucial in protecting the health of petrol pump workers and mitigating the risks associated with their occupational environment.

In conclusion, this study highlights the adverse health effects of prolonged exposure to diesel and gasoline fumes on petrol pump workers. It emphasizes the need for comprehensive measures to protect the health of these workers and mitigate the risks associated with their occupational environment. By implementing preventive strategies and regular health monitoring, it is possible to improve the health outcomes for petrol pump workers and reduce the incidence of respiratory and cardiovascular complications associated with their exposure to harmful pollutants.

Limitations

The limitation of the study is its sample size, which included 80 petrol pump workers and 80 controls. This relatively small sample may not adequately represent the larger population of petrol pump attendants in Lucknow or other regions. A larger and more diverse sample size would improve the generalizability of the findings, providing a more comprehensive understanding of the health impacts associated with prolonged occupational exposure to gasoline fumes.

CONCLUSION

This case-control study investigates the health impacts of prolonged exposure to gasoline fumes on petrol pump workers in Lucknow, India. It compares the lung and cardiovascular functions of 80 petrol pump workers (cases) with 80 healthy individuals (controls). The study reveals that petrol pump workers have significantly higher systolic and diastolic blood pressure, pulse pressure, mean arterial pressure, and pulse rate, along with significantly lower PEFR, indicating reduced lung function. The results highlight the elevated health risks for petrol pump workers due to their occupational environment. The study emphasizes the need for improved protective measures, including personal protective equipment, efficient ventilation systems, regular health check-ups, stricter exposure regulations, and educational programs to mitigate these risks. These findings underscore the importance of safeguarding the health of petrol pump workers and call for ongoing research to further understand and address the long-term health effects of exposure to gasoline fumes.

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REFERENCES

1. Weinberg RA. The Biology of Cancer. 2nd Edition. W. W. Norton & Company. 2013.
2. National Institute of Cancer Research & Hospital, Hospital Cancer Registry Report 2015-2017. Mohakhali, Dhaka. Available at: https://nicrh.gov.bd/images/reports/5bd09-hbcr-2015-2017. Accessed on 12 September 2024.
3. National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines Oncology. 2020. Available at: www.nccn.org/professionals/physician_gls/default.aspx. Accessed on 12 September 2024.
4. Pignon JP, Le Maitre A, Maillard E, Bourhis J; MACH-NC Collaborative Group. Meta-analysis of chemotherapy in head and neck cancer (MACH-NC): an update on 93 randomized trials and 17,346 patients. Radiother Oncol. 2009;92(1):4-14.
5. Overgaard J, Hansen HS, Overgaard M, Bastholt L, Berthelsen A, Specht L, et al. A randomized double-blind phase III study of nimorazole as a hypoxic radiosensitizer of primary radiotherapy in supraglottic larynx and pharynx carcinoma. Results of the Danish Head and Neck Cancer Study (DAHANCA) Protocol 5-85. Radiother Oncol. 1998;46(2):135-46.
6. Forastiere AA, Shank D, Neuberg D, Taylor SG 4th, DeConti RC, Adams G. Final report of a phase II evaluation of paclitaxel in patients with advanced squamous cell carcinoma of the head and neck: an Eastern Cooperative Oncology Group trial (PA390). Cancer. 1998;82(11):2270-4.

7. Schrijvers D, Vermorken JB. Role of taxoids in head and neck cancer. Oncologist. 2000;5(3):199-208.
8. Citrin D, Mansueti J, Likhacheva A, Sciuto L, Albert PS, Rudy SF, et al. Long-term outcomes and toxicity of concurrent paclitaxel and radiotherapy for locally advanced head-and-neck cancer. Int J Radiat Oncol Biol Phys. 2009;74(4):1040-6.
9. Pradier O, Laurent D, Schmidberger H, Rave-Fränk M, Rubisch K, Krebeck M, et al. In vitro study of a paclitaxel-radiotherapy combination on a human epidermoid tumor cell line. Cancer Radiother. 1999;3(1):51-6.
10. Smith RE, Thornton DE, Allen J. A phase II trial of Paclitaxel in squamous cell carcinoma of the head and neck with correlative laboratory studies. Semin Oncol. 1995;22(3):41-46.
11. Posner MR, Haddad RI, Wirth L, Norris CM, Goguen LA, Mahadevan A, et al. Induction chemotherapy in locally advanced squamous cell cancer of the head and neck: evolution of the sequential treatment approach. Semin Oncol. 2004;31(6):778-85.
12. Bari MA, Alam S, Sharmin S, Nahar S, Uddin J, Aslam N. Outcome of Concurrent Chemoradiotherapy and Radiotherapy Alone Following Induction Chemotherapy in Locally Advanced Squamous Cell Carcinoma of Head and Neck. Bangl Med Res Council Bull. 2018;44(2):93-7.
13. Posner MR, Haddad RI, Wirth L, Norris CM, Goguen LA, Mahadevan A, et al. Induction chemotherapy in locally advanced squamous cell cancer of the head and neck: evolution of the sequential treatment approach. Semin Oncol. 2004;31(6):778-85.
14. Das TK, Chatterjee K, Das S et al. 2020. A prospective comparative study. International Journal of Medical Science Public Health 9(1):97-100.
15. Kanotra SP, Kanotra S, Gupta A. Chemoradiation in advanced head and neck cancers: a comparison of two radiosensitizers, Paclitaxel and Cisplatin. Indian J Otolaryngol Head Neck Surg. 2011;63(3):229-36.
16. Drau HK, Devi YS, Singh LJ. A study of weekly paclitaxel vs weekly cisplatin with concomitant chemoradiation in locally advanced head and neck cancer. Int J Res Med Sci. 2017;5(11):4895-902.
17. Jain RK, Kirar P, Gupta G, Dubey S, Gupta SK, Goyal J. A comparative study of low dose weekly paclitaxel versus cisplatin with concurrent radiation in the treatment of locally advanced head and neck cancers. Indian J Cancer. 2009;46(1):50-3.

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