

# **Internal Contamination with Uranium Isotopes in the Civilian Population of Tora Bora, Kabul, and Jalalabad after Operation Enduring Freedom**

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## **Abstract**

The aim of this study was to analyze the concentration and quantitative relationship of four uranium isotopes in the urine of civilians after Operation Enduring Freedom in Afghanistan.

Five male subjects from the Tora Bora, Lal Mah village of Jalalabad, and Bibi Mahro district of Kabul, presenting with a complex nonspecific symptomatology of fatigue, fever, respiratory, musculoskeletal, and neurological alterations, had their urine samples collected under controlled conditions. The specimens were analyzed by pre-concentration, coprecipitation, evaporation, oxidation of organic matter, ion exchange chromatography, and mass spectrometry using a Thermo-Elemental Plasma54 multi-collector ICP-MS with an ion-counting Daly<sup>®</sup> detector. A blank control < 50 pg of uranium and a urine internal standard of 11.79 ng/L of uranium of natural ratio ( $^{238}\text{U}/^{235}\text{U} = 137.88$ ) were analyzed by the same method after determination of correct values for standards.

$^{238}\text{U}/^{235}\text{U}$  ratio of  $138.16 \pm 0.22$  with the respective percent values of  $99.276 \pm 0.001$  and  $0.719 \pm 0.001$  indicate the presence of natural uranium. Total uranium of 446.40 ng/L was 37.86 times higher than British control (11.79 ng/L) and 47.49 times higher than Afghan control.

Total values of  $^{234}\text{U}$  were  $6.3 \times 10^{-3} \pm 3 \times 10^{-4}$  and  $^{236}\text{U}$  of  $2.9 \times 10^{-4} \pm 9 \times 10^{-5}$  percent with a  $^{234}\text{U}/^{238}\text{U}$  ratio of  $6.4 \times 10^{-5} \pm 3 \times 10^{-6}$  and a  $^{236}\text{U}/^{238}\text{U}$  ratio of  $2.9 \times 10^{-6} \pm 9 \times 10^{-7}$  indicating a presence of minute quantities of  $^{236}\text{U}$  with an interpretation compromised by the levels close to the detection limits.

Our results confirm a significantly elevated presence of uranium isotopes in the urine of Afghan civilians after Operation Enduring Freedom. Possible explanation of our findings may be either a consequence of exposure due to deployment of weapons containing non-depleted uranium or unusually high levels of natural uranium in drinking water or soil in the particular geographic areas. Our current investigations of critical evaluation of biological specimens and environmental samples are in progress.