Indolent Lung Destruction; Assessing the Risk of the Petrol Fuel Attendant in the Urbanized Area of the Southern Region of Nigeria

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ABSTRACT

Background: health hazards remain a challenge globally and many workers know little or nothing about these deleterious challenges. The petrol fuel attendant is exposed to petrol fumes most times without adequate protection, this habit is often due to either ignorance or unregulated activities of the retail arm of the petrochemical industry. There is a possibility of increased risk for developing acute and chronic respiratory diseases in this group compared to those without this exposure, therefore this study seeks to access the risk associated with the progressive injury to the lung due to petrol fumes exposure.

Methodology: A community-based, cross-sectional, analytical study conducted over six months in an urban setting in Esan West Local Government Area of Edo State, South-South Nigeria with an area of 502 Km2 and a population of 127,718 as recorded in the March 2006 census. A DTspiro spirometer (Model POP-10. Serial no 110843-005) was used to accessed lung function in selected petrol pump attendants with their corresponding control group. Ethical approval was obtained from Irrua Specialist Teaching Hospital Research and Ethics Committee with approval number ISTH/R&ETHICS/COM/83. Data analysis was done using the International Business Machines Statistical Product and Service Solutions (IBM- SPSS) version 22. The mean forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC, forced vital capacity (PEFR) and forced expiratory flow (FEF25%-75%) were calculated and compared using the student's t-test. The risk of developing lung function impairment following exposure to petrol fumes was assessed by calculating the odd ratio (OR) at 95% confidence interval using the binomial logistic regression.

Results: A significant reduction in mean Peak expiratory flow rate PEFR (P=0.001), forced vital capacity FVC (P=0.003), FEV1 (P=0.003), FEV1/FVC (P=0.036) and FEF25 - 75 (P=0.001) was observed in the study group compared to the control group. The lung function impairment in the study group was an obstructive and restrictive pattern with predominantly restrictive impairment accounting for 27.9% while the obstructive pattern was found in 8.6% while the control group also shows a predominantly restrictive pattern 8.6% and obstructive in only 2.9%. This difference was statistically significant with p= 0.001. A significant fourfold risk of development of lung function impairment when exposed to petrol fumes (OR = 4.44, $p < 0.001$ at Confidence Interval of 95%) was recorded.

Conclusion and recommendation: The study shows that continous exposure to petrol fumes as seen in petrol pump attendant resulted in significant reduction of their lung functions and increased risk of developing respiratory diseases. Therefore, awareness and use of personal protective equipment with regulation of the retail arm of the petroleum industry would be important to mitigate this dawdling cause of lungs injury.

Keywords: lung destruction, petrol attendant, soot, safety, hydrocarbons, urbanization, southern, Nigeria.

INTRODUCTION

Exposure to petrol fumes has been linked to severe health issues, not only in those working in petrol stations but also in those who live near petrol refining plants [1]. This contamination is mainly due to unregulated industrial activity and the lack of knowledge on the use of Personal Protective Equipment by workers [2]. Inhalation of petrol fumes increases the risk of acute and chronic respiratory diseases and cancer [3]. Occupational

environments have a major influence on the health of exposed individuals, which is particularly true for petrol pump attendants who are constantly exposed to these fumes. The health hazard gets more severe when the duration of exposure increases. This fact is more significant in the case of petrol pump attendants who are constantly exposed to petrol fumes in their work environment [4].

Petrol, or gasoline, is a combination of various hydrocarbons with aliphatic compounds making up 95% and aromatic compounds making up less than 2% when in a vapour state. The composition varies depending on the source of crude oil used and the refining process it goes through [5]. As petroleum use rises, so does the likelihood of inhaling toxic substances and other systemic complications which generally affect the respiratory system [6]. Chronic exposure to petrol has been linked to depression of the bone marrow, leukemia, cardiac abnormalities, heart attack, cancer of lungs, brain and stomach as well as respiratory symptoms such as coughing, breathlessness and wheezing [5-8]. Lung function tests are a useful tool for measuring pulmonary function in individuals with possible lung diseases, it measures peak expiratory flow rate (PEFR), forced vital capacity (FVC) and forced expired volume in the first second (FEV1) therefore it is considered in screening those with suspected lung disease [9,10].

However, while more people are being employed in petroleum businesses due to its rapid growth and urbanization, there is surprisingly little known about how to prevent health hazards for petrol pump attendants, therefore assessing the risk in them is important to serve as template for their education on their job hazard and also deployed clinically to manage complications arising from them.

MATERIALS & METHODS

A community-based, cross-sectional study conducted over a six months period in an urban setting in Esan West Local Government Area of Edo State, South-South Nigeria with an area of 502 Km2 and a population of 127,718 as recorded in the March 2006 census. The study area is home to a tertiary institution, post office, banks, and other educational institutions. There are fifty petrol filling stations in the area with four petrol attendants each making a total of about two hundred attendants [11].

The estimated sample size came to be 133 using Cochran's formula [12]. A multi-stage sampling technique was used to select the participants of the control sample and subject sample. A multi-stage sampling technique was used to select both the control and study participants. In selecting the controls, balloting was done in ten wards of the local government area and from which seven streets were selected from each; one respondent was taken from every two houses on the said streets for a total of fourteen respondents from each ward making up 140 controls altogether. From the fifty petrol stations, forty-five were randomly selected using balloting by which three pump workers were chosen from each station - making 135 subjects which were later made up to one hundred and forty to match up with the control group.

A DTspiro spirometer (Model POP-10. Serial no 110843-005) was used for the study. Spirometry was performed after calibration of the device each day prior to use. The participants were relaxed and comfortably seated during spirometry measurement. The technique was explained to the respondents thereafter correct technique was demonstrated for the participants to see before they were allowed to perform the lung function test.

Ethical approval was obtained from Irrua Specialist Teaching Hospital Research and Ethics Committee with approval number ISTH/R&ETHICS/COM/83. Data was analyzed using the International Business Machines Statistical Product and Service Solutions (IBM- SPSS) version 22 (19). The mean and standard deviations of continuous variables such as forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC, forced vital capacity (PEFR) and forced expiratory flow (FEF25%-75%) were calculated and compared using the student's t-test. The risk of developing lung function impairment following exposure to petrol fumes was assessed by calculating the odd ratio (OR) at 95% confidence interval using the binomial logistic regression and it was interpreted as follows.

OR = 1 Exposure (petrol fumes) does not affect odds of outcome (lung function impairment)

OR > 1 Exposure (petrol fumes) associated with higher odds of outcome (lung function impairment)

OR < 1 Exposure (petrol fumes) associated with lower odds of outcome (lung function impairment)

The p values of these variables were calculated and p value < 0.05 was considered statistically significant.

RESULTS

Lung Function Test Pattern Among Respondents

Table 1 shows the lung function parameters among the sampled population. The mean peak expiratory flow rate (PEFR) of petrol pump attendants was 496 ± 24.12L/mins which was significantly reduced when compared to the control which was 543 ± 18.6 L/mins (p =0.001). The forced vital capacity (FVC) of petrol pump attendants compared to the control with the mean values of 3.09 ± 0.71L and 3.39 ± 0.93L (p =0.003) was significantly reduced. The forced expiratory volume in one second (FEV1) for the petrol pump attendants was 2.76 ± 0.68L which was significantly reduced when compared to the control 3.04 ± 0.88L (p=0.003) the FEV1/FVC for petrol pump attendants was also observed to be significantly reduced than the control with their respective values being 86.18 ± 15.81% and 90.89 ± 21.16% (p = 0.036). The forced expiratory flow (FEF25 - 75) for the petrol pump attendants and control also shows a significant reduction in their respective values 3.01 ± 0.73L/Sec and 4.28 ± 0.84L/Sec (p =0.001).

Table 1: Mean of measured Lung Functions of Petrol Pump Attendants and Controls *Significant statistic at p-value < 0.05 Lung Function Impairment Among Sampled Population

PARAMETERS	MEAN±SD		STATISTICAL TEST	P value
	Petrol pump Attendant (n = 140)	Control (n= 140)		
PEFR(Litres/mins)	496 ± 24.12	543 ± 18.60	t=18.21	p=0.001*
FEV1(Litres)	2.76±0.68	3.04±0.88	t=2.98	p=0.003*
FVC (Litres)	3.09±0.71	3.39±0.93	t=3.03	p=0.003*
FEV1/FVC (%)	86.18±15.81	90.89±21.16	t=2.11	p=0.036*
FEF25% - 75%L/Sec	3.01±0.73	4.28±0.84	t=13.5	p=<0.001*

Table 2 shows the pattern of lung impairment among the respondents. The lung function impairment among petrol pump attendants were obstructive and restrictive pattern with predominantly restrictive impairment accounting for thirty-nine (27.9%) while obstructive pattern was found in twelve (8.6%). The control group also shows predominantly restrictive pattern twelve (8.6%) and obstructive four (2.9%) respectively. No mixed pattern of lung impairment was observed in this study. The petrol pump attendants shows that eight-nine (63.6%) had normal lung function while the control group shows one hundred and twenty-four (88.6) with normal lung function. These differences observed was statistically significant with p= 0.001

Table 2: Lung function impairment among respondents *Significant statistic at P < 0.05 Risk of Development of Lung Function Impairment By Petrol Pump Attendants

Lung function impairment	Petrol pump attendant n=140	Control n=140	Statistical test	P value
Normal	89(63.6%)	124(88.6%)	x2=24.05	P=0.001*
Restrictive	39(27.9%)	12(8.6%)		
Obstructive	12(8.6%)	4(2.9%)		

Table 3 shows there was a significant risk of development of lung function impairment when exposed to petrol fumes (OR = 4.44, p < 0.0001 at Confidence Interval of 95%) when compared to the control group.

Table 3: Risk of developing impairment in lung function in petrol pump attendants. Odd ratio OR (CI)= 4.44 (2.29 -8.71) (P < 0.001; at 95% Confidence Interval). There is a risk of developing impairment in lung function at OR ≥1

Petrol-pump attendants	Impairment in lung function		Total	OR	95% CI	P value
	Impairment	No impairment				
Petrol-pump attendants	51	89	140(100)	4.44	2.29 - 8.71	0.001
Control	16	124	140			
Total	67	213	280			

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DISCUSSION

Exposure to petrol vapor can cause numerous health issues, particularly impacting the respiratory system, not only for those who work in petrol stations like pump attendants but also for individuals living near or travelling through areas with these fumes [1]. Occupational health safety is of utmost importance since long-term exposure to pollutants can lead to long-term health conditions. Luckily, the hazardous effects are usually minimal as long as safe and healthy practices are followed [13]. Pump attendants may also inhale the fumes emitted from car engine exhausts, increasing their risk of negative health impacts.

The lung functions test among the petrol pump attendants showed a significant reduction in the PEFR, FVC, FEV1, FEV1/FVC and FEF25-75 when compared to the control group. These findings are in agreement with previous studies done in Nigeria by Akor-Dewu et al [14] and Adeniyi et al [15] who also reported a reduction in PEFR, FVC, FEV1 and FEV1/FVC. Sofola et al [16] who did a study on the peak expiratory flow rate of petrol pump attendants in Nigeria observed a significant reduction in the peak expiratory flow rate which was similar to the reduction in PEFR in this study however Ezejindu et al [17] who did a similar study among thirty exposed workers to petrol fumes found that there was no significant difference in the peak expiratory flow rate. They attributed their observation to the smaller sample size used in their study when they compared their findings to the study done by Sofola et al [16].

The lung impairment observed among petrol pump attendants was both restrictive and obstructive, however restrictive pattern was more predominant than the obstructive pattern in this study. This was in keeping with the findings of Kesavachandran et al [18] and Madhuri [19]. However, Adeniyi et al [15], Sandip [20] and Begum [21] observed only restrictive lung impairment. The difference may be due to the smaller sample size used by the various studies compared to this study and the studies done by Kesavachandran et al [18] and

Madhuri [19] as a larger sample size would have yielded a better result representative of the study population by increasing statistical power. The sample size for petrol pump attendants in this study was one hundred and forty while kesavachandran et al [18] used two hundred and thirty in their study unlike Adenyi et al [15] who also studied ninety-nine exposed workers

We expected normal spirometric findings among the controls but we found impaired lung functions in a few of them; both restrictive and obstructive patterns. The fact that most of the controls were either farmers or commercial motorbike riders, we consider the findings not to be unusual since they are exposed to exhaust fumes and smoke from bush burning.

The comparison of lung functions impairment among petrol pump attendants according to the duration of exposure to petrol fumes showed that there was a significant decline in lung function parameters with prolonged exposure to petrol fumes of more than three years of exposure in this study, Begum et al [21] also observed similar progressive decline in lung function with years of exposure to petrol fumes. Mauderly et al [22] also observed similar findings in their study.

In comparing petrol pump attendants with the control group, there was fourfold increased risk of developing lung function impairment among petrol pump attendants compared to the control group, which may have resulted from neglect of personal protective wear like face mask and poor knowledge of hazards associated with prolonged exposure to petrol fumes as observed in this study. This was also observed in a study done by Anuja et al [23] where none of the petrol pump workers wear personal protective equipment. Following that petrol pump attendants in this study have had exposure to petrol fumes for several hours per day for years, this may also account for why they are at risk of developing lung impairment when compared to the control group.

Unlike in Nigeria, exposure of petrol pump attendants to petrol fumes has been reduced in some part of USA and United Kingdom by placing a rubber hood over the delivery pump and by the use of self-service filling station [24]. Installation of a petrol vapor recovery system and popularization of electric powered automobiles will be helpful to reduce exposure to petrol fumes.

LIMITATIONS AND RECOMMENDATIONS

The study was unable to access the risk of lung impairment with the duration of exposure and use of personal protective equipment during rendering of services. A primary constraint is its cross-sectional design, which

identifies associations but cannot verify a causal sequence between petrol fume exposure and lung function decline. Furthermore, while duration of employment provided a useful surrogate measure, the absence of direct atmospheric monitoring for specific hydrocarbons—notably benzene, toluene, ethylbenzene, and xylene—means individual exposure levels could not be quantified with precision. Although we adjusted for several major confounders, the potential for residual confounding persists due to factors such as unrecorded variations in smoking history or exposure to domestic air pollution, which were not captured in our assessment.

These limitations establish a clear agenda for further research. Longitudinal studies that track lung function over time, integrated with personal air monitoring and biomonitoring of relevant urinary metabolites, are necessary to establish causality and define dose-response relationships. Beyond further investigation, our results point to an immediate need for practical intervention. The protection of this workforce warrants strengthened occupational health policies, including the mandatory provision of certified respiratory protection and the systematic implementation of engineering controls, such as vapor recovery systems, at fuel dispensing points.

CONCLUSIONS

Conclusion: This study had shown that prolonged exposure to petrol fumes by petrol pump attendants resulted in a significant reduction of lung functions indices such as PEFR, FVC, FEV1, FEV1 / FVC, and FEF25-75 when compared to the control group. This study also showed impairment of lung function with a fourfold increased risk of developing lung function impairment among petrol pump attendants compared to the control group.

Declarations

Ethics Approval and Consent to Participate

Ethical approval was obtained from Irrua Specialist Teaching Hospital Research and Ethics Committee with approval number ISTH/R&ETHICS/COM/83. All procedures adhered to the ethical standards of this committee. We obtained written informed consent from every participant before their enrolment in the study.

Consent for Publication

Individual details, images or videos are not included in this manuscript and therefore remained anonymous.

Availability of Data and Material

The datasets used and analysed in this study are available from the corresponding author upon reasonable request. The data is not publicly available due to privacy restrictions concerning the participants.

Conflict of Interest

All authors declare no competing interests, financial or non-financial.

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Authors Contributions

CAO conceived and designed the study, provided overall project supervision, and took the lead in writing and revising the manuscript. OE codesigned the study methodology, performed all statistical analyses and data interpretation, and contributed to manuscript preparation. VTE managed project administration, including participant recruitment, field data collection, quality control, and data validation. PIC provided senior guidance and critical oversight throughout the project, contributed to the literature review, and helped refine the final manuscript. Every author discussed the results, contributed to editing the manuscript, and gave their approval for this final version to be submitted.

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