Uranium Bone Content as an Indicator of Chronic Environmental Exposure from Drinking Water

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Uranium (U) is an ubiquitous radioelement found in drinking water and food. As a consequence of its prevalence, most humans ingest a few micrograms (mg) of this element daily. It is incorporated in various organs and tissues. Several studies have demonstrated that ingested U is deposited mainly in bones. Therefore, U skeletal content could be considered as a prime indicator for low-level chronic intake. In this study, 71 archived vertebrae bone samples collected in seven Canadian cities were subjected to digestion and U analysis by inductively coupled plasma mass spectrometry. These results were correlated with U concentrations in municipal drinking water supplies, with the data originating from historical studies performed by Health Canada. A strong relationship (r^2 = 0.97) was observed between the averaged U total skeletal content and averaged drinking water concentration, supporting the hypothesis that bones are indeed a good indicator of U intake. Using a PowerBASIC compiler to process an ICRP systemic model for U (ICRP, 1995a), U total skeletal content was estimated using two gastrointestinal tract absorption factors (f_1 = 0.009 and 0.03). Comparisons between observed and modeled skeletal contents as a function of U intake from drinking water tend to demonstrate that neither of the f_1 values can adequately estimate observed values. An f_1 value of 0.009 provides a realistic estimate for intake resulting from food consumption only (6.72 µg) compared to experimental data (7.4 ± 0.8 µg), whereas an f_1 value of 0.03 tends to better estimate U skeletal content at higher levels of U (1 - 10 µg L^{-1}) in drinking water.

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