



# THE ROLE OF THE MICROBIOME IN THE DEVELOPMENT, PROGRESSION, AND TREATMENT OF CANCER

EL PAPEL DEL MICROBIOMA EN EL DESARROLLO, PROGRESIÓN Y TRATAMIENTO DEL CÁNCER

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## Dear. Editor:

It is known that there is a wide variety of extensive and diverse populations of bacteria, viruses, and fungi occupying every surface of the body<sup>(1)</sup>. It is estimated that there are nearly 30 trillion bacterial cells living within each human being, and there is a genetic diversity 100 times higher than that of bacteria, encoding metabolic capabilities that influence their microbial ecosystem and the host tissue's specific immune system<sup>(2)</sup>.

These microbes are collectively known as the human microbiota, while the set of microorganisms, genes, and metabolites that inhabit a particular place are known as the microbiome<sup>(3)</sup>.

Knowing that the microbiome is present in different and large parts of our body, it has been shown to be related to the development and progression of certain diseases, such as cancer. This relationship has become increasingly relevant in recent years, as there is evidence that the microbiome influences the development, progression, and even treatment of oncological diseases in both positive and negative ways<sup>(4-6)</sup>.

Despite the importance of this topic, there is very little scientific evidence available, as conducting research with these variables is challenging and costly for various reasons. Each type of cancer has its own characteristics, as does each individual who suffers from the pathology<sup>(7)</sup>. On the other hand, most microbiome studies are conducted through next-generation sequencing (NGS), which demands a relatively high cost<sup>(8)</sup>.

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The following table presents the main findings of recent research studies:

N°	Author, place and date	Title	Conclusions
1	Arjona Hernandez <sup>(7)</sup> . Spain, 2024	Microbiota and cáncer	Microorganisms from the microbiome cause DNA damage, leading to somatic mutations, which can interfere with cancer growth and spread. There are positive effects of the microbiota on cancer, such as detoxification of dietary components, reduction of inflammation, and regulation of cell proliferation.
2	Yiwen Long, et al. <sup>(9)</sup> China, 2023	Causal relationship between gut microbiota and cancers: a two-sample Mendelian randomization study	There is evidence of a direct causal relationship between the genetics of the gut microbiome and cancer, with different associations depending on the type of cancer. The gastrointestinal microbiota is considered an important micro-environmental factor in preventive or risk development for various diseases, including cancer.
3	Nyssa Cullin, et al. <sup>(2)</sup> Germany, 2021	Microbioma and cáncer	Each microbial ecosystem influences cancer development in certain ways, showing community-level interactions mediated by altered microbiome configurations, direct interaction of individual members, secreted pathways, or modulated metabolites. Additionally, the intratumoral microbiome also has some local effect on oncogenesis.
4	Gregory Sepich, et al. <sup>(10)</sup> USA, 2021	The microbiome and human cancer	Some interactions between the microbiome and the human immune system are reflected in cytokine signaling pathways, microbial metabolic effects, and antigenic mimicry of cancer cells. Microbial metabolites are involved in regulating tumor somatic mutation phenotypes and modulating the efficacy of immune checkpoint inhibitors. There is an effort to use the immunomodulatory effects of the microbiota to alter its composition for use in immunotherapy.
5	Vyara Matson, et al. <sup>(5)</sup> Chicago, 2021	Cancer and the microbiome: influence of commensal microbiota on cancer, immune responses and immunotherapy	The development of clinical research on microbiome-based therapies is based on the interference of systemic immune responses caused by the microbiota and its ability to positively and/or negatively influence the efficacy of immunotherapy.
6	Francisco Arvelo, et al. <sup>(4)</sup> Venezuela, 2021	Cáncer and Microbiota	The microbiota directly affects the development and progression of carcinogenesis, where specific bacteria are involved in genetic instability, cell proliferation, susceptibility to host immune responses, and response to antitumor therapy.
7	Sofia A. Tsvetkova, Elena I. Koshelev <sup>(11)</sup> Russia, 2020	Microbiota and cancer: host cellular mechanisms activated by intestinal microbial metabolites	Microbial metabolites from the diet can trigger cell cycle alterations, influencing the carcinogenesis process by either promoting or suppressing it. The antitumor power of short-chain fatty acids and polyphenols is highlighted.



8	Silvia Vivarelli, et al. <sup>(6)</sup> Italy, 2019	Intestinal microbiota and cancer: from pathogens to therapy	The dual effects of the microbiome in the pathological process of cancer are evidenced, as the by-products generated from it can directly modulate the epithelium where it resides or modulate the immune system. The importance of probiotics in helping to fight against tumorigenesis is emphasized.
9	Muhammad Hassan Raza <sup>(12)</sup> Pakistan, 2018	Microbiota in the development and treatment of cancer.	The quantity and species within the microbiome vary according to their location within the same organ and also vary from one individual to another, influencing the development of various diseases, such as cancer. However, the absence of a microbiome in certain organs does not exclude them from experiencing an oncological process, as exposure to microorganism-associated molecular patterns (MAPs) and bacterial metabolic products also influence carcinogenesis.

For the aforementioned reasons, it is proposed that there is a relationship between the microbiome and cancer. However, it remains a challenge to standardize the details due to the heterogeneity of patients, the microbiome, and the existing types of cancer. This makes it crucial to understand and design research strategies for studying the microbiome and its interactions associated with cancer, with the aim of understanding processes, developing preventive

measures, and increasingly effective treatments, such as the case of the human papillomavirus (HPV) vaccine, which has a protective effect against cancer linked to this virus. Currently, the Instituto de Investigaciones en Ciencias Biomédicas of the Universidad Ricardo Palma (INICIB-URP) is developing research projects on the microbiome and breast cancer, in order to expand knowledge on this subject.

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