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LUNG FUNCTION ABNORMALITIES AMONG FUEL FILLING WORKERS IN KARACHI, PAKISTAN

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ABSTRACT

It is observed fact that petrol pump workers (filling attendants) are continuously exposed to the Organic and inorganic substances present in the petrol. The present study aims to evaluate the pulmonary function of filling attendant exposed to volatile organic and inorganic compounds (voc)arising from fuel on fuel filling stations, in order to judge the level of respiratory compromise. Health effects of occupational exposure to petroleum vapors and air pollution from filling station is relatively unexplored among petrol filling workers in Karachi.

The research is a case- control study that comprises a total of 130 controls and 130 cases (fuel station workers).The data were collected by convenient random sampling technique. Lung function of workers was evaluated by using vitalograph. Lung function parameters FVC, FEV_1, FEV_1% and PEFR were assessed. Data analysis was done on SPSS 16 version.

Mean age group for both control and cases was 28.63± 1.5 yrs. Filling stations were divided in three categories according to the type of fuel available i.e. CNG, petrol and both, with majority falling in the both. On the basis of duty hours employs were categorized in three groups i.e. less than 8 hours, 8-12 hours and more than 12 hours with majority falling in more than 12 hours; it was found that the duty hours are indirectly related to VC of individuals. For this study the individuals were matching age, height and weight so that no significant difference were observed. However, it was observed that significant decrease was seen in VC, FVC, FEV_1, PEFR and FEV_1%, .This, suggests that these variables are markedly affected between the control and case study. The study showed that lung functions are altered in petrol pump workers as compared to the control group, because of petrol fumes.

Keywords: Petrol pumps workers, pulmonary function test, vitalograph.

ABBREVIATION

FVC: Forced Vital Capacity
FEV_1: Forced Expiratory volume in at the end of 1 sec
FEV_1%: Forced Expiratory Volume Ratio
PEFR:Peak Expiratory Flow Rate
SOB: Shortness of Breath
PFT: Pulmonary Function Test
VC: Vital Capacity
CNG: Compressed Natural Gas

Introduction

It is a well-documented fact that polluted air causes ill effect on the health. With urbanization and rapidly increasing number of automobiles in most of the cities there is increase in air pollution. Studies showed the recognized fact that petrol pump workers (filling attendants)are continuously exposed to organic and inorganic substances present in the petrol (Majumdar et.al, 2008). These are numerous, but to name a few, are volatile compounds including benzene and toluene along with toxic gases such as carbon monoxide and traces of soot. They can have deleterious effect on general health particularly on the respiratory system. A study published in the Journal of Environmental Management from the University of Murcia in Spain showed that the air at petrol stations and in their immediate surroundings is especially affected by emissions stemming from evaporated vehicle fuels. This includes un-burnt fuel from fuel loading and unloading operations, refueling and liquid spillages. The study also concluded, dangerous airborne pollutants from garages could contaminate buildings as far as 100m away(Isabel et.al, 2010). Therefore one can very well deduce the high levels of aromatic hydrocarbons at the filling station. Some airborne organic compounds - such as benzene - have been recorded at petrol stations at levels above the average levels for urban areas where traffic is the primary source of emission (Sergioet.al, 2012, Isabel et.al, 2010). This nullifies the general opinion that road side air pollution is the only area of concern to environmental management. The average daily exposure to filling attendants to these air pollutants exceeds that of non filling healthy controls. Some of them are working for more than a decade. Health effects of occupational exposure to petroleum vapors and air pollution from filling station is relatively unexplored among petrol filling workers in Karachi. Hence, the present study aims to evaluate the pulmonary function of filling attendant at fuel filling stations,

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to judge the level of respiratory compromise and to highlight the necessity for any improvement in the precautionary measurement taken at the filling station.

Methodology

It is a case - control study, conducted in Karachi, Pakistan. during the period of 1st August 2013 to 1st October 2013. The sample size, as calculated by open epi .com is 130 each controls and cases. The samples were collected by a convenient random sampling technique via filling out questionnaires and performing spirometeric based test by vitalograph.

Inclusion criteria: The study includes:

- Males
- People older than 15 years
- People working on fuel pumps for more than 6 months

Exclusion criteria: The study excludes:

- People with known pulmonary disorders

The main instrument used in the study is vitalograph which is a portable and digital device it calculates FVC, FEV_1, FEV_1% and PEFR, along with other tools like Weighing machine, measuring tape and nose clip.

Data collection procedure:

Data was collected by convenient random sampling technique. Informed consent was obtained from each subject prior to study. The present study included a total of 130 workers engaged in fuel filling station for more than 8 hrs/day, and 130 healthy controls of same age, height and weight. Questionnaire was filled and instruction and demonstration were given on how to perform the spirometer test. The Vitalograph is a portable instrument used for recording parameters for pulmonary function tests that include VC, FVC etc.

Statistical analysis:

Data analysis is done on SPSS 16 version to calculate mean percentage and Chi square test to see the significance of study.

Ethical consideration:

Research is conducted by keeping in view the ethical considerations. It is approved by an ethical review committee (for any research relating to human subjects a review committee must go through the proposal after the approval of this the research will be conducted) Permission was taken from the fuel pump managers and each of the workers, individually. All of the participants gave their informed consent prior to their inclusion in the study.

Results

It was observed that the factors which are associated with altered pulmonary function like cough, SOB and SOB on walking showed significant difference between control and cases 0.028, 0.001 and 0.000 respectively ($p< 0.05$ and $p< 0.01$) (Table 1). Smoking does not play any role in this scenario because both control and cases includes the smokers and it was also showed in results as non significant.

Table 1. Associated factor affecting lung function

	Control (%)	Case (%)	Chi square test
Smoking	45.5	54.5	0.508
Cough	21.4	78.6	0.028*
SOB	15	85	0.001**
SOB(Walking)	13.3	86.7	0.000**
Chest illness	33.3	66.7	0.561

$p< 0.05$*
$p< 0.01$ **

The three types of filling stations considered for this study among them 80% were petrol filling stations (Figure 1). Table 2 showed that among them no significant differences were observed in the PFT.

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Figure 1: Types of filling station

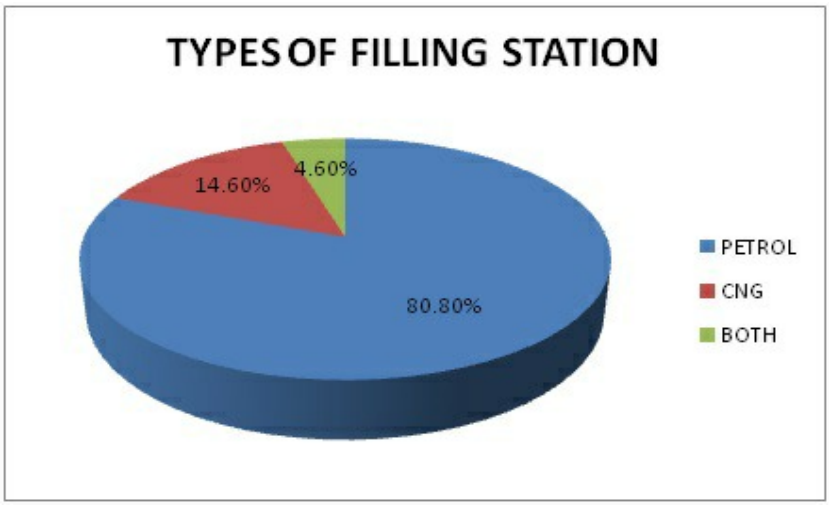

Table 2: Mean , Standard Deviation and P value of pulmonary function test of different categories

	CNG		Petrol		Both		P- Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
VC	4.18	0.2	4.1	0.25	4.17	0.25	0.38
FVC	2.81	0.88	2.8	0.84	2.61	0.82	0.85
FEV_1	2.45	0.96	2.21	1.05	2.4	0.75	0.62
PEFR	237.95	162.17	248.06	138.94	192.83	76.73	0.63
FEV_1 %	80.95	16.09	77.12	27.94	91.83	5.34	0.36

Regarding the duration of their working hours in these stations it also does not show any differences in the workers pulmonary function (Table 3).

Table 3: Mean , Standard Deviation and P value of pulmonary function test at different working durations.

	< 6 Months		6 Month - 1 years		1 years - 3 years		>3 years		P- Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
VC	4.19	1.22	4.16	0.31	4.19	0.18	4.12	0.24	0.16
FVC	2.65	0.85	2.49	0.98	2.91	0.74	2.8	0.85	0.44
FEV_1	2.04	1.01	2.01	1.19	2.26	1.09	2.25	1.03	0.61
PEFR	217.53	129.5	216.33	135.47	253.67	137.353	250.7	145.18	0.72
FEV_1 %	75.18	28.18	76.58	30.29	78.22	30.97	79.12	24.29	0.94

The employment type showed significant difference in PEFR of regular employees as compared to daily wages ones at $p<0.05$. (Table 4)

Table 4: Mean, Standard Deviation and P value of pulmonary function test of different type of employees

	Regular		Daily Wage		P- Value
	Mean	Standard Deviation	Mean	Standard Deviation	
VC	4.1	0.24	4.09	0.28	0.69
FVC	2.83	0.86	2.56	0.63	0.25
FEV_1	2.27	1.06	2.1	0.699	0.54
PEFR	252.47	141.28	179.33	114.04	0.05*
FEV_1 %	78.35	26.96	78.47	18.05	0.98

$p< 0.05$ *

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Figure 2: Duty hour of employees

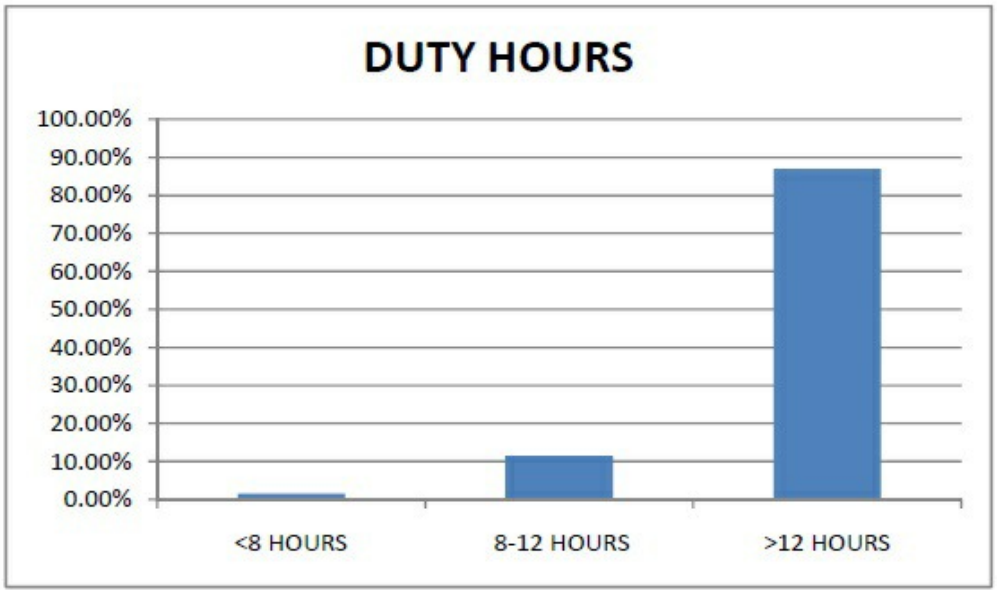

Table 5: Mean , Standard Deviation and P value of pulmonary function test of different duty hours of employees.

	< 8 hrs.		8-12 hrs.		>12 hrs.		P- Value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
VC	3.93	0.08	3.98	0.27	4.14	0.23	0.029*
FVC	2.99	0.51	2.81	0.88	2.8	0.84	0.94
FEV_1	2.65	0.41	2.45	1.04	2.22	1.03	0.62
PEFR	279.5	96.87	257.13	156.64	241.66	139.19	0.86
FEV_1 %	89	1.41	83.93	21.32	77.43	26.77	0.56

p< 0.05*

ANOVA was done to see the difference in lung function test among the workers of filling stations. It was observed that among all the variables only significant result was seen in VC at p< 0.05. It also showed that as long as the workers live in that environment their vital capacity was affected. So the duty hours are inversely proportional to VC of individuals. (Figure 2, Table 5)

TABLE 6: Mean difference in Pulmonary function test of both groups

	Control		Case				
	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference	Independent t-test	P- Value
AGE	28.63	11.282	29.89	10.727	1.262	0.92	0.356
HEIGHT	5.61	0.301	5.581	0.221	0.029	0.9	0.368
WEIGHT	69.22	1.02	67.19	3.98	2.03	0.56	0.573
VC	4.203	0.31	4.12	0.24	0.08	2.3	0.02*
FVC	3.06	0.79	2.8	0.84	0.261	0.5	0.011*
FEV_1	2.8	0.84	2.25	1.03	0.54	4.6	0.000**
PEFR	298.15	119.07	244.03	140	54.1	3.3	0.001**
FEV_1 %	88.5	14.87	78.36	26.03	10.1	3.8	0.000.**

*p<0.05 = Significant
**p<0.01 =highly significant

For this study the individuals were taken matching age, height and weight. As such no significant difference was observed in these variables. However, it was observed that significant decrease was seen in VC, FVC, FEV_1, PEFR and FEV_1%.This suggests that these variables are markedly affected between the control and cases studied. (Table 6)

Discussion

Particulate pollutants are the established causative factors that affect the pulmonary function. The study undertaken focused on Vitalograph readings of FVC, FEV_1, PEFR and FEV_1%. When the data of the control & case group was compared; significant difference ($p=<0.005$) was found. The decline in FVC/FEV_1 (FEV_1%) in the workers group was not found to be associated with hours of duty on work. Smoking & vehicular exhaust containing SO_2, NO_2, CO & particulate matter are independent variables affecting FEV_1; in addition to the aliphatic & aromatic hydrocarbons & more importantly, the 1-5% benzene content of petrol fumes. Since petrol pumps are usually located at road side, workers are also exposed to other pollutants as well (Chawla & Lavania 2008). According to this research, the frequency of restrictive type of lung abnormality in the petrol pump workers was more in comparison with the control group. Decrease in pulmonary function tests can be explained on the basis that it is a chronic process rather than an acute one. Lymphoid & connective tissue reaction in the terminal & respiratory bronchioles & interstitial inflammatory cells including macrophages can be found (Pinkerton 2000). It was found that fuel fumes have particles that are very minute ranging from 0.02-0.2nm in diameter. They have greater surface area to mass ratio & the fraction of toxic compounds, e.g. metal particles & hydrocarbons is more as well; so they easily reach up to the terminal bronchioles invading the parenchyma causing chronic inflammation & thus, leading to restrictive pattern of lung disease (Begum &Rathna 2012).

In overall this study showed altered lung functions in petrol pump workers as compared to the control group. This is, because of petrol fumes, the major component of which is benzene that is impairing the lung function.

Conclusion

This research study depicted the significant difference in the lung function test results of petrol pump workers from the control, this point toward the fact that the mechanical properties of breathing are hampered due to chronic exposure to the fuel fumes. Protective measures, lung function exercise and regular follow up may help reduce the burden of this occupational hazard.

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