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Exposure to polycyclic aromatic hydrocarbons: first nationwide survey in Spain

The BIOAMBIENT.ES project is the first human biomonitoring programme to estimate levels of environmental pollutants at national level in Spain. This study reports its findings on polycyclic aromatic hydrocarbons (PAHs), chemicals that are ubiquitous in the environment. The results will help to establish reference values, identify highly exposed populations and evaluate effectiveness of policies.

Chemical substances are everywhere — in the air we breathe, water we drink, food we eat, products we use and the clothes we wear. Some of these chemicals may be harmful. However, for many, their presence and effects in the human body remain entirely unknown. Human biomonitoring can provide reliable estimates of exposure to environmental chemicals by measuring their concentrations or metabolites in humans. This generates exposure information for different populations and demographics that is important for identifying trends, contributing factors and possible health risks.

Biomonitoring was pioneered in Europe by the German Environmental Survey in the 1990s. Since then, many other European countries have followed suit. In Spain, the first national human biomonitoring programme for environmental pollutants (BIOAMBIENT.ES) was established in 2009.

This study reported the programme's findings regarding exposure to PAHs. These are chemicals produced due to the incomplete combustion of organic compounds, including wood, coal and tobacco. As well as being produced by engines and incinerators, they are also found in cooked food. Their ubiquity is a cause for concern, as a number of these chemicals are known or suspected to be carcinogenic in humans and listed in EU regulation on Persistent Organic Pollutants[1].

To establish baseline information on PAH exposure in Spain, this study selected and assessed a representative sample of the adult Spanish population. Participants were required to be employed, over 16 years old and resident in Spain for at least five years. A total of 957 subjects were randomly recruited and urine samples collected as part of their annual occupational medical check-up from 2009–2010.

The urine samples were analysed for PAH biomarkers: 1-hydroxypyrene (the primary metabolite of a PAH called pyrene and the preferred biomarker to assess PAH exposure) and Σhydroxyphenanthrenes (1-,2-,3-,4- and 9-hydroxyphenanthrenes, metabolites of a widespread PAH called phenanthrene). The main metabolite of benzo[a]pyrene, 3-hydroxybenzo[a]pyrene, was also analysed but found to be under the quantification limit in all urine samples.

Information on socio-demographic profile, lifestyle and environmental conditions was also investigated in a questionnaire, in addition to a separate 'food frequency' questionnaire that asked about usual diet.

The results revealed significant associations between exposure and smoking. As smoking is known to contribute to PAH exposure, the authors built models including smoking habits as a confounder to assess the influence of other factors. This identified links between PAH exposure, high body mass index, and coal and wood heating. There were also geographical differences in exposure; those who lived in the northwest of Spain had higher levels of the metabolites in their urine.

Using data from the food questionnaire, the authors evaluated the influence of dietary habits on exposure. Clear associations were found with intake of eggs, legumes and sweets. Based on other studies, the authors suggest the link between obesity and PAH metabolite concentrations may be due to high consumption of fats, cooked meat and sweets. However, they say further studies are needed to fully understand the contribution of diet to PAH exposure.

Continued on next page.

1. Annex III of Regulation 850/2004/EC on Persistent Organic Pollutants. See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:158:0007:0049:EN:PDF

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(continued)

The authors say the dispersion of PAHs and many variables that influence exposure make it difficult to identify reasons for geographical differences, but suggest climate as a factor. They say high temperatures and hours of sunshine can promote degradation of these pollutants. A previous study also showed levels of the PAH benzo(a)pyrene in the air, soil and vegetables to be higher in the northwest of the country.

Finally, the authors compared their findings on exposure to those in other European countries, including Belgium, Germany, Italy, Poland, Sweden and the UK. Metabolite levels were generally in the same range or lower.

This study presents the first values for urinary PAH metabolite levels in a nationwide representative sample of the Spanish workforce and will enable reference values to be established. It also presents an approach to biomonitoring that could be employed by other countries. In the longer term, evaluations of trends over time could be used to assess the effectiveness of legislation.