Inside the Female Microbiome: Nutrition, Hormones and Gut Health

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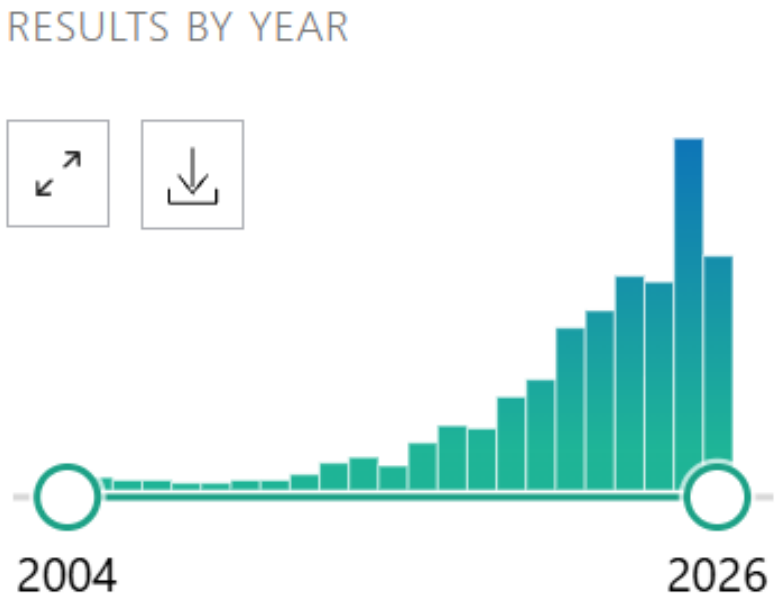
Topics

- Review current research on the interactions among the gut microbiome, estrogen metabolism, and women’s health
- Explain the role of the estrobolome and its relevance to women's health outcomes
- Evaluate the effects of fiber, prebiotics and probiotics on microbiome composition and function
- Assess how microbiome changes throughout the female lifespan may influence disease risk and symptom management
- Discuss microbiome-supportive nutrition recommendations

A New Era of Women’s Wellness

- The intersection of women's health, the gut microbiome, and estrogen metabolism has become one of the most active areas of recent health research



2020- 36 publications
2022-60 publications
2024-70 publications
2025-120 publications
2026-80 publications (so far)

Why This Matters

More than **1 million women** in the U.S. experience menopause each year (*National Institute of Aging*)

8-16 million women are navigating the perimenopausal transition in the U.S. at any given time (*Menopause Society*)

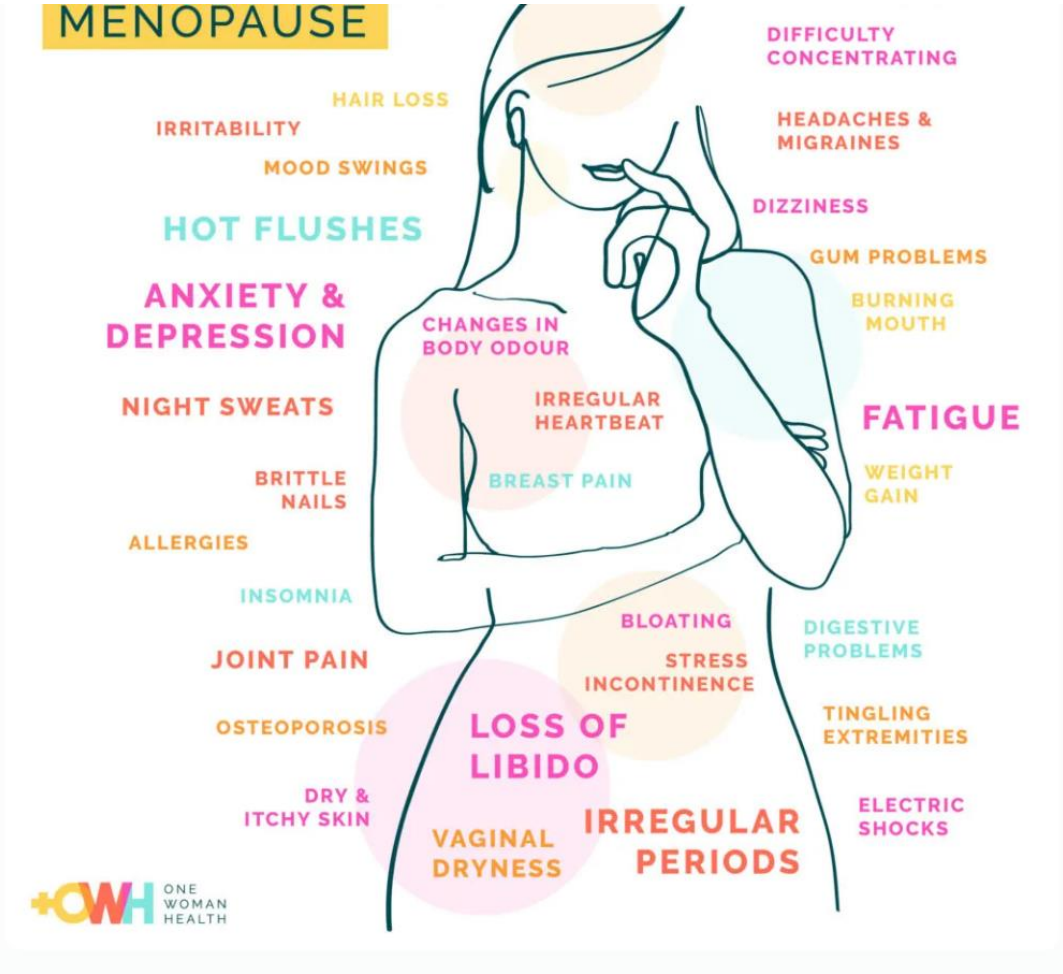


Image credit: One woman health

National Institute on Aging
The Menopause Society

Physiological Changes in Perimenopause and Beyond

- Prior to perimenopause, the female gut microbiome maintains a **highly diverse,** stable ecosystem

- Estrogen supports diverse bacterial richness and helps regulate the ***estrobolome****- which is the specific collection of microbes responsible for metabolizing and recycling estrogen*

- Perimenopause marks a ***critical*** transition in women's lives, characterized by declining estrogen levels
- Estrogen fluctuations disrupt the microbial balance in the vagina, intestine, urethra, and oral cavity, contributing to heightened disease risk
- Menopause is also closely linked to a spectrum of health issues

The Role of the Gut Microbiome in Female Health

Breast cancer and the gut microbiome
A decrease in gut microbiota diversity and an increase in *Clostridiales*

Menopause and the gut microbiome
Marked difference in the gut microbiomes and their metabolites in premenopausal and postmenopausal women; The gut microbiota has been implicated in obesity, breast cancer, Alzheimer's disease, bone-related diseases, and skeletal muscle synthesis in postmenopausal women

Cervical cancer and the gut microbiome
Marked differences in α and β diversity were observed between healthy women and cervical cancer patients. Patients had increased *Proteobacteria, Prevotella, Porphyromonas,* and *Dialister* but lower *Bacteroides, Alistipes,* and members of the *Lachnospiracea*

Ovarian cancer and the gut microbiome
While the effects of chemotherapy need to be investigated, an increase in *Prevotella* regardless of platinum sensitivity is reported

Healthy female gut microbiome
A lower *Bacteroides* abundance but higher α diversity than males

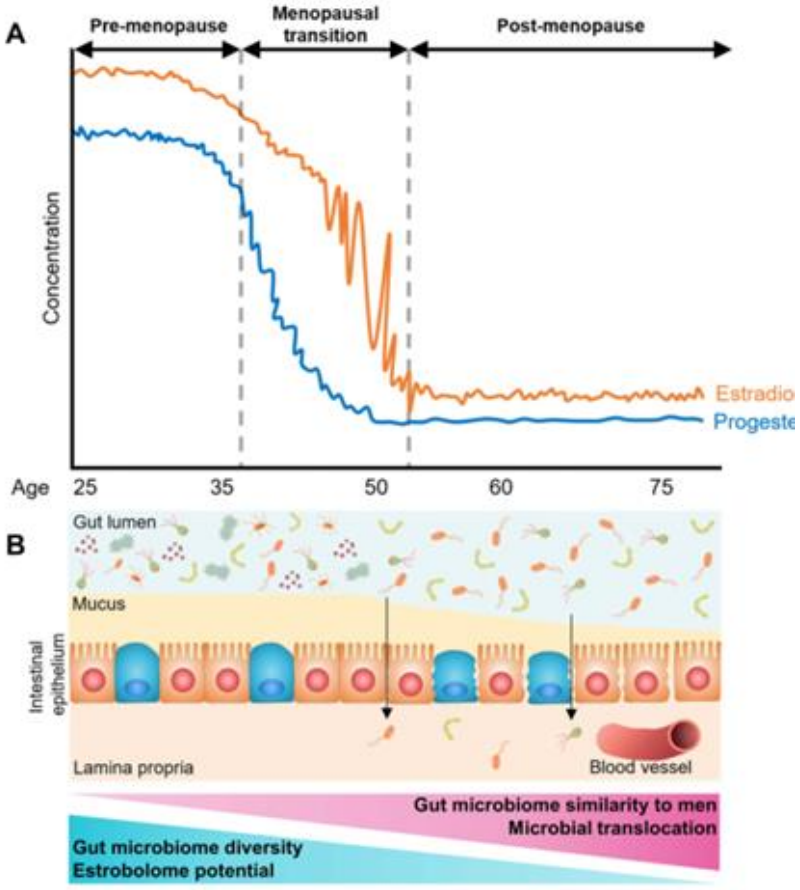
Menstruation and the gut microbiome:
Little is known about the relationship between the gut microbiota and menstrual cycle. However, menstruation has been shown to influence vaginal and oral microbiome

Pregnancy and the gut microbiome:
Marked alterations in the microbial profile of the gut microbiome during the progression of pregnancy such as an increase in *Actinobacteria*, *Proteobacteria* and opportunistic pathogens, and a decrease in SCFA producers and in overall species richness

PCOS and the gut microbiome:
PCOS patients have a less diverse gut microbiome and compositional differences. *Bacteroides vulgatus, Firmicutes, streptococcus,* and the ratio of *Escherichia/Shigella* are increased in PCOS patients. Conversely, *Tenericutes ML615J-28, Tenericutes 124-7, Akkermansia, Ruminococcaceae,* and *Bacteroidetes S24-7* were reduced

Siddiqui R, et al. *Biology* 2022

Summary of Changes in the Human Gut Microbiome Related to the Menopausal Transition



- Declines in estradiol and progesterone during the menopausal transition contribute to changes in the gut microbiome and gut epithelium during menopause.
- With declining hormones, the diversity of the gut microbiome and estrobolome potential is reduced and microbiome composition becomes more similar toe men.
- Hormone declines also lead to permeability of the gut barrier; allowing microbial translocation to occur

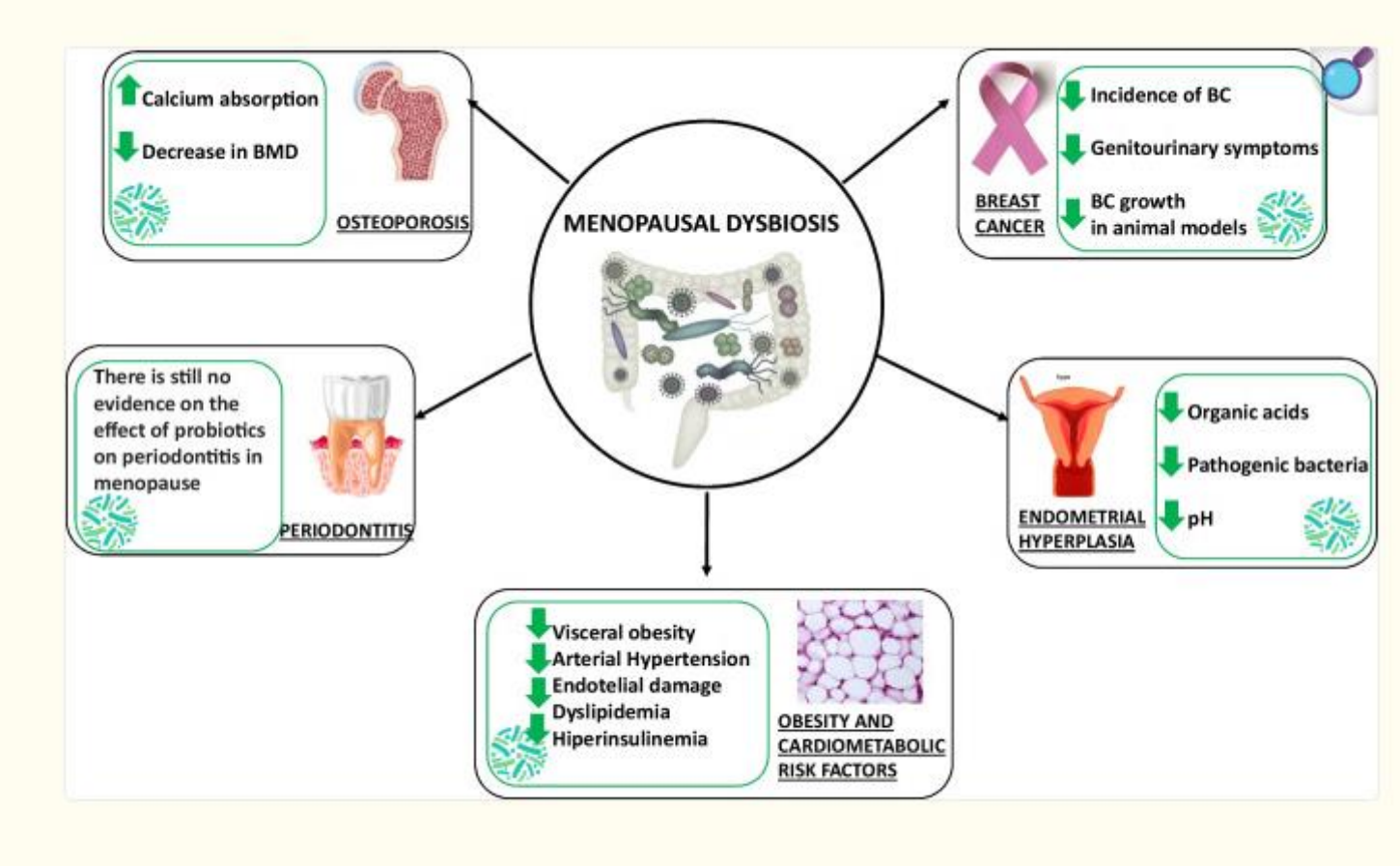
Peters B.A. *Intl J Women's Health* 2022

The Changing Microbiome Before and After Menopause

Microbiome Site	Changes in the Microbiome before/after menopause	Health Effects	Intervention Measures and Principles
Gut	Estrogen induced shifts in richness, diversity, Firmicutes-Bacteroides ratio and short-chain fatty acid production	Impairs intestinal function, absorption, and immune regulation in menopausal women	Optimize diet & lifestyle (fiber-rich, supplement with prebiotics, probiotics, exercise, avoid antibiotics)
Duodenal	Postmenopausal women (non-hormone therapy users) have more Proteobacteria and less Bacteroidetes	Association with increased risk for CVD, chronic inflammation, and metabolic dysfunction	Hormone therapy to restore beneficial flora, dietary supplementation to modulate flora and reduce inflammation
Vaginal	Microbial shift in vaginal flora pre-and post menopause	Increased risks of vaginal, urethral and systemic diseases	Topical estrogen and probiotic use for vaginal microecology regulation
Oral	Oral microbiome changes from pre- to post-menopause	Periodontitis symptoms, oral microbiome imbalance and systemic health risks.	Improving oral health, microbiome balance through proper diet

Lin et al. *BioMed Engineer* 2025

Dysbiosis and Menopause-Related Diseases



Barrea L, et al. *Curr Nutr* Rep 2023

Prebiotics and the Menopausal Transition

Promising and rapidly evolving science

Certain prebiotic types can improve:

✓Gut microbiota composition

✓Bone health through calcium absorption

✓Support metabolic health

✓Modulate immune function and strengthen

the gut barrier

Best studied prebiotics include:

- Inulin
- Chicory root fiber
- FOS
- GOS

Other prebiotic types also have potential

Hee K, et al. 2004
Dietary Fiber.org

Probiotics and Menopause-Related Diseases

Limited evidence so far, BUT probiotic supplementation in postmenopausal women could represent a feasible and safe strategy to manage menopausal-related diseases

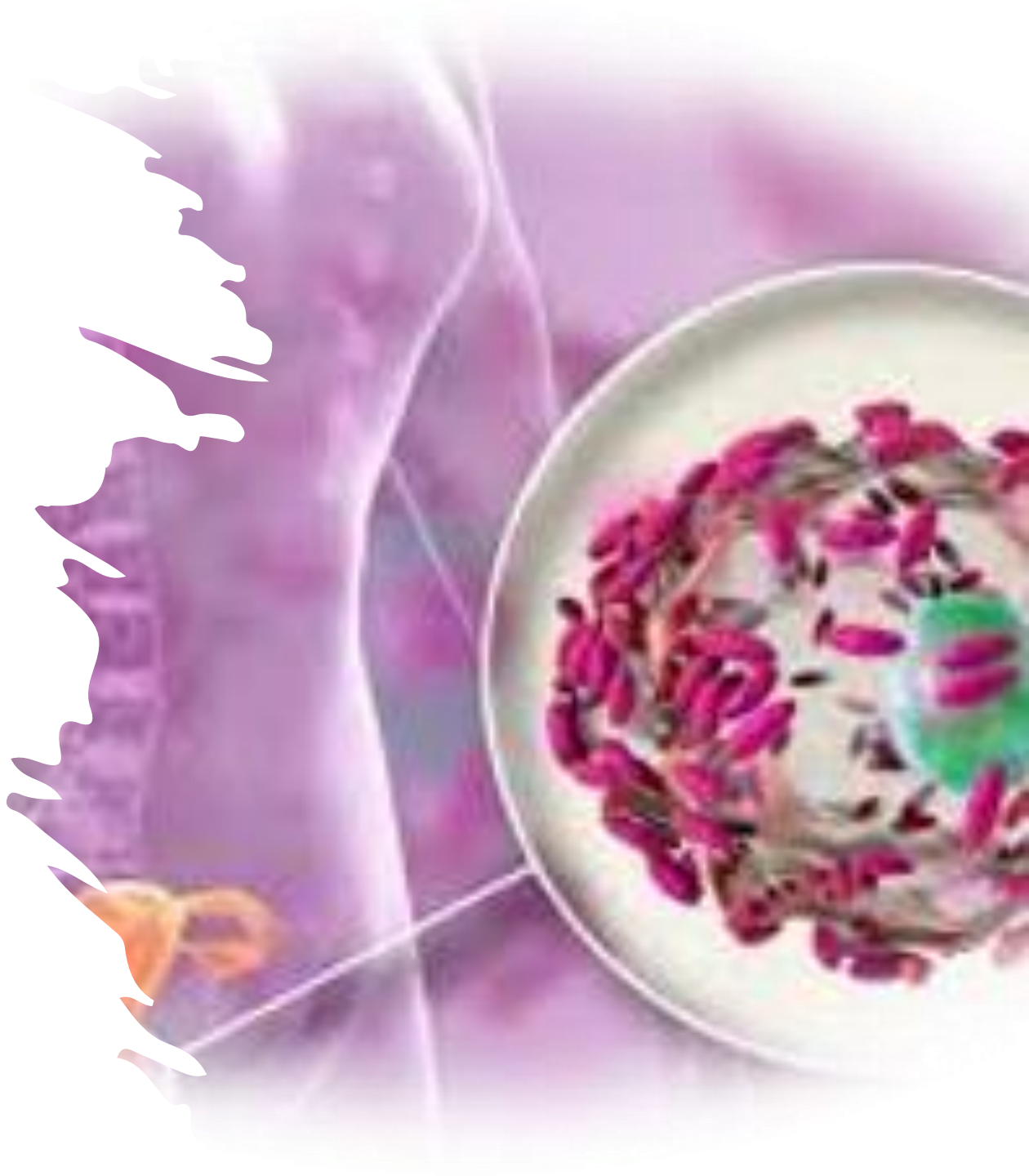
Promising candidates:

- *Lactobacillus spp. casei, helveticus, rhamnosus, and reuteri* may have pleiotropic effects on health by:
- Increasing intestinal Ca absorption and reducing a further decrease in BMD in women with osteoporosis
- Improving insulin resistance

Barrea L, et al. *Curr Nutr* Rep 2023

Key Takeaways

- ✓ Menopause is more than a hormonal transition, it also includes shifts in the microbiome
- ✓ Estrogen and the gut microbiome are closely connected
- ✓ Microbial diversity declines during menopause
- ✓ Nutrition can be a powerful tool to help with the transition
- ✓ The science on pre and probiotics is evolving



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