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Rising Young-Onset Cancers: Environmental Exposures, Microbiomes, and Data Blind Spots

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Abstract

The global rise in young-onset cancers, diagnosed before age 50, is an emerging public health concern. Once considered a disease of aging, cancers such as colorectal, breast, pancreatic, and gastric are increasingly affecting younger populations in both high- and middle-income countries. This review examined recent evidence on incidence trends, risk factors, and research gaps. Literature was identified through searches in PubMed, Scopus, and Web of Science for studies published between 2018 and 2025, using terms related to young-onset cancers, environmental exposures, microbiomes, and cancer surveillance. Grey literature from WHO, IARC, and the Global Burden of Disease database supplemented peer-reviewed sources. Screening focused on epidemiological, mechanistic, and global burden studies with recent, high-quality data. Analysis shows colorectal cancer incidence in people aged 20–39 has risen over 15% in two decades, while early-onset pancreatic cancer has surged by 73% since 1990. Drivers include early-life environmental exposures, pollution, ultra-processed diets, obesity, and microbiome disruption. Surveillance systems often mask these trends due to broad age categories, and screening programs rarely target younger adults. Addressing this trend requires refined surveillance, targeted research, earlier screening innovations, and environmental health policies to mitigate upstream risks and reduce premature cancer mortality worldwide.

Keywords: Cancer, Mircrobiomes, Environmental Exposures.

The global rise in young-onset cancers (defined as cancers diagnosed under the age of 50) has emerged as an unexpected and unsettling trend [1]. While cancer has long been considered a disease of aging, new data suggest that colorectal, breast, pancreatic, and gastric cancers are increasing in incidence among adolescents and young adults across high- and middle-income countries. A study by Mima et al. (2023) shows the prevalence of early-onset cancers in the colorectum, oesophagus, gallbladder, liver, stomach, pancreas, bone marrow (multiple myeloma), breast, head and neck, kidney, prostate, thyroid, and uterine corpus (endometrium) that are diagnosed in adults under 50 [2]. This pattern represents a paradigm shift that challenges current public health strategies, screening paradigms, and etiological assumptions. This commentary explores three interrelated drivers of this surge: environmental exposures, microbiome disruption, and the absence of age-specific cancer surveillance. Although the precise contributions of each of these factors are still unknown, researchers have hypothesized the etiological functions of diets, lifestyles, environments, and the microbiome from early life to adulthood (i.e., across one's life course). Diet, lifestyle choices, and environmental

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exposures have demonstrated the ability to alter the oral and intestinal microbiome [3]. Such an observation calls for an integrated, anticipatory response rooted in science, systems transformation, and equity.

According to Global Burden of Disease (GBD) 2019 estimates, colorectal cancer incidence has increased by over 15% among individuals aged 20–39 in the last two decades. In the United States, colorectal cancer is now the second leading cause of cancer death in adults under 50 [1]. Similarly, early-onset breast cancer has risen steadily in regions of East Asia and North Africa, while pancreatic and endometrial cancers are rising among young adults in Europe and Latin America [4]. As of 2020, breast cancer has surpassed lung and prostate cancers as the most common cancer diagnosed worldwide. The frequency of breast cancer is rising worldwide [5]. The predicted number of new breast cancer cases and fatalities worldwide in 2022 was 2.3 million and 666,000, respectively, making up 23.8% and 15.4% of all female cancer cases and deaths. South-Central Asia recorded the most deaths (135,348, ASMR: 13.41/100,000), whereas Eastern Asia reported the most cases (480,019, ASIR: 37.54/100,000). Due to its large population, China had the most instances at the national level, whereas India recorded the most fatalities. Interestingly, only transitioning nations show a rise in early-onset breast cancer cases, whereas transitioned countries show a decrease in cases [6]. In 2020, gastric cancer accounted for 7.7% of all cancer deaths (ranked fourth in mortality) and 5.6% of all new cancer cases (ranked fifth in incidence), making it a common cancer globally. The diagnosis of gastric cancer is more common in people over 50, with very low incidence rates and a tiny percentage of younger patients. Comparing young-onset stomach tumors to older populations, the former frequently exhibit distinct clinicopathological features and inferior outcomes, such as reduced quality of life and shorter survival rates [7].

A highly malignant gastrointestinal tumor, pancreatic cancer has a five-year survival rate of fewer than 12%. 1. 2. By 2030, we expect pancreatic cancer to become the second most common cause of cancer-related fatalities in the United States. The incidence of new cancer diagnoses in people under 50 has risen by 79% in the last 30 years [8]. Early-onset pancreatic cancer (EOPC), which is identified before the age of fifty, has become much more common. In 2021, there were 42,254 EOPC cases, a 73% increase from 1990, and 26,996 fatalities, a 57% increase. With the quickest rise in Western Sub-Saharan Africa and Australasia, Central and Eastern Europe had the largest EOPC burden. Despite an increase in female preponderance, males bore roughly twice as much of the burden as females [9].

This phenomenon is not limited to one geography or one tumor type. The increase in early-onset cancers appears globally synchronous, with the most consistent increases observed in gastrointestinal malignancies. The cross-cutting nature of this trend suggests shared upstream determinants that are distinct from traditional risk factors. Early-life environmental exposures are increasingly implicated as key drivers of cancer risk later in life. These include air and water pollution, endocrine-disrupting chemicals, ultra-processed foods, and chronic low-grade inflammation from sedentary lifestyles or obesity. For example, recent studies suggest that early exposure to PFAS (per- and polyfluoroalkyl substances) is associated with increased risks of liver and kidney cancer [10]. According to a different study by Zottl et al. (2025), smoking, diabetes, and excess body weight are important modifiable risk factors. In the US, smoking accounts for 13.9% of pancreatic cancer cases, and excess body weight accounts for 17.9% (8). According to Lewandowska et al. (2019), modifiable risk variables include cancers. These lifestyle-related risk factors include exposure to ultraviolet (UV) light and tanning with UV-emitting devices, infections, parasites, smoking, alcohol use, environmental exposures, dietary factors, hormone replacement therapy, and ionizing radiation exposure [11]. Similar study by Kabalan et al. (2021) shows that the participants positively identified the following environmental risk factors for cancer: environmental pollution (91.5%), smoking (90.4%), industrial pollution (88.3%), nuclear rays (85.5%), UV radiation (83.5%), X-rays (72.6%), tobacco exposure (72.4%), genetically modified food (65.2%), long-term use of preservatives (68.8%), excessive sunlight exposure (65.9%), artificial sweeteners (63.5%), pesticides (65.4%), high-sugar diet (63.4%), living near high-voltage transmission lines (62.0%), alcohol (61.8%), stress (58.7%), plastic bottles (58.4%), hormone in beef (51.9%), red meat (50.9%), diesel exhaust (49.9%), unbalanced diet (49.8%), mobile phones (48.3%), paints (48.3%), obesity (45.5%), and hormonal treatment after menopause (45.5%) [12].

Childhood antibiotic exposure, Cesarean delivery, and reduced breastfeeding are also being scrutinized for their long-term impact on immune development and the inflammation link that may influence cancer susceptibility. Structural determinants such as food deserts, industrial proximity, and economic deprivation compound these factors. The human gut microbiome is shaped within the first three years of life and plays a crucial role in immune modulation and carcinogen metabolism. Alterations in the composition, diversity, and function of gut flora—termed dysbiosis—have been linked to colorectal, pancreatic, liver, and other cancers [13]. Similarly, a study by Li et al. (2022) supported that antibiotic exposure during the first year of life was 53.04% among the 2140 participants, primarily from cephalosporins (53.39%) and erythromycins (27.67%) for the treatment of respiratory tract infections (79.56%). There was no significant difference in the exposure levels between the subgroups. With larger percentages of Faecalibacterium, Agathobacter, and Klebsiella and lower percentages of Bifidobacterium, the group treated with antibiotics had higher rates of pediatric overweight and obesity at two and a half years compared to the control group. Additionally, there were positive potential correlations between early-life antibiotic exposure and the disruption of Faecalibacterium, Agathobacter, Klebsiella, and Bifidobacterium at two and a half years, as well as accelerated anthropometric measures [14].

Young-onset colorectal cancers, in particular, have been associated with enriched Fusobacterium nucleatum and other pro-inflammatory taxa, alongside decreased short-chain fatty acid-producing bacteria [15]. Modern diets high in emulsifiers and low in fiber, overuse of antibiotics, and diminished microbial exposures in urban settings have been implicated in promoting oncogenic dysbiosis [16]. Microbiome-focused oncology is still in its infancy, but it offers promising pathways for risk stratification, prevention, and precision therapy. The emerging field of onco-microbiomics illustrates the importance of longitudinal, multi-omics datasets from birth onward [17]. Current cancer surveillance systems are poorly equipped to detect trends in young-onset disease. National cancer registries often aggregate data into broad age categories (e.g., 15–44 or 20–49), obscuring more granular age shifts. Moreover, routine screening programs for breast, colorectal, and cervical cancer typically begin at age 45 or 50, missing early-onset disease altogether [18].

In response to rising incidence, the U.S. Preventive Services Task Force lowered the recommended age for colorectal cancer screening to 45 in 2021. However, in many LMICs, screening access remains limited even for older populations. There is currently no global strategy for young-onset cancer surveillance or risk-adjusted screening [19]. Non-communicable diseases (NCDs) currently account for the majority of deaths worldwide, with cancer accounting for at least 20% of all fatalities. Even though low- and middle-income countries (LMICs) have a lower overall cancer incidence than high-income countries (HICs), their overall cancer-related mortality rates are much higher, particularly for those under 65. These countries face particular challenges due to the increased economic impact of premature mortality and lost years of productivity [20]. The rising cancer burden in LMICs puts additional strain on already fragile health care and economic infrastructures and creates specific obstacles, especially since extrapolating the experiences of cancer control programs in HICs to LMICs is frequently inappropriate. In 2015, 78% of all deaths worldwide attributable to NCDs, including cancer, occurred in LMICs, with nearly 50% of these deaths being deemed premature. In addition to assuming that the undiscovered cancer would have been the primary cause of death, the justification for cancer control programs that place a high priority on screening and surveillance to increase the likelihood of early cancer diagnosis also assumes that there will be sufficient downstream resources available to properly attend to and manage the increased number of preclinical cases diagnosed [21]. The rising rates of obesity, sedentary lifestyles, dietary factors, excessive use of tobacco and alcohol, and chronic carcinogenic infections such as Helicobacter pylori, hepatitis B virus, and human papillomavirus, among other less well-known contributing factors, have also greatly contributed to the rising cancer-related mortality in LMICs [21].

The burden of young-onset cancers is not evenly distributed. Disparities exist based on race, ethnicity, geography, and socioeconomic status. In the U.S., Black, Hispanic, and American Indian populations face higher mortality from early-onset colorectal and breast cancers, often due to delayed diagnosis and barriers to treatment [22].

Similarly, environmental justice concerns are central. Marginalized communities are more likely to live in polluted environments, have limited access to nutritious foods, and face chronic stressors that influence cancer risk via neuroendocrine-immune pathways. Addressing young-onset cancers must therefore include an equity lens rooted in structural determinants.

Recommendation

Addressing the alarming global rise of young-onset cancers demands a comprehensive and urgent multisector response. This growing public health concern necessitates targeted strategies across surveillance, etiologic research, and policy reform to safeguard the health of younger generations.

1. Enhancing Global Cancer Surveillance

Robust and granular cancer surveillance systems worldwide are crucial to effectively addressing the growing incidence of early-onset cancers. Governments and international health organizations must mandate and enforce the meticulous collection and documentation of cancer registry data, disaggregated by five-year age intervals starting from birth. This level of detail is critical because it enables more reliable trend analysis, precise action targeting, and the identification of specific risk windows or environmental factors impacting different age cohorts. Furthermore, to enhance monitoring and response tactics, international health organizations should proactively integrate markers unique to early-onset cancers, such as specific genetic predispositions, early life environmental exposures, or unique tumor characteristics, into global cancer surveillance frameworks [23].

2. Investing in Etiologic Research

A deeper, sustained investment in etiologic research is equally paramount to unraveling the complex origins of young-onset malignancies. Top priority ought to be given to longitudinal birth cohort studies, which can meticulously track individuals from gestation through young adulthood. These studies are uniquely positioned to illuminate the intricate interactions among early-life environmental exposures, the human microbiome, epigenetic changes, and broader societal determinants of health. Such investigations are vital for yielding critical information about the precise origins of cancers that appear early in life. Concurrently, expanding biobanking initiatives and systematically proteomics, metabolomics) from early life stages will deepen our understanding of disease mechanisms and facilitate the development of highly individualized preventative strategies [24].

3. **Fostering Innovation in Screening and Policy Reform.**

Innovation in screening methodologies and proactive policy reform are indispensable components of this response. We must develop and rigorously implement non-invasive, risk-based screening instruments specifically designed and validated for younger populations. These tools could be seamlessly integrated into existing health checkups or incorporated into workplace and educational initiatives that combine comprehensive cancer education and awareness with accessible screening programs.

Concurrently, regulatory bodies must adopt more aggressive measures against the production and use of chemicals known to cause cancer or disrupt hormones, ensuring safer environments for children and young adults. This requires a precautionary approach to chemical regulation. Simultaneously, public policy should actively aim to lessen the systemic disparities in food and environmental systems, such as unequal access to nutritious food, clean air, and safe water that disproportionately impact vulnerable groups and contribute to cancer risk.

Table 1: Global Trends in Young-Onset Cancers (2000–2022) [26]

Cancer Type	Region	%Increase (Age <50)	Age Group Most Affected
Colrectal	North America	+19%	20-39
Breast	East Asia	+14%	30-49
Pancreatic	Europe	+10%	40-49
Gastric	Latin America	+11%	20-39

Lastly, and critically, equity must be the primary consideration when planning any intervention. Every strategy, from prevention to diagnosis and treatment, must ensure fair and universal access to cancer care, irrespective of an individual's age, geographic location, or socioeconomic status [25]. It is our collective responsibility to ensure that no

young person is left behind in the fight against cancer.

Conclusion

The rise in young-onset cancers globally serves as a critical indicator for public health. It signals the need to look upstream, beyond individual behaviors and genetics, to the cumulative effects of environments, exposures, and exclusions. It calls for a transformation in how we monitor, study, and respond to cancer, not only at older ages, but from the earliest stages of life. This generation's rising cancer burden is not inevitable. We can reverse it with the right investments in data, discovery, and justice.

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Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. Di Martino E, Smith L, Bradley SH, Hemphill S, Wright J, Renzi C, et al. Incidence trends for twelve cancers in younger adults—a rapid review. British Journal of Cancer 2022 126:10 [Internet]. 2022 Feb 7 [cited 2025 Jun 27];126(10):1374–86. Available from: https://www.nature.com/articles/s41416-022-01704-x
2. Mima K, Hamada T, Inamura K, Baba H, Ugai T, Ogino S. The microbiome and rise of early-onset cancers: knowledge gaps and research opportunities. Gut Microbes [Internet]. 2023 Dec 18 [cited 2025 Jun 27];15(2). Available from: https://www.tandfonline.com/doi/pdf/10.1080/19490976.2023.2269623
3. Dong TS, Gupta A. Influence of Early Life, Diet, and the Environment on the Microbiome. Clin Gastroenterol Hepatol [Internet]. 2018 Jan 1 [cited 2025 Jun 27];17(2):231. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6422042/
4. Xi Y, Xu P. Global colorectal cancer burden in 2020 and projections to 2040. Transl Oncol [Internet]. 2021 Oct 1 [cited 2025 Jun 27];14(10):101174. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8273208/
5. Arzanova E, Mayrovitz HN. The Epidemiology of Breast Cancer. Cancer Res [Internet]. 2022 Aug 6 [cited 2025 Jun 27];23:1503–13. Available from: https://www.ncbi.nlm.nih.gov/books/NBK583819/
6. Zhang Y, Ji Y, Liu S, Li J, Wu J, Jin Q, et al. Global burden of female breast cancer: new estimates in 2022, temporal trend and future projections up to 2050 based on the latest release from GLOBOCAN. Journal of the National Cancer Center [Internet]. 2025 Jun 1 [cited 2025 Jun 27];5(3):287–96. Available from: https://www.sciencedirect.com/science/article/pii/S2667005425000225
7. Li Y, Hahn AI, Laszkowska M, Jiang F, Zauber AG, Leung WK. Global burden of young-onset gastric cancer: a systematic trend analysis of the global burden of disease study 2019. Gastric Cancer [Internet]. 2024 Jul 1 [cited 2025 Jun 27];27(4):684. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11193827/
8. Zottl J, Sebesta CG, Tomosel E, Sebesta MC, Sebesta C. Unraveling the Burden of Pancreatic Cancer in the 21st Century: Trends in Incidence, Mortality, Survival, and Key Contributing Factors. Cancers 2025, Vol 17, Page 1607 [Internet]. 2025 May 9 [cited 2025 Jun 27];17(10):1607. Available from: https://www.mdpi.com/2072-6694/17/10/1607/htm
9. Li L, Li J, Yan A, Xiang W, Gao W, Zhu H. Temporal trends in cross-country inequalities of early-onset pancreatic cancer: a comprehensive analysis for the global burden of disease study 2021. Scientific Reports 2025 15:1 [Internet]. 2025 Apr 28 [cited 2025 Jun 27];15(1):1–13. Available from: https://www.nature.com/articles/s41598-025-93892-8
10. Seyyedsalehi MS, Boffetta P. Per- and Poly-fluoroalkyl Substances (PFAS) Exposure and Risk of Kidney, Liver, and Testicular Cancers: A Systematic Review and Meta-Analysis. Med Lav [Internet]. 2023 Oct 25 [cited 2025 Jun 27];114(5):e2023040. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10627102/
11. Lewandowska AM, Rudzki M, Rudzki S, Lewandowski T, Laskowska B. Environmental risk factors for cancer - review paper. Annals of Agricultural and Environmental Medicine [Internet]. 2019 [cited 2025 Jun 27];26(1):1–7. Available from: https://www.researchgate.net/publication/328935344_Environmental_risk_factors_for_cancer_-_review_paper
12. Kabalan M, El-Hajj M, Khachman D, Awada S, Rachidi S, Al-Hajje A, et al. Public awareness of environmental risk factors of cancer and attitude towards its prevention among the Lebanese general population. J Prev Med Hyg [Internet]. 2021 Jul 1 [cited 2025 Jun 27];62(2):E466. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8451343/
13. Lamont RF, Luef BM, Jørgensen JS. Childhood inflammatory and metabolic disease following exposure to antibiotics in pregnancy, antenatally, intrapartum and neonatally. F1000Res [Internet]. 2020 [cited 2025 Jun 27];9:F1000 Faculty Rev-144. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7043129/
14. Li P, Chang X, Chen X, Wang C, Shang Y, Zheng D, et al. Early-life antibiotic exposure increases the risk of childhood overweight and obesity in relation to dysbiosis of gut microbiota: a birth cohort study. Ann Clin Microbiol Antimicrob [Internet]. 2022 Dec 1 [cited 2025 Jun 27];21(1):1–14. Available from: https://ann-clinmicrob.biomedcentral.com/articles/10.1186/s12941-022-00535-1
15. Ionescu VA, Diaconu CC, Gheorghe G, Mihai MM, Diaconu CC, Bostan M, et al. Gut Microbiota and Colorectal Cancer: A Balance Between Risk and Protection. Int J Mol Sci [Internet]. 2025 Apr 1 [cited 2025 Jun 27];26(8):3733. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC12028331/
16. Koletic C, Mrad A, Martin A, Devkota S. Diet's impact on gut microbial assemblage in health and disease. J Clin Invest [Internet]. 2025 Jun 2 [cited 2025 Jun 27];135(11):e184319. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC12126223/
17. Chacon J, Faizuddin F, McKee JC, Sheikh A, Vasquez VM, Gadad SS, et al. Unlocking the Microbial Symphony: The Interplay of Human Microbiota in Cancer Immunotherapy Response. Cancers 2025, Vol 17, Page 813 [Internet]. 2025 Feb 26 [cited 2025 Jun 27];17(5):813. Available from: https://www.mdpi.com/2072-6694/17/5/813/htm
18. Slimovitch R, Shing JZ, Fantin R, Vanegas JC, Porras C, Herrero R, et al. A surveillance study of cancer incidence and mortality among young adults in Costa Rica. Lancet Regional Health - Americas [Internet]. 2024 Oct 1 [cited 2025 Jun 27];38:100872. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11399702/
19. Davidson KW, Barry MJ, Mangione CM, Cabana M, Caughey AB, Davis EM, et al. Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement. JAMA - Journal of the American Medical Association. 2021 May 18;325(19):1965–77.
20. Torre LA, Siegel RL, Ward EM, Jemal A. Global cancer incidence and mortality rates and trends - An update. Cancer Epidemiology Biomarkers and Prevention [Internet]. 2016 Jan 1 [cited 2025 Jun 27];25(1):16–27. Available from: https://pubmed.ncbi.nlm.nih.gov/26667886/
21. Shah SC, Kayamba V, Peek RM, Heimburger D. Cancer Control in Low- and Middle-Income Countries: Is It Time to Consider Screening? J Glob Oncol [Internet]. 2019 [cited 2025 Jun 28];5(5):JGO.18.00200. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6452918/
22. Muller C, Ihionkhan E, Stoffel EM, Kupfer SS. Disparities in Early-Onset Colorectal Cancer. Cells [Internet]. 2021 May 1 [cited 2025 Jun 28];10(5):1018. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8146231/
23. Ngwa W, Addai BW, Adewole I, Ainsworth V, Alaro J, Alatise OI, et al. Cancer in sub-Saharan Africa: a Lancet Oncology Commission. Lancet Oncol [Internet]. 2022 Jun 1 [cited 2025 Jun 28];23(6):e251–312. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1470204521007208
24. Ahn J, Hayes RB. Environmental Influences on the Human Microbiome and Implications for Noncommunicable Disease. Annu Rev Public Health [Internet]. 2021 Apr 1 [cited 2025 Jun 28];42:277. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8641399/

25. Dennison R, Morris S, Clune RJ, Wright S, Waller J, Usher-Smith J. Risk-based innovations in cancer screening and diagnosis: A discrete choice experiment to explore priorities of the UK public. BMJ Open [Internet]. 2025 May 31 [cited 2025 Jun 28];15(5). Available from: https://pubmed.ncbi.nlm.nih.gov/40449953/
26. Li J, Kuang X. Global cancer statistics of young adults and its changes in the past decade: Incidence and mortality from GLOBOCAN 2022. Public Health [Internet]. 2024 Nov 7;237:336–43. Available from: https://www.sciencedirect.com/science/article/abs/pii/S003335062400444X
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