

## HEALTH RISK ASSESSMENT OF CHILDREN'S AND ADULT'S EXPOSURE TO ARSENIC BOUND TO PM<sub>10</sub> IN THE CITY OF BOR

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One of the most polluted cities in Serbia and Europe is Bor, due to mining and smelting processes in Mining-Metallurgical Complex in Bor. Mining activities release mainly SO<sub>2</sub> and particulate matter in air (1) and, as arsenic is usually found in copper and lead ores, air quality monitoring in Bor has been showing its presence in exceeded annual limit concentrations in past few years. Exposure to arsenic is related with anemia, skin changes, peripheral neuropathy and cancer development. This study was carried out to assess children's and adult's exposure to arsenic bound to PM<sub>10</sub> and to characterize risk from their exposure through the air in the city of Bor. Mean yearly concentrations of arsenic were used from Reports of the Serbian Environmental Protection Agency, for measuring stations: Bor-City park, Bor 1, Bor 2 and Bor-Jugopetrol. The USEPA method was used to assess non-carcinogenic and carcinogenic risk, which classifies non-carcinogenic risk as acceptable (<1) or unacceptable (>1) based on hazard quotient (HQ) values for three main exposure pathways, while cancer risk classification is based on CR values also as acceptable (<1×10<sup>-4</sup>) or unacceptable (>1×10<sup>-4</sup>) (2). HQ<sub>inh</sub> values exceeded safe level both for children and adults on all measuring stations, describing risk as unacceptable via inhalation exposure. Unacceptable carcinogenic risk for children was calculated on measuring station Bor-Jugopetrol and for adults on measuring stations Bor-City park, Bor 1 and Bor-Jugopetrol. Actions for reduction of arsenic release into the air should be taken due to obtained results for city of Bor.

### References

1. Serbula M. Arsenic and SO<sub>2</sub> hotspot in South-Eastern Europe: An overview of the air quality after the implementation of the flash smelting technology for copper production. *Science of the Total Environment* 777 (2021); 145981.
2. Megido L. Suburban air quality: Human health hazard assessment of potentially toxic elements in PM<sub>10</sub>. *Chemosphere* 177 (2017); 284-291.

### Acknowledgments

This research was partly funded by the Ministry of Education, Science and Technological Development, Republic of Serbia through Grant Agreement with University of Belgrade-Faculty of Pharmacy No: 451-03-68/2022-14/200161.

## PROCENA RIZIKA OD IZLOŽENOSTI DECE I ODRASLIH ARSENU U PM<sub>10</sub> ČESTICAMA PUTEM ZAGAĐENOG VAZDUHA U BORU

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Grad Bor spada među najzagađenije gradove u Republici Srbiji i Evropi. Najveći izvor zagađenja u ovom gradu predstavlja rudnik bakra, Rudarsko-topioničarski basen Bor, usled emisije, predominantno, SO<sub>2</sub> i suspendovanih čestica (1). Arsen je čest pratilac ruda bakra i olova, te se iz godine u godinu monitoringom kvaliteta vazduha uočava njegovo prisustvo u koncentracijama koje prelaze dozvoljene godišnje granice. Izloženost arsenu može dovesti do razvoja anemije, promena na koži, periferne neuropatije, ali i razvoja karcinoma. Cilj rada bio je da se proceni izloženost i okarakterise rizik dece i odraslih od izloženosti arsenu iz PM<sub>10</sub> čestica tj. putem zagađenog vazduha u gradu Boru. Vrednosti prosečnih godišnjih koncentracija arsena u vazduhu su preuzete iz godišnjih izveštaja Agencije za zaštitu životne sredine, za merne stanice: Bor-Gradski park, Bor 1, Bor 2 i Bor-Jugopetrol. Zdravstveni rizik je procenjen metodologijom koju preporučuje Američka agencija za zaštitu životne sredine. Na osnovu vrednosti količnika hazarda (HQ) za oralni, inhalacioni i dermalni put unosa, ne-karcinogeni rizik se klasifikuje kao prihvatljiv (<1) ili neprihvatljiv (>1), dok se karcinogeni rizik klasifikuje na osnovu vrednosti CR, takođe kao prihvatljiv (<1×10<sup>-4</sup>) ili neprihvatljiv (>1×10<sup>-4</sup>) (2). Izračunate vrednosti HQ<sub>inh</sub> za decu i odrasle prelaze vrednost 1 ukazujući na neprihvatljiv rizik od izloženosti arsenu preko PM<sub>10</sub> čestica iz zagađenog vazduha na svim razmatranim mernim stanicama. Neprihvatljiv karcinogeni rizik za decu je izračunat na stanici Bor-Jugopetrol, a za odrasle na stanicama Bor-Gradski park, Bor 1 i Bor-Jugopetrol. Dobijeni rezultati ukazuju na preku potrebu preduzimanja mera u cilju smanjenja emisije arsena u vazduh u Boru.

### Literatura

1. Serbula M. Arsenic and SO<sub>2</sub> hotspot in South-Eastern Europe: An overview of the air quality after the implementation of the flash smelting technology for copper production. *Science of the Total Environment* 777 (2021); 145981.
2. Megido L. Suburban air quality: Human health hazard assessment of potentially toxic elements in PM<sub>10</sub>. *Chemosphere* 177 (2017); 284-291.

### Zahvalnica

Istraživanje je delom finansirano od strane Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije kroz Ugovor sa Univerzitetom u Beogradu – Farmaceutskim fakultetom broj: 451-03-68/2022-14/200161