ORIGINAL ARTICLE

Haematological Assessment of Petrol Pump Workers of Jaipur City

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ABSTRACT:

Background: Monitoring of occupationally exposed workers could be one of the important steps in evaluating risks and implementing strategies for improving occupational conditions in order to establish a safe working environment. With this perspective, this study was undertaken to find out the effect of gasoline vapors on the hematological parameters of the petrol pump filling attendants working at various petrol pumps of Jaipur city.

Material and methods: This study was conducted with 40 petrol pump workers working for more than three years at various petrol pumps of Jaipur city as study group and 40 matched male adults working as peons and ward boys in the different departments of the institute as the control group. Complete blood picture analysis was done using Automated 5 part Differential Cell Counter available at the Central Pathology Laboratory in S.M.S Hospital Jaipur. Mean± standard deviation values for each parameter were determined for both the study and control groups and compared using an unpaired *t*–test, and $P < 0.05$ was considered significant.

Result: The mean values of hemoglobin levels, total red blood cells (TRBC) and platelet count (PLT count) was significantly decreased in the petrol pump workers when compared to the control group. No significant differences were observed in differential leucocyte counts (DLC) between both the study and control group except the eosinophil count whose mean values were found highly significant in the petrol pump workers in comparison to the control group.

Conclusion: This preliminary study concludes that the petrol pump workers could be at greater risk to develop hematological alterations with time. So, further long-term studies with large sample size and regular follow-ups are required to get better insights into the results.

Keywords: Gasoline vapors, Occupational exposure, Petrol pump workers, Complete blood count

INTRODUCTION

In recent decades, along with the economic growth, the level of urbanization in India has increased from 27.81% in 2001 to 31.16% in 2011[1]. This substantial rise in the urban population throughout the country has led to many problems like increasing slums, poor sanitation and has also placed heavy demands on the urban transport systems and personalized vehicles[2,3]. Consequently, mushrooming of petrol filling stations to gratify the increasing fuel needs of the expanding vehicular fleet[4].

According to the Annual report entitled "Indian petroleum and natural gas statistics (2014-15)" brought by the Ministry of Petroleum and Natural gas, Government of India, New Delhi, the total petroleum retail outlets (petrol pumps) in India, has outgrown progressively from 36921 in 2008 to 53419 till march, 2015[5].

These Indian Petrol pumps, alike many developing countries are manned by unskilled workers who dispense petrol/diesel without wearing any protective devices and many work for as long as 10-12 hours each day[6]. Thus, these fuel dispensers are continuously exposed to various gasoline derivatives like benzene, toluene, ethylbenzene, xylene in the form of vapors and tailpipe-emissions[7].

The U.S National Institute for Occupational Safety and Health (NIOSH) considering BTEX as potentially hazardous to human health, stressed on the need to reduce

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its workplace exposure to the lowest feasible limit and suggested the recommended exposure limits (RELs) to be 0.1ppm (0.319mg/m^3), 100ppm (375mg/m^3), 100ppm(435mg/m^3), and 100 ppm(435mg/m^3), respectively for 8 hours-time weighted average (TWA)[8]. Also in India, Central Pollution Control Board (CPCB) has limited the benzene levels to be 5 micrograms per meter cube[9].

However, a study conducted in Delhi by Sehgal et al from The Energy and Resources Institute (TERI) monitored benzene at 40 petroleum-filling stations in Delhi and within the breathing zone of the dispensing crew during 2009–2010 recognized an extremely high concentration of benzene, toluene and xylene at the filling stations with maximum observed values of 6406, 5890, and 9512 microgram per meter cube, respectively during winter months which was far exceeding than those laid down by the Indian national ambient air quality standards[10].

An overseas study conducted in Italy showed that in a single refueling operation that lasts for about one minute, the mean air concentration of benzene to which a petrol pump worker is exposed is 3709 µg/m3, which indicates that the petrol pump workers are exposed to high concentrations of benzene in their breathing zone while fueling and re-fuelling of vehicles[11]. Exposure to gasoline derivatives in form of vapors are not considered to be safe even inhaled for a brief period of time and owing to their occupation, the petrol pump workers are continuously exposed to such noxious chemical substances[12].

Thus, monitoring of such occupationally exposed workers could be one of the important steps in evaluating risks and implementing strategies for improving occupational conditions in order to establish a safe working environment.

Hence, this study was undertaken to find out the effect of gasoline vapors on the hematological parameters of the petrol pump filling attendants working at various petrol pumps of Jaipur city.

MATERIALS AND METHOD:

This study was undertaken at the Upgraded Department of Physiology in collaboration with the Central laboratory of the S.M.S Medical College, Jaipur after obtaining approval from the ethical committee of our institute and the written informed consent from the volunteers of the study.

A total of 80 subjects (40 petrol filling male attendants working for more than three years at various petrol pumps of Jaipur city and 40 matched controls from the institute working as peons and ward boys in the different departments) who met the selection criteria were included in the study. Subjects of both study and control group having a history of smoking, alcoholism, any acute or chronic illness, any major surgery (Cardiac, pulmonary, abdominal), any type of known allergic conditions, were excluded from the study. After, a brief physical, anthropometric (height, weight, body mass index [BMI]), and clinical examination, around 3ml of blood sample of each selected subject was collected in EDTA coated tube under aseptic precautions following the standard blood sampling protocols. Each EDTA coated tube containing the blood sample was labeled with a registration number issued for each subject by the computerized registration counter of the SMS hospital and was delivered within 2 hrs of the sample to the central laboratory of the Department of Pathology, SMS hospital, Jaipur for complete blood picture analysis using Automated 5 part Differential Cell Counter. All the tests were carried out during the morning OPD hours and the volunteers in the study were instructed for to avoid beverages such as tea, coffee, and other stimulants before reporting at the department for the tests.

Statistical Analysis :

Each parameter of complete blood counts of each subject was expressed as mean ± standard deviation; statistical analysis was performed using unpaired Student's *t*-test and $P < 0.05$ was considered significant.

RESULTS

Table '1' observed that there was no statistically significant differences (p value >0.05) was found in the means age, height, weight and BMI between study and control groups. The mean exposure years to gasoline in the study group (Petrol pump workers) were observed to be 9.78 ± 3.29.

Table '2' depicted that all studied hematological parameters found to be decreased in study group than control group. This difference was statistically significant (p value<0.05) in Hemoglobin, Total Red Blood Cell counts and Platelet counts but not in Total Leukocyte Count.

Table '3' depicted no significant differences (p value >0.05) between both the study and control group for neutrophil count, lymphocyte count and monocyte count however, the Mean ± SD values for the eosinophil count were highly significant in the study group in comparison to the control group. Also, as the Mean ± SD values for the basophile count in the control group was observed (0.00±0.00) so, the significance of difference in means for this hematological parameter between the petrol pump workers and the control group could not be calculated by the unpaired 't' test .

Table 1 : Characteristics Comparison of Subjects in Petrol Pump Workers and Control

Characteristics of Subjects		Mean ± SD		*p* value	Significance
		Petrol pump workers (N=40)	Control Group (N=40)		
Anthropometric Parameters	Age (Yrs)	30.70±3.04	29.90±2.72	0.21	NS
	Height (Cms)	167.55±3.12	168.18±2.78	0.34	NS
	Weight (Kg)	61.70±3.95	63.25± 4.89	0.12	NS
	BMI (Kg/M^2)	21.97±1.07	22.34±1.25	0.15	NS
Gasoline Exposure	Years	9.78±3.29	-	-	-

NS: Not significant (p value >0.05)

Table 2 : Comparison of Hematological Parameters in Petrol Pump Workers and Control

Hematological Parameters	Mean ± SD		*p* value	Significance
	Petrol pump workers (N=40)	Control Group (N=40)		
Hb (gm/dl)	13.89±0.90	14.69±0.59	<0.001	S
TLC(*1000/mm^3)	6.86±1.12	7.07±1.26	0.43	NS
TRBC (million/mm^3)	4.58±0.51	5.06±0.25	<0.001	S
Platelet count (Lakhs/mm^3)	2.01±0.47	2.54±0.53	<0.001	S

NS: Not significant (p value >0.05) S=Significant (p value ≤0.05)

Table 3 : Comparison of Differential Leukocyte Counts in Petrol Pump Workers and Control

Various Types of WBC	Mean ± SD		*p* value	Significance
	Petrol pump workers (N=40)	Control Group (N=40)		
Neutrophils (%)	54.47±6.20	56.40±6.61	0.18	NS
Lymphocytes (%)	34.82±5.78	34.68±6.28	0.92	NS
Monocytes (%)	6.53±2.23	6.13±2.57	0.45	NS
Eosinophils (%)	4.13±2.42	2.80±1.57	0.004	S
Basophils (%)	0.05±0.11	0.00±0.00	-	NC

NS : Not significant (p value >0.05), S=Significant (p value ≤0.05), NC= Not Calculated

DISCUSSION

In this study, some hematological investigations: complete blood counts were performed and compared between the petrol pump workers and the control subjects as these investigations are considered as good window to look into the general state of an individual's health.

It was observed that the mean values of hemoglobin levels were significantly decreased in the petrol pump workers when compared to the control group. By WHO criteria, anemia is defined as a hemoglobin concentration lower than 13 gm/dl in men[13]. In this study, 12.50 % of the petrol pump workers were found to be anemic.

Okoro et al (2006)[14], Ali AA Shab (2011)[15], T. Tunsaringkarn et al (2013)[16] also reported a significant decline in the hemoglobin levels in petrol pump workers (exposed group) in comparison to the individuals who are not exposed to the workplace.

Additionally, the mean values of the total red blood cells (TRBC) and platelet counts (PLT count) were although within their respective reference ranges but were found significantly reduced in the exposed group, however, no significant differences were evident in the total leucocyte counts (TLC) between both the groups.

These findings were in accordance with the previous studies conducted by Anslem O Ajugwo et al (2014)[17], which observed a significant decline in hematological indices (Hemoglobin levels, TRBC) in both the fuel filling attendants and auto-mechanics as compared to the control group. Hala Samir Abou-El Wafa et al (2015)[18], Prosper Opute et al (2015)[19] also reported a significant reduction in the formed elements of blood among the petrol pump workers.

As far as the results of differential leukocyte counts (DLC) were concerned, no significant differences were observed between both the study and control group for the neutrophil count, lymphocyte count and monocyte count, however, the mean values for the eosinophil count were found highly significant in the exposed group (Petrol pump workers) in comparison to the control group. Ray et al (2007)[20] also found a marked increase in the number of eosinophils and monocytes among such exposed workers.

In contrary to the hematological findings of this study, Tsai et al (2004)[21] in a comparative study did not reveal any overt hemato-toxicity among the workers of petro-chemical industry. However, Lan et al (2004)[22] ascertained a significant reduction in the number of White Blood Cells and platelet counts among the workers occupationally exposed to benzene even below 1ppm. Qu et al (2002)[23] also observed a significant decrease in red blood cells, white blood cells and neutophil counts in the benzene exposed workers.

According to Synder and Hedli (1996)[24] benzene toxicity involves both bone marrow depression and leukemogenesis caused by damage to multiple classes of hematopoietic cells and variety of haematopoietic cell functions. In milder forms of benzene toxicity individual cytopenias: anaemia, leucocytopenia and thrombocytopenia may occur.

This seems true to some extent in this study also as some of the petrol pump workers exhibited anemia, decrease in total red blood cell (TRBC) counts and platelet counts reflecting that with the prolonged exposure to the gasoline fumes, the fuel dispensers are more likely to develop the features of benzene toxicity.

The possible metabolic mechanisms for the underlying hematological alterations proposed by various investigators worldwide is that following inhalation, benzene and the other hydrocarbons present in gasoline are readily absorbed from the lungs and get metabolized in the liver by CYP450 2E1 oxidative pathways which lead to production of free radicals and quinine metabolites like phenol, hydroquinone, benzo-quinone, 1,2,4 benzenetriol. These free radicals and toxic metabolites cause lipid peroxidation and damage of hepatic cell membrane. The toxic metabolites like Phenol, catechol and hydroquinone are then transported in the bone marrow where these metabolites are further oxidized by myeloperoxidase (MPO) to benzoquinones and reactive oxygen species[25]. Synder et al (1993) hypothesized that these benzene metabolites act together on early stem and progenitor cells, as well as on early blast cells, such as pronormoblasts and normoblasts and inhibit their maturation and amplification. Also, these metabolites inhibit the function of micro-environmental stromal cells necessary to support the growth of differentiating and maturing marrow cells[26].

Although, these peroxidase-mediated activation of phenolic metabolites of benzene which generates reactive quinones can be detoxified by NAD (P)H:quinone acceptor oxidoreductase (NQO1) and via conjugation with glutathione but many researchers believe that high

CYP 2E1, MPO and low or negligible NQO1,GSTM1 and GSTT1 activities (high bio-activation with low detoxification) may be responsible for the increased risk of such benzene induced bone marrow toxicity[27,28].

However, despite of several lines of research, the precise mechanism so far remains inconclusive and still needed to be fully elucidated[28].

The limitation of this study was its small sample size, so it would be too early to generalize the results of this study to the entire population of petrol pump workers; however, the outcomes of such occupations become apparent after a number of years and thus, implication of strict rules and regulations, improvement in fuel quality and vehicle technologies, regular health checkups and providing safety devices to workers could be some early steps in prevention of long term morbidities[18,29,30].

CONCLUSION

This preliminary study concludes that the petrol pump workers could be at greater risk to develop hematological alterations with time. So, further long-term studies with large sample size and regular follow-ups are required to get better insights into the results.

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