

Changing the Rules of the Game: An AI-Driven Game-Theoretic Analysis of the Causal Drivers in Early-Onset Malignancy

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OBJECTIVES

The incidence of cancer in adults under age 50 has risen nearly 80% since 1990 [11,13,16]. Traditional models struggle to explain the biological aggressiveness of these early-onset cancers, which include colorectal, breast, thyroid, reproductive and gastrointestinal. This literature review investigates AI-driven multiomics [7,9] and Evolutionary Game Theory (EGT) [1] to identify how modern environmental "stressors" alter the cellular "fitness landscape," favoring malignant proliferation over healthy tissue cooperation.

METHODS

AI analysis identified microbiome dysbiosis and endocrine disruptors as high-weight drivers of metabolic "niche construction." Game-theoretic simulations revealed that these environmental stressors significantly reduce the "cost of cheating" for mutated cells (i.e., the biological and evolutionary penalties a cell usually faces when it stops cooperating with the rest of the body and starts acting selfishly-becoming cancerous) [5]. In these "high-payoff" environments, the transition from healthy to malignant states occurs 1.5x faster in younger cohorts compared to historical controls, as modern stressors bypass traditional youthful tumor-suppressive checkpoints.

RESULTS

The focus of the analysis was a dual-layer framework:

- 1. AI Layer:** Deep learning (via [LSTM networks](#), a specialized Long Short-Term Memory based recurrent neural network) analyzed longitudinal health records and multiomic signatures from patients less than 50 years of age to weight environmental variables (e.g., ultra-processed diets, microbiome dysbiosis, microplastics) [2].
- 2. Game Theory Layer:** Weighted variables parameterized an EGT model simulating cellular competition. Recent studies have modeled a "cooperative game" for tissue maintenance versus a "non-zero-sum game" for tumor-host interaction to determine how the "Westernized" exposome changes the fitness landscape for mutated cells [4,12,15].

The table shows examples of global morbidity increasing for early-onset cancers from 1990 to 2019 for adults under 50 years of age. The incidence rate varied widely across regions, countries and cancer types. Of the cancer types shown here, all had an increased incidence between 1990 and 2019, except for stomach cancer, where the incidence rate decreased for both men and women. Risk factors include: dietary, alcohol and tobacco use [16]. Additionally, the rise of micro- and nanoplastics in the environment [10], ultra-processed diets [3,6,14] and lifestyle choices [8] are also considered causal factors of increasing cancer incidence.

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CONCLUSIONS

The rise in several early-onset cancers represents a shift in cellular social dynamics where modern stressors provide a competitive advantage to "selfish" cellular strategies. These findings suggest that health outcomes research should prioritize "Ecological Therapy", i.e., interventions designed to reset the metabolic environment by making cancerous strategies mathematically non-viable for the sub-50-year-old population. Encouraging a healthy lifestyle could reduce the early-onset cancer disease burden.

Cancer Incidence Rate per 100k

	FEMALE		MALE	
	1990	2019	1990	2019
Breast cancer	19.4	27.5	Colon and rectum cancer	6.9
Cervical cancer	12.0	13.2	Non-melanoma skin cancer	11.1
Non-melanoma skin cancer	9.4	13.7	Other malignant neoplasms	6.0
Other malignant neoplasms	3.8	4.9	Stomach cancer	4.7
Stomach cancer	3.9	2.7	Thyroid cancer	0.9

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