

Environmental human genomics

Many common diseases are linked with environmental exposures, including cancers, asthma, allergies, neurodegenerative conditions, developmental disorders and neurological disease. Climate change and new trends in human behaviour are likely to both exacerbate existing environmental risks, and create new ones.

What is it?

Every one of us is exposed to multiple environmental factors throughout our lifetime.

Environmental human genomics seeks to understand how these external factors interact with the human genome (known as gene-environment interactions, or GxE) to determine responses to environmental exposures.

Its study can be divided into two broad categories:

- The effect of environmental exposures on the human genome as a whole i.e. which genes interact with environmental factors to cause disease, and how this occurs.
- Identifying genetic variants associated with different types of response. i.e. even if exposed to the same level of a particular environmental factor, not everyone will respond the same way.

Outlook

Specific environmental and genetic interactions have been shown to contribute to the development of diseases, in individuals and in certain populations. It is therefore important to incorporate such information into more personalised risk prediction and disease prevention - when the evidence makes it feasible. Until research has progressed to allow reliable predictions to be made about the impact of these interactions on health, it is unclear how environmental human genomics can be put to practical use in clinical medicine or public health programmes.

How could it help?

Understanding gene-environment interactions may help predict risk and improve precision diagnosis and treatment, particularly in the following areas:

Age-related diseases

The later onset of diseases such as Alzheimer's and Parkinson's means that there is a longer time for the environment to make a significant contribution.

Adverse environmental exposures during development

Individuals may be particularly vulnerable to air pollution from the pre-natal period up to adolescence, potentially resulting in developmental disorders and increased risks of chronic disease later in life.

Respiratory disease

Respiratory diseases linked to air pollution may also have a genetic element. E.g. there is some evidence that risk of lung cancer in areas of high air-pollution is greatest in those with most genetic risk.

Ready for patients?

Although not a new idea, environmental human genomics is still an emerging science in its earliest stages.

The variability in each person's genetic makeup and in the environments in which they exist make it exceptionally challenging to identify true links between a specific interaction and a specific disease. Furthermore, we have only limited ability to assess and record our exposure to the many elements in a given environment.

So far, studies have tended to be relatively small, lacking the power to identify genuine gene-environment associations. However, new large-scale population studies such as *Our Future Health* in the UK are ideally positioned to integrate genomics analyses with environmental data.

How accurately and consistently disease subtypes (e.g. type and stage of heart disease) are defined and recorded also needs improvement.

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