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Comparing the levels of exposure to polycyclic aromatic hydrocarbons (Naphthalene) among different Iraqi automobile workers groups

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Abstract:

The workers in the field of car repairing are usually exposed to the exhaust emissions from cars containing polycyclic aromatic hydrocarbons (PAHs), which can cause an increase in the possibility of cancers to them. One of the most representative of these PAHs is naphthalene according to the reports of many organizations (WHO, and EPA). Therefore, the levels of naphthalene were measured in the blood serum of three groups of workers (auto repairmen, painters, spare parts sellers) in addition to control group. The results indicate that the above-mentioned groups are exposed to high levels of PAHs, where there was a high significant difference ($P<0.05$) in naphthalene levels among studies groups. Automobile worker recorded High levels of naphthalene (2.46 ng/ml) flowed by painter group (1.52 ng/ml), and spare part seller group recorded lowest levels (0.096 ng/ml).

Key works: naphthalene, painter, PAHs.

Introduction

It is well known, many harmful effects occur due to exposure to toxic chemicals, but more importantly for both individuals and the whole population, are cancers and genetic defects caused by exposure to these chemicals [1]. Vehicles

exhaust is considered one of the worst type of exposure, where it is emitted to the ground near the level of breathing, and thus gives the maximum exposure of human, and contain PAHs, So the car repairers in workshops have a higher opportunity for exposure to PAHs [2-3]. The exhausts commonly emit particles that have a large surface area that make them carriers of toxic substances such as PAHs and heavy metals on their surface, these toxin-land particles have the ability to accumulate in lung for long Time. PAHs and heavy metals are among the most common toxins present in this work environments, where many workers (especially in car repair shops) suffer from frequent exposure to these pollutants [4]. note that these compounds (PAHs) are ranked ninth on the agencies list of toxic substances and diseases registered as the most common compounds that threaten human health [5], Also diesel exhaust has been classified as a probable human carcinogen (Group 2A) by the International Agency for Research on Cancer [6]. A large number of auto-repair workers lack technical education, so they have a high potential of exposure to these pollutants despite occupational safety precautions. Where the literatures indicate that the auto-repair shops are heavily contaminated with PAHs [7], these shops contain many PAHs sources such as small combustion sources, electric power generation units, paint units, internal penetration engines [8-9]. All of the aforementioned reasons made many literatures consider car garages as anthropological sources for the PAHs [10]. as these compounds are emitted in the form of a complex mixture containing hundred carcinogenic compounds, also the components and concentrations of these compounds in the mixture vary according to their emission sources [11,12]. In general, polycyclic aromatic hydrocarbons are large group of aromatic compounds that consist of two or more benzene rings fused together [12], PAHs generally have a high degree of carcinogenicity to humans [13], its carcinogenic pathway depends on the enzyme metabolize it, starting from the first step and ending with the mutagenic metabolites that are characterized by its higher reactivity toward macromolecules like proteins, lipids and DNA, to form (PAHs-macromolecules) adducts [14]. Naphthalene is the simplest representative of PAHs, consisting of two aromatic rings. Naphthalene inhalating causes a number of symptoms, including irritation of the nose and throat. High exposure to naphthalene causes fatigue, tremors, headaches, nausea [6,9]. Generally the adducts may lead to persistent mutations (If not repaired), that lead to cell transformation and eventually tumor progression, particularly the PAHs-DNA adduct have been associated to an increased risk of lung cancer [15]. Generally, the automobile mechanics are at an increased risk of skin and lung cancers as a result of exposure to PAHs [15-16].

This study, conducted for first time in the city of Hilla, and was designed for the purpose of identifying the levels of PAHs (represented by naphthalene) in the blood serum of auto repairmen, painters, and spear parts sellers that are exposed to. There is very little literature about these groups of workers in the world compared to other group coke oven workers, asphalt workers, and bus drivers.

Martials and Methods

This work involves sixty (n=60) male subjects, with age range (20-35 years). The subjects were divided into four groups based on the severity of their exposure to the PAHs as shown in Figure 1.

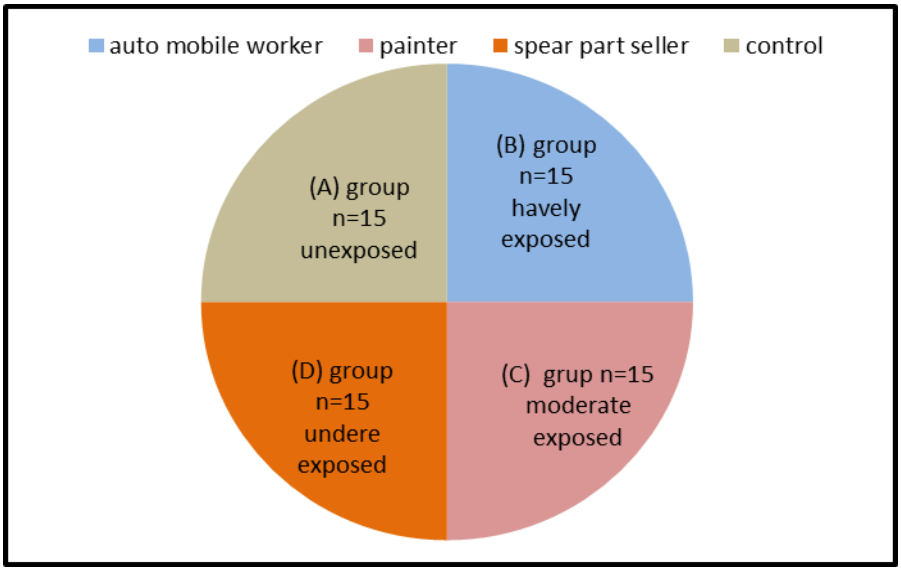

Fig.1: The division of subjects covered in the current study.

Blood Samples Collection

Using disposable syringes, 5 ml of blood were drawn from each volunteer and slowly pumped into disposable gel containing tube. At room temperature the tubes were allowed to clots for 20 minutes, then the serum was separated by centrifugation at 3000 rpm for 10 min. The samples were stored at -20^{o}C until utilized in the determination of naphthalene.

naphthalene determination

polycyclic aromatic hydrocarbons mixture (purchased from sigma-aldrich, 99.9%) was used in the preparation of standard curve by acetonitril (purchased from merch, Germany, 97%) to accomplish a series of concentrations from 0.05-150ng/ml. The naphthalene was extracted according to Madhavan. protocol [17] and naphthalene concentration in samples were detected by used Knauer-HPLC, with C18 reverse phase column, diode array detector, flow rate 1ml/min, weave length was 254 nm. Water (as component A) and acetonitrile (as component B) were used in preparation of a gradient mobile phase. In general, the peaks of naphthalene were distinguished by matching with UV-spectra and retention time of naphthalene standards.

Statistical analysis

SPSS software (IBM Corp. 2012). was used to complete the statistical calculations in this work, the results expressed by mean ± SD, and probability of $P< 0.05$ was considered statistically significant.

Results and Discussion

The resulted of chromatogram for naphthalene and other PAHs shown in figure 2. Which shows a good separation has been completed for naphthalene and other PAHs in standard mixture and serum. naphthalene has been identified by retention time and UV-spectrum matching with its standard solution. where the UV- spectra of naphthalene peaks in chromatogram obtained from different sera samples were compared with those obtained from standard solutions as in figure

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3. And the Figure (3) shows the UV-spectra of naphthalene standard and of the chromatographic peak from serum (sample 1) at same retention time, and that the spectra are identical and compatible for both compounds in standard and serum.

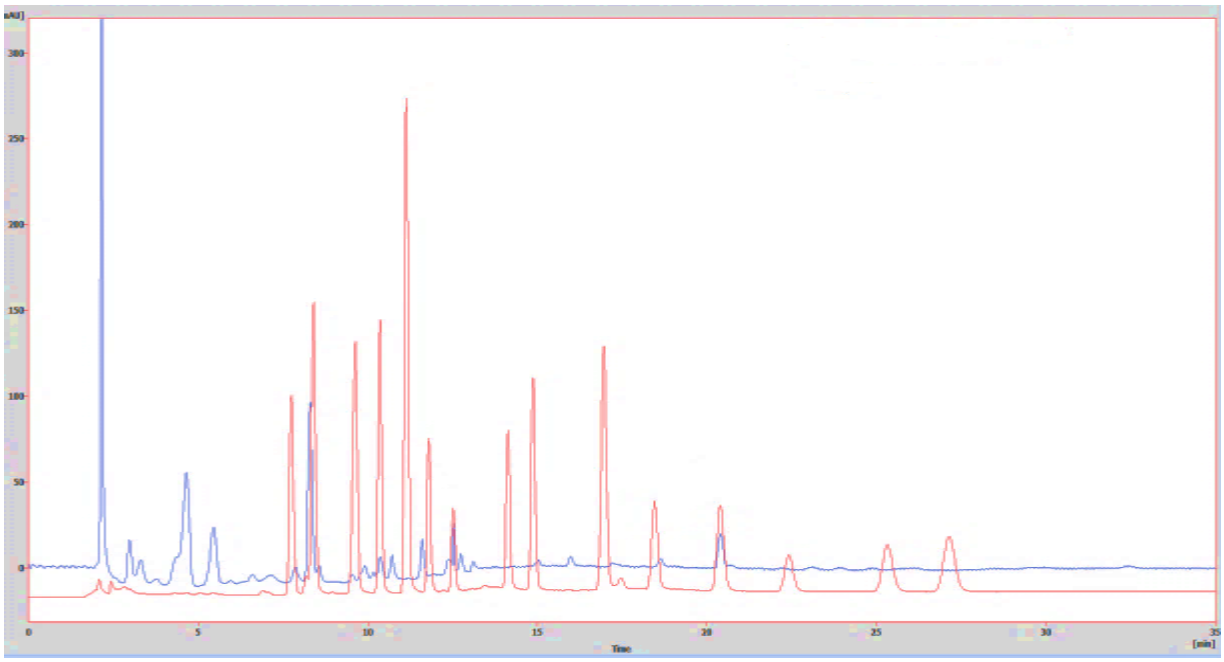

Fig. 2: Chromatogram of HPLC obtained from the 16 PAHs listed by US EPA (analyzed only one compound 1 naphthalene in standard and serum, the blue line is serum chromatogram, red line is standard chromatogram.

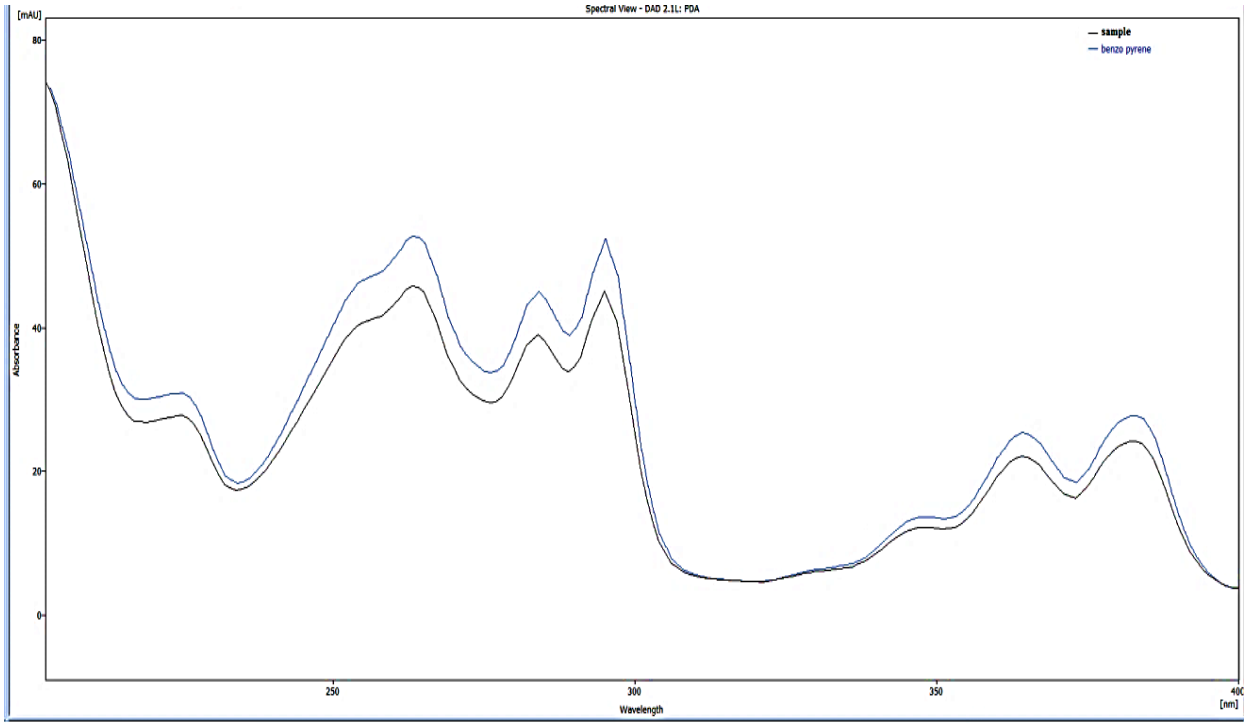

Fig. 3: Comparison of the UV-spectra of the standard of naphthalene with same spectra of sample obtained from chromatographic peak, at same retention time and under same chromatographic conditions, the blue line is serum spectrum, black line is standard spectrum.

All the 60 volunteers were age-matched males, and the age of volunteers ranged (25-35 years). There was no statistically difference between exposed (A, B, C) and non-exposed (D) groups in terms of age (33.4 vs 29.61) as show in table 1, and there was no significant differences between the exposed and non-exposed groups (P=0.832) (table.1). This is consistent with findings of Tolos, W et al, [18] who found that, there is no significant difference (P=0.538) between the control group and coke oven workers exposed to PAHs regarding the smoking status.

Table 1. Demographic of the studied groups.

parameters	Exposed (mean±SD)		Non exposed (mean±SD)		P-value
Participants	45 (75%)		15 (25%)		--------
Age	33.4±10.02		29.61±8.85		0.083
Naphthalene ng/ml	1.97±2.1		0.32±0.45		0.031
Smoking status	smoking	Non-smoking	smoking	Non-smoking	0.081
	19 (35.1%)	21 (46.6%)	9 (60%)	6(37.5%)	

Table 2. comparison of PAHs levels among studied groups based on t-student test.

group	A group (mean±SD)	B group (mean±SD)	C group (mean±SD)	D group (mean±SD)	P-value
naphthalene	------	2.46±0.087	1.52±0.081	0.096±0.061	<0.0001

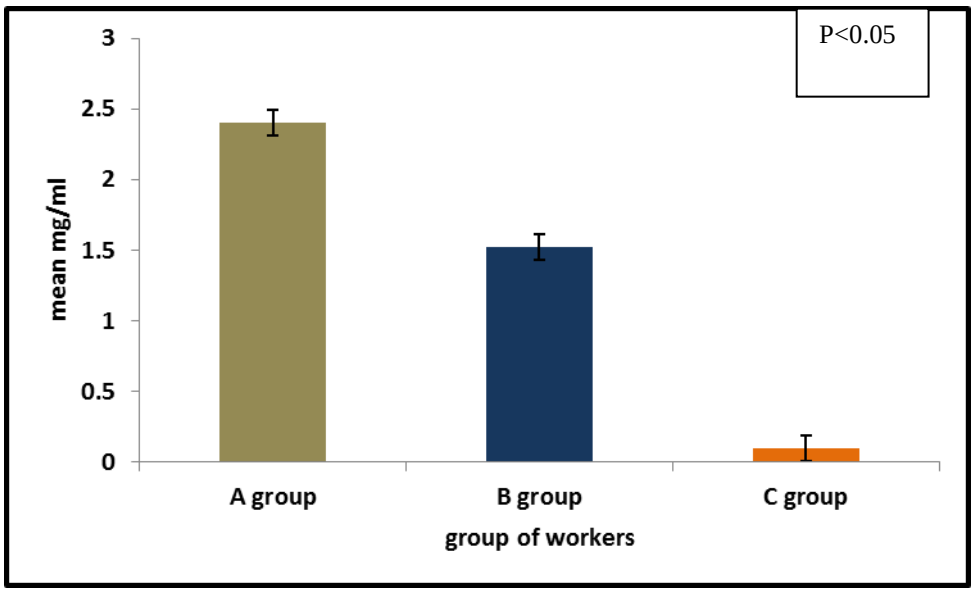

Fig.4: Comparison levels of naphthalene in studied groups, A, B, and C.

The importance of this work is based on measuring the levels of exposure of some workers to PAHs based on the internal exposure, which can be used as a sensitive biomarker of exposure to toxins. Naphthalene was assessed in the serum of three groups of workers, as an internal dose biomarker for PAHs exposure. The results of this study recorded the highest levels of naphthalene among auto-mobile workers (2.40±0.092), after that the painters (1.06±0.071), while the lowest levels were found among sellers of spare parts (0.094±0.087). This is consistent with the results of Domenico et al [19] how reported that auto mobile workers are exposed to higher PAHs levels than painters' group. Where the naphthalene level was significantly higher ($P<0.0001$) in automobile worker and painters group compared to the spare part sellers' group, and also no PAHs detected in any background blood serum samples of control group. Since the PAHs known as non-threshold limit substance [20], it is necessary to compare the levels of PAHs to which Iraqi workers are exposed to workers from other countries to know whether risk exposure occurred or not. In automobile mechanics in Rawalpindi, kamal *et al*. reported the PAHs levels in serum was (0.333ng/ml). This means that Iraqi car repairers are exposed to PAHs by seven times higher than what the repairmen in Rawalpindi are exposed to. The differences between the groups of automobile worker in Babylon with those in Rawalpindi attributed to Poor hygiene, ventilation in the workplaces, in addition to the random distribution of workshops in crowded prohibited areas [21-23], and the concentrations of PAHs in mixtures are vary according to the sources emission as most important factors predicting differences between workplaces that would enhance the extent of exposure to chemicals [7]. The burden of these congeners on the body can be said to be significantly higher in car repairers and spare part sellers than the control in our study and in the literatures values in a similar studies. The levels of PAHs detected in current study were statistically significant and could be causative agents for many future diseases, thus, naphthalene levels can become investigative tools, that may affect workers of studies groups. As another comparison between the occupational categories (Iraqi car repairers) in current study, and other occupational groups, in previous studies, the coke-oven workers show a heavy PAHs exposure by using urinary 1-OHP as a biomarker [24], the level of exposure of coke oven workers to PAHs (in Taranto in southern Italy) was slightly more than the level of exposure by Iraqi car workers (2.9 vs 2.4 ng/ml), this is an indication of the severity of exposure of this group of workers.

Conclusions

Automobiles repair workers are exposed to higher levels of PAHs compared to painter and spare parts sellers. and this indicates severe pollution of car repair workshops in the city of Hilla.

Author Contributions Statement

The author confirms that he is the one who completed the practical work and writing.

Declaration of competing interest

The author confirms that there was no competing interest with others.

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