

Chapter 1

Introduction to


Exposome in

Gametogenesis

Teratogenesis


and Cancer

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ABSTRACT

Risk factors provides a chance to comprehend the cancer formation, and its molecular classification. The exposome represents a thorough evaluation of all environmental factors that affect a person throughout their life, including biological, research has demonstrated the connection between adverse developmental outcomes, including growth restriction, preterm birth, and morphological and functional abnormalities, and environmental chemical exposures for both the mother and the father prior to, during, and following conception. According to recent studies, human pregnancy and

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development can be significantly impacted by environmental exposures to chemical, biological, and physical variables that both the mother and the father experience. Exposures associated with poor developmental outcomes include metals, volatile and persistent organics, chemicals in food, occupational exposures, agricultural chemicals, and pollution of the air and water. Premature birth, mortality, growth restriction, and structural and functional abnormalities are developmental endpoints linked to these exposures.

INTRODUCTION

The dynamic interplay between environmental factors and biological systems represents a frontier in understanding the etiology of developmental and proliferative disorders across the human lifespan. Gametogenesis, teratogenesis, and carcinogenesis are processes governing reproductive cell development, embryonic formation, and neoplastic transformation, respectively. They exhibit remarkable sensitivity to exogenous influences at critical developmental windows. Despite extensive progress in genomic medicine, contemporary epidemiological evidence reveals that modifiable environmental and occupational exposures contribute to approximately 60% of global mortality, with nine million deaths annually attributed to pollution alone (Landrigan *et al.*, 2018). This striking environmental burden substantially exceeds the explanatory power of genetic variation, particularly for common multifactorial conditions (Ioannidis *et al.*, 2009). The exposome concept, introduced by Wild in 2005, provides a comprehensive framework to systematically characterize the “environmental complement to the genome”, encompassing the totality of non-genetic exposures throughout the life course, from chemical pollutants and dietary constituents to psychosocial stressors and physical factors (Wild, 2012). This paradigm transcends traditional reductionist approaches by capturing both external exposures and their corresponding internal biological perturbations. As Rappaport and Smith (2010) articulated, these exposures are not limited to exogenous chemicals entering the body but include compounds produced through inflammation, oxidative stress, lipid peroxidation, and microbiome interactions, all of which can disrupt critical molecular pathways governing cellular differentiation, embryonic development, and tissue homeostasis (Rappaport & Smith, 2010). The succeeding chapters aim to examine how the exposome paradigm, coupled with technological advances in high resolution mass spectrometry (HRMS) and network medicine (Barabási & Oltvai, 2004), illuminates the chemical-biological interface in three interconnected domains where environmental influences may be particularly consequential: the formation and maturation of gametes, the development of embryonic and fetal tissues, and the dysregulated cellular proliferation characteristic of neoplastic disease.

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