Environmental Chemicals and the Tumor Immune Microenvironment

Tongtong Zhang[1#],Yanxia Hu[1#],Weiran Zhang[2#],yang Jin[3#],
Chaoyang Sun[4*],Afshin Samali[5*],Sunqing Xu[6*],Xia Sheng[1*]

[1] School of Life and Health Sciences, Hainan University, Haikou,China.

[2] School of Basic Medical Sciences, Chongqing Medical University, Chongqing, China.

[3] Department of Biosciences, University of Oslo, Oslo, Norway.

[4] Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China.

[5] University of Galway, Galway, Ireland.

[6] School of Environmental Science and Technology, Hainan University, Haikou, China.

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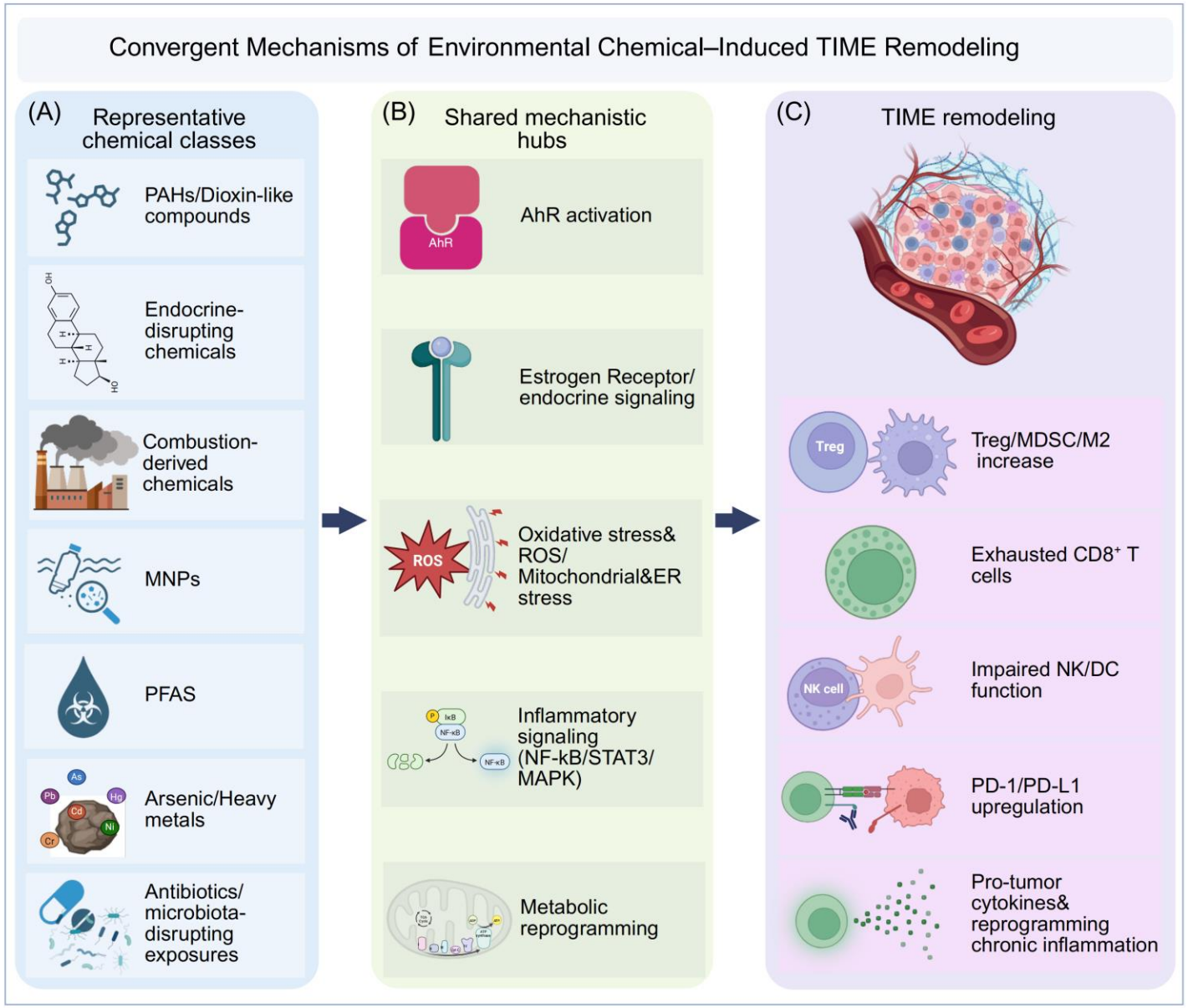
Background

- The tumor immune microenvironment (TIME) is shaped by a complex interplay of (epi)genetic and environmental factors, and plays a central role in the initiation and progression of human cancers.

- Intrinsic regulators of the TIME have been extensively studied, the contribution of extrinsic factors, particularly environmental chemicals, has received far less attention.

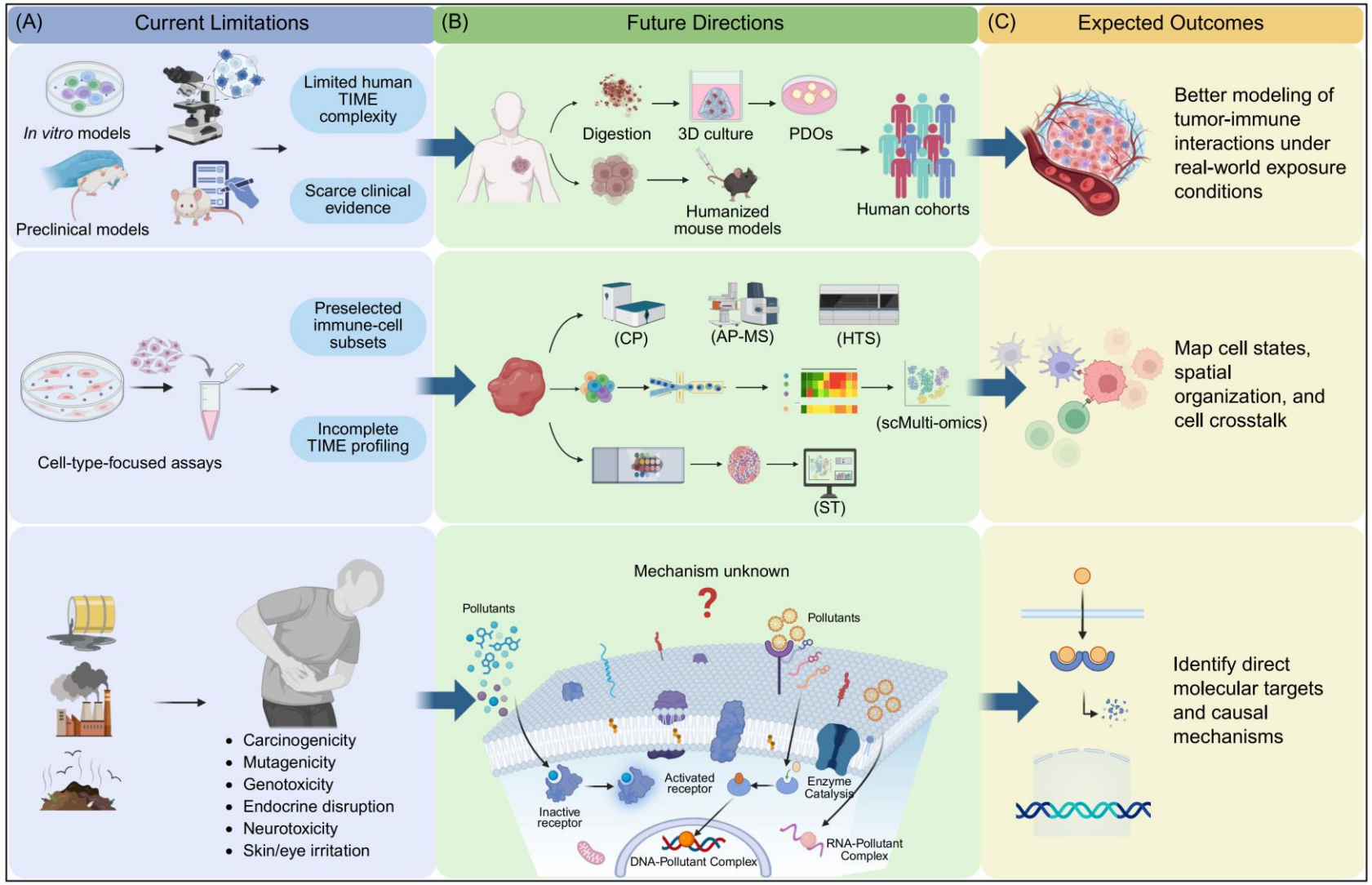
- Environmental chemicals are widely distributed, subjecting humans to frequent or chronic exposure with insidious health consequences. Increasing evidence indicates that such chemicals are not only mutagenic and carcinogenic, but also important TIME modulators.

Impact of prevalent environmental chemicals on the TIME



- Human industrial production and daily life generate a vast array of environmental chemicals, which exert insidious effects on human health.
- Receptor activation, cellular stress, metabolic dysregulation, and various other distinct mechanisms play roles in the regulation of the TIME by environmental chemicals.
- Environmental chemicals remodel the TIME by altering immune cell composition and function and modulating the expression of immune checkpoint molecules, thereby influencing tumor progression.

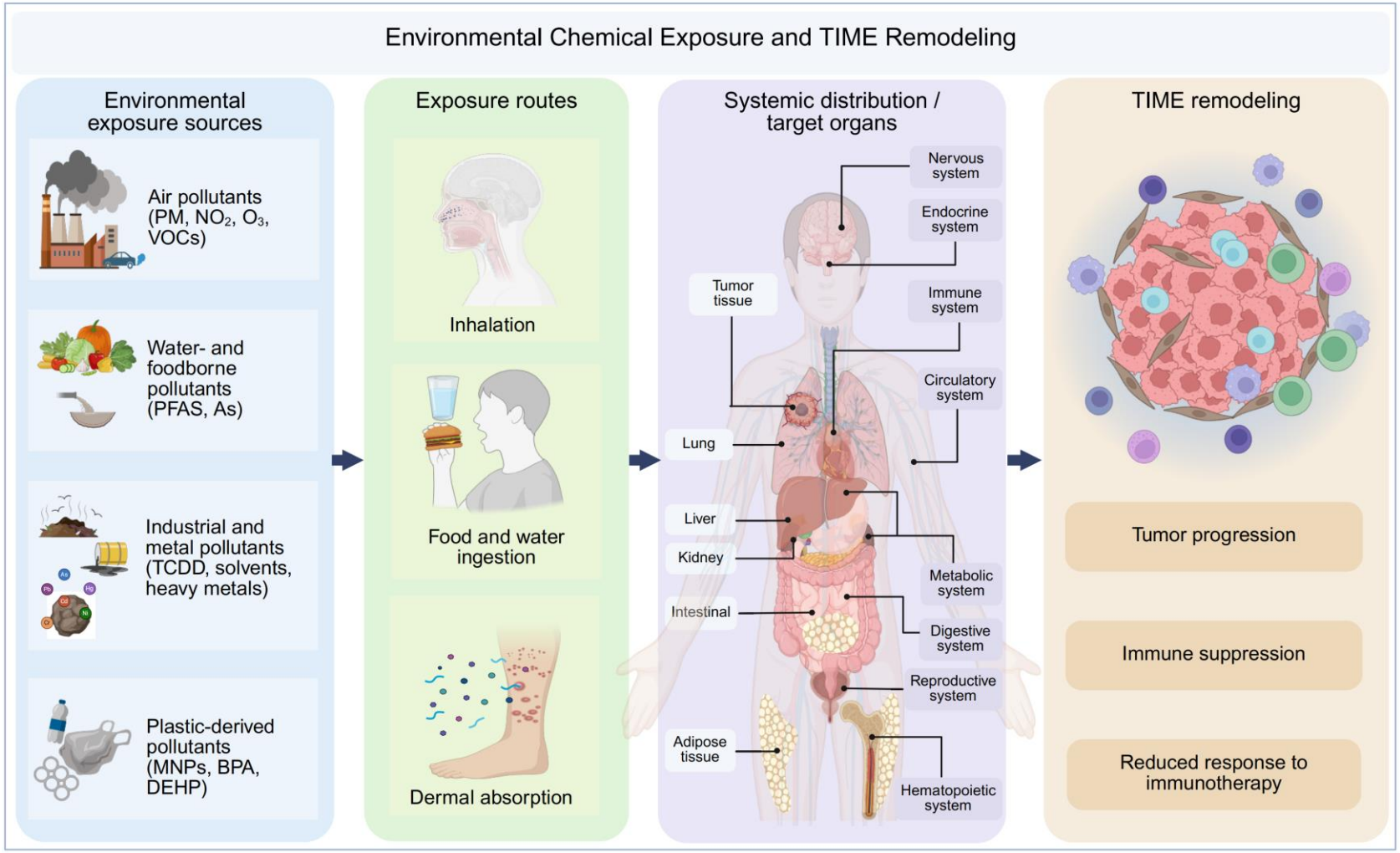
Current limitations and future perspectives



- Current research still exhibits limitations in multiple aspects. Herein, we propose priority directions for future research

- Adopting more convincing models.
- Employ biochemical methods to map molecular initiating events.
- Integrate single-cell multi-omics and spatial transcriptomics data.
- Construct representative mixed-exposure models integrated with exposomics analytical techniques.

Conclusion



- Focus on the critical remodeling role of exogenous environmental chemicals in the tumor immune microenvironment.
- Systematically summarized the common effects and complex mechanisms of action of environmental chemicals as "TIME modulators".
- Proposed clear, systematic, and forward-looking future research directions.

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