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The Intersection of Environmental Health and Epigenetics: Rewriting the Biological Narrative of Disease

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Abstract

The dichotomy between genetic and environmental determinants of disease has been significantly redefined by advances in epigenetics. Environmental epigenetics explains how external exposures can induce heritable changes in gene expression without altering the DNA sequence. This review examines the interaction between environmental health and epigenetic mechanisms, highlighting their role in disease etiology, prevention, and transgenerational health effects. Environmental exposures such as pollutants, nutrition, and psychosocial stressors can result in persistent epigenetic modifications, influencing disease susceptibility across the lifespan. The developmental timing of exposure plays a critical role, supporting the Developmental Origins of Health and Disease (DOHAD) framework. Although epigenetic mechanisms offer opportunities for intervention due to their reversible nature, challenges remain in interpreting complex exposure–response relationships. Furthermore, the potential for transgenerational inheritance raises ethical and public health concerns. Understanding these interactions is essential for advancing precision public health strategies and addressing health disparities.

Keywords: Epigenetics; Environmental Health; DNA Methylation; DOHaD; Pollution; Public Health

Abbreviations: DOHaD: Developmental Origins of Health and Disease

Introduction

The traditional distinction between genetic and environmental influences on human health has been increasingly challenged by the field of epigenetics. Epigenetics refers to heritable changes in gene expression that occur without modifications in DNA sequence and is influenced by environmental exposures [1]. This emerging paradigm demonstrates that environmental factors are not merely external contributors but active regulators of biological processes.

Environmental health encompasses chemical, physical, and social exposures that affect human well-being. Recent evidence indicates that these exposures can induce long-lasting epigenetic modifications, thereby influencing disease susceptibility and progression [2]. This interaction provides a mechanistic explanation for how environmental factors become biologically embedded.

Mechanisms of Environmental Epigenetics

Epigenetic regulation involves several key mechanisms, including DNA methylation, histone modifications, and non-coding RNA activity [3]. These processes regulate gene expression dynamically and are highly responsive to environmental stimuli.

Environmental chemicals such as heavy metals, endocrine disruptors, and air pollutants have been shown to alter DNA methylation patterns and gene expression profiles [3-4]. These disruptions can lead to altered cellular function and contribute to disease development. Importantly, such epigenetic changes may persist long after the initial exposure.

Environmental Exposures and Disease Risk

Environmental epigenetics has significantly improved our understanding of disease etiology by linking exposure to biological outcomes. Traditional toxicology focuses on dose-response relationships; however, epigenetic research emphasizes the importance of exposure timing and developmental windows [5].

The DOHAD hypothesis suggests that early-life exposures, particularly during prenatal development, can program long-term health outcomes [2-5]. Epigenetic modifications induced

during these critical periods are associated with increased risks of chronic diseases such as cancer, cardiovascular diseases, and neurodevelopmental disorders.

Pollutants including particulate matter and persistent organic pollutants can induce oxidative stress and inflammation via epigenetic pathways [6-7]. These effects may not be immediately evident but can contribute to long-term disease susceptibility.

Epigenetic Plasticity and Intervention

A key characteristic of epigenetic mechanisms is their reversibility. This plasticity offers opportunities for preventive and therapeutic interventions.

Nutritional factors play a significant role in modulating epigenetic processes. Nutrients such as folate and bioactive compounds influence DNA methylation and gene expression [8]. This highlights the potential of dietary interventions in reducing disease risk.

In addition, lifestyle and pharmacological interventions may help reverse adverse epigenetic modifications, supporting the development of precision public health strategies [9].

Transgenerational Effects and Health Inequalities

One of the most compelling aspects of environmental epigenetics is the possibility of transgenerational inheritance. Environmental exposures may induce epigenetic changes that are passed on to subsequent generations [10].

This phenomenon raises important ethical and public health considerations. Environmental exposures affecting one generation may have long-term consequences for future populations. Moreover, disadvantaged populations exposed to higher levels of environmental risk may carry a greater epigenetic burden, contributing to persistent health disparities.

Discussion

Environmental epigenetics provides a comprehensive framework for understanding how environmental exposures influence disease risk at the molecular level. However, epigenetic responses are highly context-dependent and influenced by multiple factors, including tissue type and individual susceptibility.

The integration of epigenetic data into public health and regulatory frameworks remains limited. Current risk assessment models often fail to account for early molecular changes that precede clinical outcomes. Advances in epigenomic technologies are improving our ability to detect and interpret these changes, but challenges remain in data analysis and ethical considerations.

Conclusion

The intersection of environmental health and epigenetics represents a paradigm shift in understanding disease mechanisms. It highlights the dynamic interaction between environmental exposures and gene regulation, emphasizing that health outcomes are shaped by both biological and environmental factors.

Future research should focus on translating epigenetic findings into practical interventions and policies that promote health equity and prevent disease across generations.

Acknowledgement

Not applicable.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Nwanaji-Enwerem CJ, Khodasevich D, Gladish N, Shen H, Bozack KA, et al. (2026) The environmental chemical exposome and health insurance: Examining associations and effect modification of epigenetic aging in a representative sample of United States adults. Exposome 6(1).
2. Ho S-M, Johnson A, Tarapore P, Janakiram V, Zhang X, et al. (2012) Environmental Epigenetics and Its Implication on Disease Risk and Health Outcomes. ILAR Journal 53(3-4): 289-305.
3. Baccarelli A, Bollati V (2009) Epigenetics and environmental chemicals. Current Opinion in Pediatrics 21(2): 243-251.
4. Zhang A, Luo X, Li Y, Yan L, Lai X, et al. (2024) Epigenetic changes driven by environmental pollutants in lung carcinogenesis: a comprehensive review. Front Public Health 12.
5. Ruiz-Hernandez A, Kuo C-C, Rentero-Garrido P, Tang W-Y, Redon J, et al. (2015). Environmental chemicals and DNA methylation in adults: a systematic review of the epidemiologic evidence. Clinical Epigenetics 7(55).
6. Tiffon C (2018) The Impact of Nutrition and Environmental Epigenetics on Human Health and Disease. Int J Mol Sci 19(11): 3425.
7. He X, Liu J, Li G (2023) Editorial: Role of epigenetics in environmental pollution associated diseases. Front Genet 14.
8. Filipa Sobral A, Cunha A, Costa I, Silva-Carvalho M, Silva R, et al. (2025) Environmental Xenobiotics and Epigenetic Modifications: Implications for Human Health and Disease. J Xenobiot 15(4): 118.
9. Wu W (2024) Editorial: Environmental factors, epigenetics and reproductive health. Front Endocrinol 15.
10. Perera PUB, Silvestre F (2023) Environmental Epigenomes. Epigenomes 7(3): 21.

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