

DISTRIBUTION OF URANIUM IN URINE, HAIR AND NAILS IN RESIDENTS OF NISKA BANJA TOWN, A HIGH NATURAL BACKGROUND RADIATION AREA

Zora S. Žunic¹, Ljudmila Benedik², Sarata Kumar Sahoo^{3*}, Rawiwan Kritsanawanuwat^{3,4}, Nenad Veselinovic¹, Zdenka Stojanovska⁵, Shinji Tokonami⁶

¹ University of Belgrade Institute of Nuclear Sciences "Vinca", Belgrade, Serbia, ² Jožef Stefan Institute, Department of Environmental Sciences, Ljubljana, Slovenia, ³ National Institutes for Quantum and Radiological Science and Technology (QST), Chiba, Japan, ⁴ Chulalongkorn University, Bangkok, Thailand ⁵ Goce Delcev University, Stip, Republic of Macedonia, ⁶ Hirotsuki University, Hirotsuki, Japan

E-mail: saho.sarata@qst.go.jp

AIM OF STUDY

Quantification of uranium in human urine is a valuable technique for assessing occupant and public exposure to uranium in HBRA.

Human hair and nails can be considered as bio-indicators of the public exposure to certain natural radionuclides and toxic metals over a long period of months or even years.

Advantages of hair and nail

Hair and nail have many of the characteristics to be ideal tissue for assays:

- ✦ Painlessly removed
- ✦ Easily collected and transported
- ✦ Highly stable at room temperature
- ✦ Normally discarded
- ✦ Relatively high with element concentration compared to body fluids and tissues
- ✦ Reflect the actual exposure over a period of months, or even year. (Blood and urine tend to show current or recent body status)

Sampling Location



Niška Banja, a spa town of Serbia is located in the quaternary alluvium of River Nišava along the contact of the Koritnik limestone and travertine rock.

The high value of ²²⁶Ra concentration in soil and indoor-outdoor radon concentrations found around Niška Banja make this region a high background radiation area.

Radionuclide in soil

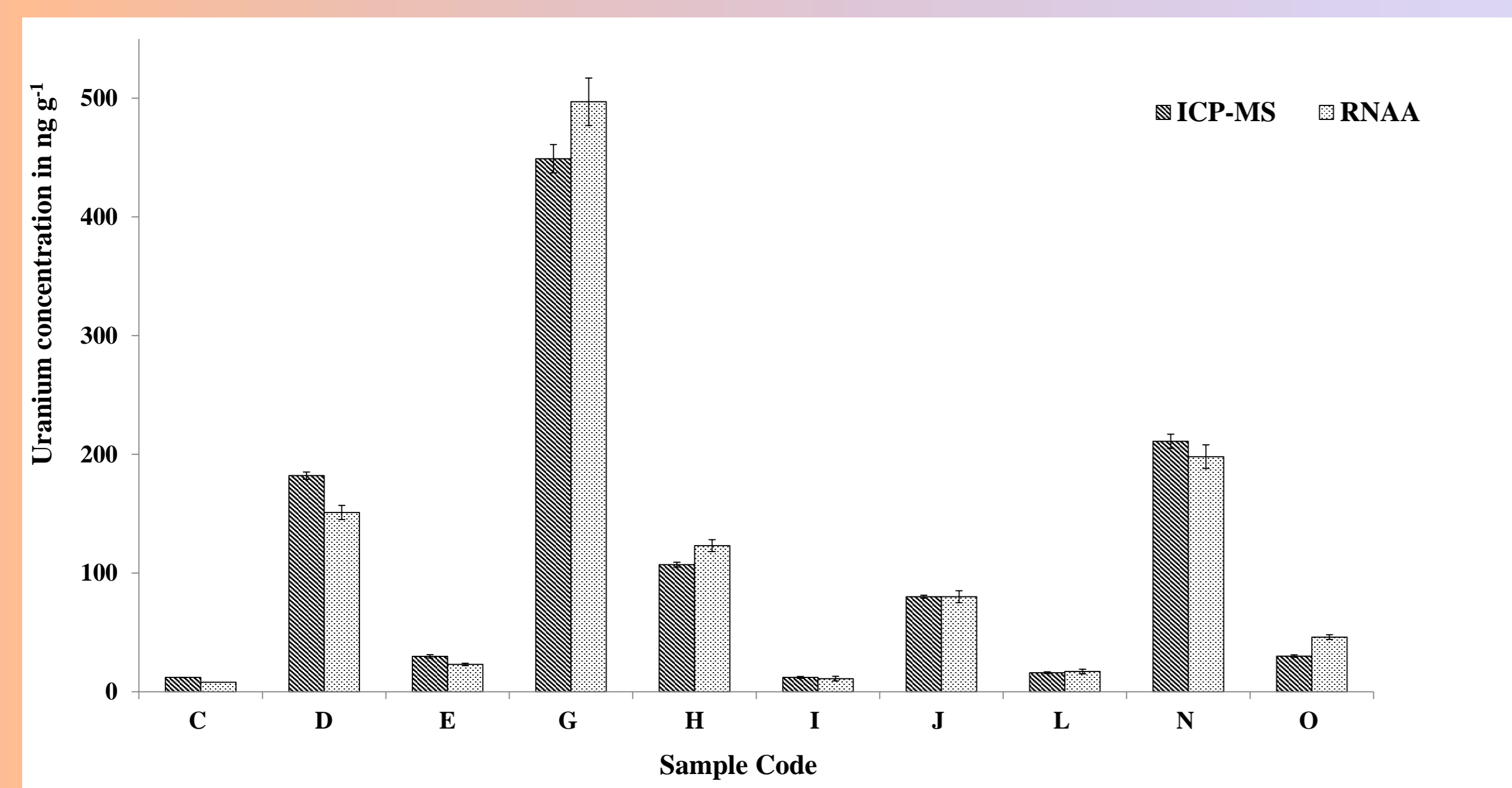
Radionuclide	Concentration (Bq/Kg)
²²⁶ Ra	10.2 – 750.2
²³² Th	6.8 - 46.1
⁴⁰ K	95.8 - 583.5

²²² Rn Concentration	Bq/m ³
Indoor	6000
Outdoor	168

MATERIALS AND METHODS

- ❖ Urine, hair and nail samples were collected from same subjects.
- ❖ One day urine samples were collected for each subjects.
- ❖ Hair samples were cut with ceramic equipment to avoid any contamination.
- ❖ Alpha-spectrometry was used for uranium determination in urine.
- ❖ Hair and nail samples were micro-wave digested and uranium concentration was determined using ICP-MS.

Method validation results



Analytical validation between the ICP-MS and RNAA for uranium analysis in hair are within analytical error $\pm 2\%$.

Advantages of ICP-MS

Inductively coupled plasma-mass spectroscopy (ICP-MS) is the analytical technique of choice because of its:

- ✦ Multi-element capability
- ✦ Low detection limit and high sensitivity
- ✦ Ability to measure a large range of concentration
- ✦ Simple experimental procedure

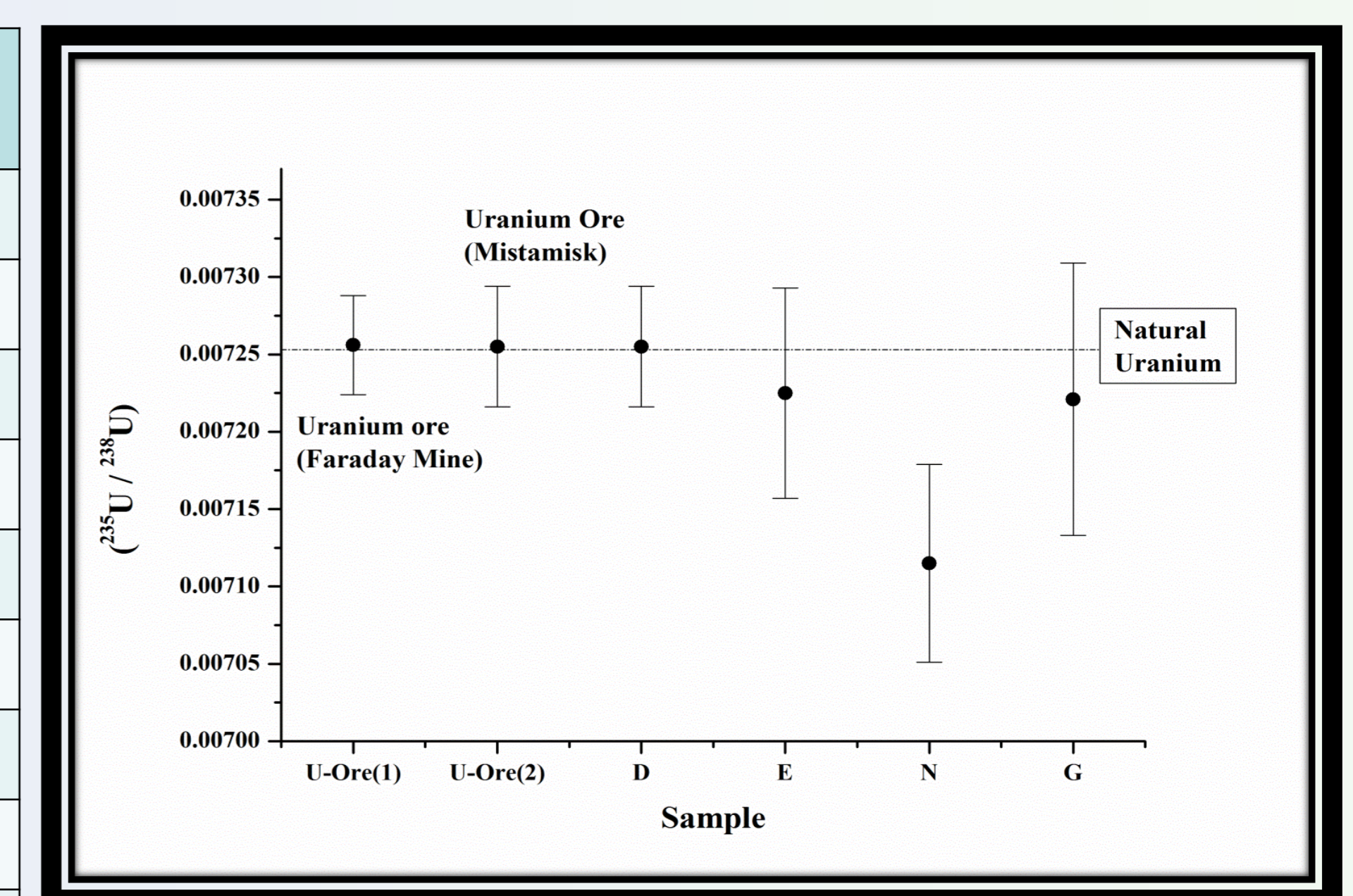
Funding

This work was partially supported by President Fund of National Institute of Radiological Sciences.

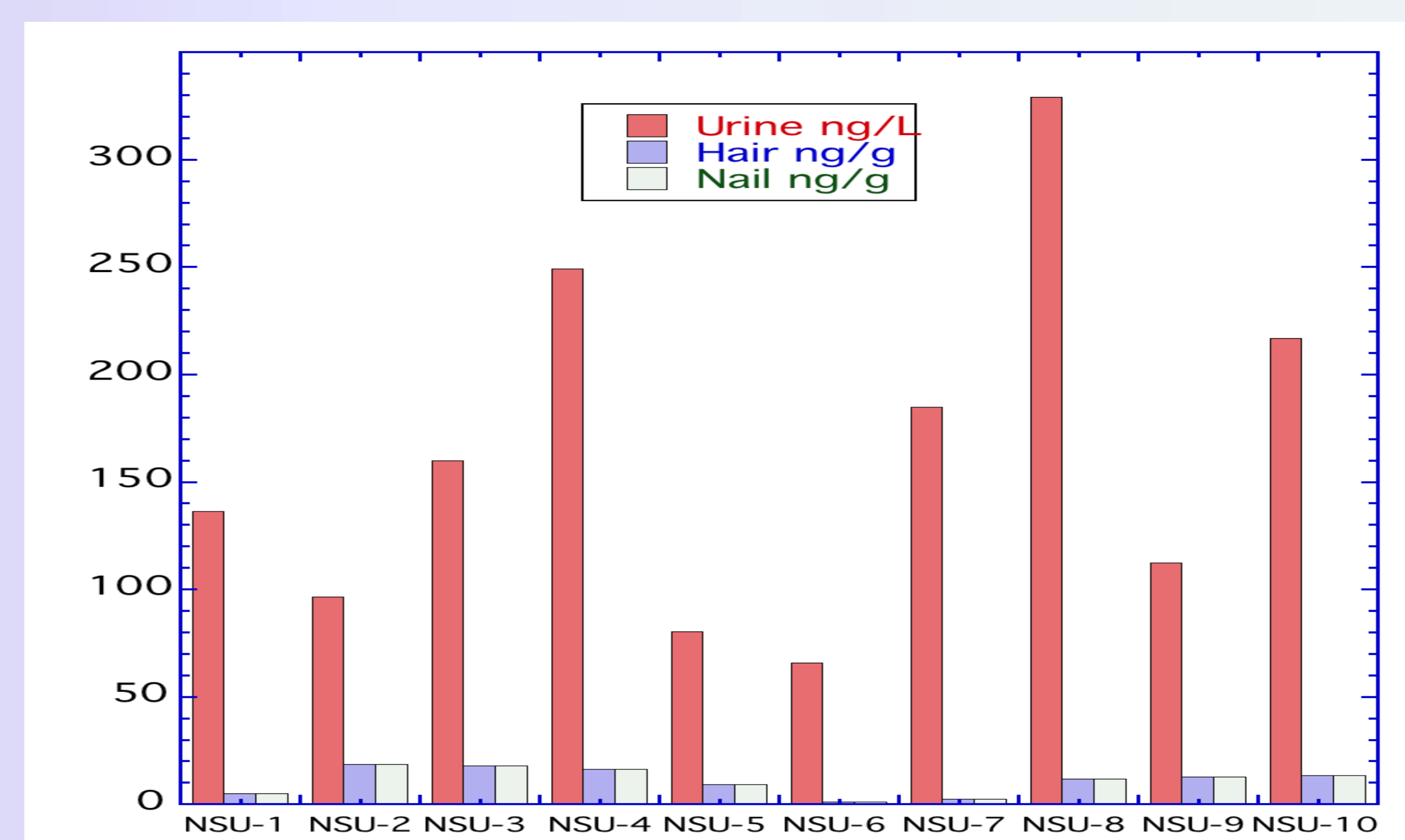
RESULTS

Concentration of ²³⁴U and ²³⁸U in Urine (mBq/g)

Subjects	Age (y)	U-238 mBq	U-234 mBq
NSU-1	64	1.1±0.4	0.62±0.2
NSU-2	40	1.7±0.3	0.96±0.23
NSU-3	47	1.1±0.2	0.68±0.16
NSU-4	66	1.8±0.2	1.1±0.3
NSU-5	72	1.5±0.3	0.99±0.24
NSU-6	53	0.37±0.16	0.57±0.2
NSU-7	87	0.49±0.18	0.69±0.21
NSU-8	67	2.1±1.0	2.0±1.0
NSU-9	55	0.75±0.21	0.57±0.18
NSU-10	62	1.4±0.5	1.3±0.5



Uranium Isotope ratio ²³⁵U/²³⁸U in selected Hair samples measured by TIMS



Hair and nail samples were collected from the volunteers same time. Concentration in Hair > Nail

Comparison of Uranium Concentrations in Urine, Hair and Nail samples

Conclusion

- A large variation in hair, nail and urine uranium concentrations.
- U levels are relatively high in hair, nail and urine supports individuals living in high natural background radiation area (HNBRA) whereas sample size is small to conclude.
- Elevated levels of uranium in human body could be related to environmental exposure. However, dietary intake is one of the most important factor.

Literature

S.K. Sahoo et al., Distribution of uranium, thorium and some stable trace and toxic elements in human hair and nails in Niska Banja Town, a high natural background radiation area of Serbia (Balkan region, South-East Europe) J. Environ. Radioact. (2015) 145, 66-77.