Original Article

Gasoline fumes exposure and risk of respiratory disease among fuel pump attendants in Owerri Municipal Council, Nigeria

Agwah Eunice Ifeyinwa[1], Emerole CO[1], Amadi AN[1] and Nnodim Johnkennedy*[2]

[1]Department of Public Health Technology, Federal University of Technology Owerri Imo State Nigeria
[2]Department of Medical Laboratory Sciences, Faculty of Health Sciences, Imo State University Owerri, Nigeria

*Corresponding Author

Nnodim Johnkennedy
Department of Medical Laboratory Sciences,
Faculty of Health Sciences, Imo State University,
Owerri, Nigeria
E-mail: johnkennedy23@yahoo.com

Abstract

Gasoline fumes exposure and risk of respiratory disease was investigated in this cross-sectional study. The risk and factors influencing it were also assessed. A total of 216 non-smoking subjects (108 fuel and 108 shop attendants) aged between 18-60 years and above who had worked for more than 1 year in fuel stations and shops located in Owerri Municipal, Imo state participated in the study. Their socio-demographic and occupational histories were recorded with questionnaire based on informed consent. Peak Expiratory Flow Rates (PEFRs) were recorded and analyzed separately for test and control group. Data collected were analyzed with Computer software SPSS Version 16, values of P less than 0.05 were considered significant. Results obtained showed that majority of the attendants were single-female adults, aged between 20-29 years, who had worked between 0-4 and 5-9 years in fuel stations and shops respectively. Odd Ratio (risk) of 3.2 was found in fuel pump attendants. Variations in PEFR of fuel attendants were found to be significantly associated with their years of gasoline exposure (0.000), age (p=0.000), sex (p=0.000), height (p=0.000) and work schedule (p=0.010). There was a statistical significant decrease in PEFR of fuel pump attendants (308.89±51.34), when compared with that of the shop attendants (350.46±46.41). The results revealed reduced respiratory/pulmonary function and risk of respiratory disease which worsen with years of exposure to gasoline fumes in fuel pump workers. Medical observations involving pre-employment and periodic post-medical check-ups like lung function tests and use of nose mask (respirator) were recommended for the protection of fuel pump workers.

1. Introduction

Development of the city of Owerri has led to massive urbanization and industrialization with increasing use of automobiles. This has led to the establishment of a great number of filling stations. With high vehicular movement as well as other activities requiring energy (fuel) in Owerri Municipal, the level of environmental pollution has heightened. Air pollution from vehicles is an inescapable part of urban life throughout the world and long term exposure to these pollutants can have deleterious effects on the respiratory functions [1]. Air pollutants and chemicals like benzene, lead (petrol/gasoline constituents) and carbon monoxide from exhaust can cause adverse health effects by interacting with molecules which are crucial for the biochemical and physiological processes of the body [2].

The rapidly multiplying number of automobiles in Owerri is causing a grave concern. Also the failure to use personal protective equipment poses great risk to fuel pump workers [3]. Petrol/gasoline, a distillate of petroleum, contains paraffins, alkenes and aromatics [4]. The volatile nature of gasoline makes it available in the atmosphere anytime it is dispensed during fueling and refilling of vehicle fuel tanks. Gasoline undergoes combustion in the automobile engine and gives rise to combustion-derived nanoparticles (CDNPs). These particles are highly respirable and have large surface area where organic materials can be adsorbed easily [5], resulting in health problem.

Respiratory disorders related to inhalation of airborne pollutants are the most important group of occupational diseases [6]. Health problems posed by these pollutants at the work environment are closely linked to the nature and level of exposure to these hazardous chemicals [7]. The severity of the impairment of respiratory function has been shown to depend on years of exposure [8].

Occupational exposure to petroleum fumes has been reported to have toxic effects on various organs and systems, and these include respiratory, immune and nervous system. Organs such as the heart, lungs, skin and kidneys are affected resulting in various diseases and different forms of genotoxic, mutagenic, immunotoxic, carcinogenic and neurotoxic manifestations [9]. Petrol pump workers (filling attendants) are continuously exposed to the organic and inorganic substances present in the gasoline/petrol [7]. And Long term exposures to these pollutants, according to Aprajita *et al* [1], have negative impact on respiratory functions. The average daily exposure to these chemicals generally exceeds about 10 hour/daily and some of these fuel pump attendants have worked for 10 and more years [7], hence the present study to assess gasoline fumes exposure and risk of respiratory disease in subjects continuously exposed to gasoline fumes for more than one year.

Respiratory disease, a medical term that encompasses pathological condition affecting the organs and tissues that make gas exchange possible in higher organisms, is one of the health risks fuel station workers are faced due to their occupational exposure to gasoline fumes through inhalation [7]. It includes diseases of the lungs, pleural cavity, bronchioles tubes, trachea, upper respiratory tract (nose, throat and mouth e.tc.) and of the nerves and muscles of breathing. Respiratory disease conditions among fuel pump workers range from mild and self limiting conditions such as catarrh (common cold) to life-threatening conditions such as bacterial pneumonia or pulmonary embolism and lung cancer. They are common and important cause of illness and death and are traditionally divided into upper respiratory and lower respiratory tract diseases. The most common upper respiratory tract disease is catarrh (common cold) however, disease of specific organs of the upper respiratory tract such as rhinitis, sinusitis, tonsillitis,

pharyngitis, and laryngitis are also considered upper respiratory tract diseases. Others are chronic obstructive pulmonary disease (COPD), asthma, bronchitis, alveolitis etc. Lung function tests such as Peak expiratory flow (PEF)/Spirometry are some of the tests that help in the detection of respiratory disease.

Exposure to respiratory hazards (irritants, toxic chemicals and fumes) are dangerous, even lethal causing inflammation or other adverse reaction of the airways after they are inhaled, leading to damage of upper and lower airways with symptoms of nose and throat irritation, cough, shortness of breath, dysponea and resultant decline in peak expiratory flow (PEF), FVC (forced vital capacity), FEV_1 (forced expiratory volume in 1 second) over years. More dangerous is acute inflammation of the pulmonary parenchyma, as in chemical pneumonitis or non-cardiogenic pulmonary edema.

Fuel pump attendants by virtue of their occupation face daily threat of exposure to these respiratory irritants, toxic chemicals and fumes. The physical properties of these inhaled substances predict their site of deposition, producing symptoms at these sites. Large particles (10 to 20^{um}) deposit in the nose and upper airways, smaller particles (5 to 10^{um}) deposit in the trachea and bronchi, and particles less than 5^{um} in size may reach the alveoli. Particles less than 0.5^{um} are also small they behave like gases. Toxic gases are deposited according to their solubility. A water soluble gas are absorbed by the moist mucosa of the upper airway, less soluble gases deposit more randomly throughout the respiratory tract. These substances, their sources of exposure, physical and other properties, and effects on the victims cause cases of decreased productivity resulting from frequent symptoms experience of respiratory disease, restricted activity days and bed disabilities days among workers occupationally exposed to them.

Workers exposed to low levels of respiratory irritants may have sub-clinical symptoms traceable to mucous membrane irritation, such as watery eye, sore throat, runny nose and cough. With significant exposure, the added feeling of shortness of breath, wheezing, retching, hemoptysis, marked cough are common.

Occupational health problems of various groups of workers have been conducted in many parts of the world. In Delhi India, A study carried out on petrol pump workers reported adverse effects in the form of small airway involvement and restrictive impairment [7].

Chen *et al*[10] reported that the average respiratory exposure to dust was found to decrease the Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV_1) in smoking workers. Neaimi *et al* [4] reported that the greater percentage of exposed workers showed respiratory symptoms, with ventilatory function (FVC, FEV_1, FEV1/FVC and PEF) being significantly lower in these workers when compared with unexposed. In Nigeria, though occupational health problems of various groups of workers have been conducted, so far, very little attention has been paid on the relationship between gasoline (petrol) fumes exposure and risk of respiratory disease among fuel pump attendants. Related studies have been done in Nigeria on effects of petroleum products inhalation on some haematological indices of fuel attendants [11] and exposure of petrol station attendants and auto mechanics to premium motor spirit in Calabar metropolis [12]. These studies reported adverse health effects on organs and systems of workers exposed to them. The study carried out by Adewole *et al* [13] on the Respiratory symptoms and Lung function patterns in workers exposed to wood smoke and cooking oil fumes (Mai Suya) also showed a decline in ventilatory functions of exposed workers.

The rapidly increasing number of automobiles and activities requiring energy (fuel) as well as corresponding automobile exhaust derived air pollution may expose Owerri Municipal dwellers to risk of respiratory disease.

The location of Owerri municipal in the heart of Imo state has made it the hub of economic activities resulting in an increased number

of filling stations with recruitment of teeming numbers of station attendants. And this may increase the exposure of greater number of Owerri Municipal dwellers to risk of respiratory disease.

Most upper respiratory tract diseases (common cold, rhinitis, sinusitis etc) are communicable and may be transmitted through contact and by droplet sources (coughing, sneezing etc) to family members of these fuel pump attendants. And this may lead to transmission of these diseases to the greater number of individuals in the Owerri Municipal.

Non insistence on the use of Personal Protective Equipment (PPE) among workers in fuel stations in Owerri Municipal may make the problem worse since fuel pump attendants may be greatly exposed to the risk of respiratory disease when they work unprotected without nose and mouth masks (respirators).

Lack of pre-employment and post-employment periodic medical examinations of workers and environmental monitoring of fuel stations in Owerri municipal in Imo state is a source of worry. This is because health conditions/diseases are better managed or controlled if detected early than when they are well advanced.

2. Materials and method
2.1 Study area
This study was carried out in Owerri Municipal council, one of the 27 local government areas and the capital of Imo state. It is the heart of Imo state and is located in the South Eastern Igbo speaking area in Nigeria, between latitude 5^0N to $6^030'$N and longitude 6'E to $7^034'$N. Owerri Municipal is traditionally called OwerriNchi ise, showing the five communities (Umurororonjo, Amawom, Umuonyeche, Umuodu and Umuoyima- in the order of seniority) that made up the council. It is bounded on the North by Amakohia, on the North East by Uratta, on the East by Egbu, on the South by Nekede and on the North West by Irete. It is the epicenter of all economic, social, religious activities in the state and has a well-developed network of major roads and access roads because of its vantage position as the seat of government.

According to the 2006 National census, Owerri Municipal has a population of 127,123 inhabitants, made up of 62,990 males and 64,223 females. Transportation (intercity/intracity) and other businesses/investments thrive well in the council. As a result of these, vehicular movement is very high with attraction of many fuel stations within Owerri Municipal.

2.2 Study population
The study population is 216 nonsmoking adult subjects aged 18 years and above of both sexes. One hundred and eight of them are fuel pump attendants who formed the test group and are drawn from eighteen fuel stations located in Owerri Municipal. The remaining one hundred and eight shop attendants formed the control group and are selected to represent those who are not working in or around filling station but in shops located in Owerri Municipal.

2.3 Research design
The study is a descriptive cross-sectional survey carried out to assess gasoline fumes exposure and risk of respiratory disease among fuel pump attendants in Owerri Municipal. The target population is fuel pump attendants who have worked for up to one year and above to serve as test group and shop attendants with same number of years of work selected from shops located in Owerri municipal to serve as control group. The ages of the subjects both target and control are 18 years and above of both sexes.

2.4 Sample and sampling technique
The sample is fuel pump and shop attendants of both sexes. A sampling frame was drawn from 18 fuel stations in Owerri Municipal. Simple random sampling method was used in the selection of these fuel stations. Six fuel pump attendants per fuel station were chosen by simple balloting provided the attendant is 18 years and above, for a total of one hundred and eight (108) fuel pump attendants who formed the test group.

The same technique was used in selecting subjects from shops in Owerri Municipal using the same criteria of age of attendants, whose work do not involve exposure to gasoline fumes, for a total of one hundred and eight shop attendants who formed the control group for the study.

Informed consent (oral and written) was obtained for in-depth questionnaire distributed to fuel pump attendants and shop attendants as regards their age, gender, height, smoking /non-smoking habit, history of respiratory problem, number of years/duration of work in fuel station/shop, number of hours worked per day (work schedule), type of accommodation, number of persons they are living with and their cooking source. Their years of exposure were taken as the duration of work in their respective occupations.

2.5 Administration of instruments/ procedures

Questionnaires were distributed and accurately filled; candidates who met the criteria for participation in the study were admitted into the study. Several fuel stations and shops located in Owerri Municipal were used as sites for this study. A total of two hundred and sixteen subjects took part in the study, consisting of one hundred and eight test-subjects and one hundred and eight control-subjects of both sexes.

Subjects were instructed to stand up and height of each of the subjects was taken three times with meter rule, and the average recorded. After this, the peak expiratory flow rate of each of the subjects was taken using a hand held peak flow monitor (Praxis-Service Boehringer Ingelheim, England). The subjects were instructed to take deep breath in and forcefully blow out air into the peak flow monitor within 1 min, with the help of stop watch as time keeper. The indicated reading on the peak flow monitor was taken three times and the highest reading recorded to represent the forced expiratory flow rate in 1 min. Presence of other signs indicating minor respiratory diseases were checked and recorded. This was done for both fuel pump attendants and shop attendants.

2.6 Validation and reliability of the instrument

Sample questionnaires from related studies were analyzed and redesigned to achieve the objectives of this study (overseen and confirmed by research supervisor). The instruments were pre tested on volunteer subjects who were randomly selected before use on study group to certify their reliabilities. The zero points of the instruments were checked for accuracy before usage on the subjects.

2.7 Questionaire administration and response

A total of 250 self-structured questionnaires were administered to both fuel pump attendants and shop attendants within the randomized fuel stations and shops in Owerri municipal for a period of one week. The researcher helped the respondents in clarifying questions not understood by some respondents. Out of 250 administered, 216 were duly completed, accounting for about (86.6%) response and were used for analysis. The rest were rejected due to incomplete information. The questionnaire gave information about the Demographic characteristics of respondents as regards their age, sex, marital status, level of education, Occupational characteristics as regards history of respiratory disease before the present work, respiratory symptoms, frequency of symptoms, number of days off due to the symptoms, work schedule, work shift, use of personal protective equipment, and Social characteristics as regards type of accommodation, number of persons living with respondents and cooking source of respondent.

2.8 Technique of data analysis

Frequency tables and Bar charts were used for clearer understanding of the data. Mean and standard deviation (SD) were calculated and used for quantitative variables.

Z and t-tests were used to test the difference between the mean Age, Height, Duration of work (occupational years) and PEFRs of test subjects (fuel pump) and controls (shop attendants) with significant level at P<0.05.

The relationship between Demographic, Occupational, Social history and variations in Peak Expiratory Flow Rate (Risk of respiratory disease) of the attendants was done using Pearson co-relation in SPSS with significant level at P<0.05.

Odd ratio was used to measure the strength of relationship between the risk factor (gasoline fumes) and effect (risk of respiratory disease) in exposed workers. Ratio below one was considered unlikely to has caused respiratory disease, while value above one was considered more likely to has caused respiratory disease.

3. Results

This chapter presents the analysis of data collected from the field survey. The analysis was based on the total of 216 questionnaires fully completed and returned from sampled fuel pump and shop attendants in Owerri Municipal.

These are presented in tables, charts, diagrams for clearer understanding of the findings. Important snapshots taken on the field to show the activities of the fuel pump and shop attendants as it relates to the scope of this study, were also shown.

3.1 Demographic data

Age, Sex, Marital status and level of education of the respondents were considered since these variables tend to reveal the characteristics of the population under study.
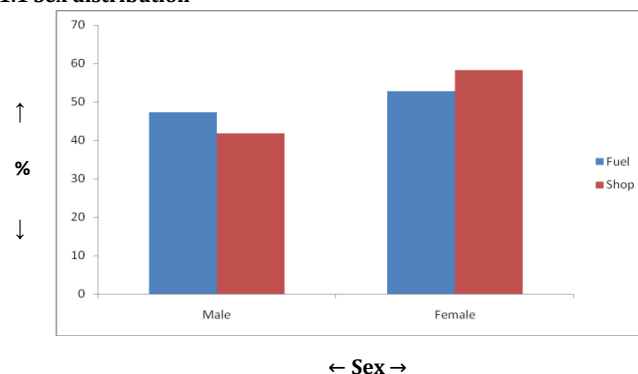
3.1.1 Sex distribution

← Sex →

Figure 1: Sex of Respondents

Sex distribution of the respondents (fig. 1) showed that the majority of them involving 57 fuel and 63 shop attendants representing 52.8% and 58.3% are female, while minority of the respondents involving 51 and45 shop attendants representing 47.2% and 41.7% are male.

3.1.2 Age distribution

Table 1: Ages of Respondents

Age	Fuel attendants		Shop attendants	
	N	%	N	%
<20	5	4.6%	23	21.3%
20-29	67	62.0%	54	50.0%
30-39	29	26.9%	25	23.2%
40-49	7	6.5%	6	5.5%
50-59	0	0.0%	0	0.0%
>60	0	0.0%	0	0.0%
Total	108	100.0%	108	100.0%

Age distribution of the respondents (table 1) ranged between less than 20 and greater than 60 years. Majority of them involving 67 fuel pump and 54 shop attendants representing 62.0% and 50.0% respectively are 20-29 years of age, while the minority of the respondents involving 5fuel pump and 6 shop attendants at 4.6% and 5.5% are less than 20 and 40-49 years of age respectively.

3.1.3 Marital status

Table 2: Marital status of Respondents

	Fuel attendants		Shop attendants	
Marital status	N	%	N	%
Married	10	9.3%	15	13.9%
Single	95	88.0%	88	81.5%
Widowed	2	1.8%	5	4.6%
Divorced	0	0.0%	0	0.0%
Separated	1	0.9%	0	0.0%
Total	108	100.0%	108	100.0%

Marital status of the respondents (table 2) revealed that majority of them representing 88.0% and 81.5% of 95 fuel pump and 88 shop attendants respectively are single, while 10 fuel pump and 15 shop attendants representing 13.9% and 9.3%respectively are married. 2 fuel pump and 5 shop attendants at 1.8% and 4.6% respectively are widowed, while 1 fuel pump representing 0.9% is separated. No respondent is divorced.

3.1.4 Level of educational
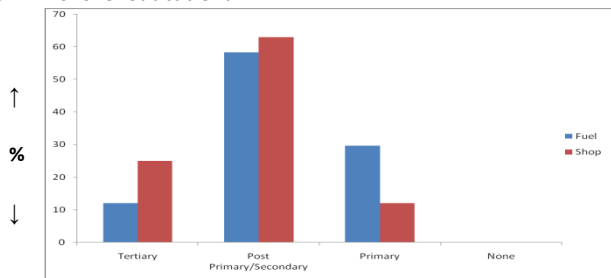
← Educational Level →

Figure 2: Educational level of Respondents

Educational level of respondents (fig. 2) showed that majority of them involving 63 fuel pump and 68 shop attendants representing 58.3% and 63.0% have attained post primary/secondary education. This is followed by tertiary education with 13 fuel pump and 27 shop attendants at 12.0%and 25.0% respectively. Minority of the respondents with 32 fuel pump and 13 shops representing 29.6% and 12.0% respectively have attained primary education.

3.2 Occupational history

History of Respiratory disease before present job, Experience of respiratory symptoms, Occupational years (duration of work), and Work schedule were considered as these reveal exposure level of a worker.

3.2.1 History of Respiratory disease before present job

Table 3: History of respiratory disease before present job

	Fuel attendants		Shop attendants	
Respiratory disease	N	%	N	%
Yes	0	0.0%	0	0.0%
No	108	100.0%	108	100.0%
Total	108	100.0%	108	100.0%.

History of respiratory disease before the present job among the respondents (table 3) revealed that none of all the 216 (100%) respondents have had respiratory disease before the present job.

3.2.2 Occupational years (Duration of work) of Respondents
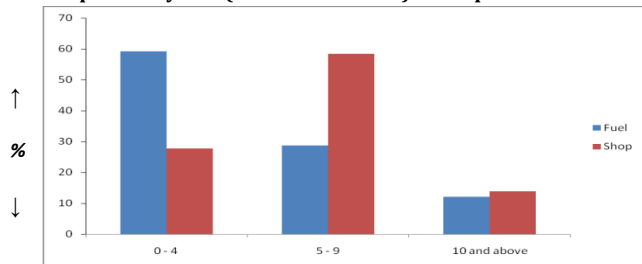
← Occupational Years →

Figure 3: Frequency and Percentage of occupational years (duration of work) of respondents

Occupational years (duration of work) of the respondents (fig. 3) revealed that majority of them involving 64 fuel pump and 63 shop attendants representing 59.3% and 58.3% have worked between 0-4 and 5-9 years respectively. Minority of them involving 14 fuel pump and 15 shop attendants representing 12.0% and 13.9% have worked 10 and above years.

3.2.3 Experience of Respiratory symptoms

Table 4: Experience of respiratory symptoms among respondents

	Fuel attendants		Shop attendants	
Respiratory symptoms	N	%	N	%
Catarrh	15	13.9%	8	7.4%
Cough	4	3.7%	0	0.0%
Chest pain	3	2.7%	0	0.0%
Breathlessness	0	0.0%	0	0.0%
None	84	79.6%	100	92.6%
Total	108	100.0%	108	100.0%

Experience of respiratory symptoms among respondents (table 4) showed that majority of them involving 84 fuel pump and shop attendants representing 79.6% and 92.6% respectively have no symptom, while 22 fuel pump and 8 shop attendants of 13.9% and 7.4% respectively have catarrh. Only fuel pump respondents, with 4 and 3 attendants representing 3.7% and 2.8% have cough and chest pain respectively.

3.2.4 Frequency of experience of Respiratory symptoms in the last 6 months

Table 5: Frequency of experience of respiratory symptoms in the last 6 months among respondents

	Fuel attendants		Shop attendants	
Symptoms in 6 months	N	%	N	%
Once	15	72.7%	8	85.7%
Twice	4	18.2%	0	14.3%
Thrice	3	9.1%	0	7.0%
Four times	0	0.0%	0	0.0%
Five times & above	0	0.0%	0	0.0%
Total	22	100.0%	8	100.0%

Frequency of experience of respiratory symptoms in the last 6 months (table 5)among the respondents revealed that majority involving 15 fuel pump and 8 shop attendants representing 72.7% and 85.1% have experienced respiratory symptoms once in the last 6 months

3.2.5 Response on stay-off work due to respiratory symptoms

Table 6: Response on stay-off work due to respiratory symptoms

	Fuel attendants		Shop attendants	
Response	N	%	N	%
Yes	0	0.0%	0	0.0%
No	22	100.0%	8	100.0%
Total	22	100.0%	8	100.0%

Response on stay-off work due to respiratory symptoms (table 6) among the respondents revealed that of 22 fuel pump and 8 shop attendants who had experienced respiratory symptoms in the last 6 months, none of them representing 100% stayed-off work.

3.2.6 Work Schedule of Respondents

Table 7: Frequency and Percentage of work schedule of Respondents

	Fuel attendants		Shop attendants	
Work schedule	N	%	N	%
<8hrs/day	0	0.0%	0	0.0%
8hrs/day	34	31.5%	0	0.0%
>8hrs/day	74	68.5%	108	100.0%
Total	108	100.0%	108	100.0%

Work schedule of the respondents (table 7) showed that majority of them involving74 fuel pump representing 68.5% and 108 shop respondents representing 100.0% work more than 8 hours per day, while only 34 fuel pump respondents representing 31.5% work 8 hours per day.

3.2.7 Work shift of Respondents

Table 8: Frequency and Percentage of Work shift of Respondents

Work shift	Fuel attendants		Shop attendants	
	N	%	N	%
Yes	34	31.5%	0	0.0%
No	74	68.5%	108	100.0%
Total	108	100.0%	108	100.0%

Work shift of the respondents (table 8) showed that majority of them involving 74 fuel pump representing 68.5% and 108 shop attendants representing 100% work without shift, while 34 fuel pump attendants representing 31.5% work with shift.

3.2.8 Use of Personal Protective Equipment (PPE)

Table 9: Frequency and Percentage of use of Personal Protective Equipment by Respondents

Use of PPE	Fuel attendants		Shop attendants	
	N	%	N	%
Apron	13	12.0%	0	0.0%
Nose mask	0	0.0%	0	0.0%
None	95	88.0%	108	100.0%
Total	108	100.0%	108	100.0%

Use of Personal Protective Equipment (PPE) by respondents (table 9) revealed that majority of them involving 95 fuel pump and 108 shop attendants representing 88.0% and 100.0% respectively do not use PPE. Only 13 fuel pump attendants representing 12.0% use Apron, while no attendant uses nose mask/respirator.

3.3 Social history

3.3.1 Smoking habit of Respondents

Table 10: Frequency and Percentage of smoking habit of respondents

Smoking habit	Fuel attendants		Shop attendants	
	N	%	N	%
Yes	0	0.0%	0	0.0%
No	108	100.0%	108	100.0%
Total	108	100.0%	108	100.0%

Smoking habit of the respondents (table 10) revealed that none of all the 216 (100%) respondents smoke.

3.3.2 Cooking source of Respondents

Table 11: Frequency and Percentage of cooking source of respondents

Cooking source	Fuel attendants		Shop attendants	
	N	%	N	%
Wood	0	0.0%	0	0.0%
Stove	104	96.3%	108	100.0%
Gas cooker	4	3.7%	0	100.0%
Electric cooker	0	0.0%	0	0.0%
Total	108	100.0%	108	100.0%

Cooking source of respondents (table 11)showed that majority of them involving 104 fuel pump and 108 shop attendants representing 96.3% and 100.0% respectively cook with stove, while only 4 fuel pump attendants representing 3.7% cook with gas cooker.

3.3.3 Accommodation of Respondents
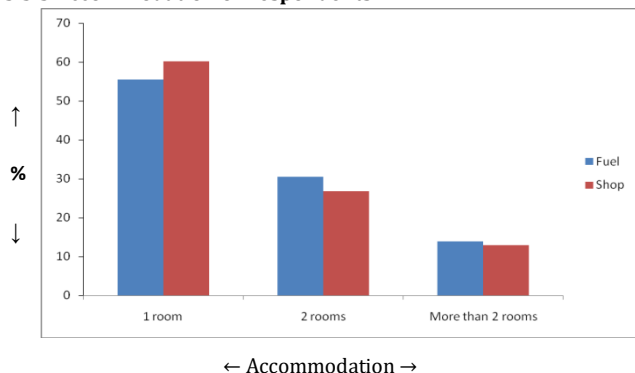

← Accommodation →

Figure 4: Frequency and Percentage of type of accommodation of respondents

The type of accommodation respondents have (fig. 4) revealed that majority involving 60 fuel pump and 65 shop attendants representing 55.5% and 60.1% respectively live in I room apartment, while 33 fuel pump and 29 shop attendants representing 30.6% and 26.9% respectively live in 2 room apartment. Minority of the respondents involving 15 (13.89%) fuel and 14 (12.96%) shop attendants representing 13.9% and13.0% live in more than 2 room apartment.

3.3.4 Number of persons living with Respondents

Table 12: Frequency and Percentage of number of persons living with respondents

Accommodation	No of person	Fuel attendants		Shop attendants	
		N	%	N	%
1 room	1-2	53	88.3%	48	73.8%
	3-4	7	11.7%	17	26.2%
	5-6	0	0.0%	0	0.0%
	7 & above	0	0.0%	0	0.0%
Total		60	100.0%	65	100.0%
2 rooms	1-2	20	60.6%	0	0.0%
	3-4	13	39.4%	13	44.8%
	5-6	0	0.0%	16	55.2%
	7 & above	0	0.0%	0	0.0%
Total		33	100.0%	29	100.0%
More than 2 rooms	1-2	0	0.0%	0	0.0%
	3-4	2	13.3%	0	0.0%
	5-6	11	73.4%	4	28.6%
	7 & above	2	13.3%	10	71.4%
Total		15	100.0%	14	100.0%

Number of persons living with respondents (table 12) showed that of 60 fuel pump and 65 shop attendants who live in 1 room apartment, majority of them involving 53 fuel pump and 48 shop attendants representing 88.3% and 73.8% respectively live with 1-2 persons, while minority of them involving 7 fuel pump and 17shop attendants representing 11.7% and 26.2% respectively live with 3-4 persons. Also, of 33 fuel pump and 29 shop attendants who live in 2 room apartment, majority of them involving 20 fuel pump and 16 shop attendants representing 60.6% and 55.2% respectively live with 1-2 and 5-6 persons respectively, while minority involving 13 fuel pump and 13 shop attendants representing 39.4% and 44.8% respectively live with 3-4 persons. Again, of 15 fuel pump and 14 shop attendants who live in more than 2 room apartment, majority involving 11 fuel pump and 10 shop attendants representing 73.3% and 71.4% respectively live with 5-6 and 7 & above persons respectively, while minority involving 2 fuel pump and 4 shop attendants representing 13.3% and 28.6% respectively live with 3-4, 7 & above and 5-6 persons respectively.

4. Observations

Table 13: Mean Height (cm), Age (yrs), Duration of work (occupational years) and Peak Expiratory Flow Rate (L/min) among Respondents

Variables	Fuel Attendants		Shop Attendants	
	n	X ± SD	n	X± SD
Height	108	158.53 ± 9.86	108	158.67 ± 7.80
t - value = - 0.107, p-value = 0.915, df =214, P>0.05				
Age	108	28.52 ± 6.71	108	26.30 ± 12.19
Z - value = 0.439, p-value = 0.661, df =214, P>0.05				
Duration of work	108	5.14 ± 3.50	108	6.81 ± 3.15
Z - value = 3.686, p-value = 0.000, df =214, P<0.05				
PEFR	108	308.89 ± 51.34	108	350.46 ± 46.41
t - value = - 6.243, p-value = 0.000, df =214, P<0.05				

Key: P>0.05 (Not significant) P<0.05 (significant)

Comparison of the difference of mean height, age, years/duration of work and Peak Expiratory Flow Rate (PEFR) among respondents (table 13) revealed that mean height and age difference are statistically not significant at P<0.05 when t and Z-test were used respectively, while mean years/duration of work (occupational years) and Peak Expiratory Flow Rate (PEFR) among respondents are statistically significant at P<0.05 with Z and t- test respectively. This answers research question 1.

Relationship between gasoline fumes exposure and risk of respiratory disease (PEFR) among respondents

Table 14: Relationship between Socio-demographic, occupational characteristics and Variations in Peak Expiratory Flow Rate (PEFR) of Respondents

Variables	Fuel Attendants		Shop Attendants	
Age group	n	X ± SD	n	X ± SD
<20 yrs	5	320.0 ± 62.45	23	367.39 ± 38.99
20-29 yrs	67	317.76 ± 52.59	54	346.67 ± 50.43
30-39 yrs	29	297.24 ± 42.25	25	350.00 ± 44.53
40-49 yrs	7	264.29 ± 41.17	6	321.67 ± 21.37
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value= -0.226, p-value = 0.000, N = 213, P<0.05				
Sex (gender)				
Male	51	324.90 ± 50.69	45	392.22 ± 24.94
Female	57	294.76 ± 47.96	63	320.63 ± 33.26
Total	108	308.89 ±51.34	108	350.46 ± 46.41
r-value= -0.516, p-value = 0.000, N = 213, P<0.05				
Height				
<150	27	294.07 ± 45.00	19	335.26 ± 46.71
150-159	35	301.14 ± 52.51	40	351.75 ± 43.85
160-169	23	297.39 ± 44.74	38	351.05 ± 49.09
≥170	23	349.57 ± 43.95	11	370.00 ± 42.90
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = 0.264, p-value = 0.000, N = 213, P<0.05				
Duration of work				
0-4 yrs	64	323.59 ± 54.32	30	356.33 ± 38.99
5-9 yrs	31	291.93 ± 42.69	63	352.38 ± 50.43
10 yrs & above	13	276.92 ± 21.36	15	330.67 ± 44.53
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = -0.261, p-value = 0.000, N = 213, P<0.05				
Respiratory symptoms				
Nasal congestion/catarrh	17	328.24 ± 46.53	8	352.50 ± 59.94
Cough	2	320.00 ± 56.57	-	-
Chest pain	3	280.00 ± 34.64	-	-
None	86	305.81 ± 52.23	100	350.30 ± 45.54
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = -0.101, p-value = 0.141, N = 213, P>0.05				
Work schedule				
<8 hrs/day	0	-	-	-
8 hrs/day	34	290.88 ± 44.20	-	-
More than 8 hrs/day	74	318.17 ± 51.89	108	350.46 ± 46.41
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = 0.176, p-value = 0.010, N = 213, P<0.05				
Work shift				
Yes	34	291.67 ± 44.24	-	-
No	74	317.50 ± 52.75	108	350.46 ± 46.41
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = 0.117, p-value = 0.089, N = 213, P>0.05				
PPE use				
Apron	13	291.67 ± 44.24	-	-
Nose mask/respirator	-	-	-	-
None	95	317.50 ± 52.75	108	350.46 ± 46.41
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = 0.068, p-value = 0.318, N = 213, P>0.05				
Type of accommodation				
One room	60	311.83 ± 53.38	65	350.92 45.68
Two rooms	33	305.76 ± 51.24	29	352.07 ± 47.84
More than 2 rooms	15	304.00 ± 45.32	14	345.00 ± 49.88
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = -0.047, p-value = 0.491, N = 213, P>0.05				
Number of persons in a house				
1-2	73	313.40 ± 54.00	48	352.63 ± 48.46
3-4	22	298.57 ± 44.37	30	348.18 ± 40.90
5-6	11	310.40 ± 54.27	20	345.26 ± 47.30
7 and above	2	315.00 ± 49.50	10	353.00 ± 50.12
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = -0.035, p-value = 0.610, N 213, P>0.05				
Cooking source				
Stove	104	310.19 ± 51.12	108	350.92 ± 45.68
Gas cooker	4	275.00 ±51.96	-	-
Electric cooker	-	-	-	-
Wood	-	-	-	-
Total	108	308.89 ± 51.34	108	350.46 ± 46.41
r-value = -0.906, p-value = 0.159, N = 213, P>0.05				

Key: P>0.05 (Not significant) P<0.05 (significant)

Pearson correlation (r) is used to determine the relationship between independent variables and variations in Peak Expiratory Flow Rate (PEFR)

Relationship between Socio-demographic and occupational characteristics and variations in Peak Expiratory Flow Rate (PEFR) among Respondents (table 14) showed that Age, Sex, Height, Duration of work (Occupational years) and Work schedule are statistically significant, an indication that they influence the risk of respiratory disease in attendants, while Work shift, Type of Accommodation, Number of persons living with respondent, Cooking source and Use of PPE are statistically not significant at P<0.05 when Pearson Correlation in SPSS Version 16 was used to test the relationship. Table 14 provides answers for research questions 2 and 3.

Odd ratio

Table 15: Measure of strength of relationship between Risk factor (gasoline exposure) and Effect (risk of symptoms of respiratory disease)

Respondents	Cases	Non-cases	Total
Exposed (fuel pump)	22	86	108
Unexposed (shop)	8	100	108
Total	30	186	216

Association between gasoline fumes exposure and risk of symptoms of respiratory disease among respondents (table 15) showed that of the 108 fuel attendants who are exposed to gasoline fumes, 22 of them have cases of symptoms of respiratory disease, while 86 have no cases of symptoms of respiratory disease. Also, of the 108 shop respondents who are not exposed, 8 of them have cases of symptoms of respiratory disease, while 100 have no cases of respiratory disease. Upon the subjection of the data in the above table to Odd Ratio, the risk was found to be 3.2 times in the exposed. Table 15 above provides answer to question 1 and 3.

5. Discussion

Occupational exposure to gasoline fumes affects the respiratory/pulmonary functions of the body. The present study focused on fuel pump workers engaged in dispensing fuel to vehicles during their duty hours for more than one year in Owerri Municipal, Imo state. 108 non-smoking fuel pump attendants aged between 18-60 years and above formed the test group, while 108 shop attendants with same characteristics working in shops located in Owerri Municipal formed the control group. Results obtained from the study, showed that majority of the attendants were single female adults, aged between 20-29 years, who had worked between 0-4 and 5-9 years in fuel stations and shops respectively. Risk of developing symptoms of respiratory disease was 3.2 times in fuel pump attendants. Variations in Peak Expiratory Flow Rates of attendants were found to be associated with their occupational years/duration of work, age, height, sex (gender) and work schedule. There was a continuous statistical significant decrease in the Peak Expiratory Flow Rate (PEFR) of fuel pump attendants with increased years of gasoline exposure, an indication of risk of respiratory disease, when compared with PEFR of shop attendants with same number of years of work.

The demographic characteristics of the study group, made up of 216 respondents as described in Chapter four, showed that majority of the respondents are female. This may be due to the fact that females are more in the population of Owerri Municipal (National Census, 2006). Females often have fewer financial responsibilities and are supported by parents, relatives or well-wishers; hence they pick up jobs with average remuneration unlike their male counterpart.

Age distributions of respondents revealed that majority of them are between 20-29 years of age. These are young adults, some have not been able to secure employment in formal sector, hence they pick fuel station job to support themselves and family members. The rest of them serve as attendants in shops of relatives or well-wishers. The minority of respondents are aged between 40–49 years. These are less qualified/skilled adults who have worked as fuel pump attendants or shop representatives for some years and have taken these jobs as their means of livelihood.

Level of education of an individual has a lot to do with his/her job placement. Finding son level of education among respondents, showed that majority of them has attained post primary/secondary education. These are young adults who for lack of qualification or financial support to further their education, pick up appointment with fuel stations or shops. Few who have tertiary education are young adults who picked temporary appointment with fuel stations or shops while waiting for their National Youth Service placement, or formal employment in public sector. Primary school drop-outs among the respondents are mainly less qualified/skilled respondents who had gone into trading or fuel attendant job immediately after their primary education.

Findings on marital status of respondents, revealed that majority of them are single. This is in tandem with their age distribution which showed that majority of the respondents are aged between 20-29 years. At this age bracket, most young adults are single. The married, widowed or separated respondents which formed the minority may have belonged to any of the three age brackets considered in the study.

Occupational history of a worker reveals the exposure level of such worker. History of respiratory disease of respondents before their present jobs, revealed that none of all the 216 respondents in the study have had respiratory disease before their present employment. This is in agreement with inhalation disorders which respiratory disease forms a part [6]. These disorders only present themselves due to inhalation of respiratory toxicants and may not occur if a worker has never been exposed to them. No wonder none of the 216 respondents have had any before their present employment. Also, occupational respiratory disease is a rare disease with long latency period [14]. And attendants who may have inhaled respiratory toxicants in their former places of work may not have known they have the disease and there are no pre-employment medical records to say otherwise.

Findings on the occupational years /duration of work among respondents showed that majority of them have worked between 0-4 years and 5-9 years in fuel stations and shops respectively. This shows that fuel station job is of a more temporary nature than shop attendant job.

Experience of respiratory symptoms among respondents showed that more number of fuel pump attendants had respiratory symptom than shop attendants. In addition to this, fuel attendants have more symptoms of cough and chest pain in addition to catarrh unlike shop attendants who have catarrh as the only symptom. This must have been due to exposure of fuel pump attendants to gasoline fumes in addition to other pollutants that are prevailing in Owerri as in other urban cities of the world [1]. Similar findings were observed in study carried out on lung function abnormalities among petrol pump workers of Lucknow, India by Kesavachandran *et al* [15], which also showed a high prevalence of respiratory symptoms in exposed workers as well as significant decline of pulmonary functions, primarily a consequence of exposure to petrol vapors found in the work place of petrol filling stations. The finding also confirms the risk of developing symptoms of respiratory disease in Owerri Municipal, which was found to be 3.2 times in fuel pump attendants than in shop attendants. This provides answer for research questions 1 and 3. Majority of the respondents have no symptom. This may have been due to long latency period of occupational disease which respiratory disease forms a part [14]. It may also have been because of the temporary nature of fuel station job as seen in occupational years/duration of work among respondents. Most fuel attendants may have gone out of fuel station work by the time symptoms of respiratory disease may have started manifesting.

Frequency of experience of respiratory symptoms in the last 6 months among respondents revealed that majority of them, have had respiratory symptoms once in the last 6 months. This may be due to the long latency period of occupational respiratory disease [13] and its symptoms.

Findings of response on stay-off work due to respiratory symptoms, revealed that none of all the attendants who have had respiratory symptoms in the last 6 months, stayed-off work. This may be partly due to the mildness of the symptoms, showing that the respiratory disease have not yet reached its full-blown stage or due to the fact that most fuel stations and shops are owned by private individuals who may not have listened to any absentee/excuse. And in order to avoid termination of employment, these workers reported to duty despite their symptoms.

Results of work schedule of respondents, showed that majority of the respondents work more than 8 hours per day, while only few fuel pump attendants work 8 hours per day. This shows that shop attendants stay longer hours in their duty posts than their fuel counterpart, yet they experience fewer respiratory symptoms. This may be due the fact that they are not exposed to gasoline fumes in their respective shops. It is in agreement with average daily exposure of petrol pump workers as in the study conducted by Singhal *et al* [7], which showed that average daily exposure of petrol pump workers generally exceeds about 10 hours/day.

Work shift among respondents, revealed that majority of the respondents work without shift. Only few fuel attendants work with shift. This may be due to the fact that most fuel stations and shops are owned by private individuals who would want to make the maximum use of their employees hence no work shift. Fuel attendants who are given shift option may be married women who take care of young children or young men who do other things after their work shift.

Use of Personal Protective Equipment (PPE) among respondents, revealed that majority of them does not use PPE. Only few fuel pump attendants use Apron, while none of the respondents uses nose mask/respirator. This shows that both fuel pump and shop attendants are exposed to air pollutants prevailing in Owerri city since they do not use nose masks (as shown in plates 1, 2, 3 and 4 of appendix D). But due to the fact that fuel pump attendants in addition to these air pollutants, are exposed to gasoline fumes due to their occupation, hence they are more at risk of respiratory disease and its symptoms. Apron, the only PPE which few fuel pump attendants use, is not a protective device against exposure to gasoline fumes, since it covers only the skin. That may be the reason behind the number of fuel pump attendants that have respiratory symptoms (as in Table 4). This is in agreement with the findings of Salvi *et al* [3]; Aprajita *et al* [1], which showed that none of the test group uses PPE and are exposed. This provides answer for research question 1.

Social history of a worker reveals the standard of living as well as the kind of habit such worker has. The findings of smoking habit among respondents showed that of all the 216 respondents, none smokes. Gasoline is a volatile and highly flammable liquid [16] and only non-smokers may have been given employment opportunities in fuel stations and shops. Also, only non-smokers were administered questionnaires during data collection.

Accommodation of respondents, revealed that majority of them live in one-room apartment. Minority live in two and more than two-room apartment. This shows that attendants do not earn much, hence the majority live in one-room apartment which is more affordable than two or more than two room apartment. Those who live in two or more than two-room apartment may not have been totally independent. Some may be living with parents, relatives or well-wishers who support them. This confirms marital status, sex and age distributions of respondents which showed that majority of the attendants are single female adults aged between 20-29 years.

Findings of numbers of person living with respondents, revealed that majority of them live with 1-2 persons in 1 room

apartment. Few live with 3-4 persons, while minority of them live with 5-6, 7 &above persons in 2 room and more than 2 room apartment. An individual's standard of living as reflected by his/her income and accommodation go a long way to determine the number of persons he/she lives with. Majority of respondents live with 1-2 persons in one-room apartment due to their income, while others who are single live with other singles. Also, since majority of the respondents are single as seen in their marital status, no wonder respondents who live with 1-2 persons are greater in number. Respondents who live with 3-4 persons are married fuel and shop attendants, while those with 5persons and above are respondents who live with parents, relatives or well-wishers.

Cooking source of respondents showed that majority of them cook with stove, while only few fuel pump attendants cook with gas cooker. This shows the availability and affordability of kerosene over gas, hence majority of the attendants use it as their source of cooking. Minority of fuel pump attendants who use gas cooker may be using it as alternative.

Anthropometric parameters of the study group, showed mean age and height of fuel pump attendants as 28.52 ± 6.71 years and 158.53 ± 9.86 centimeters respectively, while that of shop attendants were 26.30 ± 12.19 years and 158.67 ± 7.80 centimeters respectively. Comparison of means of these two groups was found to be statistically not significant, when z and t-tests were used respectively at p<0.05 to test the difference in these mean values. Results of Peak Expiratory Flow Rates (PEFRs) of the study group, revealed mean PEFR of fuel pump attendants and shop attendants as 308.89 ± 51.34 L/min and 350.46 ± 46.41 L/min respectively. These two groups differed significantly in these values, when t-test was used at p<0.05 to test the difference in their means. This implies a decline in pulmonary function of fuel pump attendants, an indication of risk of respiratory disease due to their occupational exposure to gasoline fumes and answers research question 1. The resultsare in agreement with the study conducted by Singhal *et al* [7], on Lung functions of Petrol Pump workers in India, which showed that the test group and control group did not differ significantly in their anthropometric parameters of age and height but differed significantly in lung function values. Also in study conducted by Chawla and Lavania [17], there was a significant decline evident in years of work of fuel station workers.

In testing the hypothesis 3 of this study, the relationship between socio-demographic, occupational characteristics and variations in Peak Expiratory Flow Rates of the study group was generated. Upon subjection of data to Pearson co-relation test in SPSS Version 16 to determine if there is a significant relationship, the results obtained showed that years of occupational exposure, age, sex (gender), height, and work schedule of attendants were significantly associated with variations in their PEFR, while type of accommodation, number of persons living with respondents and cooking source were not significantly associated with variations in their PEFR. This is in agreement with the study conducted by Ebomoyi and Iyawe [21] on the Peak Expiratory Flow Rate (PEFR) variations of healthy young adults, in Nigeria which showed that in healthy adults, PEFR significantly (P<0.05) increases with height, but fluctuates with increase in age especially above 30 years of age in healthy adults. This also confirms the reports of other investigators.

Similar studies conducted in Calabar, Nigeria by Okoro *et al*[11]; Udonwa *et al* [12] and Adewole *et al* [13] as regards pulmonary functions and other health problems also agree with the result. All of them showed negative health effects on some organs and systems of the body as well as significant decline in pulmonary functions of the exposed workers.

The decline in ventilatory function (PEFR) of exposed workers was found to be associated with increase in their occupational years (duration of work). This is in agreement with the findings of Alakija *et al*

[8] in his study on ventilatory functions of workers at Okpella Cement factory in Nigeria, which showed that the severity of respiratory function impairment depends on years of exposure. The severity of impairment of respiratory functions is also in agreement with most studies on pollution inflicted changes in lung functions [18].

Odd Ratio was found to be 3.2 times in fuel attendants than in shop attendants. This shows that fuel attendants are at greater risk of developing symptoms of respiratory disease than shop attendants due to their occupational exposure to gasoline fumes. Similar findings were also observed in study carried out on lung function abnormalities among petrol pump workers of Lucknow, India by Kesavachandran *et al* [19], which showed a high prevalence of respiratory symptoms as well as significant decline of pulmonary functions, primarily a consequence of exposure to petrol vapors found in the work place of petrol filling stations. Also studies carried out by Zuskin [19] and Lee *et al* [20] found that exposure to pollutants at work place had significantly more respiratory symptoms than controls. This answers research questions 1 and 3.

6. Conclusion

Respiratory disease has become an occupational health risk which fuel pump attendants face due to their exposure to gasoline fumes. The risk of respiratory disease among fuel pump attendants in Owerri Municipal was found to be 3.2 times and is associated with their years (duration of work) of gasoline fumes exposure, age, sex (gender), height and work schedule. A continuous exposure in the pump attendants for 4 to 10 and above years revealed statistically significant decline in Peak Expiratory Flow Rate (PEFR), when compared to shop attendants who have worked for same number of years.

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