

The Urinary Concentration and Ratio of Uranium Isotopes in Civilians of the Bibi Mahro Region after Recent Military Operations in Eastern Afghanistan

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Introduction

The aim of this work was to quantitatively evaluate the precise concentration and isotopic ratio of uranium isotopes in the urine of the civilians of eastern Afghanistan following the air raids during Operation Enduring Freedom. Our previous studies reported unusually high concentrations of uranium in the Jalalabad and Kabul regions of Afghanistan. The first UMRC team entered eastern Afghanistan just as Operation Anaconda ended. UMRC studies of the populations of Jalalabad, Spin Gar, Tora Bora, and Kabul areas (1, 2, 3) identified civilians with multiorgan symptomatology similar to those encountered in the Gulf War I and Balkan conflicts.



Materials & Methods

The current study focused on an area of intense bombing raids. Bibi Mahro is a suburb of Kabul. Six male subjects with the clinical presentation of non-specific multi-organ symptoms of respiratory, urinary, musculoskeletal, and neurological alterations had their urine samples collected by the field research team under controlled conditions. All subjects were exposed to the inhalation of dust during the bombing operations of Allied Forces in June, 2002. Twenty-four hour urine samples from symptomatic subjects as well as from a control population were collected by the following criteria: the correlation of symptoms to the bombing raids, the subject's presence in the area of bombings, and clinical manifestations. Control subjects were selected among the symptom free residents of non-targeted areas. All subjects including the controls were informed about the protocol and the procedures of sample collection in local Dari and Pasu languages. All samples were analyzed for concentrations and ratios of four uranium isotopes (²³⁴U, ²³⁵U, ²³⁶U, and ²³⁸U) by multicollector plasma ionization mass spectrometry (MS-ICP-MS) in the laboratories of the British Geological Survey, Nottingham, England. Internal urine standard control samples were analyzed by the same methodology (1). All samples were processed by the procedure of uranium pre-concentration with co-precipitation, evaporation, organic matter oxidation, ion-exchange chromatography, uranium purification, and mass spectrometry analysis by Thermo-Elemental Plasma54 multicollector ICP-MS with ion counting Daly[®] detector and multiple Faraday cups. The blank samples contained negligible concentration of less than 50 pg of total uranium. The chemical recovery was greater than 80% for most samples. Internal standard of the urine with 11 ng/L of uranium of natural atomic ratio ²³⁸U/²³⁵U of 137.88 was also analyzed, together with certified isotopic standards of uranium. The results of all analyses were within the correct values for the standards.

Results

The original results of the first field trip revealed significant urinary excretion of total uranium in 100% of the subjects, more than twenty times higher than the non-exposed population. The isotopic ratios identified the ratios of natural uranium (4). The second field trip in 2002 revealed uranium concentration up to 200 times higher than the control population in the districts of Tora Bora, Lal Ma, Poli Cherki, and Kabul Airport. The present results revealed the mean concentration of uranium in all six samples (389 ng/L, SD 805, SE 329) being significantly higher than the normal population values (1-20 ng/L) with an exceedingly high concentration (2032 ng/L) in one child, the sole survivor of a direct bomb impact on the family home. The ²³⁸U/²³⁵U ratio was 138.14 +/- 0.13, consistent with natural uranium. The samples showed detectable ²³⁶U with a measured ratio of ²³⁶U/²³⁸U < 10⁻⁶.



Tables

Isotopic Abundance in Urine				
Subject	% ²³⁸ U	% ²³⁵ U	% ²³⁴ U	% ²³⁶ U
1	99.2718	0.7208	7.15 × 10 ⁻³	2.28 × 10 ⁻⁴
2	99.2787	0.7144	6.25 × 10 ⁻³	5.86 × 10 ⁻⁴
3	99.2714	0.7223	6.25 × 10 ⁻³	2.18 × 10 ⁻⁵
4	99.2755	0.7181	6.16 × 10 ⁻³	2.48 × 10 ⁻⁴
5	99.2801	0.7199		
6	99.2747	0.7195	5.66 × 10 ⁻³	9.33 × 10 ⁻⁵
Average	99.2754	0.7192	6.29 × 10 ⁻³	2.35 × 10 ⁻⁴
SD	3.54 × 10 ⁻³	2.72 × 10 ⁻³	5.37 × 10 ⁻⁴	2.17 × 10 ⁻⁴
SE	1.45 × 10 ⁻³	1.11 × 10 ⁻³	2.19 × 10 ⁻⁴	8.87 × 10 ⁻⁵
Control	99.2702	0.7220	7.66 × 10 ⁻³	8.42 × 10 ⁻⁵

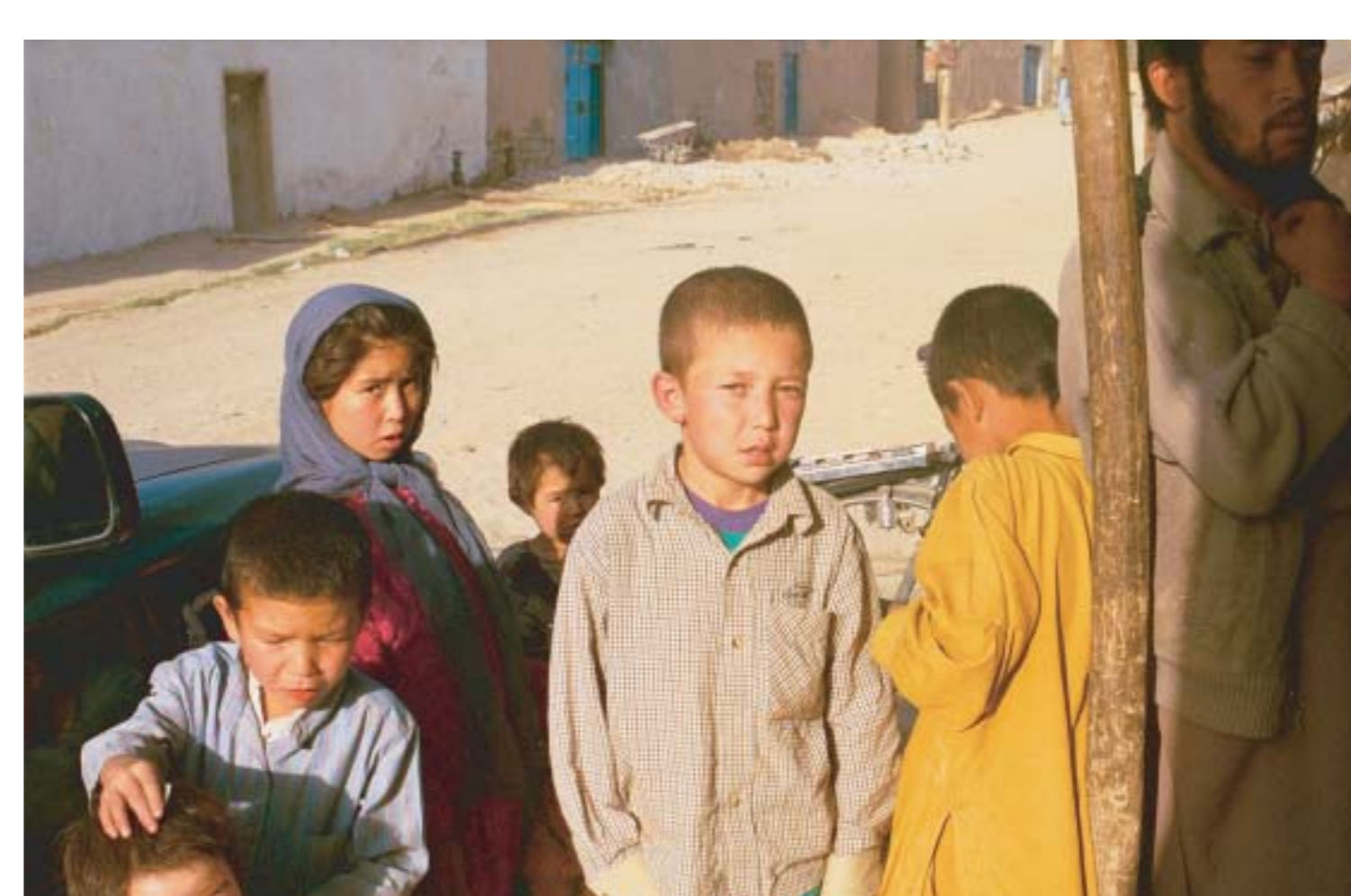
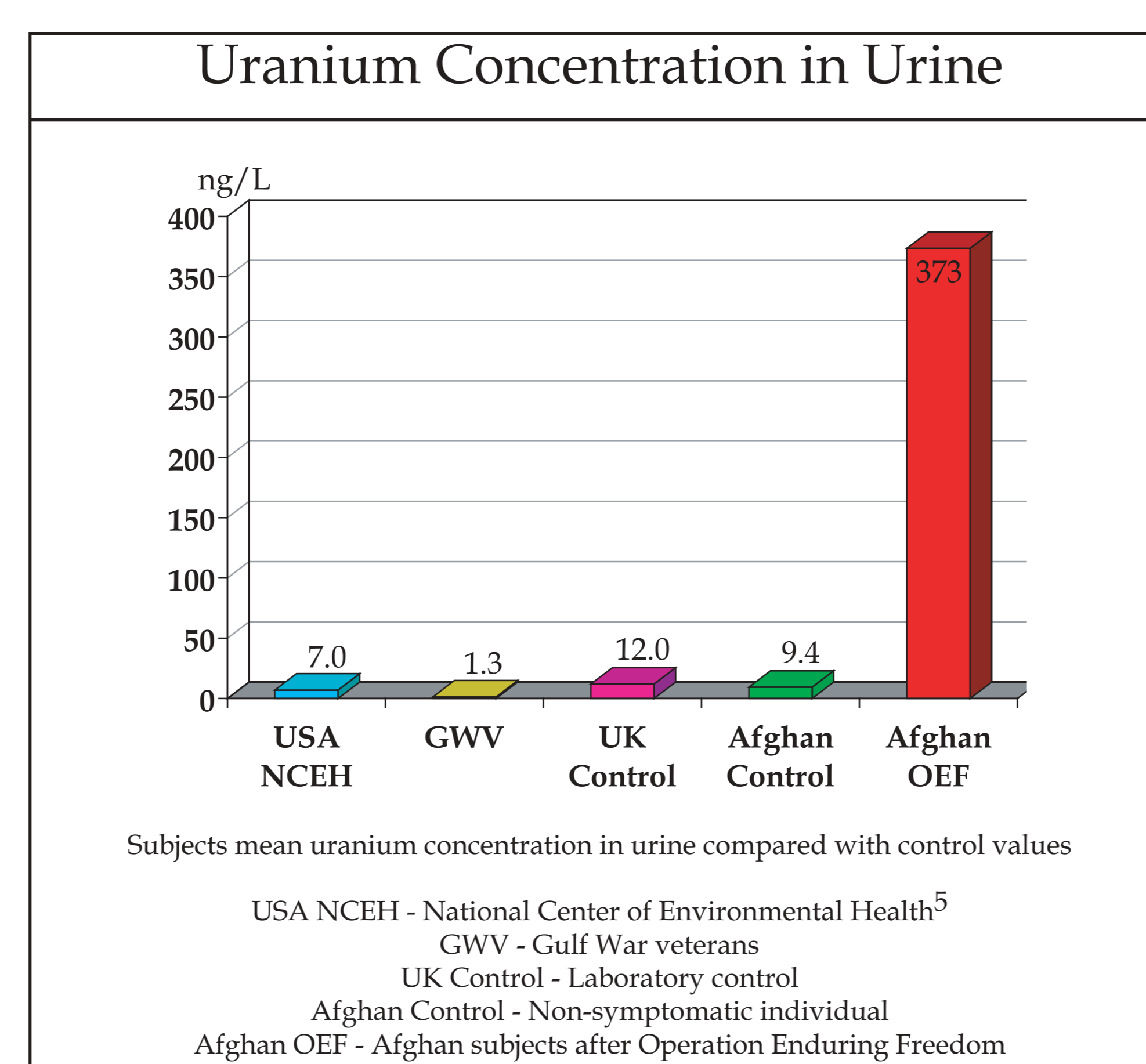
Isotopic Ratios in Urine						
Subject	²³⁸ U/ ²³⁵ U	Sigma	²³⁴ U/ ²³⁸ U	Sigma	²³⁶ U/ ²³⁸ U	Sigma
1	137.72	0.48	7.2 × 10 ⁻⁵	2.4 × 10 ⁻⁵	2.3 × 10 ⁻⁶	1.5 × 10 ⁻⁷
2	138.97	0.47	6.3 × 10 ⁻⁵	4.3 × 10 ⁻⁶	5.9 × 10 ⁻⁶	6.5 × 10 ⁻⁸
3	137.44	0.48	6.3 × 10 ⁻⁵	2.7 × 10 ⁻⁵	2.2 × 10 ⁻⁷	1.7 × 10 ⁻⁷
4	138.26	0.47	6.2 × 10 ⁻⁵	2.7 × 10 ⁻⁶	2.5 × 10 ⁻⁶	4.5 × 10 ⁻⁸
5	137.91	0.03				
6	137.97	0.47	5.7 × 10 ⁻⁵	8.6 × 10 ⁻⁶	9.4 × 10 ⁻⁷	5.7 × 10 ⁻⁸
Average	138.04		6.3 × 10 ⁻⁵		2.4 × 10 ⁻⁶	
SD	0.53		5.4 × 10 ⁻⁶		2.2 × 10 ⁻⁶	
SE	0.22		2.2 × 10 ⁻⁶		8.9 × 10 ⁻⁷	
Control	137.49	1.47	7.7 × 10 ⁻⁵	2.2 × 10 ⁻⁵	8.5 × 10 ⁻⁷	1.0 × 10 ⁻⁷

Total Uranium Concentration in Urine	
Subject	Uranium ng/L
1	10.88
2	59.93
3	9.47
4	99.62
5	2031.63
6	29.92
Average	373.57
SD	812.99
SE	331.90
Control	11.88

Uranium Concentration in Water and Soil	
Uranium Concentration	
Water (n=8)	23,771 ng/L
Soil (n=4)	7.5 mg/kg

Conclusion

These results suggest that the civilian population of the Bibi Mahro had a significant elevation of total uranium concentration, up to 200 times higher than the normal values of the range of the world environmental and geographic areas. The explanation of our findings could be either of two possible mechanisms. 1) exposure to contaminated dust in the areas of the bombing raids by natural uranium containing weapons or 2) unusual geological and environmental excessively high uranium levels contained in the soil or drinking water. Whereas some areas of central Asia have been identified as high uranium regions in the water and soil as a result of uranium mining and processing, such circumstances have not been identified in the Bibi Mahro, Afghanistan. An interdisciplinary approach to test these hypotheses is a part of our ongoing studies.



References

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