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Sci Total Environ. 2014 Jul 15;487:710-21. doi: 10.1016/j.scitotenv.2014.01.043. Epub 2014 Jan 31.



Application of a sewage-based approach to assess the use of ten illicit drugs in four Chinese megacities.

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Abstract

Sewage-based epidemiology was applied for the first time to a number of mainland Chinese megacities. The application monitored influents to 9 sewage treatment plants (STPs) to estimate the use of illicit drugs in Beijing, Guangzhou, Shenzhen, and Shanghai. Altogether, 11.4 million inhabitants were covered during September-October 2012. 24-h composite raw sewage samples were collected for 4 consecutive days at each STP. Each collected sample was analyzed for cocaine, benzoylecgonine, ecgonine methylester, methadone, 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine, 6-monoacetylmorphine, amphetamine, methamphetamine, ecstasy, mephedrone, methylenedioxypropylamphetamine, 11-nor-9-carboxy-delta-9-tetrahydrocannabinol, ketamine, and norketamine. Through the analysis of these chemical residues, the use of amphetamine, cannabis, cocaine, ecstasy, heroin, mephedrone, methadone, methamphetamine, methylenedioxypropylamphetamine and ketamine among Chinese urban inhabitants was monitored. The results obtained demonstrated in a quantitative way that the drug use patterns of Chinese are different from their European counterparts. Abuse of methamphetamine and ketamine was particularly noteworthy in China, while consumption of cocaine and ecstasy, the most popular drugs in Europe, was very low among the sampled Chinese inhabitants. Further, the use of most drugs demonstrated a geographical trend, since their use was much higher in the southern cities of Shenzhen and Guangzhou than it was in Beijing and Shanghai. Interestingly, the exclusive, but minor, metabolite of heroin, 6-monoacetylmorphine, was detected only sporadically. This would suggest that the use of heroin among Chinese urban users sampled in the study was low. Further, the patterns of drug use observed during the study are largely consistent with trends reported by the United Nations Office on Drugs and Crime. Overall, our study suggests that sewage-based epidemiology can readily be used to monitor the use of illicit drugs in those countries/regions where traditional means to monitor drug use patterns have only yielded limited or information of questionable reliability.

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KEYWORDS: China; Drugs of abuse; Ketamine; Methamphetamine; Sewage-based epidemiology; Wastewater

PMID:24485909[PubMed - in process]

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