Impact of Some Heavy Metals and BPA Resulting from Terrorist Operations in Three Regions of Baghdad, Iraq on Serotonin

Alaa H. Jawad
Department of Chemistry, College of Science, Al-Nahrain University, Baghdad-Iraq.
Corresponding author: alaaalqaisi74@yahoo.com

Abstract

In this paper the effect of terrorist operations in three regions of Baghdad, Iraq were studied on serotonin hormones, in 75 Iraqi individual from (AL-karradah and Abo-Gharib) regions as comparison with Al-jadria as (a control). The correlation between sera serotonin and the levels of lead (Pb), cadmium (Cd), mercury (Hg) and bisphenol-A(BPA) have been selected for study, relation of heavy metals, BPA and monoamine neurotransmitter frameworks has been recommended as a potential underline component of action. The serotonin framework has been moderately ignored, along these lines; the objective of this article is to audit the writing on the connection between heavy metals, BPA and the serotonin. Our examination proposes a positive correlation between serotonin and the levels of lead (Pb), cadmium (Cd), mercury (Hg) and BPA. In conclusion, that serotonin levels in the area of (Al-karadah, Abo-Gharib) pollutants areas were high as compared with the control (Al-jadria) as the lowest percentage of pollution. Thus considerable further investigation will be necessary to understand the role of serotonin in the pathogenesis and high levels in the some regions in Iraq such as AL-karradah and Abo-Gharib.
[DOI: 10.22401/ANJS.21.4.02]

Keywords: serotonin, cadmium, heavy metals, lead, mercury, bisphenol-A, pollution, Baghdad area.

Introduction

Bisphenol -A is a pseudo-persistent chemical, which despite its short half-life is universal in the environment because of continuous release. So, it has been reported that BPA is an infamous environmental contaminant which pollutes atmosphere, hydrosphere and lithosphere in circular modus. Furthermore, it also creates menace to human health. Therefore, it had unwrapped a different area of exploration with a great prerequisite to have continuous monitoring and elimination of malicious effects of BPA and its exchange between in environment. This will help in formulation of strategies which will monitor the levels of BPA in environment and decrease the level of BPA pollution. [1] Basrah also Fallujah, two heavily bombard cities, are both polluted with very poisons heavy elements like mercury also lead. The resulting polluted is suspected of causing a rise number of serious diseases everywhere Iraq, including high in congenital defects, cancer, infertility, premature births, leukemia, sterility, miscarriages also other illnesses. [2]

In Iraq, most studies on lead exposure have been conducted in exposure risk groups. However, considering that there are still many gasoline power generators and vehicles using leaded petrol in the country, it is possible that high lead levels exist in the general population living in areas of heavy traffic and high emission of lead into the atmosphere. [3]

Impact of terrorism on environment in Iraq has been investigated by study of residents in Basrah city. It was found that Pb levels were higher in parents of children with congenital defects than those without defects, the tooth of a child with congenital defects was and found to contain lead (pb) levels three times higher than those of children living in “unimpacted areas”. [2]

Cadmium (Cd) is a standout amongst a most deleterious heavy metals both to plants and animals, industrialization and culture cause cadmium most widespread also hurtful contamination in plants and animals . [4] Cadmium is of major anxiety, fundamentally due to their present at relatively rise concentrations in drinking water. [5]

Mercury is a highly toxic element. Ideally, neither children nor adults should have mercury in their bodies because it does not provide any physiological function. However,

almost all humans in the world have at least heavy metals amounts of Hg in their bodies. [6]

Metals such as mercury. Natural sources such as crustal weathering, dust storms and decomposition of biota in the water. Accumulation and distribution of heavy metals in shell of mollusks depend on many factors such as concentrations of metals, exposure time, temperature and salinity, food habits, physical conditions, growth, age, sex, and pollutants interactions. Mercury considered as a nonessential element, highly visual path spectrophotometer provide low detection toxic heavy metal and it has been a global contaminated due limits. [7]

Serotonin, or 5-hydroxytryptamine (5-HT), is an outstanding neurotransmitter that assumes imperative parts in neural exercises and social practices there is expanding proof exhibiting vital parts of serotonin in the fringe tissues, as a standout amongst the most established monoamine neurotransmitters and hormones in the focal sensory system and fringe tissues, serotonin (additionally called 5-hydroxytryptamine [5-HT]) has been found for almost 70 years. [8]

In United States of America., 900 of the 1,300 most contamination sites—as indicated by Environmental Protection Agency (EPA) assessment—are military bases as well as testing sites that produced services, military related products in addition weapons. These sites poisons to the environments and human health include training bases, abandoned disposal pits, chemical warfare also research laboratories. Poisons elements and compounds found there include organic solvents, pesticides, diesel fuel, heavy metals, rocket propellants, nuclear waste, machining oils, PCBs also toxic chemical compounds utilized in explosives. [9]

This current research objective was to limit the known variables of blood serotonin and the levels of lead (Pb), cadmium (Cd), mercury (Hg) and BPA, and the effect of terrorist and military operations on serotonin.

Materials and methods

The present study comprised of 75 individual (40 Female and 35 Male) no symptoms of thyroid disease or any endocrine disease and an individual must be nonsmoker and pregnant women. The studied group was divided into three subgroups [Al-Jadria group (control group) (25), Al-karradah group (25) Abo-Gharib(25)] aged between 15–65 years. blood samples were collected from individual in three hospitals, 1) Abdul Majeed private hospital 2) Abu Ghraib General Hospital 3) Jadria Health Center. Samples were hospitalized at laboratories in the Abdul Majeed private hospital. the samples were collected from October 2016 to February 2017. blood samples were collected (5 ml) and centrifuged at [4000 rpm] for 10 min after clotting, to separate the serum from the cells to determine human serum lead, mercury, cadmium and bisphenol-A (BPA) levels. The resultant serum was separated and stored at [-20]°C until time of analyses. Patients with endocrine disease were excluded. Human serum Serotonin was measured using (ELISA) an enzyme-linked- immune-sorbent assay kit (Sandwich) technologies for individual in three hospitals using commercially available kits Serotonin (Human,Germany).

Measurement of human serum Bisphenol-A Sample Preparation [10]

Bisphenol-A 0.01gm was dissolved in 200 mL of acetonitrile. Human serum and 50 ppm bisphenol-A was utilized by high performances liquid chromatography (HPLC) also UV detector, the analytical conditions of the HPLC system were as follows:

Table (1)
Separation Conditions of HPLC.

Column:	**C_{18}_ODS**
Flow Rate:	1ml/min
Injection details:	50 µL
Mobile phase A:	Methanol
Mobile phase B:	Water
UV detector wavelength:	280 nm

Measurement of human serum lead, mercury and cadmium [11]

Lead, Mercury and Cadmium were determined using furnace Atomic absorption spectrophotometer (Analytica Jen, Germany). it is an analytical method based on absorbing the ultraviolet and visible light by atoms of material in the gas state. and the sample is

converted to atoms bypass the sample solution to the furnace as in the form of a spray. all sera samples of the studied group were digested by 5 ml of Triton (10%) was added in 50 ml of distilled water and 1ml HNO_3 (conc.) then Ammonium dihydrogen phosphate (20%): 20gms of ammonium dihydrogen phosphate were weighted and dissolved in 100ml of distilled water with a volume of 25ml of Triton (10%), 5ml of ammonium dihydrogen phosphate (20%) and drops of HNO3 (conc) were mixed in a volumetric flask (1000ml), the volume completed to the sign with distilled water and finally 9 ml of the above solution were added to 1 ml of each sample then lead, mercury and cadmium were determined using furnace atomic absorption.

Statistical analysis

Statistically analysis of data was performance using SAS (Statistically Analysis System - versions 9.1).One-way ANOVA also Least significances difference (LSD) were performed to survey significances differences among mean. *P value* < 0.05 was considering factually significances.

Results and Discussion

Comparison of BPA in pollutants areas (Al-karadah, Abo-Gharib) and controls (Al-Jadria group) showed that BPA levels of AL-Karradah group were higher than the control group BPA (28.45±2.60 µg/L vs. controls 14.83±1.41 µg/L, P <0.0001) also BPA levels of the Abo.Gharib group was higher BPA (28.25±0.88 µg/L vs. 14.83±1.41 µg/L, *P<0.0001*).

Comparison of heavy metals in pollutants areas (Al-karadah, Abo-Gharib) and controls (Al-Jadria group) showed that the Pb, Hg and Cd levels of AL-Karradah group were higher than the control group Pb(52.42±0.82 µg/L vs. controls 42.74±1.03 µg/L, *P<0.0001*). Respectively; Hg (2.83±0.13 µg/L vs. controls 2.09±0.13 µg/L, P < 0.0001) and Cd (107.03±2.34 µg/L vs. 75.99±2.06 µg/L, *P < 0.0001*) and also Pb, Hg and Cd levels of the Abo.Gharib group was higher Pb (47.14±0.42 µg/L vs. 42.74±1.03 µg/L, *P < 0.0001*). Respectively: Hg (3.89±0.18 µg/L vs.2.09±0.13 µg/L, *P<0.0001*) and Cd (94.48±0.77 µg/L vs. 75.99±2.06 µg/L, *P < 0.0001*).

Comparison of serotonin in pollutants areas (Al-karadah, Abo-Gharib) and controls are shown that serotonin levels were significant statistically (*p<0.05*), between the both groups AL-Karradah: ST (236.09±31.19ng/ml vs. control: 109.01±13.15 ng/mL, *P = 0.024*). Also shown that the serotonin levels were significant statistically (*p<0.05*), between the both groups Abo.Gharib: ST (186.56±36.52ng/ml vs. control: 109.01±13.15 ng/mL, *P = 0.024*).

Table (2)
Mean values, standard error, (mean ±standard error), maximum, minimum and standard deviation of BPA, Pb, Cd and Hg levels in the human serum from three different hospitals in Baghdad.

Region	BPA(µg/L)	Pb(µg/L)	Cd(µg/L)	Hg(µg/L)	ST (ng/mL)
Al-Karadah Min-Max STD	28.45±2.60a (14.2-35.21) 6.87	52.42±0.82a (50.31-55.81) 2.01	107.03±2.34a (99.33-114.12) 5.73	2.83±0.13b (2.28-3.13) 0.31	236.09±31.19a (50.81-547.41) 155.93
Abo.Gharib Min-Max STD	28.25±0.88a (24.51-31.31) 2.33	47.14±0.42b (45.91-48.71) 1.01	94.48±0.77b (91.94-96.55) 1.89	3.89±0.18a (3.26-4.51) 0.43	186.56±36.52b (15.11-576.01) 182.59
Al-Jadriah (Control) Min-Max STD	14.83±1.41b (10.41-20.01) 3.72	42.74±1.03c (39.81-45.51) 2.52	75.99±2.06c (68.69-82.57) 5.03	2.09±0.13c (1.56-2.44) 0.32	109.01±13.15c (14.71-274.61) 65.72
LSD	5.2828	2.3930	5.5719	0.4306	61.036
P	<0.0001	<0.0001	<0.0001	<0.0001	0.024

a,b,c: The difference letters in the same column means a significant difference in parameters between groups.
BPA: Bisphenol-A/ Pb: Lead / Cd: Cadmium / Hg: Mercury/ ST: Serotonin
LSD: Least significant differences / STD: standard deviation

Table (3)
Correlation coefficient between Bisphenol-A, Lead, Mercury, Cadmium and serotonin parameters.

ST		Pb(µg/L)	Hg(µg/L)	Cd(µg/L)	BPA(µg/L)	ST(ng/ml)
Al-karradah	Pearson Correlation Sig. (2-tailed)	.186 .725	.387 .448	.501 .311	.073 .891	١
Abo-Gharib	Pearson Correlation Sig. (2-tailed)	.761 .079	.729 .100	.535 .275	.049 .926	١
Al-Jadria	Pearson Correlation Sig. (2-tailed)	-.346- .501	-.293- -.293-	-.220- .675	-.708- .115	١

Table (4)
Correlation coefficient between heavy metals (Pb, Hg, and Cd) and Bisphenol A parameters in Al-karradah.

Al-karradah		BPA(µg/L)
Pb	Pearson Correlation	-.818-*
	P	.046
Hg	Pearson Correlation	-.385-
	P	.451
Cd	Pearson Correlation	-.647-
	P	.165

Table (5)
Correlation coefficient between heavy metals (Pb, Hg, and Cd) and Bisphenol A parameters in Abo-Gharib.

Abo-Gharib		BPA(µg/L)
Pb	Pearson Correlation	-.601-
	P	.207
Hg	Pearson Correlation	-.583-
	P	.224
Cd	Pearson Correlation	-.774-
	P	.071

Table (6)
Correlation coefficient between heavy metals (Pb, Hg, and Cd) and Bisphenol A parameters in Al-Jadria.

Al-Jadria		BPA(µg/L)
Pb	Pearson Correlation	.346
	P	.501
Hg	Pearson Correlation	.498
	P	.315
Cd	Pearson Correlation	.331
	P	

A significant negative correlation was found between Bisphenol A ($p< 0.05$) and lead .and negative correlation was found between Bisphenol A and mercury and Cadmium.

This study examines the increase of blood lead level caused by Pb chronic exposure in the environment. In addition, the effects of elevated blood lead level on the level of serotonin neurotransmitters are also investigated. This study analyses the correlations which exists between blood lead level, and serotonin level in the body of humans. In order to examine the correlation between blood lead, and serotonin, Pearson correlation is used. The result showed that blood lead level impacts to serotonin level. The result suggests that the correlation coefficient value of blood lead level effecting serotonin level was positively in the region of AL-karradah and Abo-Gharib. Our results were agreed with other study [12]

Sharp cadmium absorption can also cause pulmonary, gastrointestinal tracts corrosion, renal injury also coma, depending on the route of toxic. Exposure to Cd has an adverse effect on levels of serotonin, serotonin levels are positively correlated to Cd and Hg concentrations. [13]

The actual study explains into evidence that trace elements contamination in natural environments, even if at a non-murderous levels, also alters serotonin apportionment pattern in an immature specimen of blood. In this study, we wanted to evaluation the impacts of environmental trace elements contamination on serotonin. [14]

Brain 5-HT neurotransmission also lead to neuropsychiatric disorders. In this Study, BPA-treated rats showed a major isozyme in central serotonin transmit. With reference to our result, it has been remind an increases of serotonin also levels in rodent brain after exposure of Bisphenol-A. [15]

Decreasing 5-HT was found following BPA exposure regarding immunohistochemistry. Compared to the control group, in human beings, serotonin levels are negatively correlated to BPA concentrations. [16]

Conclusions

Through our research, we found that the presence of heavy metals and bisphenol A in the area of al-Karadah and Abo. Gharib resulting from explosions and terrorist operations also environmental pollution in high quantities, also studied the relationship among heavy metals with BPA and serotonin. Al-karadah and Abo.Gharib populace observed positive associations between serotonin and the levels of lead (Pb), cadmium (Cd), mercury (Hg) and BPA. On the other hand an emergence of a large number of bisphenol -A pollutants found in most residents of al-Karradah and abo-Gharib areas compared to al-Jadria region (control group). We concluded that serotonin levels in the area of (Al-karadah, Abo-Gharib) pollutants areas were high as compared with the control (Al-Jadria).

References

[1] Neha S., Pandya H. A., Renu S., Critical Review on Bisphenol A: Invisible Pollution, International Journal of Pharma Research and Health Sciences, 4 (2), 1043-1049, 2016.

[2] Al-Sabbak M., Sadik A.S., Savabi O., Savabi G., Dastgiri S., and Savabieasfahani M., Metal Contamination and the Epidemic of Congenital Birth Defects in Iraqi Cities, Bulletin of Environmental Contamination and Toxicology, 89, 937–944, 2012.

[3] Al-Dosky A. H., Al-Timimi D. J., and Al-Dabbag S.A., Lead exposure among the general population of Duhok governorate, Kurdistan region, Iraq, Eastern Mediterranean Health Journal, 18(9), 974-979, 2012.

[4] Pallavi J., Chinmay P., Anath B. D., Effects of Cadmium Toxicity in Plants: A Review Article, Scholars Academic Journal of Biosciences (SAJB), 4(12), 1074-1081, 2016.

[5] Malik Q., and Khan M., Effect on Human Health due to Drinking Water Contaminated with Heavy Metals, Journal of Pollution Effects & Control, 5(1), 1-2, 2017.

[6] Bose-O'Reilly, S, McCarthy, K, Steckling, N, and Lettmeier, B., Mercury exposure and children's health. Currprobl Pediatr Adolesc Health Care. 40(8), 186-215, 2010.

[7] Estabraq M. A., Reyam N. A., Bioindicator Mercury of Aquatic Ecosystems in Iraqi Marshland by Using GIS, International Journal of Scientific & Engineering Research, 8(3), 594-605, 2017.

[8] Junhua L., and Feng L., The Role of Serotonin beyond the Central Nervous System during Embryogenesis, Frontiers in Cellular Neuroscience, 11(74), 1-7, 2017.

[9] Mauro C., Cristiano F., Germana S., Carlo B., Fiorenzo M., and Lucio T., Toxic Emissions from a Military Test Site in the Territory of Sardinia, Italy, International Journal of Environmental Research and Public Health. 10, 1631-1646, 2013.

[10] Derek H., Separation of a Mixture of PCBs Using an Accurse C18 HPLC Column. Thermo Fisher Scientific, 1-3, 2012.

[11] Man X., Zaiju H., Jing C., Jinghui J., Yuzeng Z., Weihong D., and Zehua W., Comparison of different sample preparation methods for platinum determination in cultured cells by graphite furnace atomic absorption spectrometry. Peer Journal, 1-16, 2017.

[12] Aditya M., Anies A., and Henna R. S. A., Causality pattern of the blood lead, monoamine oxidase A, and serotonin levels in brass home industry workers chronically exposed to lead. Songklanakarin Journal Sciences Technology, 38 (2), 147-153, 2016.

[13] Paul B T., Clement G Y., Anita K P., and Dwayne J S., Heavy Metals Toxicity and the Environment. NIH Public Access, 101, 133-164, 2012.

[14] S. Ferrando, T. Ferrando, L. Girosi, A. Mauceri, S. Fasulo, G. Tagliafierro, Apoptosis, cell proliferation and serotonin immunoreactivity in gut of Liza aurata from natural heavy metal polluted environments: preliminary observations. European Journal of Histochemistry, 49(4), 331-340, 2005.

[15] Beatriz C., Pilar S., Jesu´ s M. T., Esperanza O., Effects of Adult Exposure to Bisphenol A on Genes Involved in the Physiopathology of Rat Prefrontal Cortex. PLOS ONE 8(9), 1-8, 2013.

[16] Meng J., Julian P., Deficits in Striatal Dopamine and Hippocampal Serotonin Following Induction of Anxiety/Depressive-Like Behaviors by Bisphenol A. Archives of Neuroscience, 2(2), 1-6, 2014.