

Microbes Against Cancer

Probiotics and the Tumor–Microbiome Axis

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Head of the Preclinical Research Unit

Institut AllergoSan Pharma GmbH

Why now? Why the Tumor–Microbiome Axis

~20.6 M

new cancer cases worldwide (2024)

GLOBOCAN 2024



- The gut microbiome influences carcinogenesis, treatment response, and toxicity.
- Probiotics: a non-invasive, low-cost adjuvant strategy with broad applicability.
- Rapidly growing, high-quality evidence - from mechanism to phase II trials.
- mechanism → tumor entity → clinical endpoints → safety.

The Tumor–Microbiome Axis

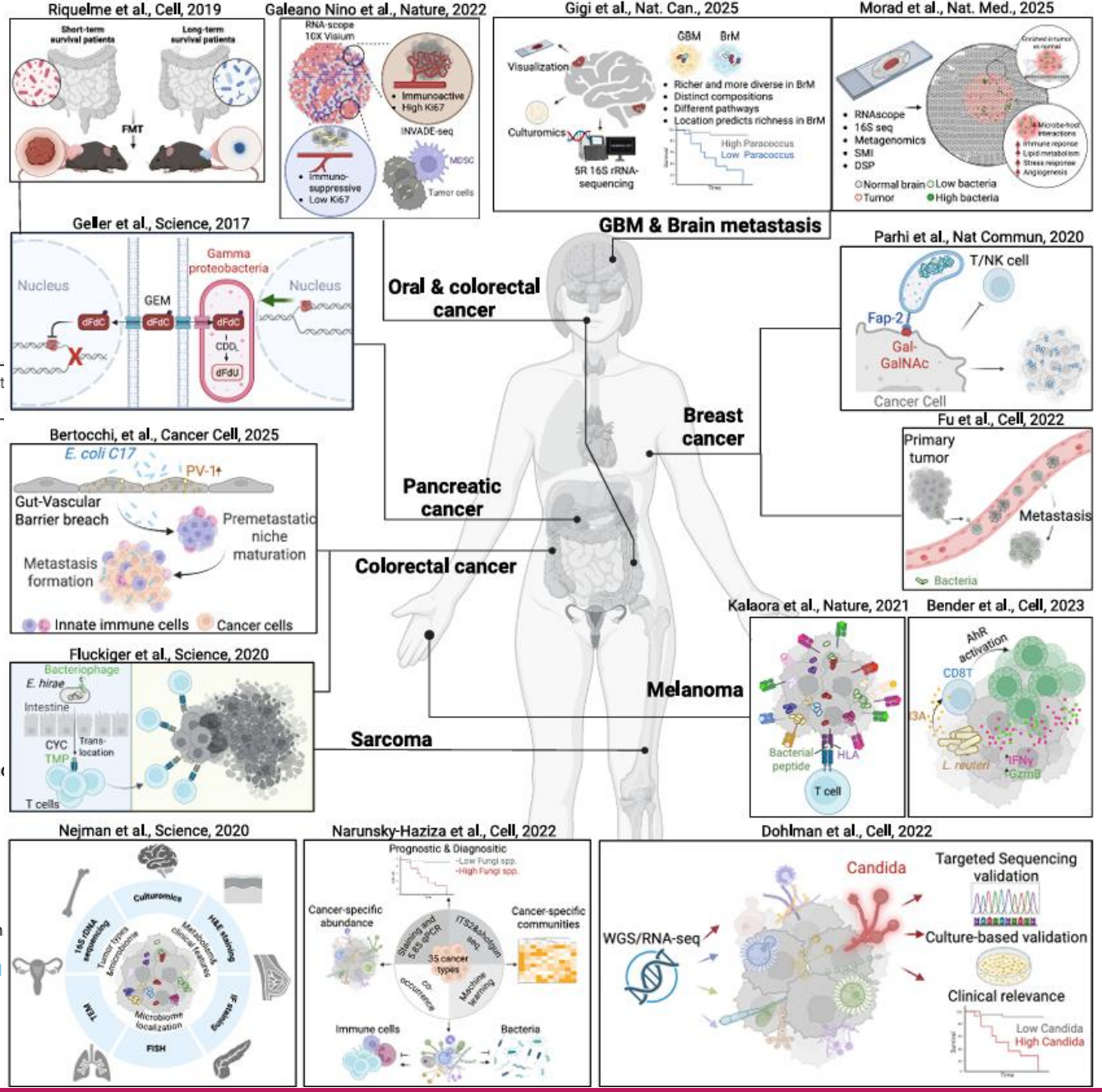
Please cite this article in press as: Duan et al., Toward a consensus on the tumor microbiota: Evidence, standards, and int
(2026), https://doi.org/10.1016/j.ccell.2026.02.011

Cancer Cell

Commentary

Toward a consensus on the tumor microbiota: Evidence, standards, and interpretation

Tingting Duan,[1] Aviel Rosenbaum,[2] Vidhi Chandra,[3,4] Luca Tiraboschi,[5] Maria Rescigno,[5,6,*] Floren
Ravid Straussman,[2,*] and Marlies Meisel[1,8,*]
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[2]Department of Molecular Cell Biology, Weizmann Institute of Science, Rehovot, Israel
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[4]Tumor Ecosystem Center, The University of Texas MD Anderson Cancer Center, Houston, TX, USA
[5]IRCCS Humanitas Research Hospital, Milan, Italy
[6]CeMM, Research Center for Molecular Medicine of the Austrian Academy of Sciences, Vienna, Austria
[7]Department of Gastrointestinal Medical Oncology, The University of Texas MD Anderson Cancer Center, Houston
[8]Cancer Immunology and Immunotherapy Program, UPMC Hillman Cancer Center, Pittsburgh, PA, USA
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https://doi.org/10.1016/j.ccell.2026.02.011

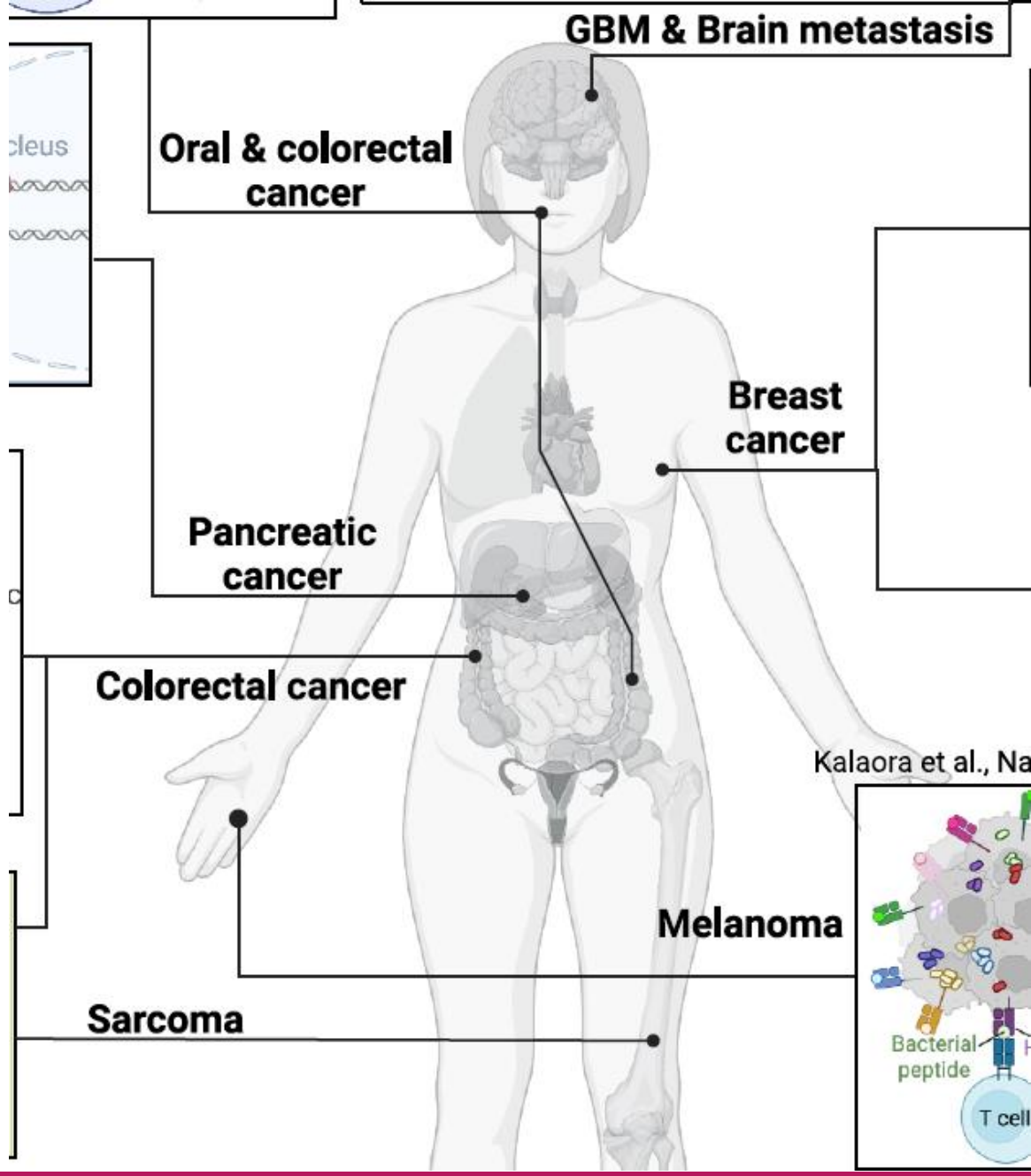


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7+
Cancer types

15+
Mechanistic studies

6+
Hallmarks affected

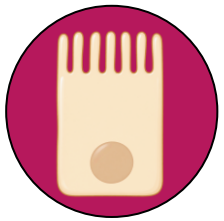


Duan et al., Toward a consensus on the tumor microbiota: Evidence, standards, and interpretation, Cancer Cell (2026), https://doi.org/10.1016/j.ccell.2026.02.011

Cell, Vol. 100, 57–70, January 7, 2000, Copyright ã2000 by Cell Press Review The Hallmarks of Cancer

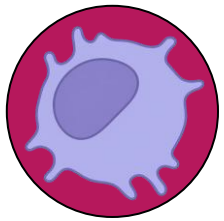
The Gut–Tumor Axis

Central mechanistic levels



Gut barrier, Pathogens, Dysbiosis

Competitive exclusion, mucosal stabilization, pathogen removal



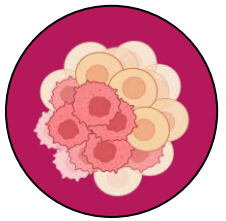
Immunomodulation

DC maturation, MHC-I, cytokine profile



Metabolites

SCFAs, tryptophan, molecular mimicry



Antiproliferative, pro-apoptotic effects

Alter cell cycle progression, promote cell apoptosis

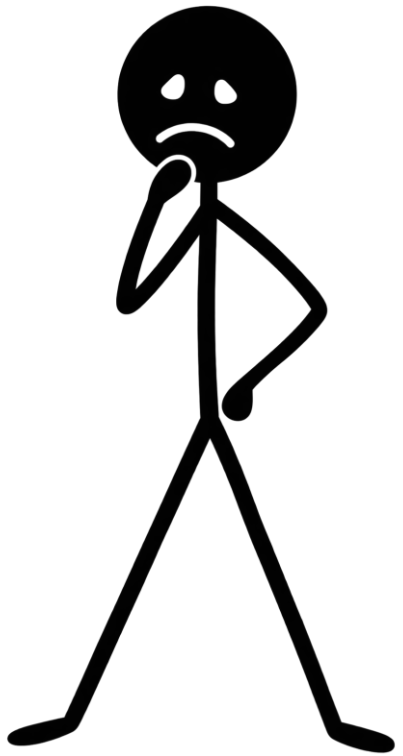
Outcome: improved tumor immunosurveillance, reduced dysbiosis, lower treatment-associated toxicity

Microbiota in cancer: current understandings and future perspectives Yao et al. 2026

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Microbiome Modulation

PROBIOTICS & Prevention



Probiotics in Prevention

Zheng *et al. Nutrition Journal* (2025) 24:45
https://doi.org/10.1186/s12937-025-01104-w

Nutrition Journal

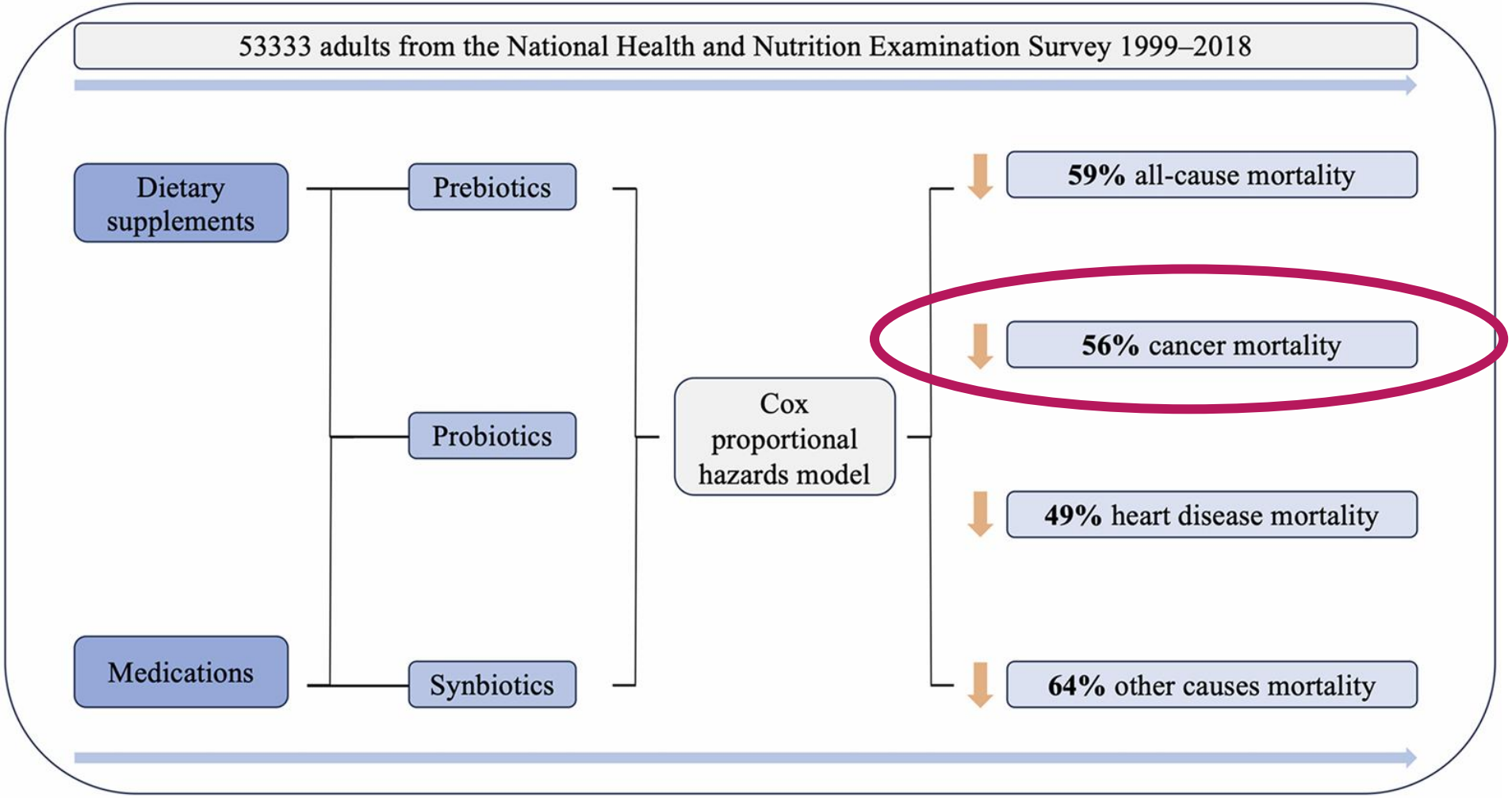


RESEARCH Open Access

Association of the use of nonfood prebiotics, probiotics, and synbiotics with total and cause-specific mortality: a prospective cohort study

Luyan Zheng[1], Jiaqi Zhang[2], Jing Yang[1], Yanbo Wang[1], Yina Zhang[1], Kailu Fang[1], Jie Wu[1*†] and Min Zheng[1*†]

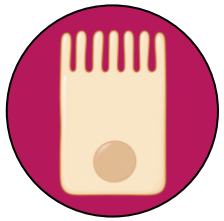
Probiotics in Prevention



Zheng et al. Association of the use of nonfood prebiotics, probiotics, and synbiotics with total and cause-specific mortality: a prospective cohort study. Nutr J. 2025 Mar 20;24(1):45..

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Probiotics: Gut barrier, Dysbiosis, Pathogens



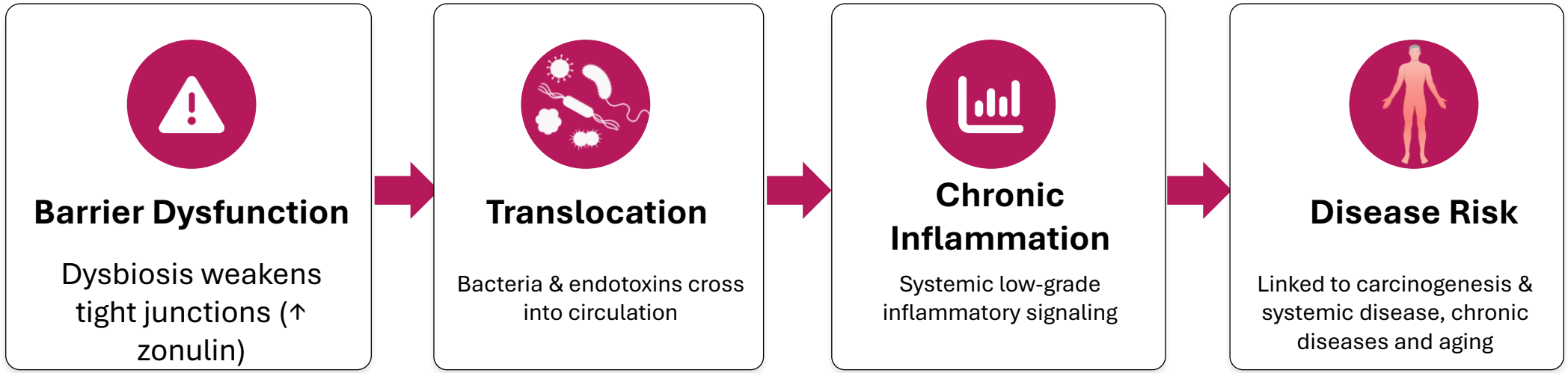
Gut barrier, Pathogens, Dysbiosis

Competitive exclusion, mucosal stabilization, pathogen removal

Key study: Al-Sadi R, Dharmaprakash V, Nighot P, et al. Bifidobacterium bifidum Enhances the Intestinal Epithelial Tight Junction Barrier... Int J Mol Sci. 2021;22(15):8070.

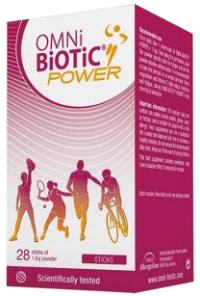
The Gut Barrier: A First Line of Defense

Why barrier integrity matters beyond the gut — and where multispecies probiotics fit in

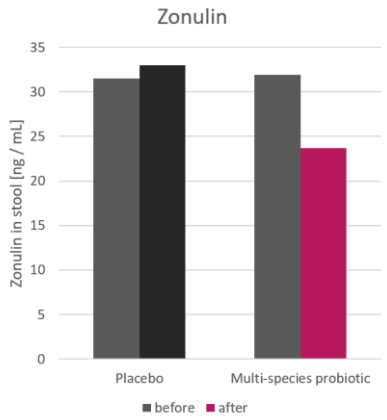


Multiple peer-reviewed studies have tested whether specific multispecies OMNi-BiOTiC® probiotic formulations can support this barrier.

OMNi-BiOTiC®: Peer-Reviewed Gut Barrier Evidence



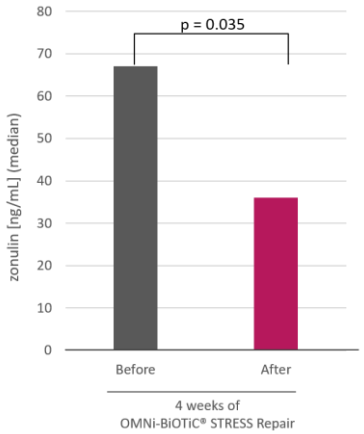
OMNi-BiOTiC® POWER



Lamprecht M, et al. J Int Soc Sports Nutr. 2012;9:45.



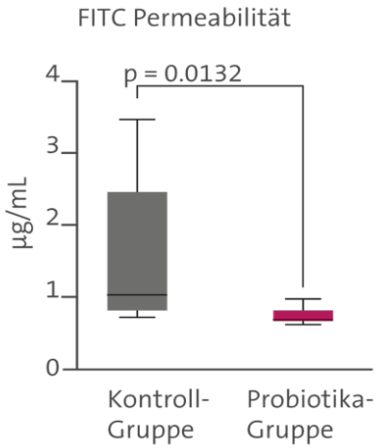
OMNi-BiOTiC® STRESS Repair



Haidmayer A, et al. Nutrients. 2020;12(8):2337. Moser AM, et al. Eur J Nutr 2018, van Hemert, Schütz et al Advances in Mikrobiology, 2013



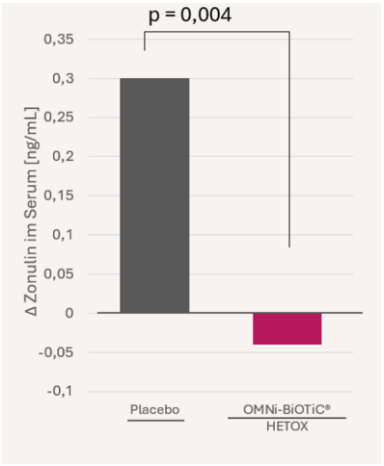
OMNi-BiOTiC® 10



Obermüller B, et al. Nutrients. 2023;15(16):3655.



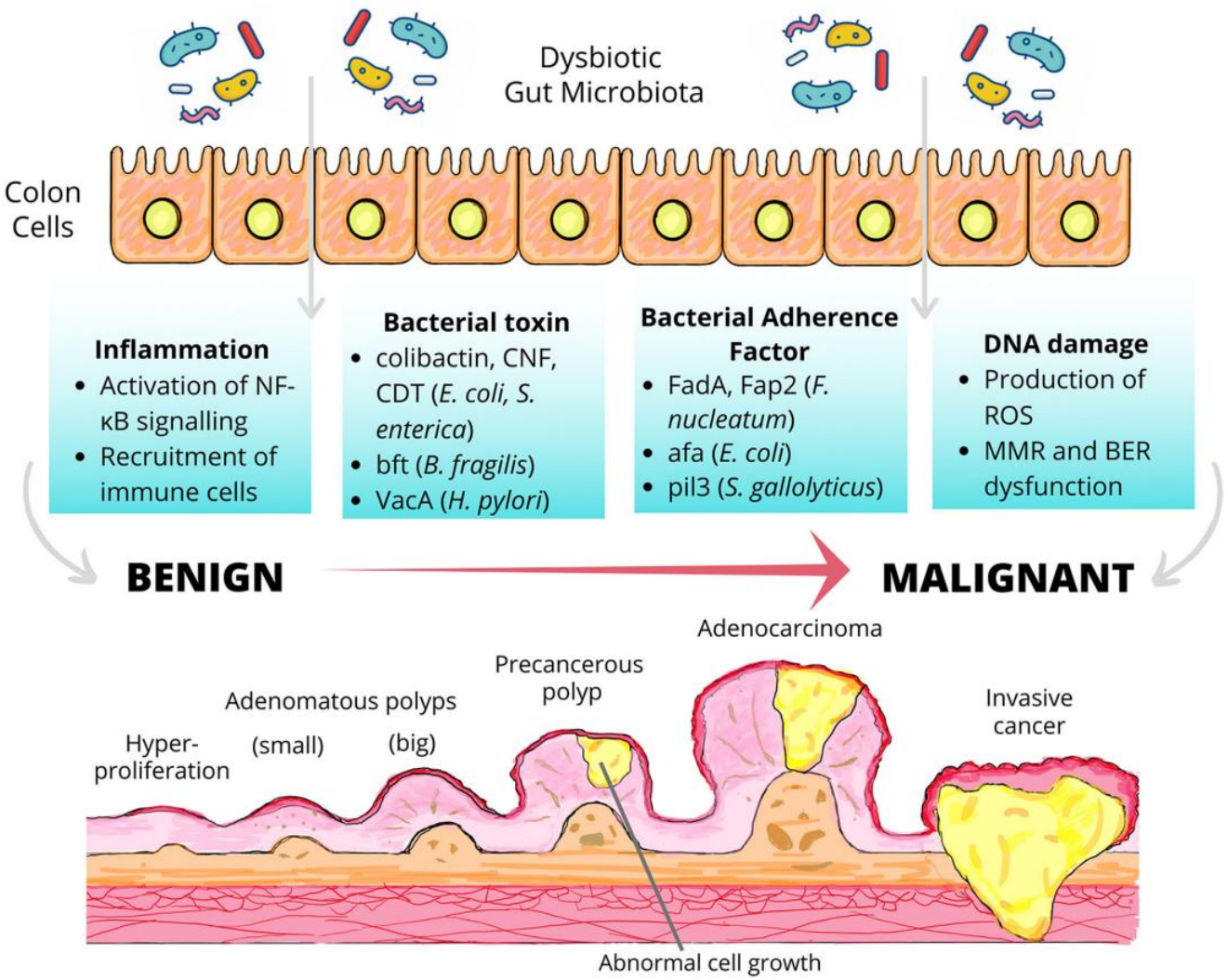
OMNi-BiOTiC® HETOX



Obermüller B, et al. Nutrients. 2023;15(16):3655.

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Dysbiosis and Cancer



Dysbiotic gut microbiota promotes abnormal cell growth and mutations through…

…chronic inflammation

…bacterial toxins

…adhesion factors that facilitate bacterial invasion into host cells

…DNA damage

Loke YL et al. Colon carcinogenesis: the interplay between diet and gut microbiota. Frotniers in Cellular and Infection Microbiology. 2020, 10:603086. doi: 10.3389/fcimb.2020.60308612

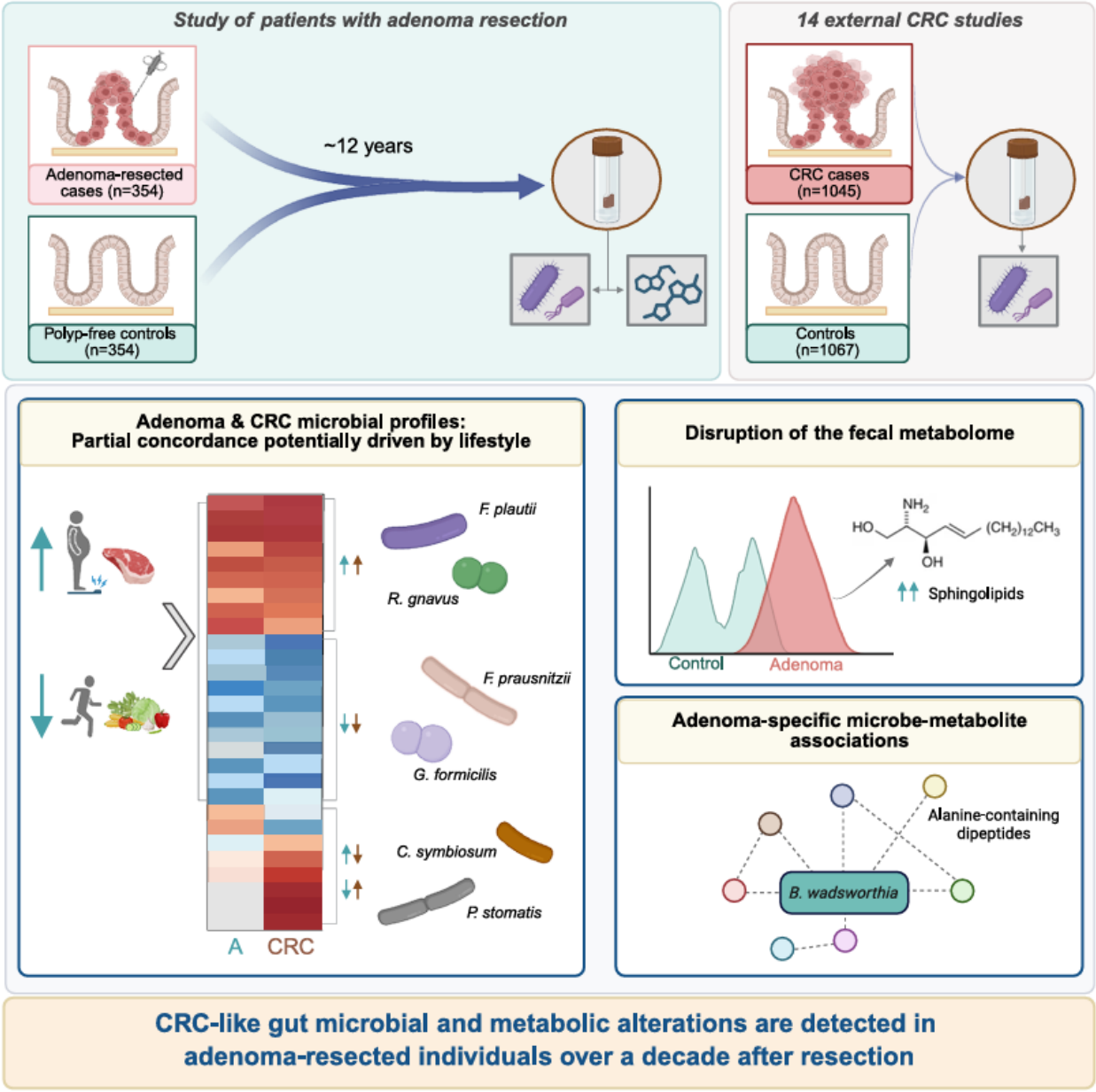
CRC - Microbiome

Ø 12,1 ± 4,8

Years after adenoma resection
(Range: 4–29 years)

354 vs. 354

Women who underwent adenoma resection vs. 1:1-matched polyp-free controls



Nogal et al., 2026, Cell Host & Microbe 34, 1135–1150 June 10, 2026

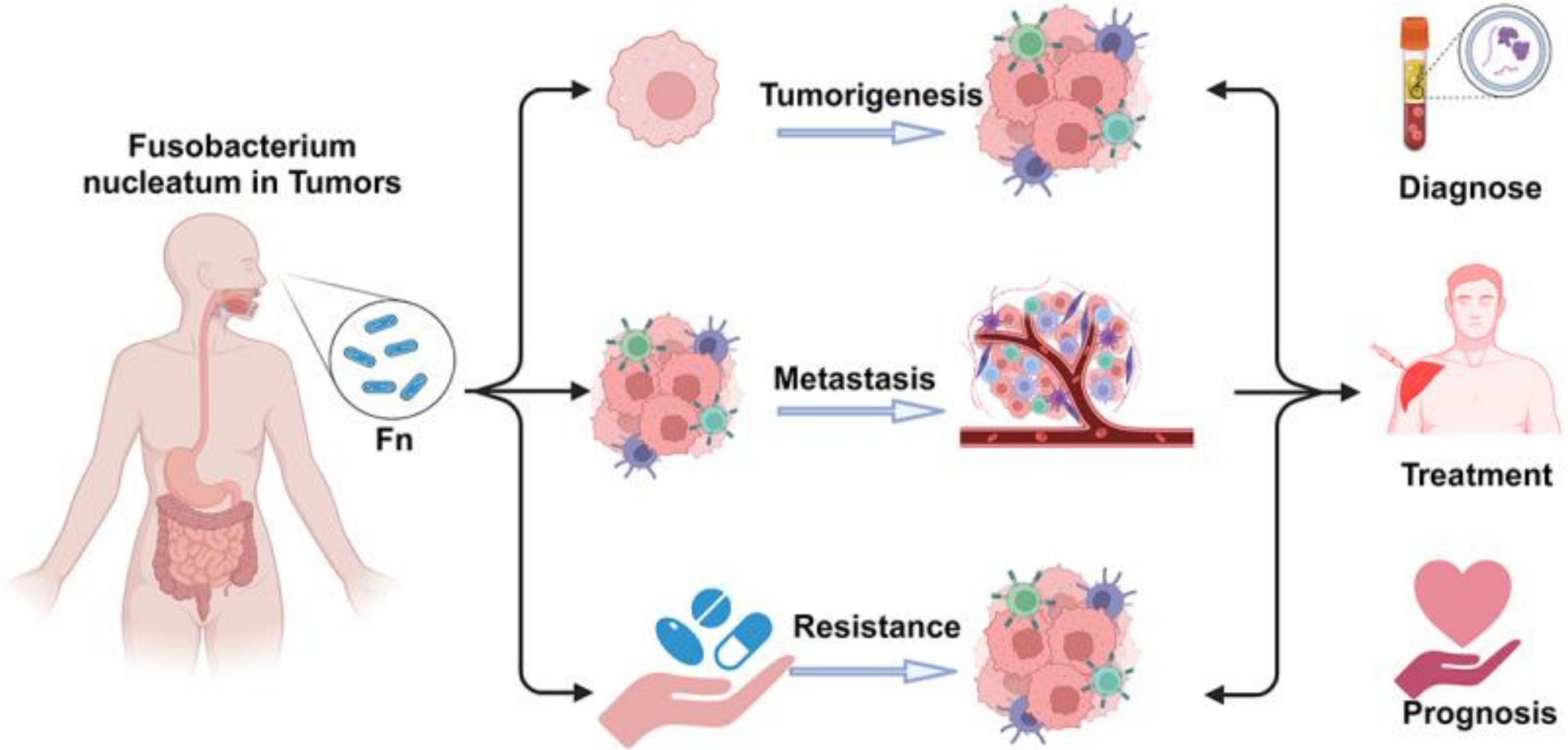
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Persistent dysbiosis resembles the CRC-associated microbiome signature

1. **Significant correlation with CRC-associated microbiome patterns**
2. **31 shared species showed altered abundance**
3. **Metabolome also altered**

Authors' Conclusion:
The gut microbiome remains altered even years after adenoma removal.

Effects of *F. nucleatum* in Tumors



Ye C, Liu X, Liu Z, et al. Fusobacterium nucleatum in tumors: from tumorigenesis to tumor metastasis and tumor resistance. Cancer Biol Ther. 2024;25(1):2306676. doi:10.1080/15384047.2024.2306676

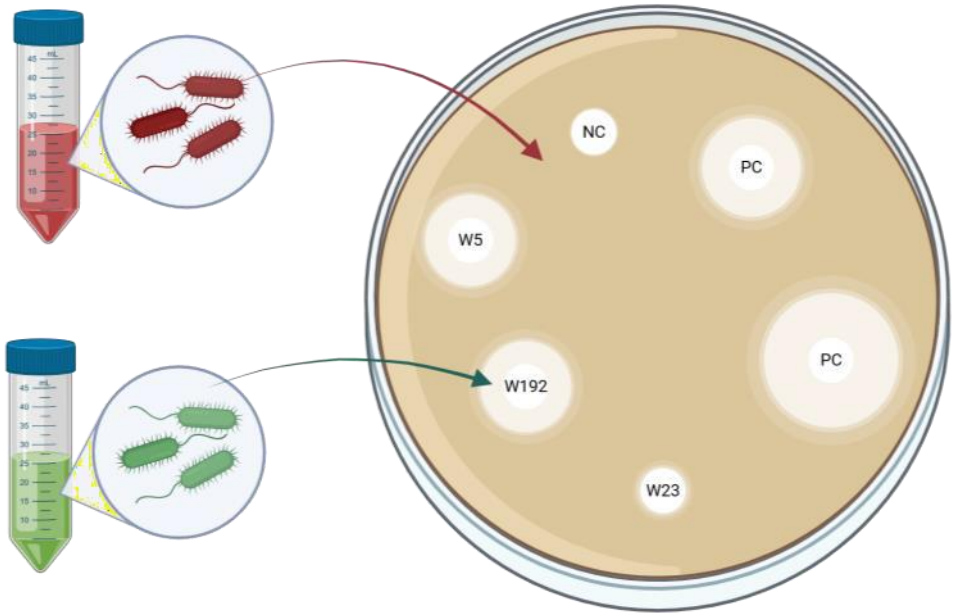
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In Vitro Study Design



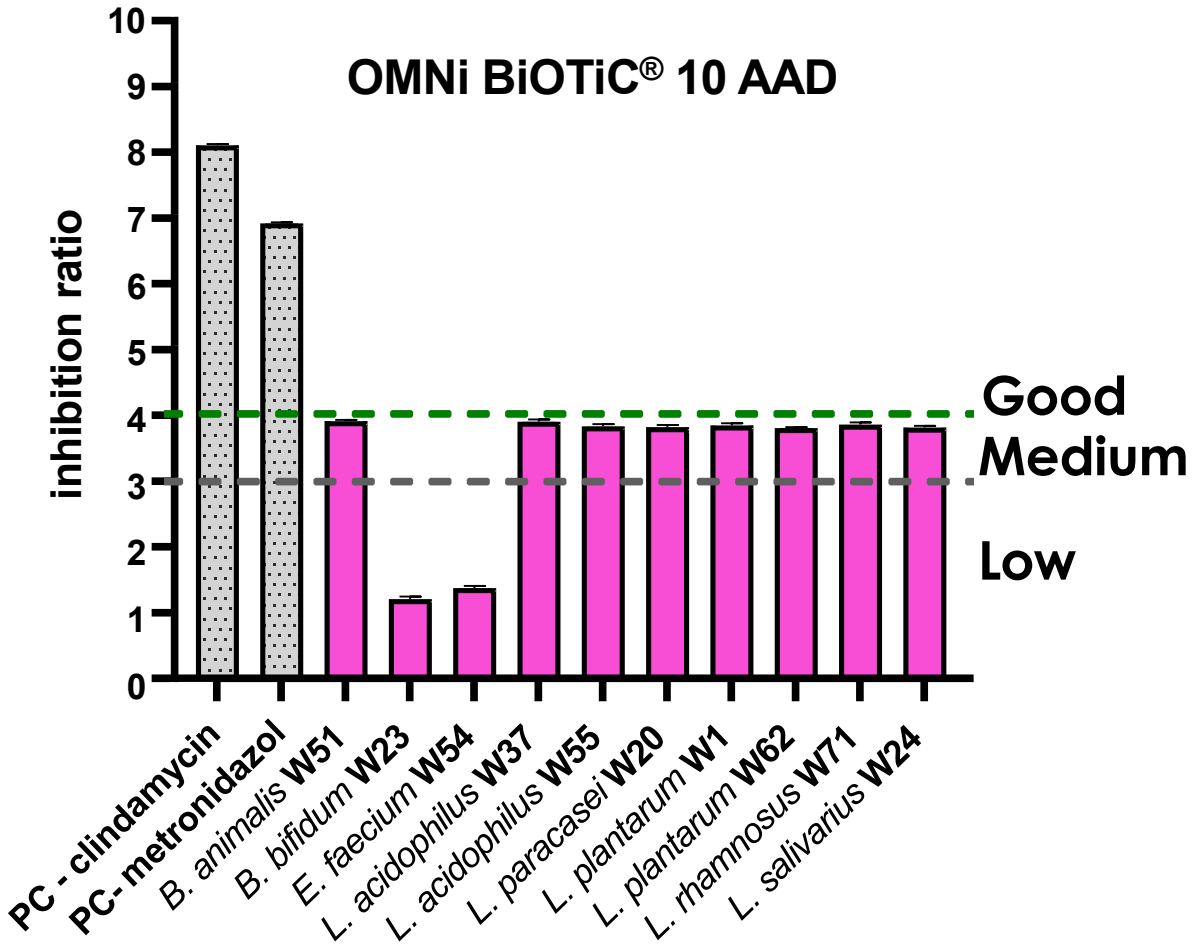
Lactobacillus acidophilus W55
Lactobacillus acidophilus W37
Lactobacillus plantarum W1
Bifidobacterium lactis W51
Enterococcus faecium W54
Lactobacillus paracasei W20
Lactobacillus rhamnosus W71
Lactobacillus salivarius W24
Lactobacillus plantarum W62
Bifidobacterium bifidum W23

Agar-Overlay-Methode



OMNi BiOTiC® 10 AAD against *F. nucleatum*





Perioperative Probiotics in CRC Surgery

Umbrella review: Perioperative Probiotics in colorectal cancer surgery

11
meta-analyses included

17 000
patients

frontiers | Frontiers in Microbiology

TYPE Systematic Review
PUBLISHED 11 September 2025
DOI 10.3389/fmicb.2025.1635409



Check for updates

OPEN ACCESS

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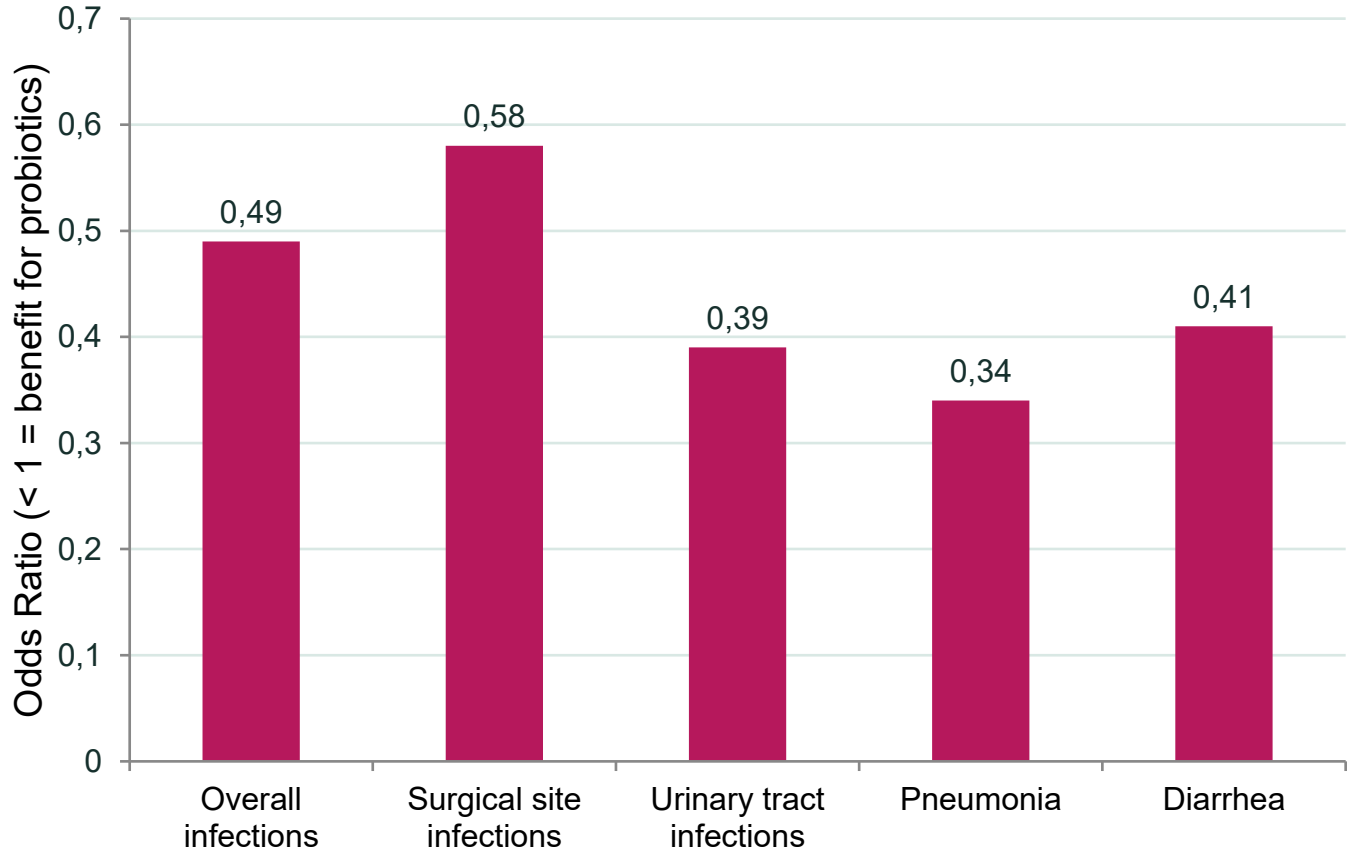
Probiotics/synbiotics supplementation reduce the infection incidence in patients undergoing resection for colorectal cancer: an umbrella review

Shilin Gao†, Xi Liao†, Yuhua He and Jie Yang*

Colorectal Cancer Center, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan, China

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Perioperative Probiotics in CRC Surgery



Conclusion

Perioperative **Probiotic supplementation** in CRC patients is associated with **reduced incidence** of overall infections, surgical site infections, urinary tract infections, pneumonia, and diarrhea.

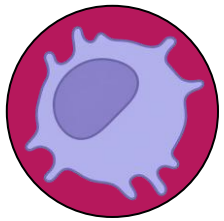
All effects statistically significant.

Gao S, Liao X, He Y, Yang J. Front Microbiol. 2025;16:1635409. DOI: 10.3389/fmicb.2025.1635409

See also: Sánchez-Alcoholado et al., Cancers. 2020;12(6):1406.

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Probiotics: Advances in Cancer Treatment



Immunomodulation

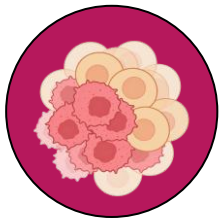
DC maturation, MHC-I, cytokine profile



Metabolites

SCFAs, tryptophan

Effects of Probiotics on Tumor Progression



Antiproliferative, pro-apoptotic effects

Alter cell cycle progression, promote cell apoptosis

International Journal of
Molecular Sciences

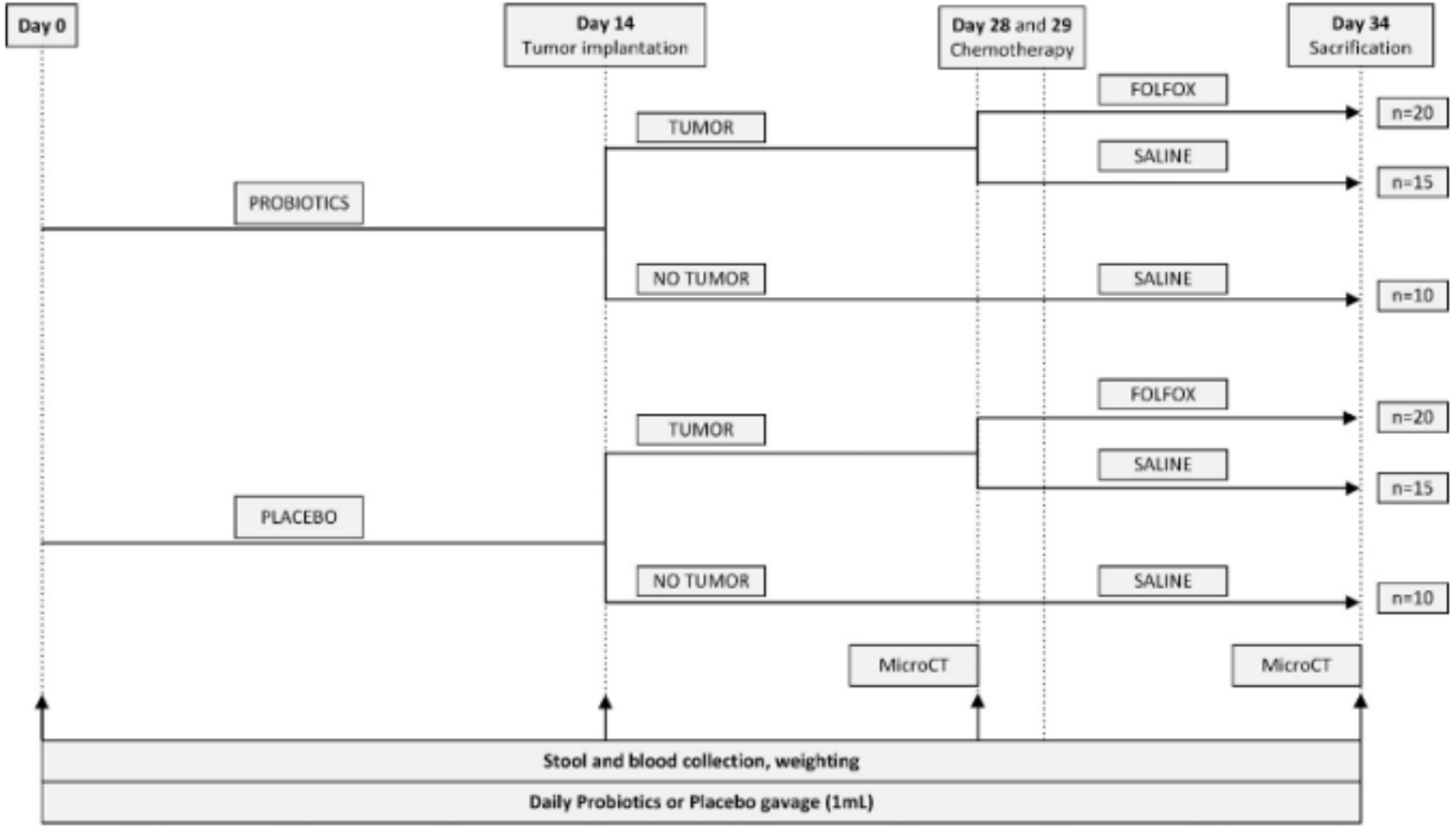
MDPI



Article

Probiotic Supplementation Suppresses Tumor Growth in an Experimental Colorectal Cancer Liver Metastasis Model

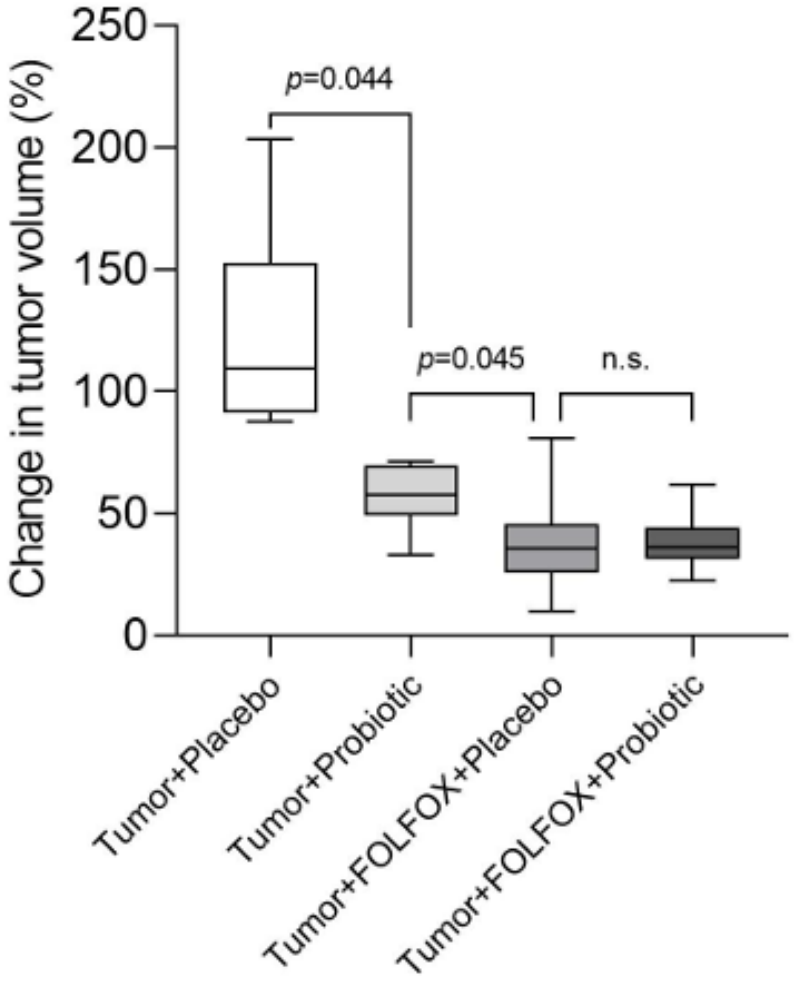
Matas Jakubauskas [1,2], Lina Jakubauskiene [1,2], Bettina Leber [1], Angela Horvath [3], Kestutis Strupas [2], Philipp Stiegler [1,*] and Peter Schemmer [1]



Med Uni Graz

Probiotics in Experimental Colon Cancer

Gavage	CONTROL Tumor (−)/FOLFOX (−)		Non-FOLFOX Tumor (+)/FOLFOX (−)		FOLFOX Tumor (+)/FOLFOX (+)	
	Placebo	Probiotics	Placebo	Probiotics	Placebo	Probiotics
Started (n)	10	10	15	15	20	20
Finished (n)	10	10	15	15	20	19 *

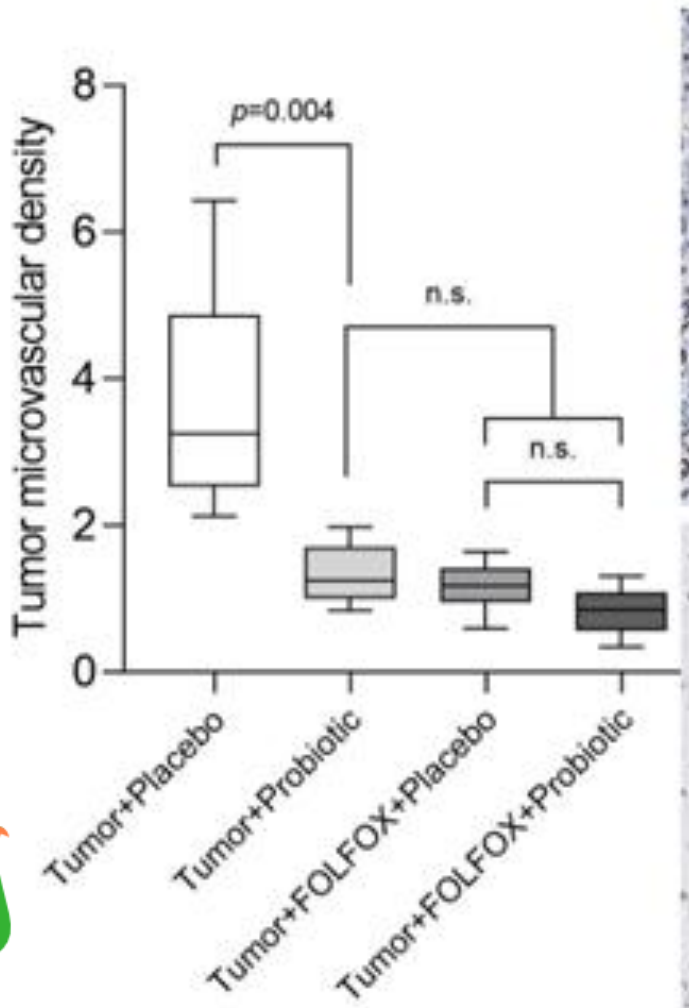


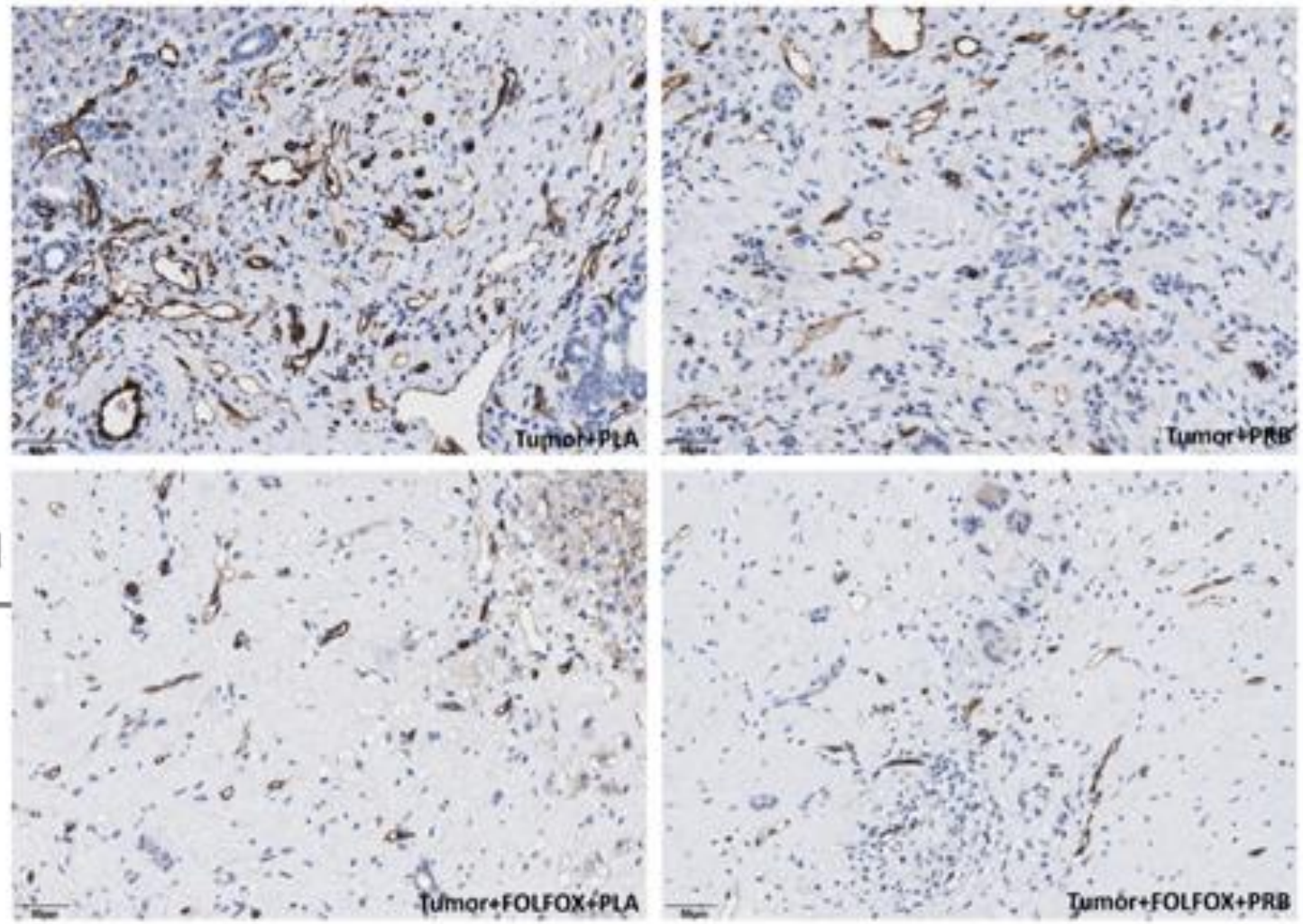
Med Uni Graz

Jakubauskas et al. Probiotic Supplementation Suppresses Tumor Growth in an Experimental Colorectal Cancer Liver Metastasis Model. Int. J. Mol. Sci.2022, 23, 7674. https://doi.org/10.3390/ijms23147674

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Probiotics Inhibit Angiogenesis





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Jakubauskas et al. Probiotic Supplementation Suppresses Tumor Growth in an Experimental Colorectal Cancer Liver Metastasis Model. Int. J. Mol. Sci.2022, 23, 7674. https://doi.org/10.3390/ijms23147674

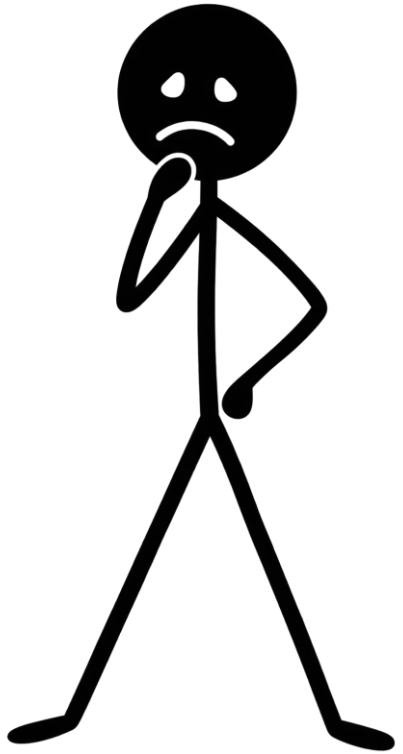
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Chemotheraoy related side effects



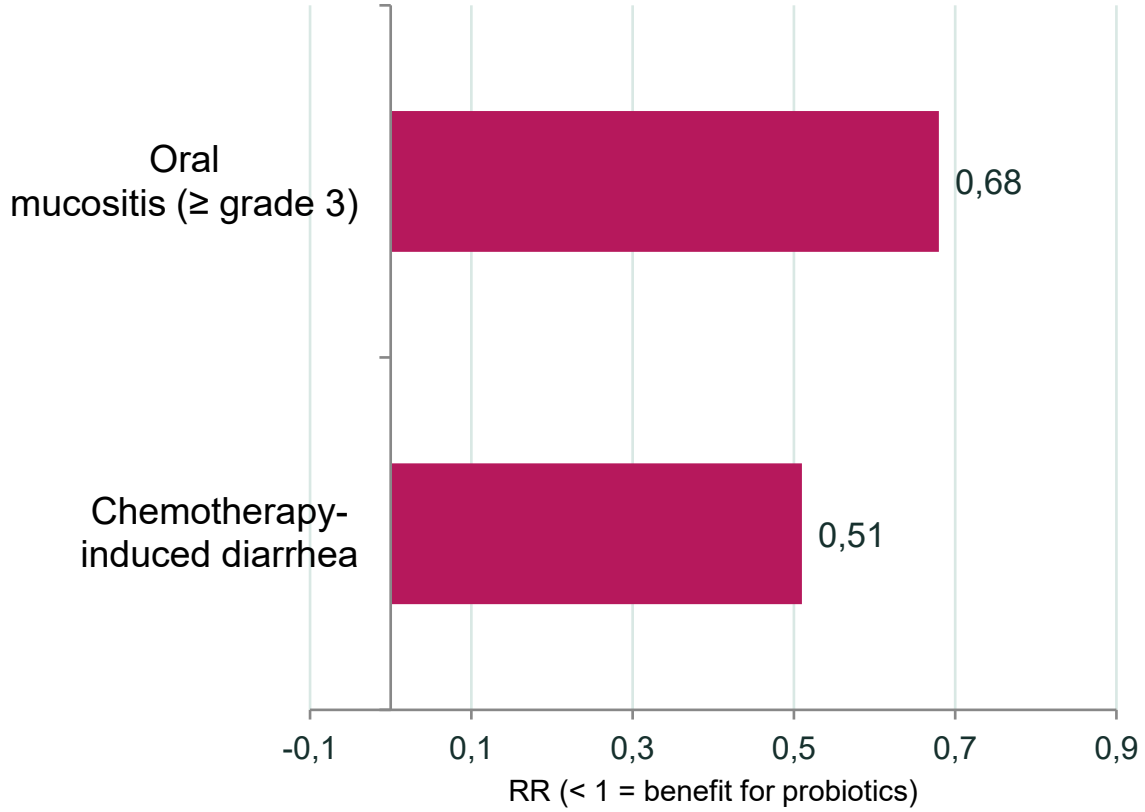
Side effects

Chemotherapy related



Add-on to Chemotherapy: Reducing Toxicity

Meta-analysis, Front Nutr 2022 - relative risk with probiotic administration vs. control



Probiotics vs Placebo

Reduce treatment discontinuation and hospital stays.
Improved quality of life during treatment.

Effects are strain- and dose-dependent — not all RCTs show consistent results.

Feng J, Gao M, Zhao C, et al. Front Nutr. 2022;9:823288, DOI: 10.3389/fnut.2022.823288

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OMNi-BiOTiC® iMMUND in Mucositis

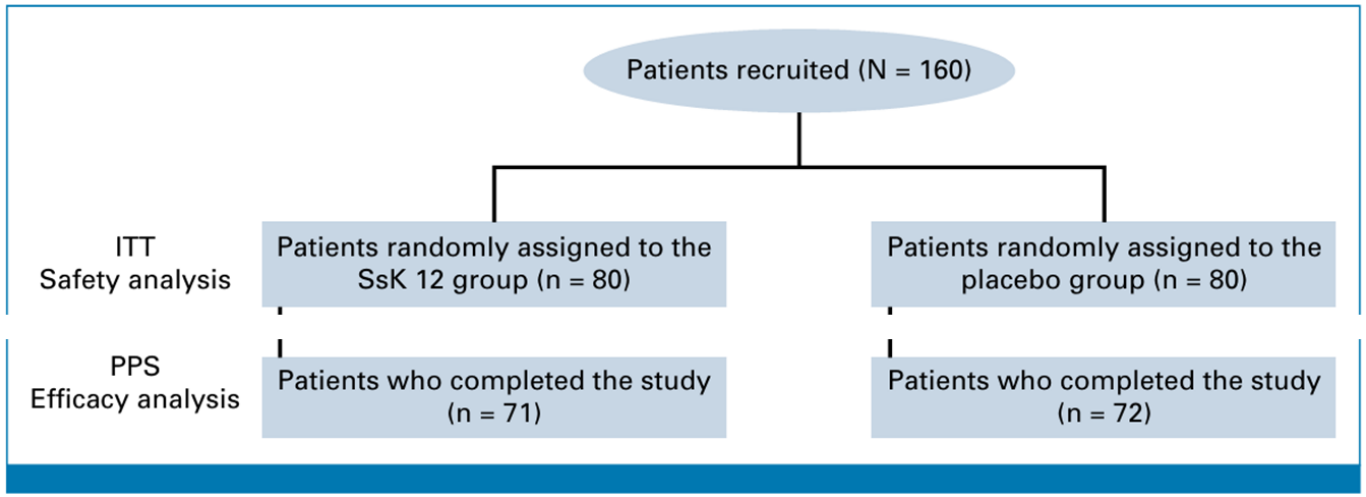
Original Reports | Head and Neck Cancer

Check for updates

Streptococcus salivarius K12 Alleviates Oral Mucositis in Patients Undergoing Radiotherapy for Malignant Head and Neck Tumors: A Randomized Controlled Trial

Xingchen Peng, MD[1]; Zixia Li, MDS[2]; Yiyan Pei, MM[1]; Shuhao Zheng, DDS[2]; Jinchi Liu, MDS[2]; Jingjing Wang, MD[1]; Ruidan Li, MD[1]; and Xin Xu, DDS[2]

DOI https://doi.org/10.1200/JCO.23.00837

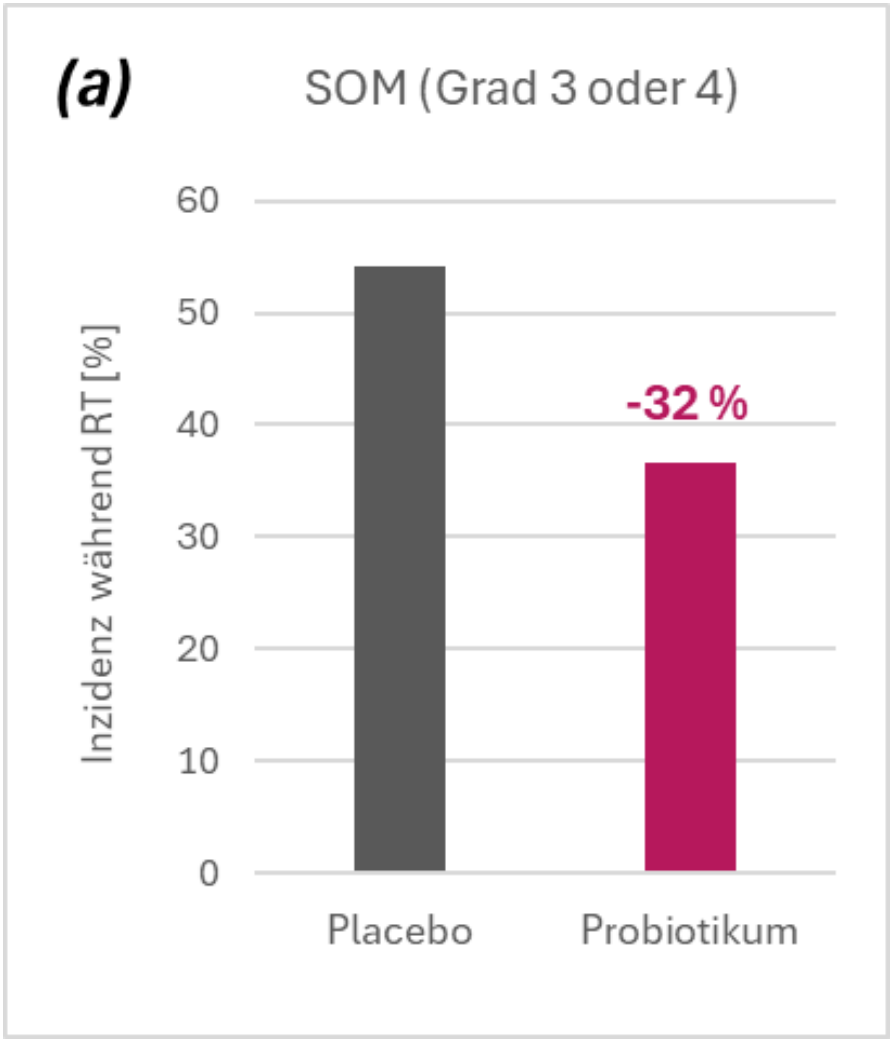




Mucositis is an inflammatory injury to the mucosal lining.

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OMNi-BiOTiC® *iMMUND* Significantly Reduces the Incidence of Severe Oral Mucositis

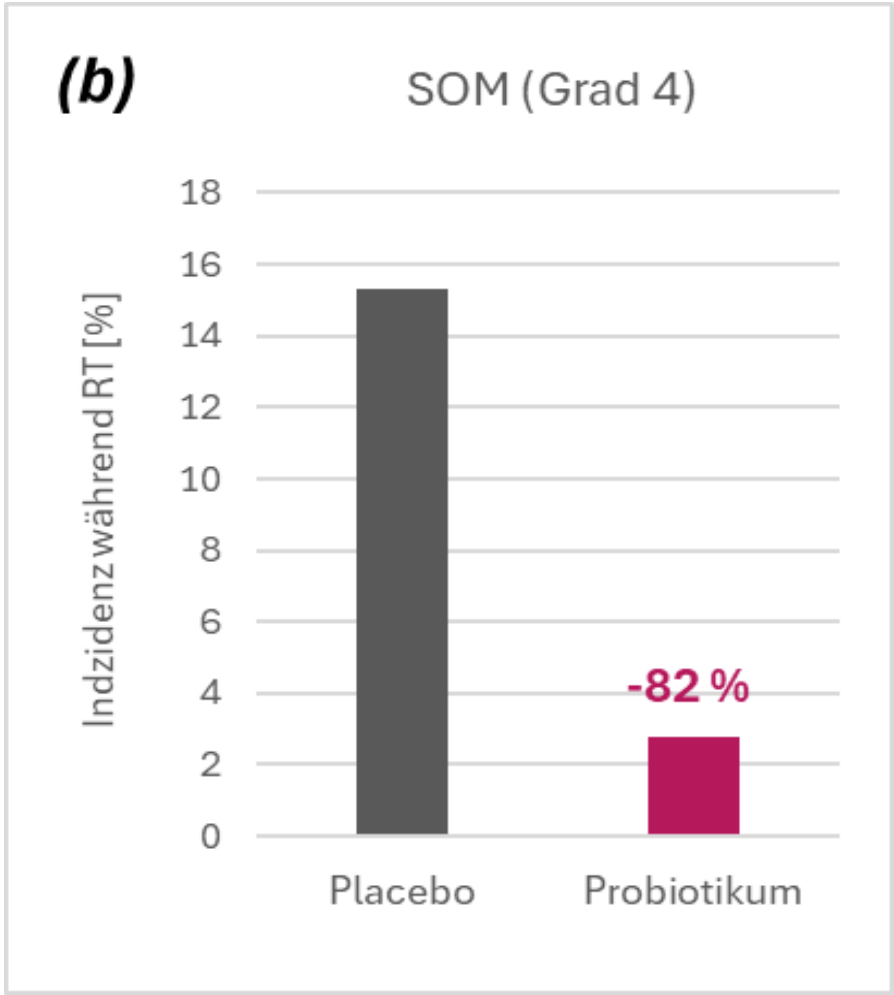


Peng X, Li Z, Pei Y, et al. Streptococcus salivarius K12 Alleviates Oral Mucositis in Patients Undergoing Radiotherapy for Malignant Head and Neck Tumors: A Randomized Controlled Trial. J Clin Oncol. 2024;42(12):1426-1435. doi:10.1200/JCO.23.00837

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OMNi-BiOTiC® *iMMUND* Significantly Reduces the Incidence of Grade 4 Mucositis

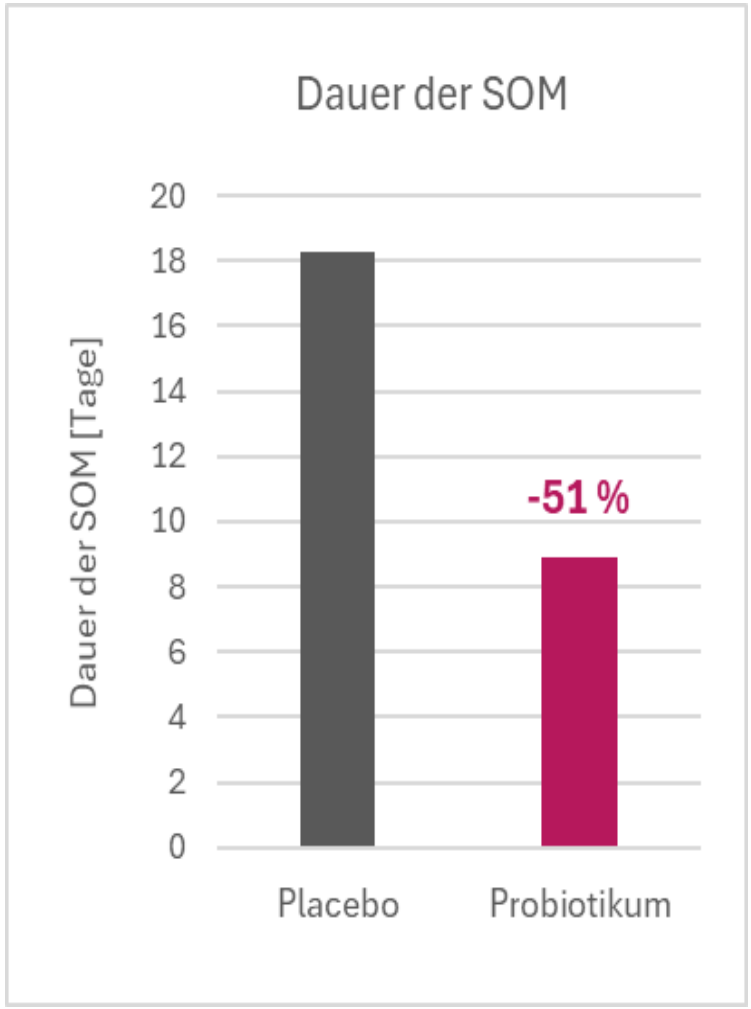
OMNi-BiOTiC® iMMUND administered **3 x daily** during radiotherapy significantly reduces the incidence of Grade 4 acute mucositis by 82%.



Peng X, Li Z, Pei Y, et al. Streptococcus salivarius K12 Alleviates Oral Mucositis in Patients Undergoing Radiotherapy for Malignant Head and Neck Tumors: A Randomized Controlled Trial. J Clin Oncol. 2024;42(12):1426-1435. doi:10.1200/JCO.23.00837

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OMNi-BiOTiC® *iMMUND* Significantly Reduces the Duration of Severe Oral Mucositis



Probiotic supplementation with **OMNi-BiOTiC® iMMUND** during radiotherapy reduces the mean duration of severe oral mucositis by more than 50%.

Peng X, Li Z, Pei Y, et al. Streptococcus salivarius K12 Alleviates Oral Mucositis in Patients Undergoing Radiotherapy for Malignant Head and Neck Tumors: A Randomized Controlled Trial. J Clin Oncol. 2024;42(12):1426-1435. doi:10.1200/JCO.23.00837

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Effects of OMNi-BiOTiC® 10 in Patients with Gynecological Cancers



36 patients with gynecological malignancies

OMNi-BiOTiC® 10 AAD vs. placebo

Randomized controlled trial (RCT)

Twice daily for 8 weeks during treatment

Primary Endpoints: Diarrhea, nausea/vomiting, constipation, and infections.

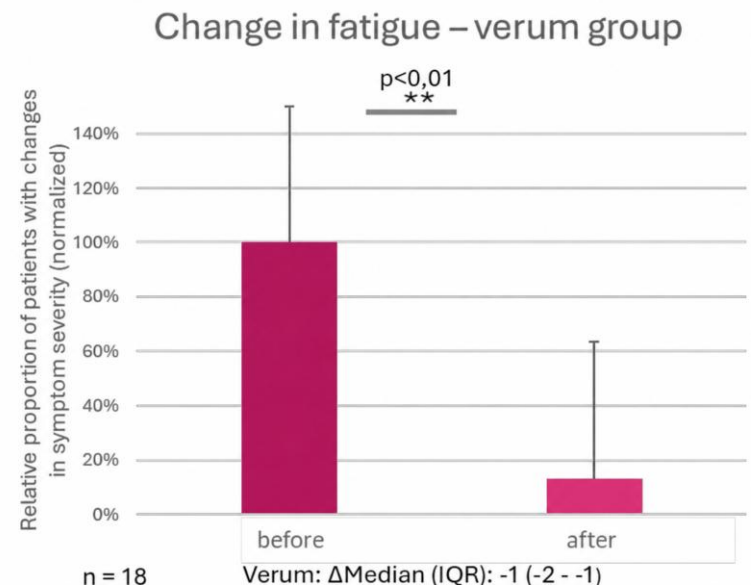
Secondary Endpoints: Fatigue, sleep disturbances, loss of appetite, CRP levels, and quality of life.

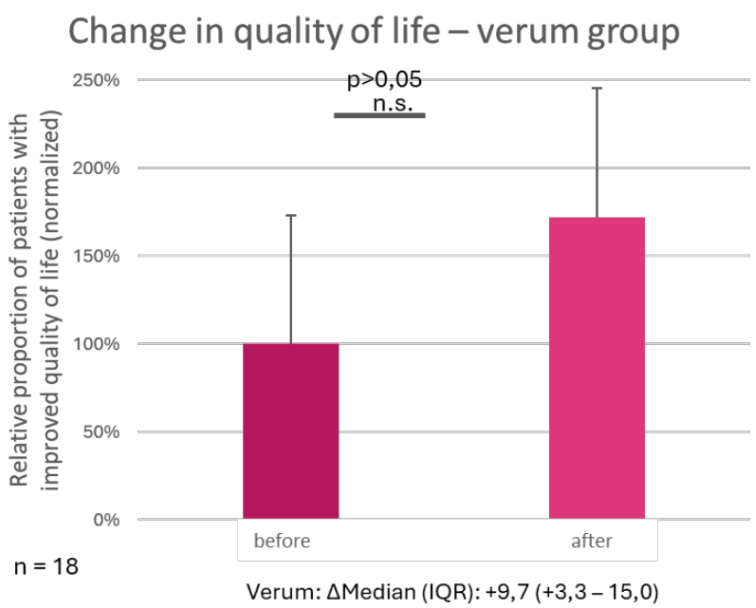
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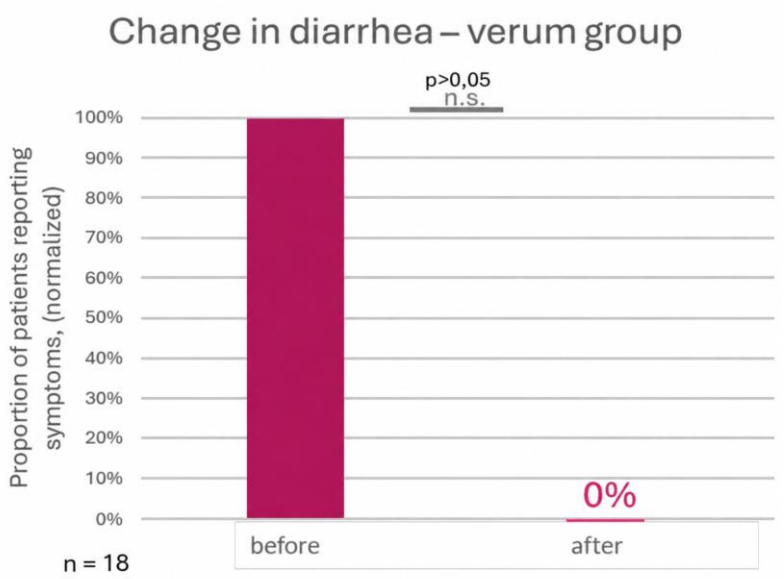
Ayguen C, Grabowski J, Sehouli J. International Journal of Gynecological Cancer, 36, DOI: 10.1016/j.ijgc.2025.104096

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Effects of OMNi-BiOTiC® 10 in Patients with Gynecological Cancers

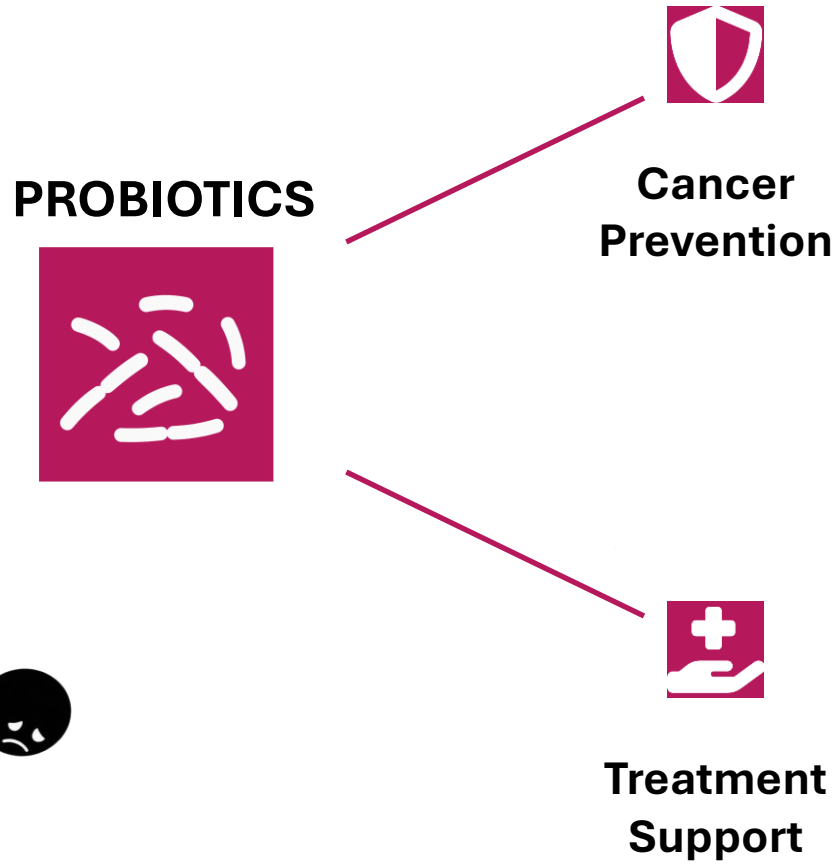






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CLOSING MESSAGE



‘Probiotics are a still underestimated but incredibly valuable microbiome-modulating intervention to support cancer treatment - and also to prevent cancer.’

