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Effect of Petroleum Fumes on Cardio -Pulmonary Efficiency in Petrol Pump Workers of Western Maharashtra.

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ABSTRACT

Although petroleum products are useful chemical compounds which form an integral part of our modern technology, they have been reported that inhalation of petroleum products cause hazardous effect on health. Long term exposure to these chemical has deleterious effect on heart and lungs. This work was undertaken to identify cardio- pulmonary efficiency among the petrol pump workers (PPW) of western Maharashtra. The study was conducted on 60 male petrol pump workers between age group of 20- 40 years who were working as petrol filling attendant for more than one year. 60 normal healthy male with same age & same socioeconomic status were chosen as control to find out the effect of occupational exposure to petroleum fumes on cardio-pulmonary efficiency. Blood pressure & 40 mmHg endurance time was measured clinically with the help of Sphygmomanometer & stop watch. Heart rate & breath holding time was measured with stop watch. There was significant increase in systolic, diastolic blood pressure & Heart Rate (HR) in petrol pump workers as compare to control group. The mean value of systolic and diastolic blood pressure increases with increased years of exposure; this change was found to be statistically significant (P-value 0.001). But the mean value of HR was not increased according to year of exposure. Also there was significant decrease in breath holding time & 40 mmHg endurance time ($p < 0.05$) in petrol pump workers as compare to control. The mean value of breath holding time & 40 mmHg endurance time significantly decreases with increased years of exposure. The cardiopulmonary tests are done & results suggest that cardio-pulmonary efficiency are significantly compromised in petrol pump workers as compared to control subject as they are exposed to traffic vehicle exhaust apart from environmental pollutants.

Keywords: Petrol Pump Workers (PPW), Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Breath holding Time (BHT), 40mmHg endurance time.

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INTRODUCTION

India is a rapidly developing country and automobiles running on roads are increasing day by day. Petrol is a generic term for petroleum fuel which is mainly used for internal combustion engines, it mainly contains toxic chemical substances like benzene, toluene, ethylbenzene, xylene (BTEX Compound) and lead. Other compounds found in petrol are manganese, naphthalene, trimethylbenzene and Methyl tert-butyl ether (MTBE).

Petrol pump workers are exposed to petroleum hydrocarbon through ingestion of contaminated food, drinking contaminated water, contact with contaminants (dermal exposure) or inhalation of vapour and air-borne soil. [1]

Urbanization has led to enormous increase in number of automobiles and accordingly in order to increased number of petrol filling stations and workshops for repairing the vehicles. Workers engaged in these places are continuously exposed to petrol and diesel fumes. The particles generated from petrol exhaust are extremely small and are present in the nuclei or accumulation modes, with diameters of 0.02nm and 0.2nm respectively.

In recent years, interest on the adverse effects of petroleum hydrocarbons has grown, and focus has been on the deleterious effects of these products on various systems of the body. Petroleum hydrocarbons not only affect the Systems (respiratory, cardiovascular, immune and nervous) but also it affects organs like heart, liver, lung, kidney, and skin. Petroleum products and its exhaust can cause significant respiratory symptoms like chronic cough, breathlessness and wheezing [2, 3]. Also it has been shown that petroleum products cause tachycardia, dysarrhythmias, dizziness, pulmonary hypertension, [4] pulmonary aspiration, severe respiratory and cardiac failure, impaired regulation of vascular tone and endogenous fibrinolysis. [5,6]

A number of studies are available on toxic effect of petroleum fumes in petrol pump workers, but none of them documented cardio-pulmonary efficiency in petrol pump workers. So, in the present study an attempt has been made to justify toxic effect of petroleum fumes on cardio-pulmonary efficiency in petrol pump workers of western Maharashtra by comparing it with normal subject.

MATERIALS AND METHODS

After the approval by institutional ethical committee, a cross sectional study was carried out on 60 petrol pump workers of Western Maharashtra (Sangli, Satara & Kolhapur Dist) with age group 20-40 years. They were further divided into three groups depending on their duration of exposure as Group I (1-5 years), II (5-10 years) & Group III (more than 10 years). 60 control subjects were chosen from paramedical staff of same age, gender and socioeconomic status from the same place for comparison. Demographic, occupational and clinical data were collected by using questionnaire and interview. Randomly selected 60 petrol pump workers were eligible to whom the experimental protocol was explained and written informed consent was obtained from them. Non-smokers, non-alcoholic healthy males, who were occupationally exposed to petroleum fumes for more than 6 hr /day with the duration of exposure from 2 to 20 years, were selected for this study. Most of the workers consumed mixed type of diet. Workers with less than 1 year exposure, any history of respiratory, cardiac diseases and smokers tobacco/mawa/Gutkha chewers were excluded from the study

The cardiopulmonary fitness of an individual was found out by performing the following tests :

Blood pressure (BP) was measured with the help of Riva Rocci Mercury Sphygmomanometer by auscultatory method, in supine position. Systolic and diastolic BP was expressed as mm/Hg.

Heart rate of each subject measured clinically for one min. after 5 min. of rest in supine position.

Breath holding time-The workers were asked to take a maximum inspiration after maximum expiration and then hold the breath by plugging the nose as long as possible. The maximum time the subject can hold the breath was noted with the help of stop watch [7] (proceedings).

40 mmHg endurance test (Flack’s Air-Force Manometer Test)-workers were asked to take deep inspiration and then close the nose. Then immediately blow in rubber tube which was connected to mercury manometer to raise the mercury level up to 40mmHg without blowing the cheeks. The workers were asked to maintain this mercury level up to 40mmHg as long as possible. Time interval between beginning of blow and breaking point was taken as 40 mmHg endurance time. Anthropometric measurements which include height & weight were recorded.

All the tests were recorded at noon before lunch. The experimental protocol was explained in detail to the workers & trials were given after the demonstrations. For each volunteers three satisfactory efforts were recorded.

Statistical analysis - Data are expressed as mean ± standard deviation (SD) of petrol pump workers and control group. Statistical analyses were done by analysis of variance (ANOVA). Unpaired student *t* – test was used to analyze the level of significance between the petrol pump workers and control groups. *P*<0.05 was considered to be significant.

RESULTS

Rapidly multiplying number of automobiles vehicles and petrol pumps has increased air pollution. So we had tried to assess cardiopulmonary efficiency in petrol pump workers. These workers are constantly exposed to exhaust fumes and fuel vapours throughout their duty hours which causes decline in cardiopulmonary efficiency.

The observed values of cardio-pulmonary efficiency tests in petrol pump workers & in control groups are given in Table 1. There was significant increase in SBP, DBP, HR in petrol pump workers than in control group. Also there was significant decrease in breath holding time & 40 mmHg endurance time (*p* < 0.05) in petrol pump workers than in control group.

Table I: Showing mean and SD of cardio-pulmonary efficiency in petrol pump Workers& in control Group.

Parameters	Petrol Pump Workers (n=60) Mean ±SD	Control(n=60) Mean ±SD	t- Value	P value
Systolic BP (mmHg)	124.00 ± 8.445	120.23 ± 7.439	-2.162	0.033 *
Diastolic BP (mmHg)	83.03 ± 5.758	79.70 ± 4.537	2.593	0.011*
Heart Rate /min.	73.77 ± 3.417	70.80 ± 4.657	-3.979	0.000*
Breath Holding Time (BHT) (sec.)	28.78 ± 12.585	37.50 ± 11.481	-3.964	0.000*
40mmHg Endurance Test (sec.)	23.00 ± 10.276	34.12 ± 10.451	-5.875	0.000*

*- statistically significant, NS- Not significant

Table II: Showing mean and SD of cardio-pulmonary efficiency in petrol pump Workers according to the duration of exposure.

Parameters	Year Of Exposure of Petrol Pump Workers			F- Value	P value
	1-5 yrs (n=20) Mean ±SD	6-10 yrs (n=12) Mean ±SD	More than 10 (n=8) Mean ±SD		
Systolic BP (mmHg)	123.74±8.354	124.33±9.335	128.0±8.485	0.249	0.780NS
Diastolic BP (mmHg)	82.65±5.964	84.00±5.117	86.00±5.657	5.646	0.005*
Heart Rate /min.	71.00 ±3.668	70.87 ±4.978	68.00 ±0.00	0.370	0.693NS
Breath Holding Time (BHT) (sec.)	40.00 ± 8.48	37.50 ± 7.84	26.02±12.54	5.511	0.005*
40mmHg Endurance Test (sec.)	23.00 ± 10.27	22.23 ± 8.511	20.75 ± 7.605	12.359	0.000*

*- statistically significant, NS- Not significant

DISCUSSION

About 95% of compositions in the petrol vapour are aliphatic and acyclic compounds while less than 2 % are aromatic compounds.[8] Inhalation of petrol fumes is associated with risk of cancer, respiratory and cardiovascular diseases.[9]

This study showed that inhalation of petroleum fumes led to significant increase in systolic, diastolic blood pressure and heart rate (Table no I). The mean value of systolic and diastolic blood pressure increases with increased years of exposure; this change was found to be statistically significant (P-value 0.001). But the mean value of HR was not increased according to year of exposure, this change was not found to be statistically significant (Table no II).

Findings of our study coincide with findings of other study done by Azeez et al. 2015, Azeez et al. 2012, Steffe et al. 1996, Chalmers 1991; Levecchio & Fulton 2001; Mills 2005. [10-15]

Also A. Akintonwa et al. 2003 [16] studied that there was significant increase in both systolic and diastolic blood pressure, about 12.5% of the petrol station attendants had systolic blood pressure range of 141-160 mmHg while 28.6% had diastolic blood pressure range from 91-110 mmHg. This increase in SBP, DBP & HR may be due to ability of petroleum hydrocarbon to enhance the sensitization of myocardium to catecholamine, impaired vagal activity & increased Baroreceptor activity with resultant vasoconstriction and increased arterial blood pressure.

Present study showed that inhalation of petroleum hydrocarbon led to significant decrease in breath holding time and 40 mmHg endurance time (Table no I). The mean value of breath holding time and 40 mmHg endurance time decreases with increase in years of exposure, (Table no II) this change was found to be statistically significant (P-value 0.001).

Breath holding time and 40 mmHg endurance is a useful biomarker in determining cardio-pulmonary fitness. These tests are considered as one of the best indicators of pulmonary efficiency. Normal voluntary breath-holding time is 45-55 seconds. During breath-holding, arterial PO_2 falls and PCO_2 rises, resulting in a state of asphyxia. Since both these factors are powerful respiratory stimulants, a point is reached where the respiratory drive becomes so strong that the person cannot hold the breath any longer. In present study there is highly significant decrease in BHT & 40 mmHg endurance time may be due to, petroleum hydrocarbons decreases tolerance to higher PCO_2 and low PO_2 .

Finding of present study suggests that petroleum hydrocarbons may have a pressor effect on cardiovascular functions. The pressor effect could be correlated to the ability of hydrocarbons to cause sensitization of myocardium to catecholamines, impairment of vasovagal event, respiratory depression, hypoxia, and hypercapnia [17,18,19] with consequent sympathetic effect and elevation of arterial blood pressure. This study revealed that inhalation of petroleum hydrocarbons led to increase baroreflex sensitivity impaired vascular tone.

CONCLUSION

The present study revealed that petrol-pump workers are highly vulnerable for Cardio-pulmonary impairment due to their occupation. It has also shown that Breath holding time and 40 mmHg endurance is a useful biomarker in determining cardio-pulmonary fitness.

Impairment cardio-pulmonary efficiency could be attributed to the lack of health awareness and protective measures during work among petrol pump workers. Hence, considerably improved awareness of the sources of toxins in the community would help the individuals to avoid them.

Recommendation: To minimize the health related issues,

- Petrol pump owners should conduct regular health checkup camps in their petrol stations.
- Petrol pump owners should make sure that health regulations are implemented, with employees being provided biennial medical surveillance program.

- There be more stringent hierarchy Petrol pump owners should provide control measures in work place, that include provision of personal protective equipments like gloves, apron, long shoes, appropriate respiratory protective equipments i.e. anti-pollution masks etc.

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