

Assessing population exposure to tobacco-specific toxicants and carcinogens using wastewater-based epidemiology

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Background: Cigarette smoking is associated with different types of cancer due to the intake of numerous toxicants and carcinogens from mainstream smoke. Some of these compounds and their metabolites have been found in urine of tobacco users and can serve as biomarkers to assess exposure and potential risks of cancer development.

Objectives: This study aimed to (a) optimise and validate an analytical method to determine tobacco-specific toxicants and carcinogens in wastewater samples and then (b) to apply it for an evaluation of their occurrence and levels in different European communities.

Method: Raw wastewater samples were collected at the municipal wastewater treatment plants (WWTPs) in Belgium (n=16), Greece (n=8) and Switzerland (n=9) and analysed for the target compounds using the developed analytical method. The WWTPs covered the sewer catchment of about 29,000 and 36,000 people in the two Belgian cities, 4,000,000 people in the Greek city and 480,000 inhabitants in the Swiss city. Target biomarkers included anatabine (ANATA), anabasine (ANABA), 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), *N*-nitrosonornicotine (NNN), 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL), *N*-nitrosoanabasine (NAB) and *N*-nitrosoanatabine (NAT).

Findings: Among the seven target analytes, NNK, NAT, ANATA and ANABA were detected frequently (70-100%), followed by NNN (<60%), whereas NAB and NNAL were not detected in the samples. ANATA and ANABA (the toxic alkaloids in tobacco) were determined at relatively high concentrations (approx. 20-60 and 10-30 ng/L, respectively), compared to NNN, NNK and NAT (the tobacco-specific carcinogens, approx. 1-2 ng/L). Preliminary evaluation of the results shows that the concentration ratio of carcinogens to alkaloids for the Swiss and Greek cities was similar among themselves and was lower than the two cities from Belgium.

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