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Finding Risk and Radiological Exposure Factor for Iraqi Workers in Selected Regions in the Center and North of Iraq

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***Abstract*- This study deals with the process of finding concentrations of Uranium in human blood in central and northern Iraq (Erbil, Samarra and Baghdad) for worker in radiation field in X-ray, MRI, CTS units and from control group, and finding the relationship between uranium concentrations and the number of working years in the field Radiation and type of human race. The technique of fission track analysis with CN-85nuclear track detector was used to determine the content of uranium in blood human samples. Results show that the highest uranium concentration in human blood of workers in X-ray unit was 2.310 ppb (male, 62 years old, 42 years' work experience, living in Erbil city) and lowest concentration1.015 ppb (female, 22 yearsold, 2 years' work experience, and living in Erbil). While for control group, the maximum uranium concentration was 1.037 ppb (male, 28 years old, and living in Samarra) and minimum concentration was 0.574 ppb (female, 25 years old, living in Erbil). It has also been found that the uranium concentration in human blood samples of workers in the radiation field are higher than those of control group, and the uranium concentrations for male workers and control group were higher than those for female workers and control group**.

***Keywords* - CN-85, Fission track, Human blood and Uranium concentration.**

I. INTRODUCTION

The element of uranium is one of the natural components in the soil and water. Its concentration ranges from (1 – 120) ppm [1]. It is a very heavy natural metal with a bright gray silver color, high density of up to 18.9 gm/cm^3, a radioactive source, found in the earth's crust and its concentration in it up to4×10^{-4} % of its weight and is found in the igneous rocks by 3ppm [2, 3]. The concentration of uranium in crustal rocks varies from one species to another within range (0.003-3.5) ppm [4]. It consists of a group of isotopes that are (^{238}U, ^{235}U, ^{234}U, ^{236}U) [1]. Depleted uranium is an accidental product of uranium enrichment or plutonium. It is also considered a nuclear waste with negative effects on the environment, where living organisms are exposed to health risks, and its designation is due to its low counterpart ratio of ^{235}U (from about 0.2 -0.4 to 0.72)% with increase of counterpart ratio of ^{238}U(from99.72 to 99.79)%[5]. Natural uranium is a natural chemical characterized by being moderately radioactive, but the uranium depleted, is a modified mixture of natural uranium isotopes that are less radioactive [6].

The uranium health effects devastating when the near solicit it for a long time as well as the effect of dust if the entry of uranium particles into the human body in various ways, including through the inhalation of uranium dust enters the upper respiratory tract and then enters the lungs mediated by the movement of air (inhalation) as being deposition process and up to 25%, but a large part of the inhaled dust and up to 75% quickly restores it out exhaled. The remaining percentage of the deposited, amounting to 25% of dust mediated by inhalation, the immune cell in the lungs is to get rid of 60% mediated Expectoration in the lymph gland surrounding Trachea absorbs 30% of deposited dust, which leads to the appearance of fibrous changes in the lymphatic tissue first, then Pulmonary tissue Second, leading to the development of lung cancer and lymph gland. The percentage of the remaining 10%, they are mixed with blood after the tissue penetration and then move on to throughout the body, causing liver and kidney damage and bone cancer and the other members of the body

[1]. Solid-state nuclear track detectors (SSNTDs) are normally used to determine the uranium concentration inhuman blood [7]. The fission track technique was suggested by Fleischer et al., who proposed the method of using thermal neutron irradiation of solid state track recordingmaterials that are in contact with both films and pressed together to dry the blood [3]. The aim of this study is to determine the concentration of uranium in the blood of the workers who are working in X-ray unit, MRI unit (Magnetic Resonance Imaging) and CTS unit (Computed Topography Scanning) in north and central of Iraq and from the healthy group.

II. EXPERIMENTAL METHOD

The experimental technique for uranium estimation is the same a reported elsewhere [8,9, 10,11 and 12]. In this study, 92 blood samples of volunteers, males and females, were collected from two groups. The first group included the workers by which 77 blood samples were collected from hospitals in Erbil, Samarra and Baghdad. While the second group included the healthy volunteers by which 15 blood samples from healthy volunteers who live in these governorates. Each sample was presented and classified according to some important parameters, age, gender, employment duration and smoking habits. The CN-85 nuclear track detector sheets of active layer (175) μm thick were used. These sheets were cut into small pieces of (1.25×1.25) cm^2 area each, two drops of blood of known volume (70μL) were dried on a square CN-85 piece in a dust free atmosphere at normal unit temperature. The pellets were covered with CN-85 track detector on both sides and were put in a plate of paraffin wax at a distance of 5 cm from Am–Be neutron source with a thermal flounce equal to (3.024×10^9 n cm^{-2}) for 7 days to cause latent damage to the detector due to ^{235}U (n, f) reaction. After the irradiation, the CN-85 detectors were etched in (N = 6.25) NaOH solution at temperature of 60 ºC for 5 h. The induced fission tracks densities were recorded using Olympus optical microscope with magnification of 400X. The fission track densities were measured on the surfaces showing uniform distribution of uranium.

III. CALCULATIONS

Explained by drawing the standard concentration (C_s) of the blood samples versus the track density, the slope of the resulted straight line was equal to (ρ_s/C_s). Uranium concentration in the samples was determined by comparing between track density registered on the detectors and that of the standard solutions from the relation [13]:

$$C_x = \rho_x \, (C_s / \rho_s) \qquad (1)$$

Where, ρ_x and ρ_s are the induced fission track densities for the unknown sample and standard solution (in tracks/mm^2) respectively, while C_x and C_s denote the uranium concentration for unknown sample and standard solution in (ppb).

IV. RESULT AND DISCUSSION

Uranium concentrations in blood samples from males and females of X-ray unit, MRI unit and CTS unit workers are shown in Tables 1, 2, 3, 4, 5 and 6. Table 1 shows that the uranium content in blood for female workers in X-ray unit in Erbil and Baghdad ranged from 1.015 ppb (female 22 years old, living in Erbil city) to 1.585 ppb (female, 50 years old, living in Erbil city) with a value averaging 1.324 ppb.

Table I

Uranium concentration in blood samples for female workers of X-ray unit

Location	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	48	15	1.448 ± 0.271
Erbil	50	26	1.585 ± 0.336
Erbil	38	17	1.466 ± 0.273
Erbil	32	8	1.323 ± 0.403
Erbil	22	2	1.015 ± 0.250
Erbil	25	2.5	1.022 ± 0.255
Baghdad	24	3	1.274± 0.129
Baghdad	31	4	1.319± 0.119
Baghdad	30	8	1.521± 0.297
Baghdad	25	3	1.267 ± 0.127
Baghdad	47	8	1.530 ± 0.283
Baghdad	24	1.5	1.241 ± 0.121

Baghdad	24	2	1.253 ± 0.121
Baghdad	24	2.5	1.264± 0.129
Average			1.324 ± 0.222

Table II shows that the content of uranium in blood for male workers in X-ray unit in Erbil, Baghdad and Samarra ranged from 1.176 ppb (male, 35 years old, living in Samarra city) to 2.310 ppb (male, 62 years old, living in Erbil city) with a value averaging 1.557 ppb.

Table III shows that the uranium content in blood for female workers in MRI unit in Erbil and Baghdad ranged from 1.044 ppb (female, 22 years old, living in Baghdad city) to 1.410 ppb (female, 40 years old, living in Baghdad city) with a value averaging 1.158 ppb.

Table IV shows that the content of uranium in blood for male workers in MRI unit in Erbil, Baghdad and Samarra ranged from 1.020 ppb (male, 25 years old, living in Erbil city) to 1.706 ppb (male, 54 years old, living in Samarra city) with a value averaging 1.256 ppb.

Table II

Uranium concentration in blood samples for male workers of X-ray unit

Location	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	34	8	1.328 ± 0.396
Erbil	54	37	2.021 ± 0.200
Erbil	62	42	2.310 ± 0.352
Erbil	51	28	1.736 ± 0.560
Erbil	51	29	1.876 ± 0.393
Erbil	47	26	1.561 ± 0.474
Erbil	52	29	1.907 ± 0.538
Erbil	49	20	1.502 ± 0.271
Erbil	62	30	2.007 ± 0.401
Erbil	28	9	1.408 ± 0.249
Erbil	30	8	1.345 ± 0.418
Samarra	27	4	1.464 ± 0.386
Samarra	24	7	1.527 ± 0.358
Samarra	35	1.5	1.176 ± 0.330
Samarra	27	2	1.214 ± 0.343
Samarra	30	6	1.517 ± 0.339
Samarra	36	5	1.494 ± 0.283
Samarra	25	2.5	1.229 ± 0.384
Baghdad	28	6	1.395 ± 0.157
Baghdad	50	27	1.900 ± 0.332
Baghdad	26	6	1.403 ± 0.159
Baghdad	40	1	1.230 ± 0.121
Baghdad	34	2	1.257 ± 0.129
Average			1.557 ± 0.329

Table III

Uranium concentration in blood samples for female workers of MRI unit

Location	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	26	4	1.069 ± 0.355
Erbil	33	11	1.166 ± 0.340
Erbil	34	7	1.078 ± 0.272
Erbil	36	7	1.089 ± 0.197
Baghdad	29	6	1.187 ± 0.338
Baghdad	22	1	1.044 ± 0.085
Baghdad	33	9	1.214 ± 0.199
Baghdad	36	3	1.165 ± 0.338
Baghdad	40	22	1.410 ± 0.371
Average			1.158 ± 0.277

Table IV

Uranium concentration in blood samplesfor male workers of MRI unit

Location	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	35	12	1.116 ± 0.280
Erbil	47	16	1.250 ± 0.370
Erbil	46	13	1.149 ± 0.336
Erbil	41	12	1.114 ± 0.377
Erbil	45	25	1.310 ± 0.446
Erbil	25	1.5	1.020 ± 0.158
Samarra	54	26	1.706 ± 0.765
Samarra	45	5	1.384 ± 0.368
Samarra	29	4	1.267 ± 0.377

Samarra	23	2	1.100 ± 0.218
Samarra	27	4.5	1.359 ± 0.404
Baghdad	43	20	1.392 ± 0.374
Baghdad	30	7	1.195 ± 0.190
Baghdad	52	10	1.226 ± 0.199
Average			1.256 ± 0.565

Table V shows that the uranium content in blood for female workers in CTS unit in Erbil and Baghdad ranged from 1.320 ppb (female, 29 years old, living in Erbil city) to 1.75 ppb (female, 52 years old, living in Baghdad city) with a value averaging 1.5 ppb.

Table V

Uranium concentration in blood samplesfor female workers of CTS unit

Location	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	29	7	1.320 ± 0.381
Baghdad	42	6	1.424 ± 0.231
Baghdad	52	26	1.756 ± 0.331
Average			1.5 ± 0.315

Table VI showed that the content of uranium in blood for male workers in CTS unit in Erbil and Baghdad ranged from 1.096 ppb (male, 43 years old, living in Erbil city) to 2.056 ppb (male, 75 years old, living in Erbil city) with a value averaging 1.447 ppb.

Table VI

Uranium concentration in blood samplesfor male workers of CTS unit

Sample code	Age (years)	No. of working years	Uranium concentration (ppb)
Erbil	35	10	1.365 ± 0.325
Erbil	37	11	1.391 ± 0.619
Erbil	53	3	1.249 ± 0.530
Erbil	43	1	1.096 ± 0.402
Erbil	35	12	1.440 ± 0.469
Erbil	32	4	1.289 ± 0.273
Erbil	48	24	1.481 ± 0.538
Erbil	75	46	2.056 ± 0.524
Erbil	57	28	1.863 ± 0.770
Baghdad	41	2	1.382 ± 0.229
Baghdad	31	4	1.404 ± 0.229
Baghdad	27	4	1.409 ± 0.231
Baghdad	23	4	1.400 ± 0.232
Baghdad	37	6	1.436 ± 0.231
Average			1.447 ± 0.400

Fig. 1 shows the average of uranium concentrations in blood samples for X-ray unit, MRI unit and CTS unit workers according to the number of working years. It was found that the following divisions were the most appropriate, as it provides an acceptable statistical number in each group: (A) 1–7 years, (B) 8–14 years, (C) 15–21 years, (D) 22–28 years, and (E) more 29 years.

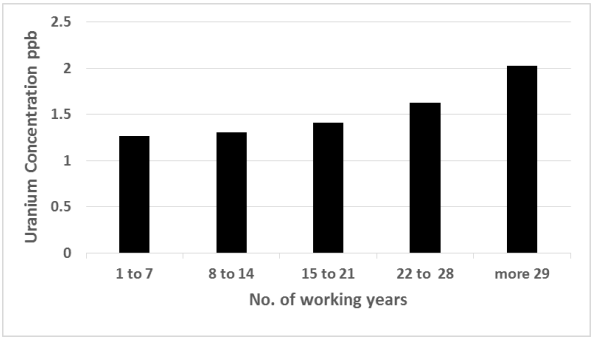

Fig. 1 The average of Uranium Concentration in Blood samples of workers in X-ray, MRI and CTS units according to the number of Working years.

V. CONCLUSIONS

The uranium concentrations in the blood samples of workers were found to increase with the increasing number of working years, and were higher than those of control group in the different governorates of Iraq. The average values of uranium concentration for male workers were higher than those for female Workers, except CTS unit the concentration of uranium in female was higher than male, this corresponds to [13] and the results show that smoking and alcohol increase the concentration of uranium in human blood.

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