



Exposure - the hidden threats that are making us sick

Why do some people develop asthma, Parkinson's or cancer? The answer is often down to the subtle interplay between our DNA, our diet, our lifestyle and the pollutants we have been exposed to.

01 September 2014 - By BENEDICT O'DONNELL

The combined effects of fatty convenience foods, pollution from Europe's overcrowded city streets, and stressful work schedules are making it more likely that we will get sick.

Over the past decade, the public health community has started referring to the total set of all non-genetic factors influencing our health as the exposome – which could provide a way for researchers to work out the risk of us getting these diseases.

The exposome concept encompasses every single exposure from conception onwards. It includes external contaminants such as air pollution and tobacco smoke, and processes inside the body such as stress and inflammation.

A few years ago, keeping track of the exposome might have seemed like science fiction. Today researchers at three EU-funded projects - HELIX, EXPOsOMICS and HEALS - are quantifying the exposure of over 100 000 EU citizens to potential health hazards in their environment.

They're working out the best way to do it using inexpensive sensors, satellite data and smartphones.

'A lot of information is already available on air quality and chemical pollutants from past and ongoing environmental and biological monitoring,' said Professor Mark Nieuwenhuijsen at the Centre for Research in Environmental Epidemiology in Barcelona, Spain.

He is helping combine this data with new information from satellites and environmental models to predict the full exposure of each test subject as part of the HELIX project, coordinated by Dr Martine Vrijheid at the same

centre. To help the project assemble enough data, volunteers also carry air pollution and ultraviolet sensors with them to complement the models with local ground measurements.

Smartphones are also offering critical support as they can track the exposure of test subjects, and monitor the exercise they get. Working out the level of exercise is important because physical activity is a key component of our exposome.

'Finding out what we're up against is only half the challenge,' said Dr Roel Vermeulen, at Utrecht University, who takes part in the EXPOsOMICS project, coordinated by Professor Paolo Vineis at Imperial College, London. 'Part of the work lies in discovering how human bodies react to their exposome.'

Thousands of molecules

Researchers need to track thousands of molecules in the bloodstream to give them enough data to start making conclusions about which ones are linked to disease.

'Because every factor in our exposome remains a potential suspect,' said Professor Denis Sarigiannis at Aristotle University in Thessaloniki, who is working on the HEALS project, 'we have to keep an open mind and track as many avenues as possible.'

It's only possible to do this thanks to recent advances in biotechnology such as transcriptomics, which looks at how genetic information is transcribed by the body, and metabolomics, which looks at the chemical fingerprints left behind by processes in our cells. These techniques mean researchers can now screen thousands of molecules in the bloodstream at prices that make it possible to monitor entire populations.

All three projects - HEALS, HELIX and EXPOsOMICS - are using blood and urine samples from thousands of people from across the EU to perform such studies, and are collecting their findings into colossal databases. Dr Vermeulen and his colleagues on the EXPOsOMICS project are now developing statistical analysis algorithms that crunch the exposome data in search of causal links between environmental exposure and health effects.

The HEALS project is also trying to identify links by studying identical twins. Studying twins is particularly revealing because it can help researchers identify which are the effects of exposure, and which are caused by the original DNA.

'This way we can explore how different exposomes affect one same genome,' said the project coordinator, Professor Isabella Annesi-Maesano, from the French Institute of Health and Medical Research, and University Pierre and Marie Curie in Paris.

Since projects in the EU Exposome Initiative last four to five years, mapping out exposomes over the entire lifespan of test subjects is not possible. Instead, the projects focus on critical periods in human development.

'Our bodies are particularly susceptible to biochemical changes during adolescence, pregnancy, and early infancy, when toddlers are forming their neural connections,' said Prof. Sarigiannis. 'But HEALS is also revealing how the exposome of parents can affect the health of children even before they are conceived, and how biological changes when we are fifty can trigger chronic diseases decades later.'

These three projects all have slightly different approaches. HELIX studies the early-life exposome, concentrating on mothers and children. EXPOsOMICS investigates the impact of air and water pollution on chronic diseases, while HEALS covers a broad range of age groups and chemicals to compare different approaches to studying the exposome.

By combining the data across all three, researchers are developing the tools that will enable us to identify the environmental factors making us sick, and work out ways avoid them, giving us healthier, longer lives.

In this video, EXPOsOMICS project researchers explain the technology they are using and the goals of the research.

More info

[HELIX](#)

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