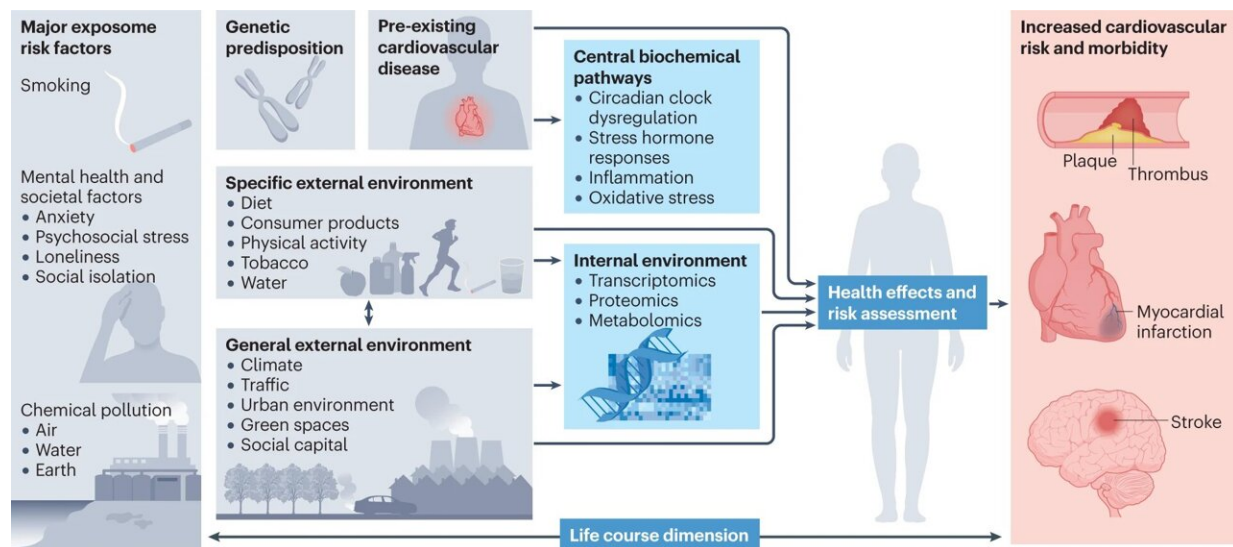


The exposome concept: How an unhealthy environment causes cardiovascular disease

May 12 2023, by Christine Vollgraf



The exposome concept. The exposome describes the totality of lifelong exposures to environmental risk factors, the induced pathological and mechanistic changes in central biochemical pathways, and the associated health effects. Within the general external environment, the environmental factor with the largest effect on health is chemical pollution. Within the specific external environment, the environmental factors with the most substantial effect on health are tobacco smoking and unhealthy dietary habits. The general and specific external environment can have adverse effects on mental health (for example, by social isolation or work strain), but the contribution of environmentally triggered mental stress to the global burden of disease and global deaths might be underestimated owing to the lack of valid exposure–response relationship data for mental risk factors. Changes in the internal environment induced by exposures are most frequently quantified by changes in the transcriptome, epigenome, proteome and metabolome (and more rarely by analysis of the

microbiome or adductome). Alterations in central biochemical pathways identified in exposome studies include dysregulation of circadian clock components that lead to impaired rhythmicity and phase shifts, the release of stress hormones (cortisol and catecholamines), production of reactive oxygen species by mitochondria and NADPH oxidase in activated immune cells, inflammation with tissue infiltration of activated immune cells, and oxidative damage in different organs (reviewed previously). Environmental exposures can act synergistically or additively with genetic predisposition or pre-existing cardiovascular disease. Environmental exposures can exacerbate detrimental cardiovascular health outcomes such as atherosclerosis, vascular stenosis, myocardial infarction, heart failure and stroke. Credit: *Nature Reviews Cardiology* (2023). DOI: 10.1038/s41569-023-00873-3

Environmental stressors such as air pollution, noise, unhealthy urban planning, and climate change increase the risk of cardiovascular disease, as do traditional risk factors such as smoking, unhealthy diet, and physical inactivity. An article recently published in *Nature Reviews Cardiology* by an international team of researchers describes the effects of environmental stressors on the cardiovascular system using the exposome concept.

The exposome concept describes lifetime exposure to all [environmental risk factors](#) and their adverse effects on the organism and health. This emerging field of research links the effects of adverse environmental exposures on health to pathophysiological changes in the body, chronic disease, and death. The application of the exposome concept to the cardiovascular field is the subject of this article.

Large epidemiologic studies have shown that nearly two-thirds of annual deaths worldwide are caused by chronic non-communicable diseases, with cardiovascular diseases being the leading cause. Contributing factors include an [aging population](#) and [environmental stressors](#) such as

land, water, air, and noise pollution, unhealthy urban design, and unhealthy lifestyles.

Two-thirds of noncommunicable diseases caused by environmental factors

Environmental physicians estimate that two-thirds of chronic non-communicable diseases are due to the sum of all environmental factors and that 16 to 22 percent of global deaths (9 to 12.6 million) are caused by chemical pollution alone. The exposome concept describes the deleterious biochemical and metabolic changes that occur due to multiple environmental exposures and can ultimately lead to adverse health outcomes and premature death.

The authors present selected cardiovascular exposome studies and show that exposures are associated with inflammation, adverse metabolic changes, and dysregulated DNA methylation (epigenetic changes) and can lead to increased blood pressure and other adverse health outcomes.

For example, the European Human Exposome Network, launched in 2020, is investigating [environmental influences](#) on the health of Europeans. More than 22 million workers will be screened for workplace exposures, focusing on chemical toxins, noise, and psychosocial stress. In addition, more than 2 million subjects will be studied using various techniques and methods to find links between exposure and health.

Exposome concept as basis for prevention strategies

Advanced tools and techniques for conducting exposome research will be presented. Mobile personal sensors allow lifetime data collection with high spatial and temporal resolution. Satellite-based exposure monitoring also contributes to a complete exposure history. However, exposome research needs help, such as analytical limitations and a complete

[lifetime exposure](#) history.

Another challenge is the problem of multiple exposures to environmental toxicants, for which there are few statistical and mathematical solutions.

The authors of the paper, Professors Thomas Münzel and Andreas Daiber from the Center for Cardiology at the University Medical Center Mainz and from the German Centre for Cardiovascular Research (DZHK) comment, "The exposome concept is an important new approach to study environmental influences on health and may help to develop prevention strategies to reduce the risk of cardiovascular and other chronic non-communicable diseases."

The authors also emphasize the need for further research to gain a comprehensive understanding of the exposome and to examine the effects of the environmental exposome on different organ systems and disease states. It is essential to quantify and account for individual exposures, as exposure to [environmental factors](#) is highly dependent on factors such as location, occupation, and individual behavior.

More information: Thomas Münzel et al, The contribution of the exposome to the burden of cardiovascular disease, *Nature Reviews Cardiology* (2023). [DOI: 10.1038/s41569-023-00873-3](https://doi.org/10.1038/s41569-023-00873-3)

Provided by Deutsches Zentrum für Herz-Kreislauf-Forschung e.V.

Citation: The exposome concept: How an unhealthy environment causes cardiovascular disease (2023, May 12) retrieved 13 May 2023 from <https://medicalxpress.com/news/2023-05-exposome-concept-unhealthy-environment-cardiovascular.html>

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