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Lead, Nickel, Copper, Cadmium and Zinc concentrations in airborne particulates and Lead in Blood, in Al- Tarmiayh city, north Baghdad-Iraq

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Abstract

The concentrations of lead, nickel, copper, cadmium and zinc in airborne particulates and lead in blood, have been measured in the area of Tarmiya, during a period of one year 2011.The air pollution levels caused by these elements are still in somehow comparatively medium or low. Concerning the Pb concentrations in blood from different groups of individuals, the levels do not exceed the safe limits. And we distinguish the groups of elements and stations by using multidimensional scaling (MDS).

Introduction

Tarmiyah area, figure (1), is a city subsidiary to the city of the Kadhimiya Baghdad, during the past years Since 1990 till now there is no work has been carried out in this urban area, to assess the atmospheric pollution by heavy metals and especially by Pb, Ni, Cu, Cd and Zn (1,2,3).

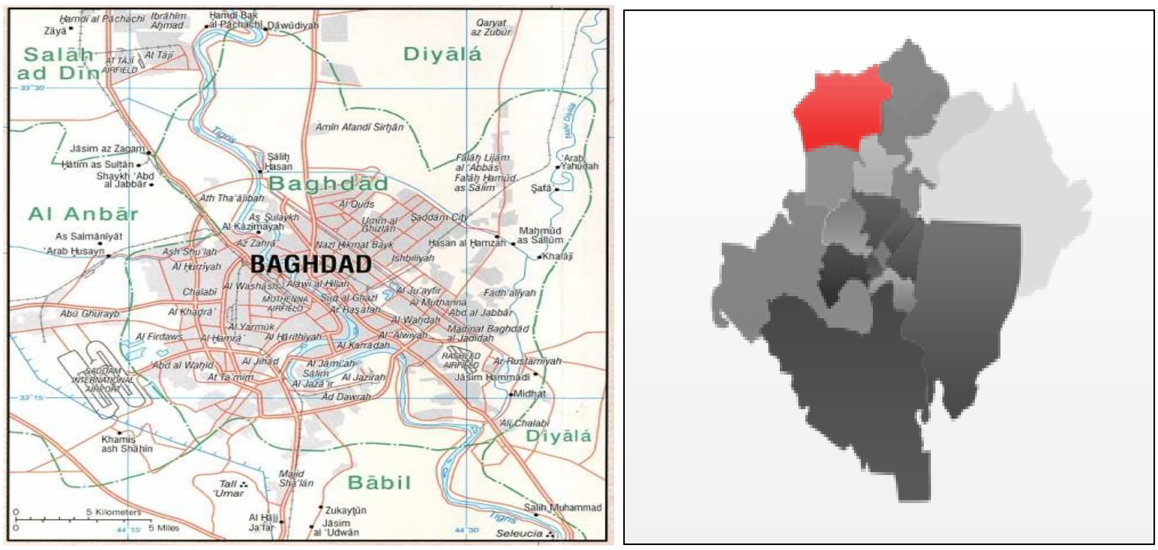

Figure (1): Al-Tarmiyah city

Elevated levels of zinc, lead and nickel have been observed in air, in the vicinity of certain industries like smelters, mines, battery manufacturing and near roads with heavy traffic or within urban areas in general. In urban atmospheres, enhanced lead and concentrations are observed, mainly due to the dense traffic. According to the literature, children living in big cities have relatively high concentrations of lead in their blood. Especially among children with high or even moderate to low blood lead levels, anemia, increased levels of erythrocyte protoporphyrin and neurological damage have been observed (4, 5, 6). On the other hand, there are still uncertainties about the significance of chronic exposures to lead, which of the many sources and routes of lead to man are the most important (7). The contamination of roadside vegetation with lead and other heavy metals in the area of Tarmiyah haven't been studied before. According to the many studies, pollution in grass and plants by lead was more pronounced near the industrial area, busy roads and inside the cities (8). Although in European countries and many Arabic countries, the lead content of gasoline was reduced to 0.12 g/L, and most of the petrol stations supplied unleaded fuel. The aim of this paper was to investigate the distribution and the seasonal variation of lead, nickel, copper, cadmium, and zinc in the ambient air of Tarmiayh as well as to find out if there is any relationship between lead concentration in air and blood from the city's population. However, in some cases, risks may not be as serious as current regulations. Metals such as lead, nickel, zinc, copper and cadmium, for example, can exist in several forms, and some of these forms may pose serious health or environmental risks.

Materials and Methods

Tarmiayh city and its suburban, has more than 250,000 inhabitants, is fairly crowded with workshops activities of lead, steel, alumina, copper, nickel, while cadmium and zinc are the state of impurities within the elements mentioned. The area faces a lot of environmental problems and especially increasing air pollution problems, due to the industrialization, the high traffic density and meteorological conditions. The technical methods of air sampling were performed at seven locations in the area of Tarmiayh. The air samples were taken twice a week using High-Volume samplers on 24 hours basis. Three of the stations 4, 5 and 6 were located in the industrial area of the city. Station 7 was located in an area with low traffic and faraway from industrial emissions. Stations 1, 2 and 3 were located in the center of the city with high traffic density. The filters (o.45μ m Millipore water) were analyzed for all elements by A.A.S. (9, 10). Blood analyses for lead concentrations were carried out by AAS with electro thermal atomization (11).

In order to assess quantitatively the magnitude of blood lead, groups of healthy not professionally exposed individuals from Tarmiayh's population were selected at the same period. Three groups of subjects (children- women and men) were blood- sampled.

Results and Discussion

Table 1 and figures 2 and 3 give the mean concentrations of Pb, Ni, Cu, Cd, Zn and TSP (Total Suspended Particulates) in the air of Tarmiayh at seven locations, during a period of one year 2011. From the data, it is clear that, the mean values concentrations of Lead and TSP are coming in two categories , the three values of Pb and TSP in stations one, two and three are higher than the other three stations four, five and six. This could be due to the location of each station; the first three stations were distributed in the central street of the city with high traffic density, while the other three stations four, five and six were located in the industrial area of the city. Although, lead concentration is higher in station 1 (1.96 μ g/m^3), it is quiet difficult to make comparison to other stations because this station is closed to the industrial area as well.

This suggests that automobile exhaust emission may be a prominent source of airborne lead in the city of Tarmiayh. In general most of the stations throughout the city, show significant correlation between lead and vehicular traffic density. The average concentration of airborne Pb was found to be lowest at station 7 (residential area). This station was chosen as a "background" station where vehicular traffic density is very low. In Tarmiayh city, there are many and different workshops activities on both sides of central street and industrial area, workshops dealing with nickel, cupper and even zinc, therefore it was quiet in time to measure the level concentrations of these elements.

It was found that, the levels of the mean concentration values of such elements were detected in stations 1, 2,5 and 6 (except zinc in station 6, figures 2 and 3), these values were the result of the use of outdated equipments and machines in manufacturing , casting and plumbing.

The reason for measuring the concentration of cadmium is the forecasting to be present with other metals as impurity. As was the expectation, the values found to be very low, and therefore it is actually exists with other metals as impurities. The highest TSP concentration was observed in station 1 (462 μg/m^3) due to its location in very crowded traffic vehicles crossing and its vicinity to the industrial area. From the obtained data in this study, concerning the airborne lead and the other elements concentrations, we can generally conclude that air pollution by Pb, Ni, Cu, Cd and Zn are still low, comparatively to other big cities (12). While the values found, in fact show the existence of air pollution by lead and the other metals, no threatening levels have been reached yet. Table 2 gives the mean values of Pb content in blood during a period of one year 2011. Concerning the lead concentration in blood, about 215 men and women and 120 children were blood-sampled for Pb determination. The examined children had Pb levels ranging from

4.6 to 26.3 μ g/100ml (mean value equal to 8.12 μ g/100ml), while the men from 5.2 to 28.10 μ g/100ml and the women from 2.3 to 20.50 μ g/100ml, with the mean values 9.63 μ g/100ml and 7.06 μ g/100ml respectively.

The upper limit of Pb considered to be safe for children is 35 μ g/100ml and no one child had levels exceeding this limit (13). The men living and working nearest to the industrial area and heavy traffic density were found to have higher Pb levels than those living away from these two places. On the other hand, the mean values of Pb in children's blood were higher than those in women's. However, the estimated Pb-concentrations in blood samples from the population in Tarmiayah area were under the safe values. A reduction in blood lead can be expected, in case there is a reduction of lead content of gasoline (from o.40 to 0.15 g Pb/L) in the petrol stations as it is planned in the near future.

Now, to generate spatial representations of stimulus (elements or stations) sets based on information regarding the dissimilarity relationships existing between the stimuli, we use the statistical technique multidimensional scaling (MDS)(14). MDS in the wide sense refers to any technique that produces a multidimensional geometric representation of data, where quantitative or qualitative relationships in the data are made to correspond with geometric relationships in the representation. MDS in the narrow sense starts with information about some form of dissimilarity between the elements of a set of objects, and it constructs its geometric representation from this information. Thus the data are dissimilarities, which are distance-like quantities (or similarities, which are inversely related to distances). The solutions for two-dimensional configurations are given in table 3 and figure 4. We can see the same results that mentioned above.

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Table (1): Mean values of Pb, Ni, Cu, Cd , Zn and TSP in seven stations

All values in units of μ g/m^3

Station	Pb	Ni	Cu	Cd	Zn	TSP/100
1	1.96	0.47	0.53	0.02	0.45	4.62
2	1.19	0.33	0.23	0.03	0.37	2.97
3	1.26	0.08	0.10	0.00	0.68	3.34
4	0.54	0.11	0.03	0.00	0.07	1.82
5	0.96	0.32	0.28	0.01	0.09	2.32
6	1.01	0.29	0.17	0.02	0.04	2.16
7	0.10	0.02	0.00	0.00	0.00	1.42

Table (2): Mean values of Pb content in blood during a period of one year.

Groups	Pb concentration in blood (μ g/100ml)		
	Min.	Max.	Mean
Children (5-17 years old)	4.6	26.30	8.12
Men	5.2	28.10	9.63
Women	2.3	20.50	7.06

Table (3): MDS Output of SPSS, Final Coordinates

Element	Dimension		Station	Dimension	
	1	2		1	2
Pb	0.183	0.239	1	1.187	0.278
Ni	-0.326	-0.070	2	0.205	-0.131
Cu	-0.357	-0.056	3	0.450	-0.244
Cd	-0.488	-0.113	4	-0.553	0.049
Zn	-0.346	0.084	5	-0.190	-0.095
Tsp	1.334	-0.084	6	-0.281	-0.125
			7	-0.818	0.269

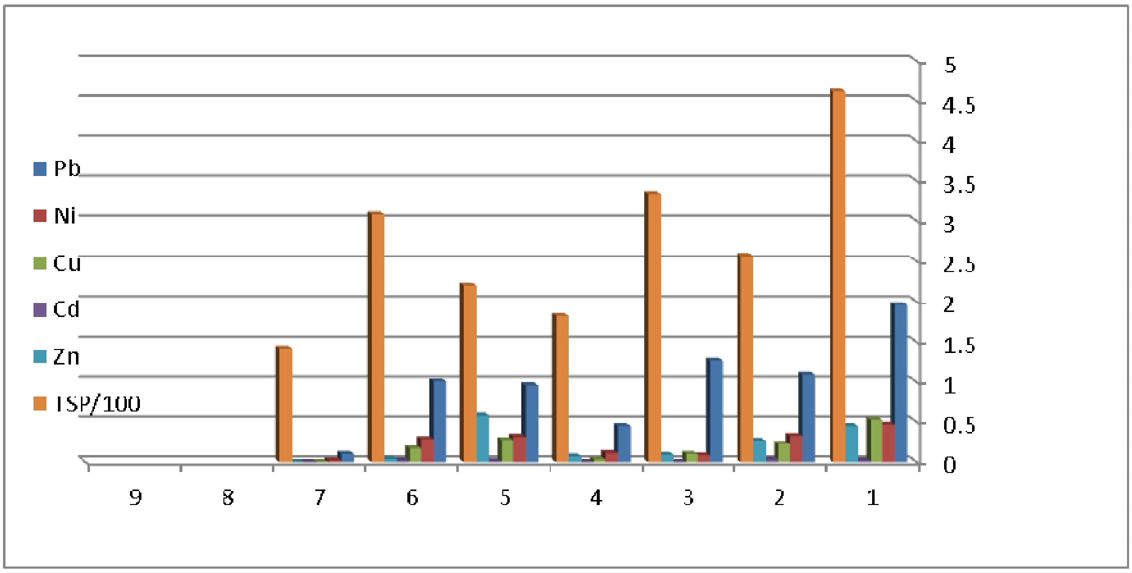

Figure (2): mean values concentrations of elements and TSP

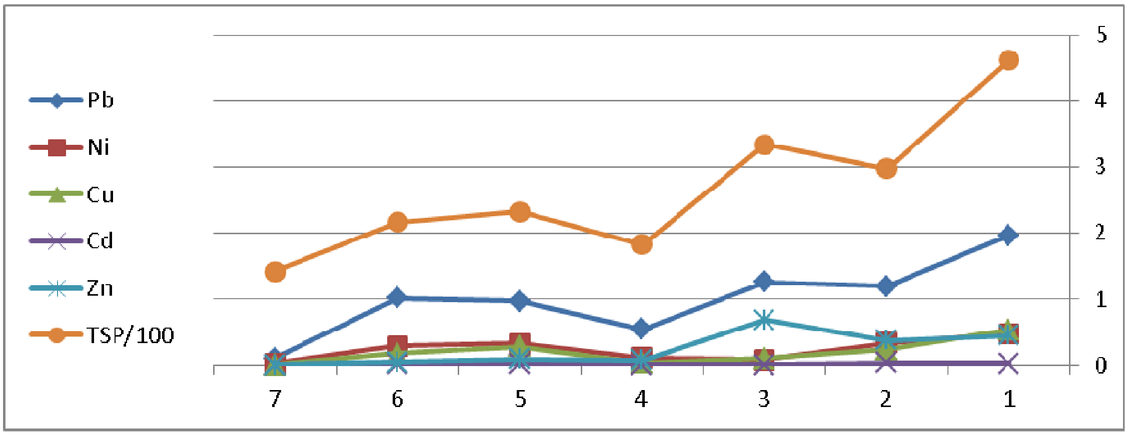

Figure (3): values variation of elements and TSP in the different sampling stations

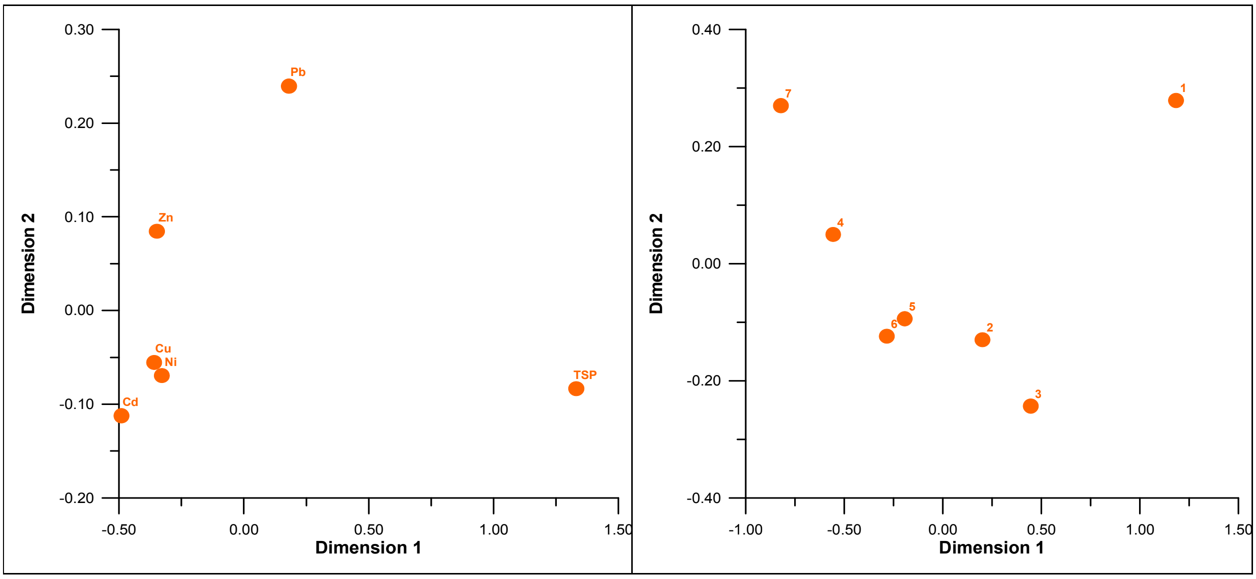

Figure (4) : MDS spatial representations for the elements (left) and for the stations (right)