Chapter 7
Exposome Insights to Action A Unified Call for Cancer Prevention, and a Vision for Precision Prevention

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ABSTRACT

Cancer exposomics moves from data acquisition to actionable interventions through a multi-step, integrative approach that spans precise exposure assessment, mechanistic insight generation, and the translation the results into targeted prevention and treatment strategies. Comprehensive exposure assessment is performed by capturing external environmental factors and internal exposures using advanced tools

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which is accomplished by combining traditional methods with omic technologies, metabolomics, genomics, transcriptomics, and proteomics to elucidate the pathways by which environmental exposures modulate disease risk and progression. Cancer exposomics its ethical dimensions demand rigorous protections around consent, privacy, and responsible communication. This chapter explores the translational potential of exposomic science, emphasizing its ability to shape personalized cancer prevention strategies. It considers ethical, legal, and societal implications (ELSI), the role of public and community engagement, and culminates with a unified, multilevel call to action for cancer prevention.

INTRODUCTION

The exposome is a term used to describe the overall environmental exposures, both external and internal, that an individual experiences from conception to death, including exogenous agents, such as pollutants, diet, radiation, and chemicals, as well as endogenous processes, such as metabolism, inflammation, and the microbiome. Most conventional epidemiological studies have underestimated the multidimensionality of exposures by examining one or a few carcinogens. By contrast, cancer exposomics is a comprehensive approach that incorporates various modern tools of analytic technology and omics research, such as genomics, epigenomics, transcriptomics, proteomics, and metabolomics, to describe the dynamic interaction of environmental factors and biological responses that contribute to the process of carcinogenesis (Bessonneau & Rudel, 2019). The integration of nanotechnology into environmental monitoring provides innovative approaches to understanding the exposome. Nanoparticle-based sensors are being developed to detect environmental toxins with high sensitivity and specificity, thereby enabling real-time monitoring of hazardous exposures (Justino et al., 2017; Koedrith et al., 2015). This technological advancement opens a new pathway for personalized public health interventions by allowing for the timely identification and mitigation of exposure risks based on individual profiles and environmental data (Yarima et al., 2020).

The idea behind cancer exposomics and environmental factors that cause cancer is that harmful exposures, whether they are chemical, physical, or biological, build up over time and cause molecular changes that lead to the main signs of cancer. This approach with many parts emerged concerning because it has been shown that gene-environment interactions are very important for determining the risk of getting cancer. By combining data on environmental exposure with sensitive molecular biomarkers and advanced data analytics, we have been able to better identify early events in carcinogenesis better. This gives us a chance to intervene and prevent cancer early on (Herceg et al., 2018).