

Determination of Urinary 1-Hydroxypyrene in Wildland Firefighters

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Background:

During fire suppression, firefighters are exposed to polycyclic aromatic hydrocarbons (PAHs), which are associated with toxic effects such as hemotoxicity and carcinogenicity. 1-Hydroxypyrene (1-HP), a metabolite of pyrene, has been used extensively as a biological monitoring indicator of exposure to PAHs. The objective of this study was to evaluate the impact of wildfires on 1-hydroxypyrene levels in firefighters by assessing their concentrations before and after exposure to the fires.

Methods:

522 urine samples were collected from six firefighter crews both before and after firefighting exposure for up to three days. Sample preparation involved an enzyme deconjugation step followed by protein precipitation and dilution. After centrifugation, the supernatant was analyzed using a SCIEX QTRAP 5500 in negative MRM mode. Separation of 1-HP was achieved on an Agilent SB-C18 column (Poroshell 120, 3.0x100 mm, 2.7µm). To enable creatinine normalization of the 1-HP results, creatinine levels were assessed using the Olympus AU480 autochemistry analyzer.

Results:

Of the 522 urine samples tested, 76.3% exhibited elevated 1-HP levels in the post-fire samples compared to the pre-fire samples. Five of post-fire samples had 1-HP concentrations exceeding the American Conference of Governmental Industrial Hygienists (ACGIH) Biological Exposure Index guideline of 2.5 µg/L. All 6 firefighter crews had higher mean 1-HP levels at the end of their rotation. Increases in 1-HP levels ranged from 24% to 91%. Crew-1 had an increase of 1-HP from 0.056 to 0.106 µmol/mol, Crew-2 increased from 0.196 to 0.244 µmol/mol, Crew-3 from 0.277 to 0.408 µmol/mol, Crew-4 from 0.140 to 0.178 µmol/mol, Crew-5 from 0.357 to 0.457 µmol/mol, and Crew-6 from 0.091 to 0.162 µmol/mol. A rapid sample preparation time was deemed essential to achieve both satisfactory signal counts and reproducibility, particularly at the 0.05 µg/L level.

Conclusions:

This study demonstrated that the post-fire urine samples exhibited elevated levels of 1-HP compared to pre-fire samples. This supports the findings that urinary 1-HP levels increase after taking part in firefighting activity.

Key words: 1-hydroxypyrene; firefighter; polycyclic aromatic hydrocarbons