

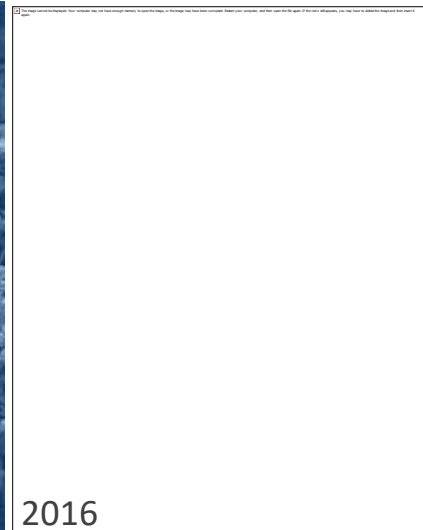
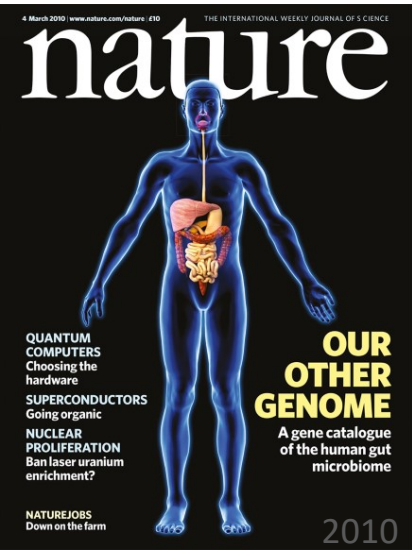
# Role of Human Microbiome in Health and Diseases

**Bhabatosh Das, MSc, MTech, PhD**

**Microbial Research Centre**

**BRIC-THSTI, Faridabad**

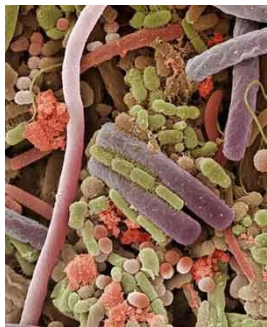




# What do we know about the human microbiome?

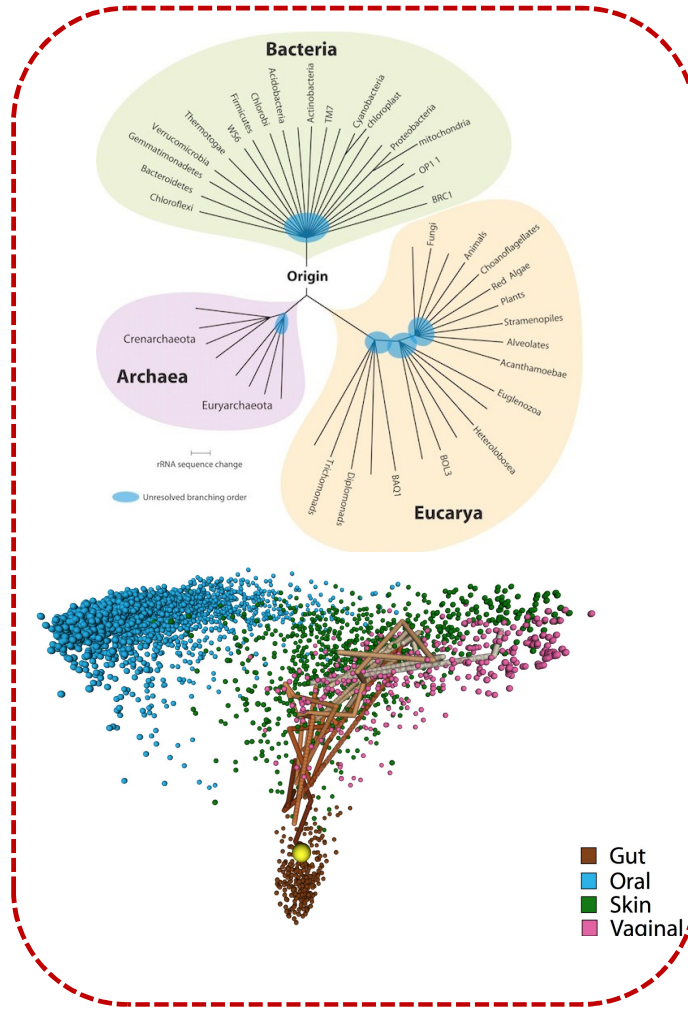


~ $3.0 \times 10^{13}$  Germ+Somatic cells



~ $3.8 \times 10^{13}$  Microbiota

Sender et al. *Cell*. 2016

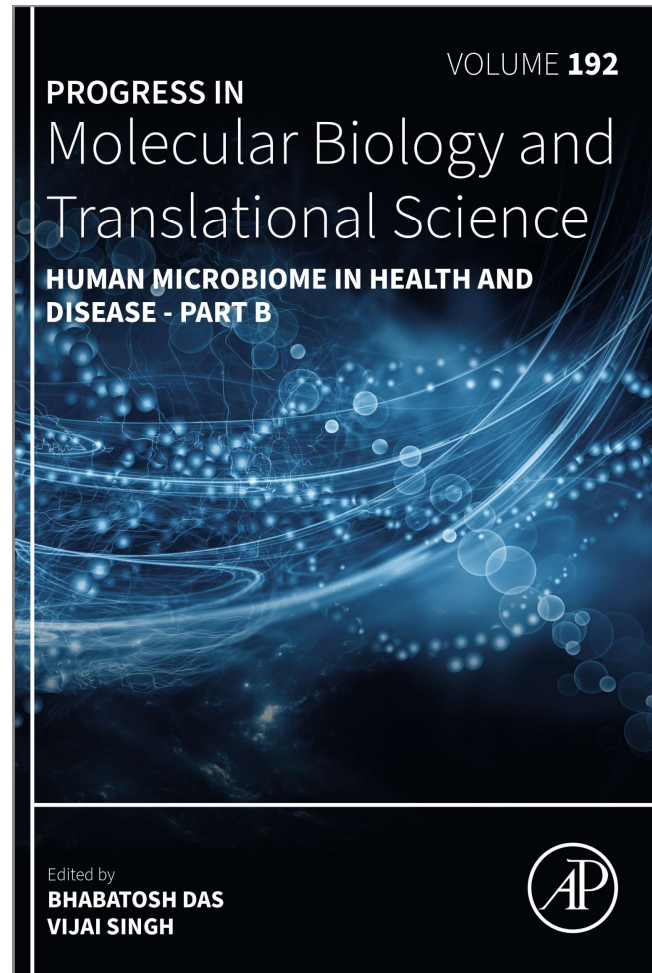
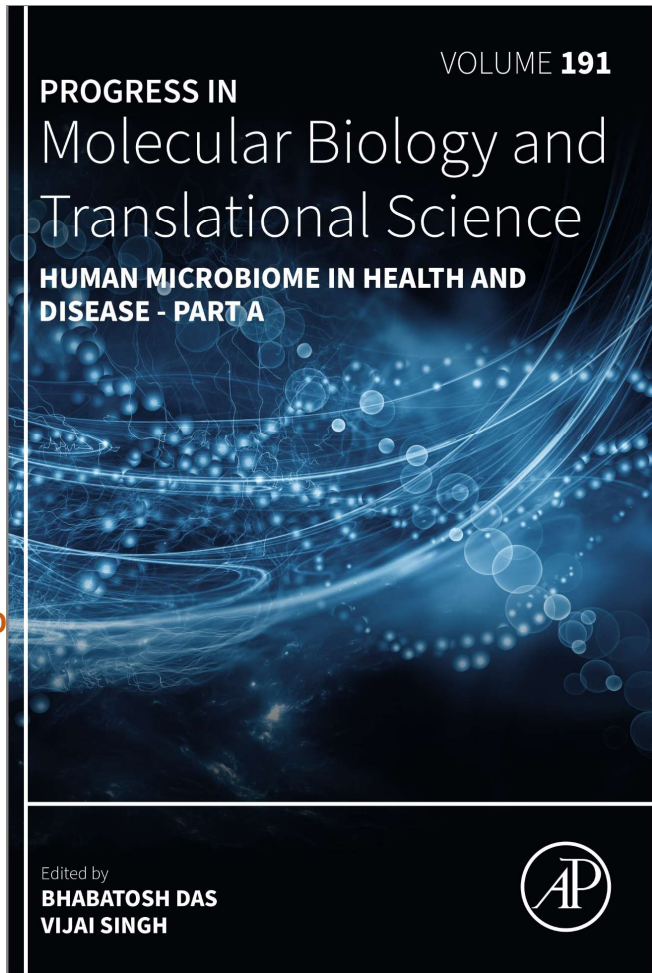


HMP, *Nature*. 2012

Body Site	Microbial load
Oral cavity	$10^{12}$ (T)
Stomach	$10^2$ /ml
Duodenum	$10^4$ /ml
Jejunum	$10^5$ /ml
Ileum	$10^8$ /ml
Colon	$10^{11}$ /ml
Nasal cavity	$10^3$ /ml
Oropharynx	$10^6$ /ml
Lungs	$10^2$ /ml
Reproductive Tract	$10^9$ /ml
Breast Milk	$10^9$ /L
Skin	$10^{11}$ (T)

Das B, 2022, *Prog. Mol. Biol. Tran. Sci*

# Human Microbiome in Health and Disease



## Volume 191

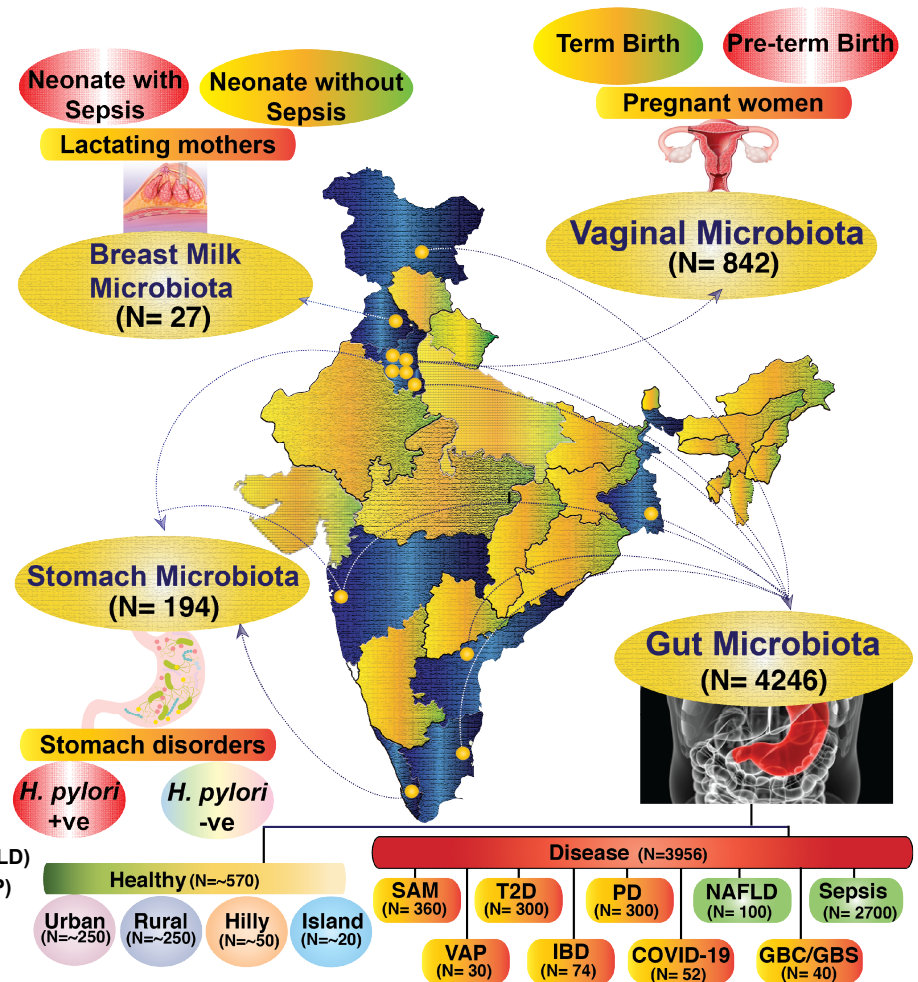
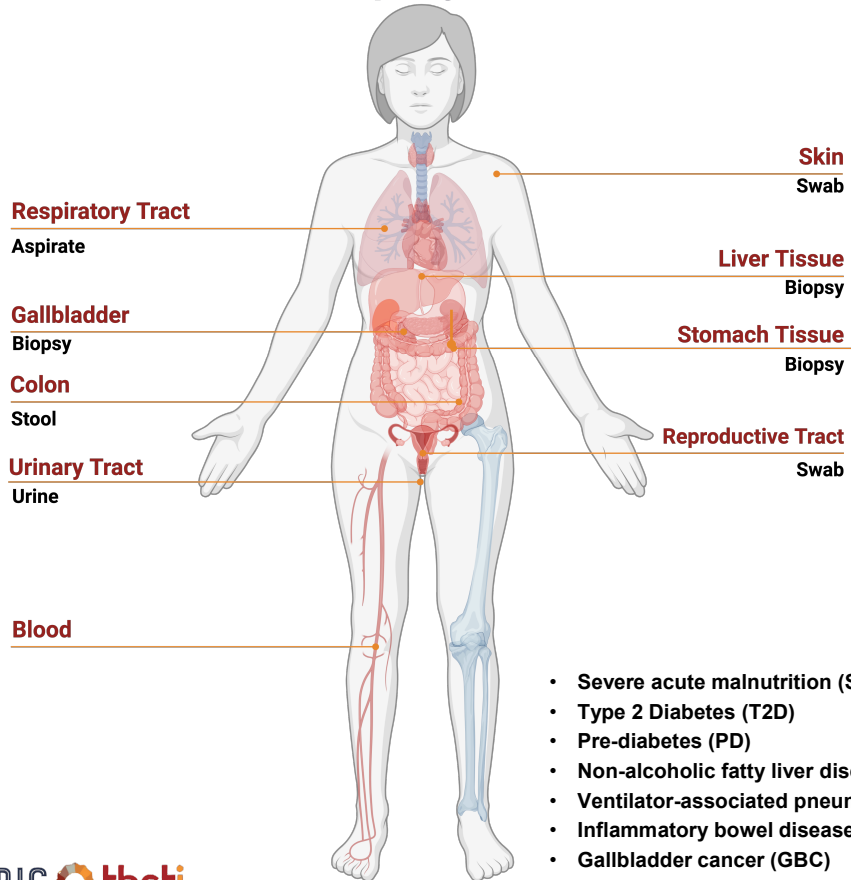
- **Human Microbiome**
- **Tools for Mb Study**
- **Diversity of HMb**
- **Cancer & HMb**
- **Gut Mb & GI Dis**
- **Microbiome & NCD**
- **Microbiome & T2D**
- **Microbiome & NAFLD**
- **Mb & Drug Metab.**
- **Mb & Therapeutics**

## Volume 192

- **Microbiome & AMR**
- **Stomach Mb & *H. pylori***
- **Resp. Mb & Pneumonia**
- **Gut Mb & Sepsis**
- **Gut Mb & Diarrhoea**
- **Gut Mb & IBD**
- **Gut Mb & SAM**
- **Microbiome & CVD**
- **Microbiome & PKD**
- **Vaginal Mb & PTB**

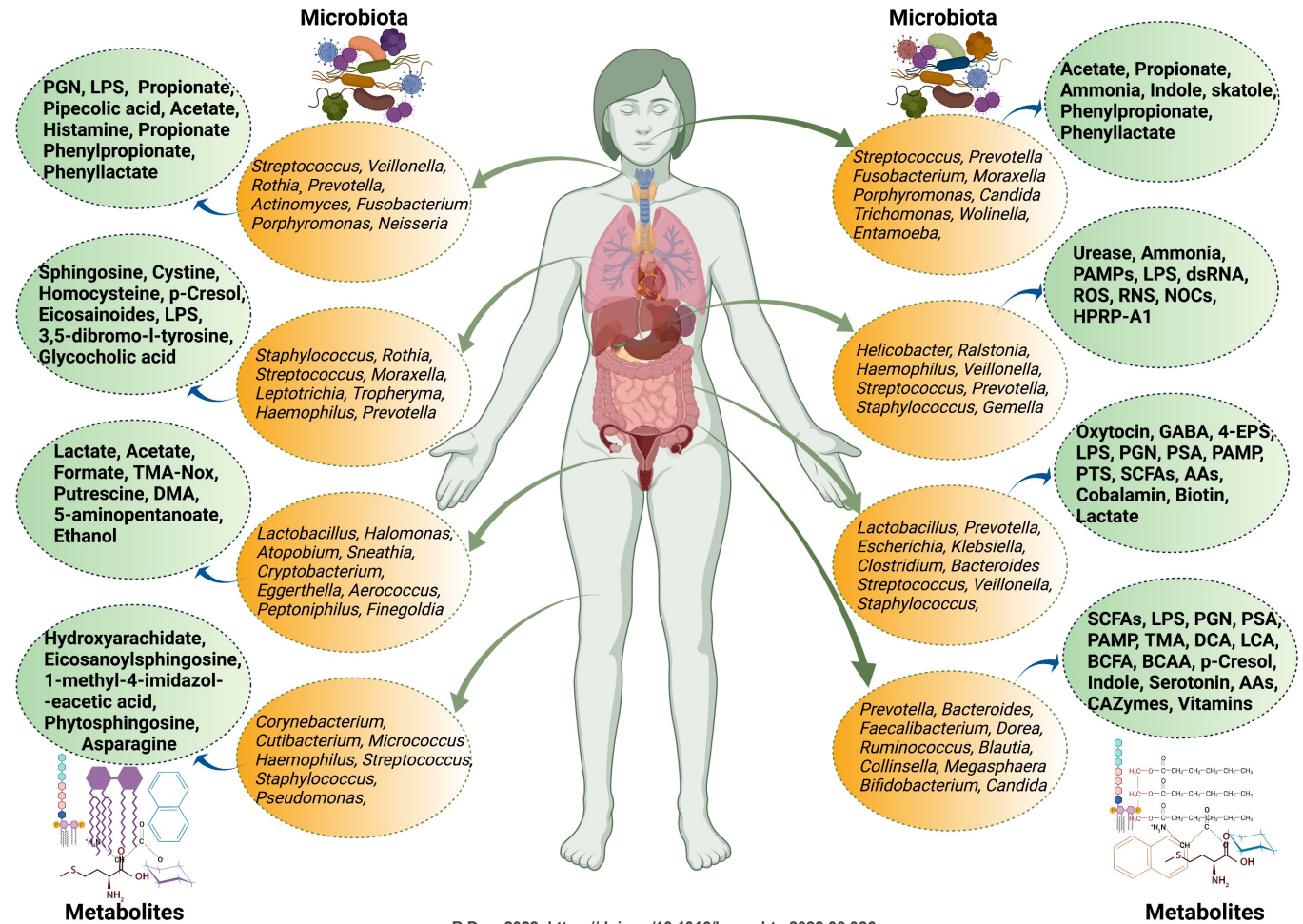
# Microbiome composition and diversity in the Indian Population

## Sampling Sites



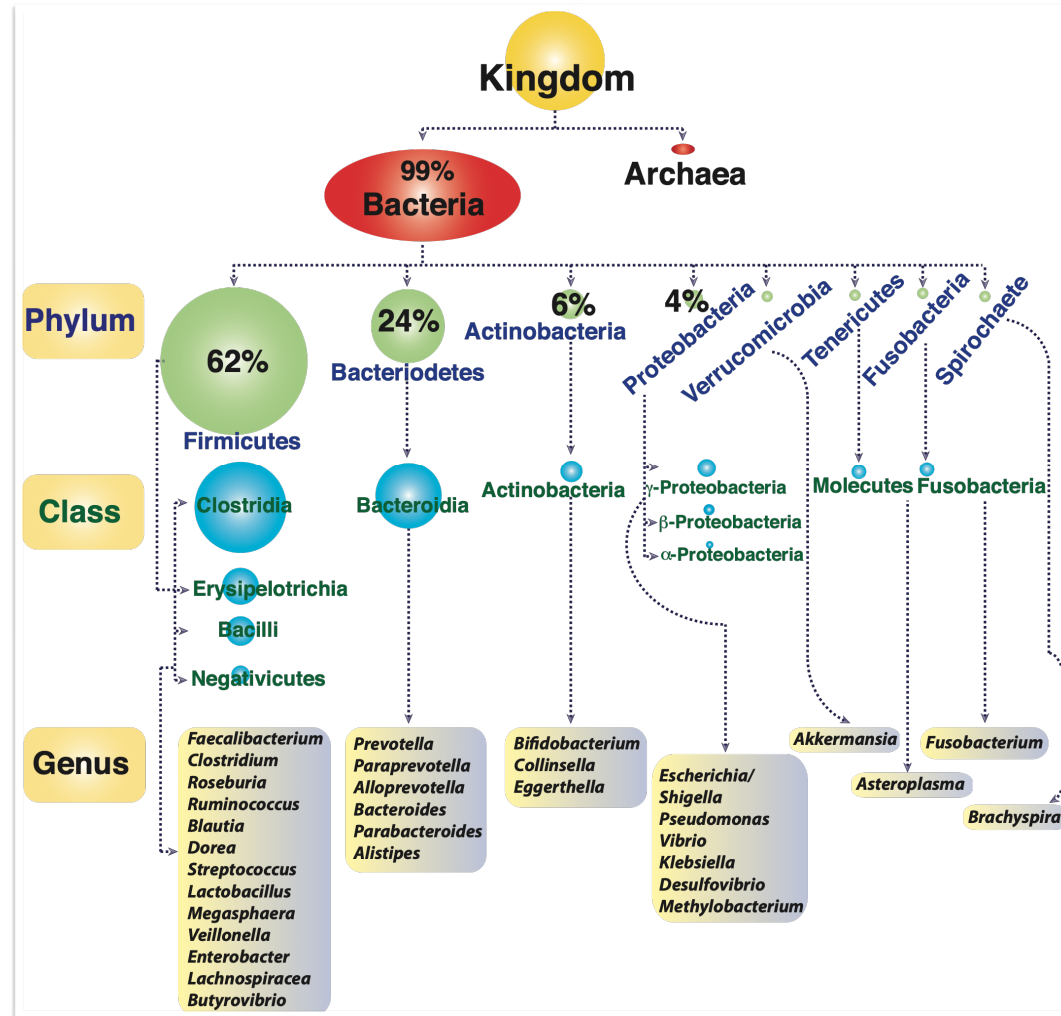
# Current understanding of human microbiome

Body Site	Microbial load
Oral cavity	$10^{12}$ (T)
Stomach	$10^2$ /ml
Duodenum	$10^4$ /ml
Jejunum	$10^5$ /ml
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Skin	$10^{11}$ (T)

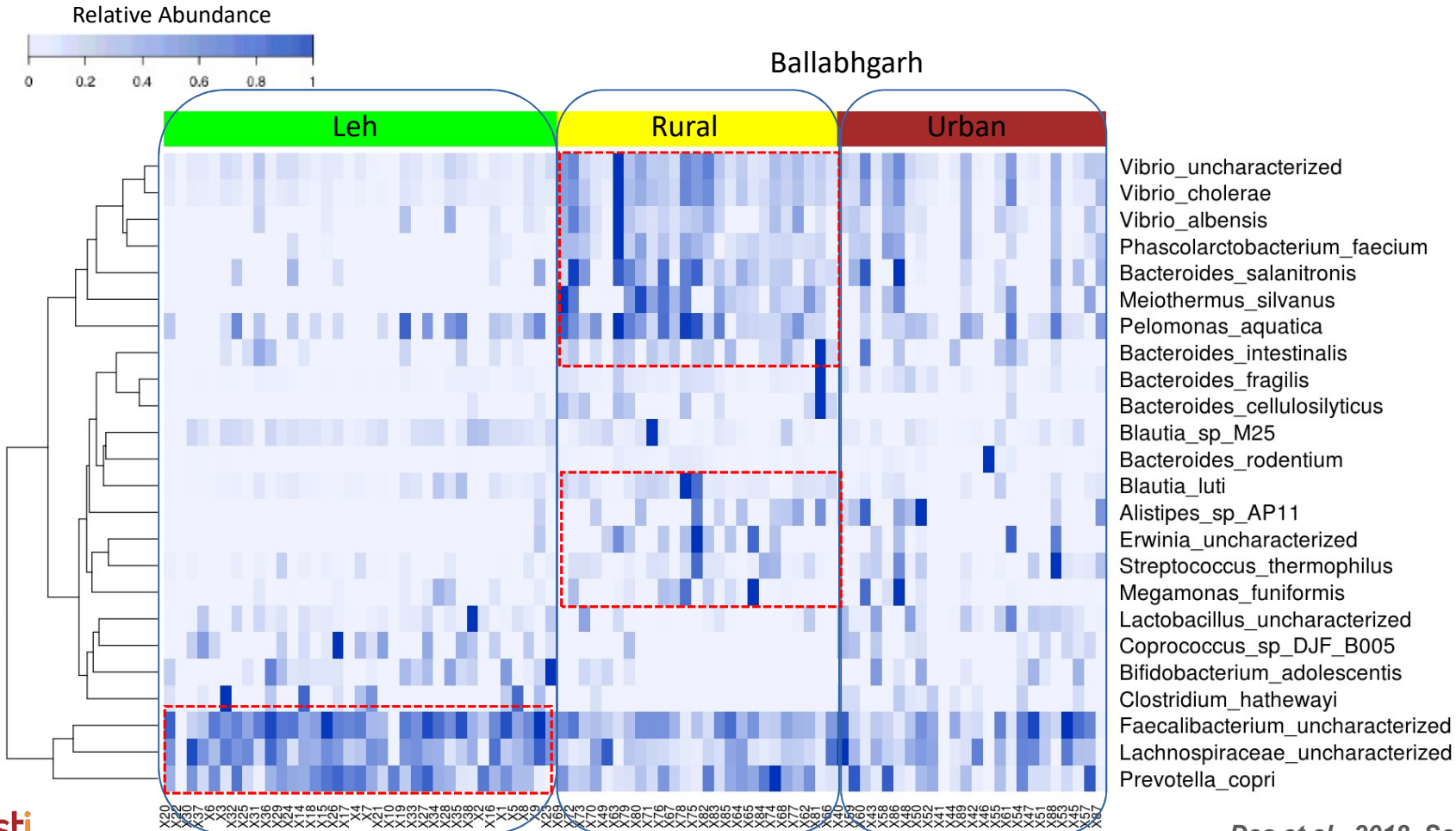


B Das, 2022, <https://doi.org/10.1016/bs.pmbts.2022.06.026>

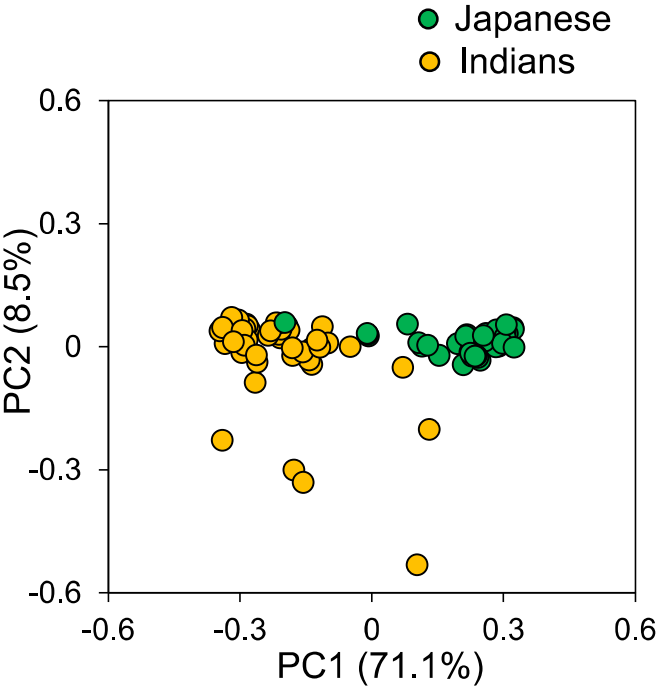
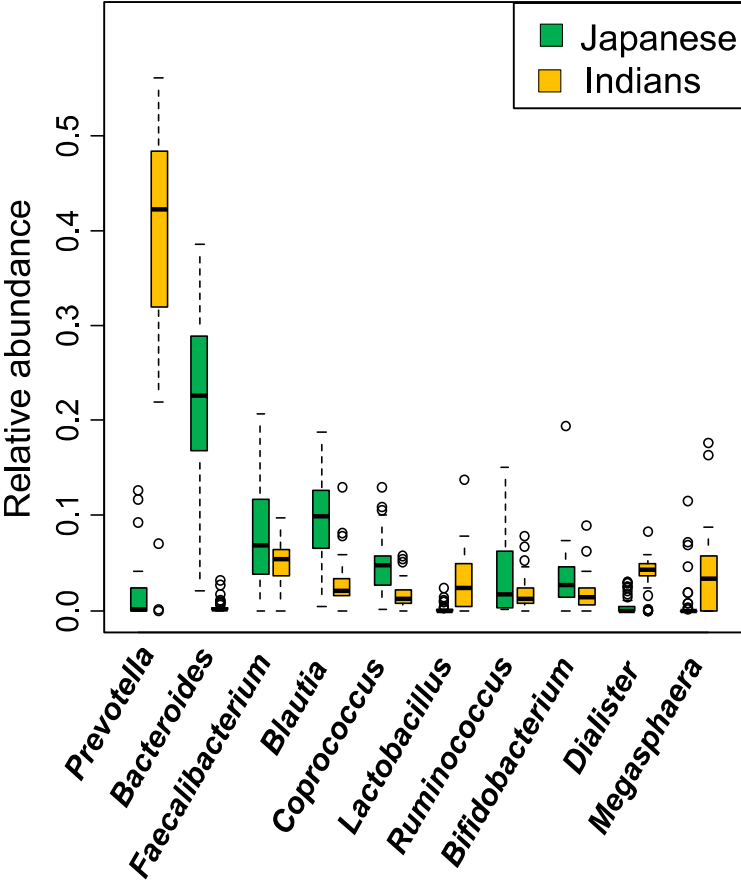
# Gut microbiome of healthy Indians (n=570)



# Urban and Rural Indians Harbor Distinct Gut Microbial Communities

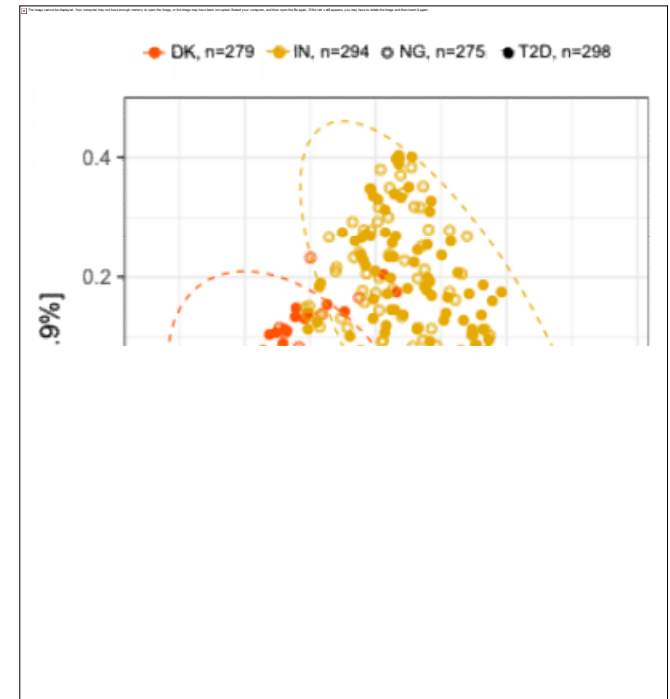
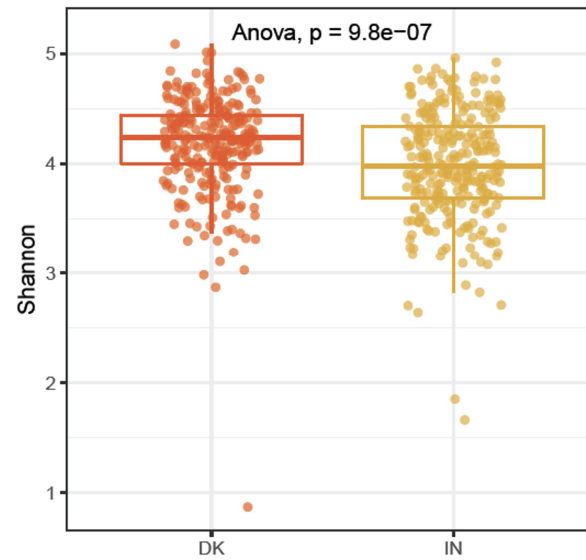
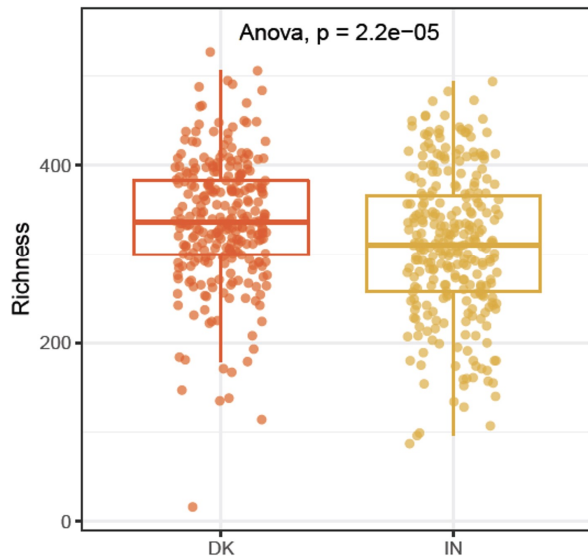


# Geographic Variation in Gut Microbial Communities: Japan and India

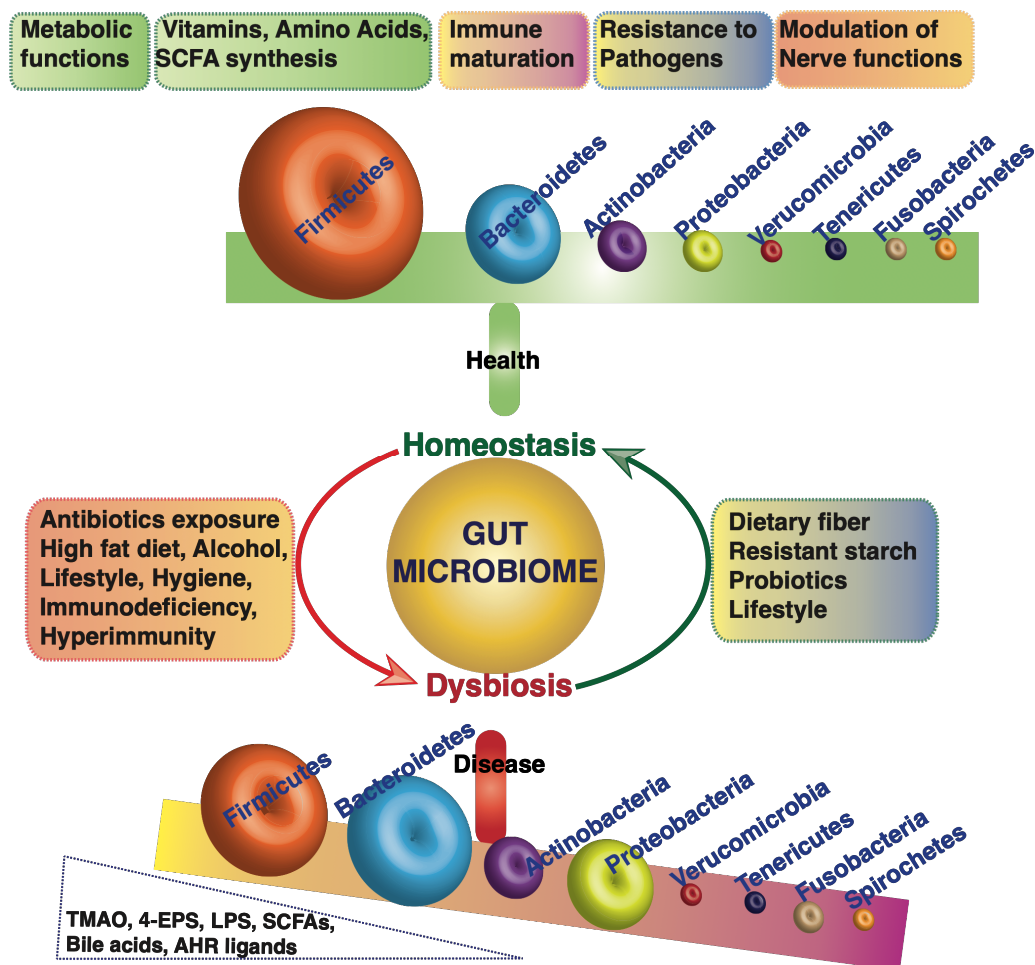


# Geographic Variation in Gut Microbiota

Danish Gut Microbiota (n=279) Indian Gut microbiota (n=294)



# Homeostasis and Dysbiosis of Human microbiome



# Microbiome dysbiosis and health disorders

## Brain and Nervous System diseases

- Appetite disorders
- Parkinson disease
- Alzheimer disease
- Multiple sclerosis
- Anxiety
- Depression
- Autism
- Stress
- Addiction

## Liver Diseases

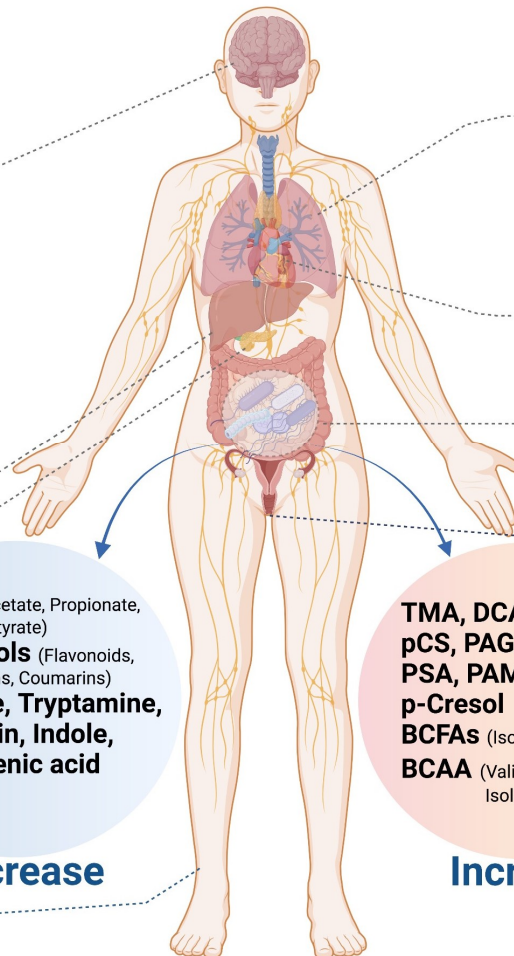
NAFLD/NASH  
ALD, PBC, PSC  
Cirrhosis  
Hepatocellular  
Carcinoma

## Endocrine Diseases

Diabetes (T1D, T2D)

## Skin Diseases

Psoriasis, Eczema  
Dermatitis, Melanoma  
Wound infection



## Respiratory Diseases

Allergy/Asthma  
Tuberculosis,  
Pneumonia,  
Cystic fibrosis

## Cardiovascular Diseases

Atherosclerosis  
Stroke  
Heart Attack

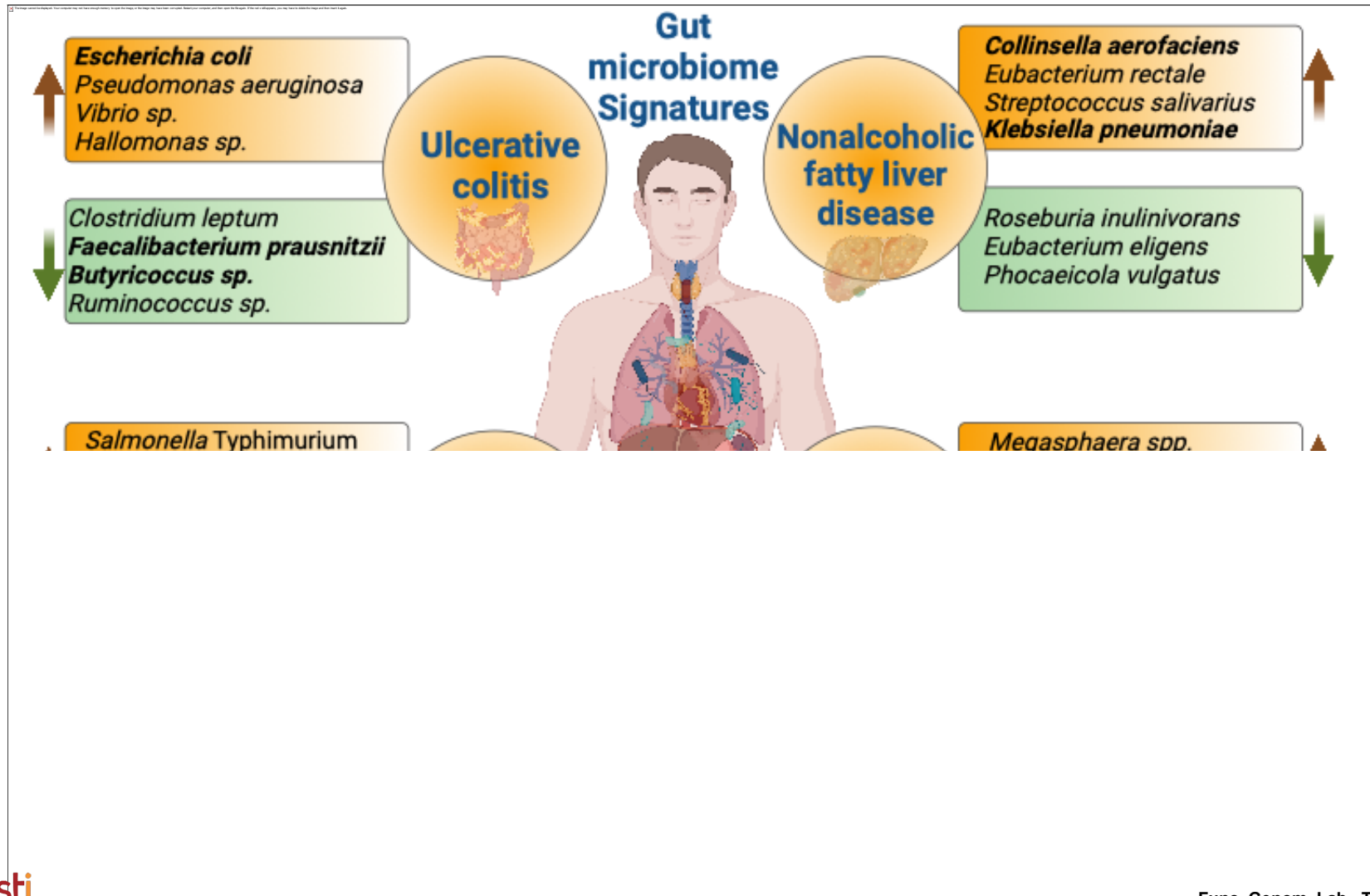
## Gastrointestinal Diseases

IBD/IBS/Colitis  
Ulcer, Colon Cancer  
Gastritis  
Diarrhoea  
Celiac Disease  
Malnutrition  
Obesity

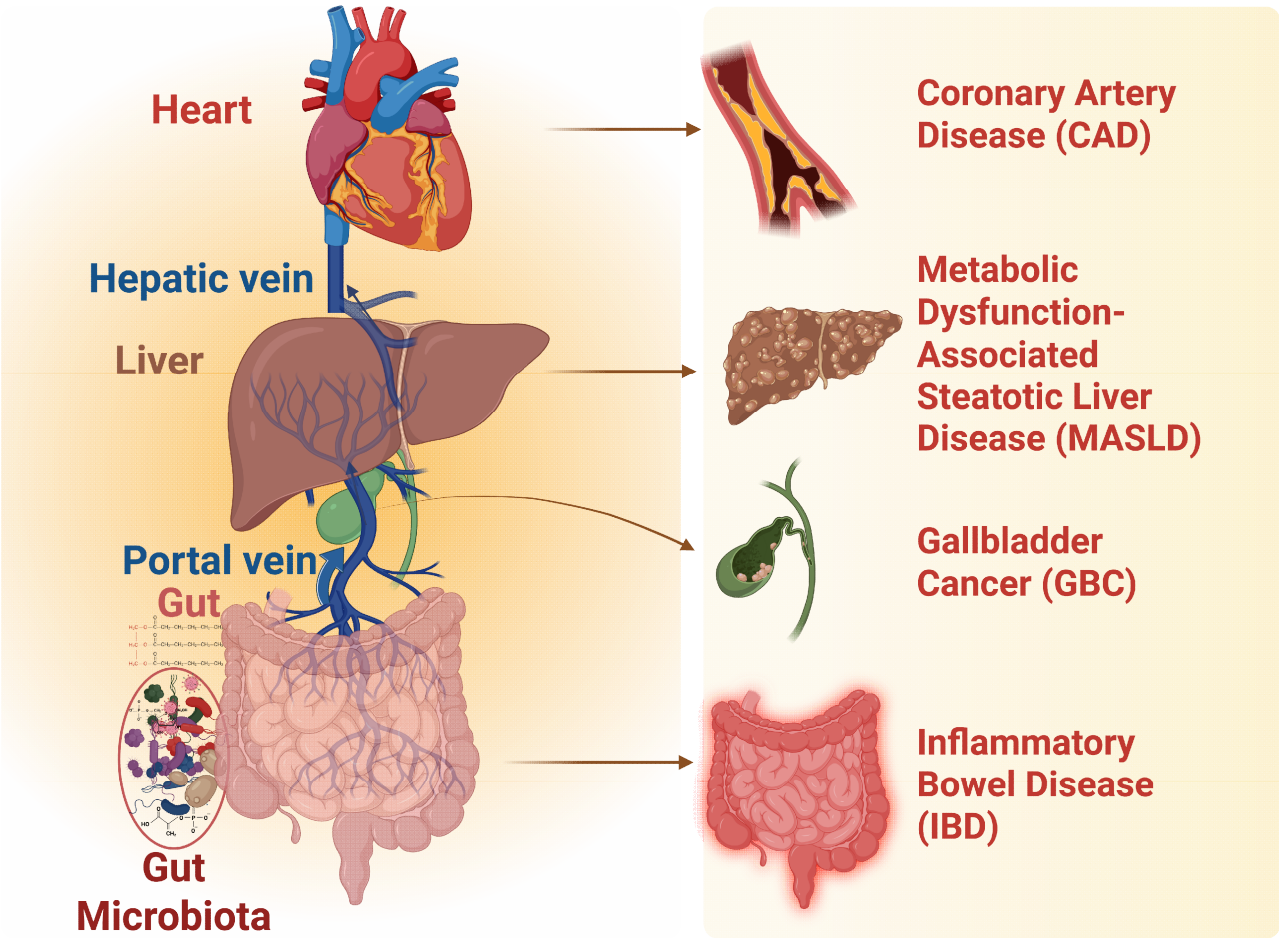
## Urinary and Reproductive Diseases

Preterm Birth  
Fetal Development  
Bacterial Vaginosis  
UTI

# Association

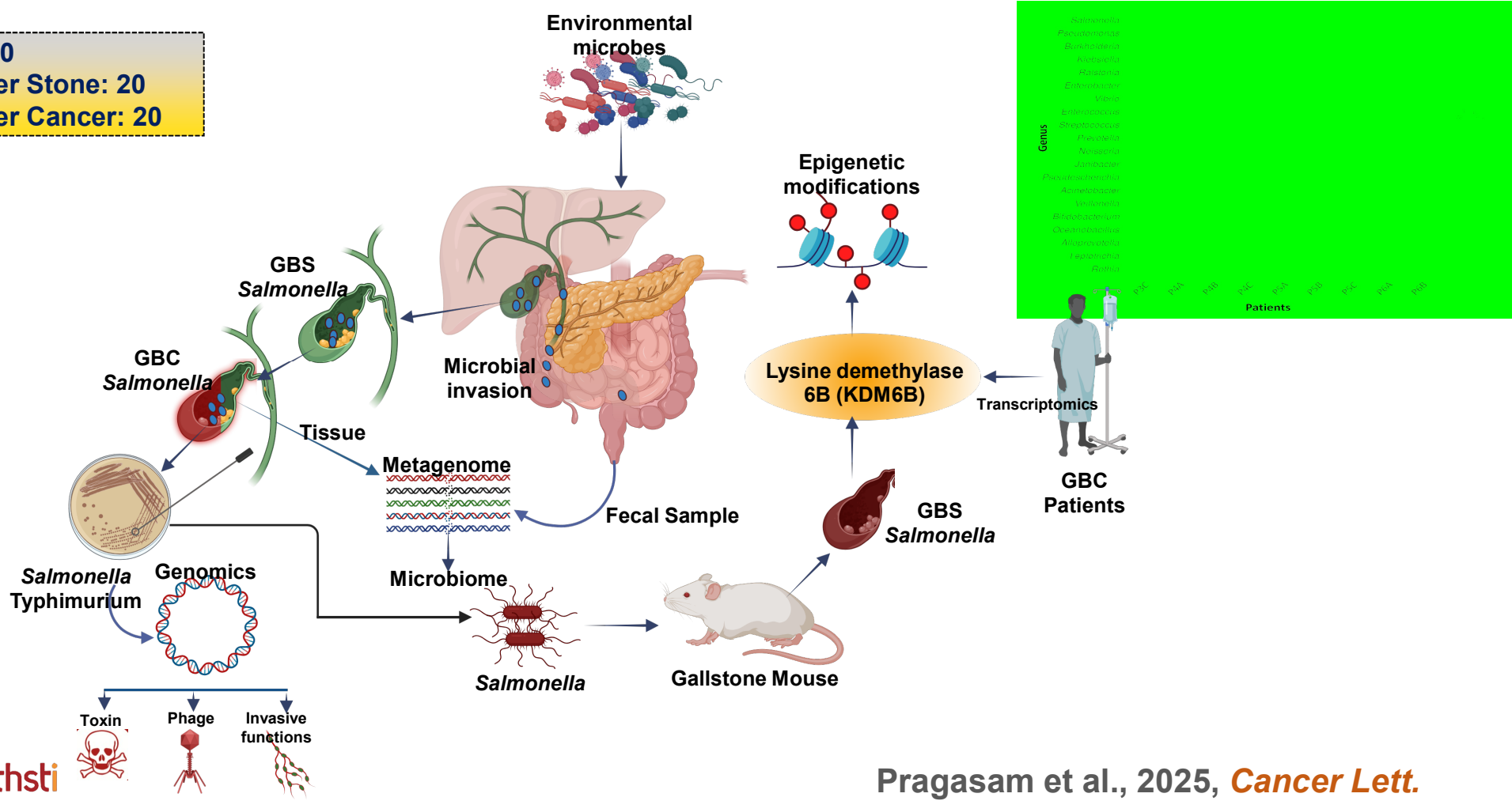


# Which microbial functional losses or gains precede disease onset?



# Chronic Salmonella colonization in gut Contributes to GBC

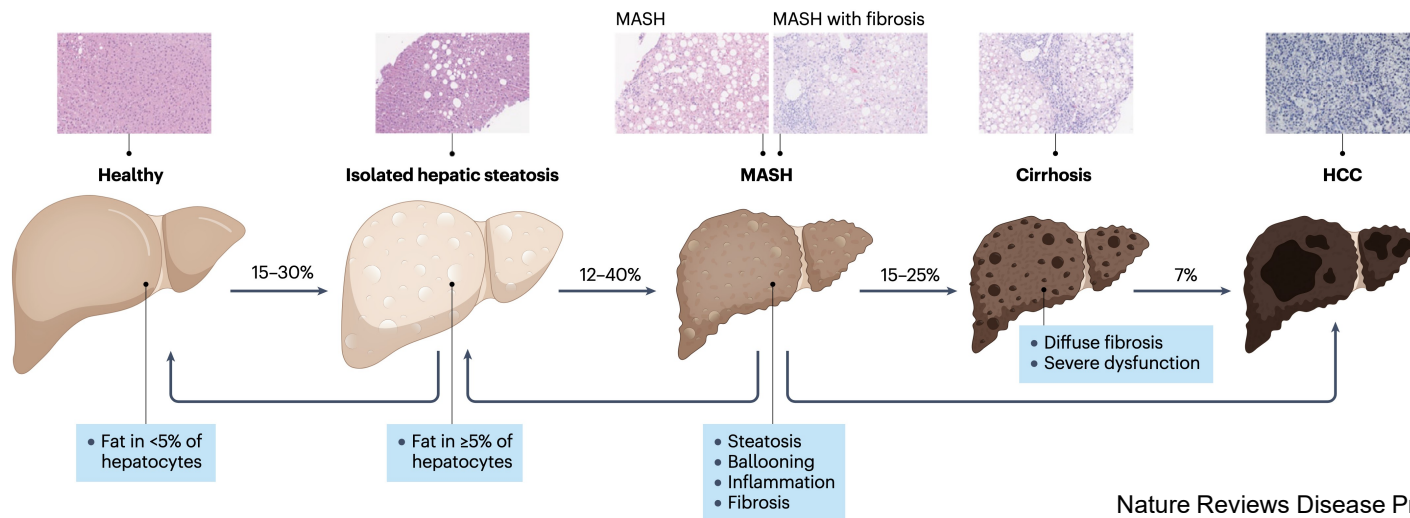
Healthy: 50  
 Gallbladder Stone: 20  
 Gallbladder Cancer: 20



Pragasam et al., 2025, *Cancer Lett.*

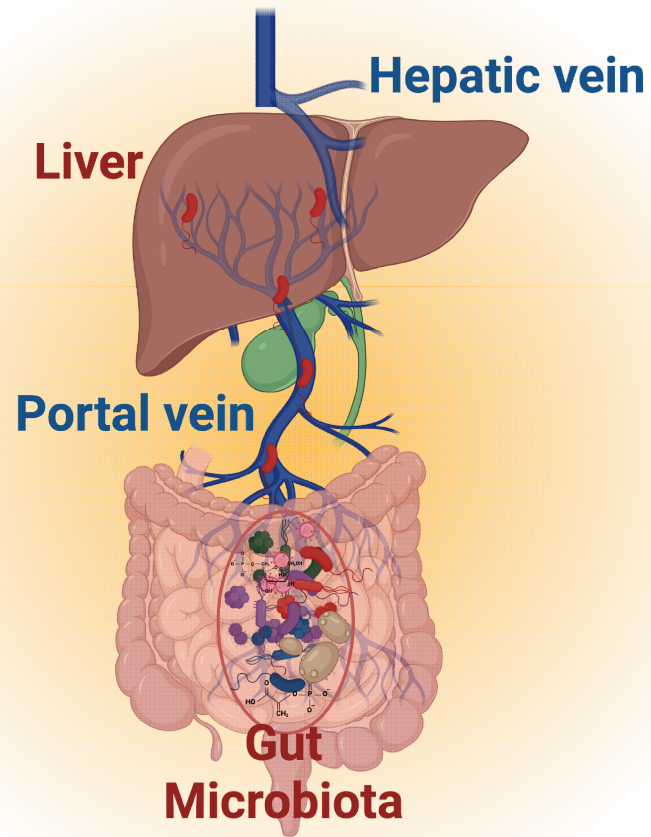
# Metabolic dysfunction-Associated Steatotic Liver Disease (MASLD)

MASLD is a **chronic liver disease** characterized by **hepatic steatosis** in individuals with at least one **cardiometabolic risk factor** in the absence of significant alcohol consumption or other identifiable causes of liver fat accumulation. (Younossi et al., 2025, Gastroenterology)



**Hypothesis:** In individuals with gut barrier dysfunction or obesity, microbes can translocate from the gastrointestinal tract to the liver and contribute to MASLD progression by promoting hepatic inflammation and altering host metabolic functions

- MASLD



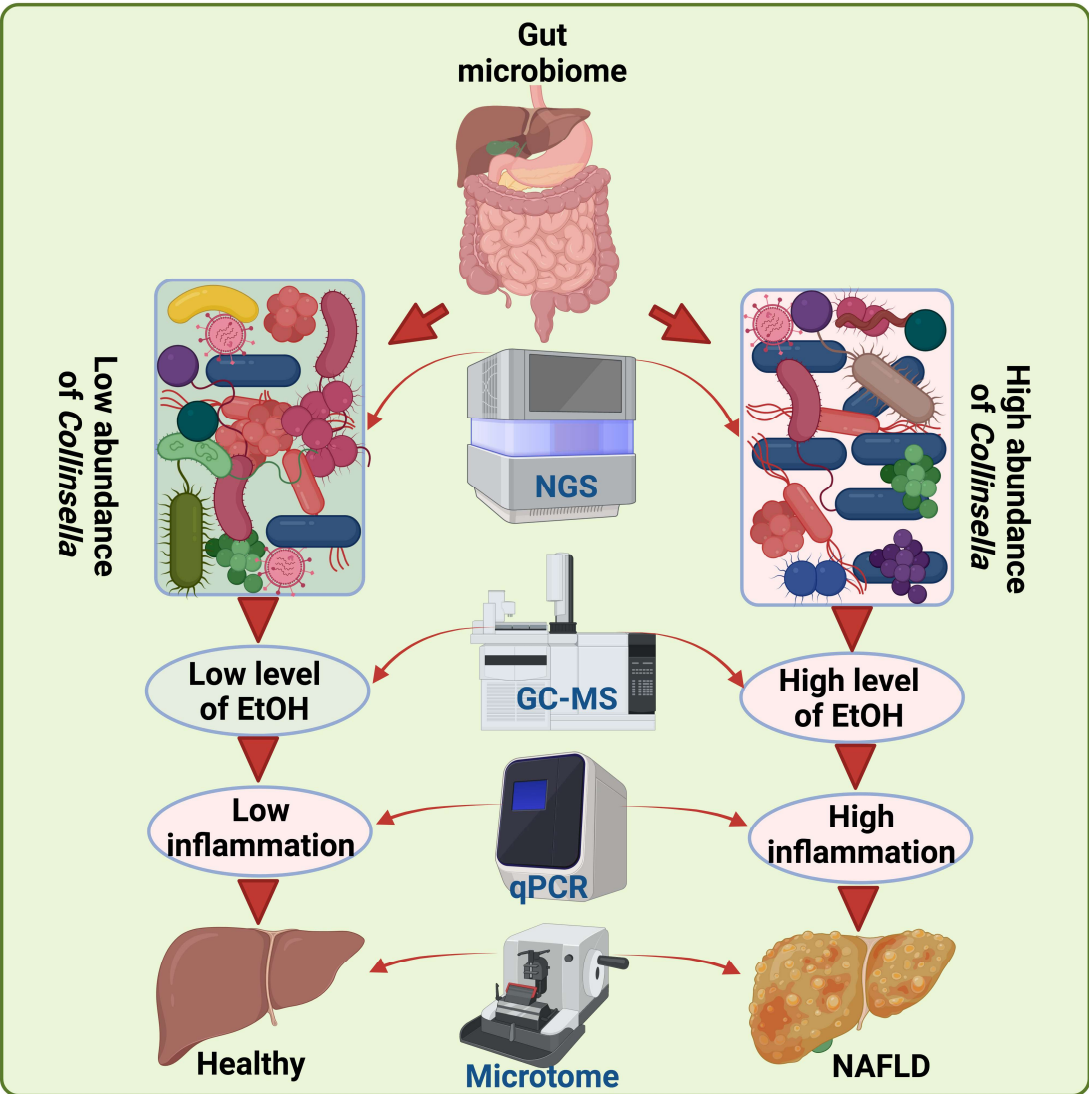
- Dysbiosis
- Invasion
- Translocation

# *Collinsella aerofaciens* linked with increased ethanol production and liver inflammation contribute to the pathophysiology of NAFLD

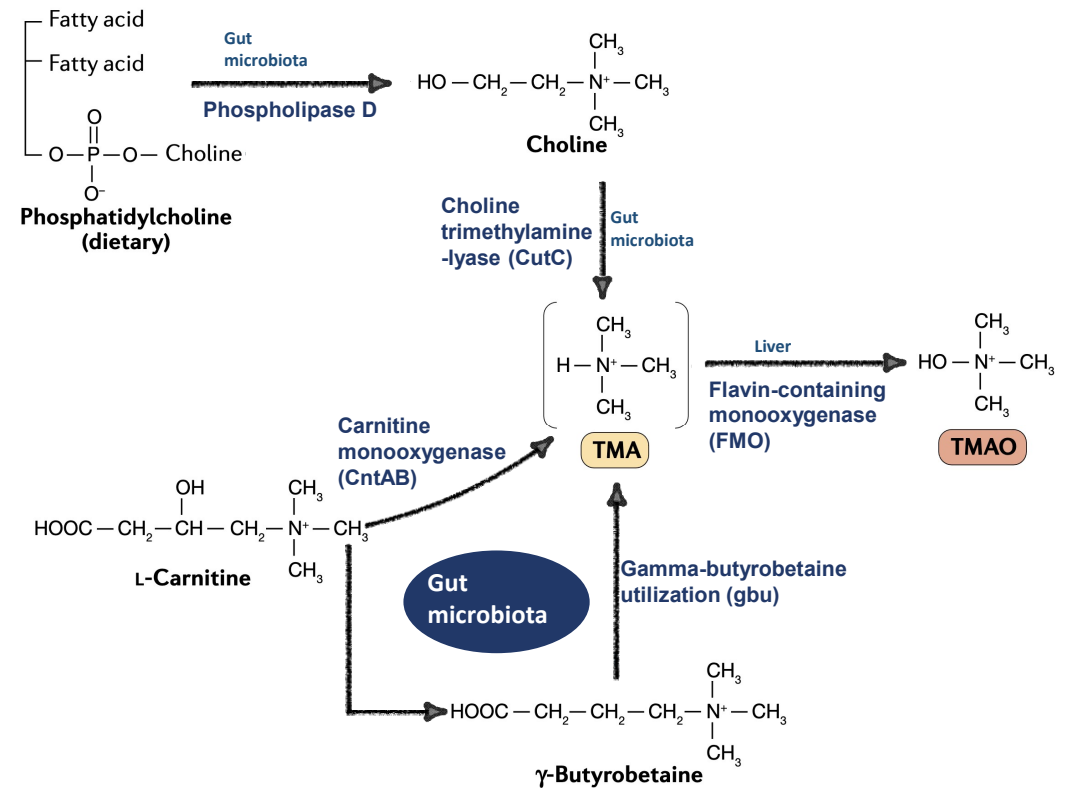
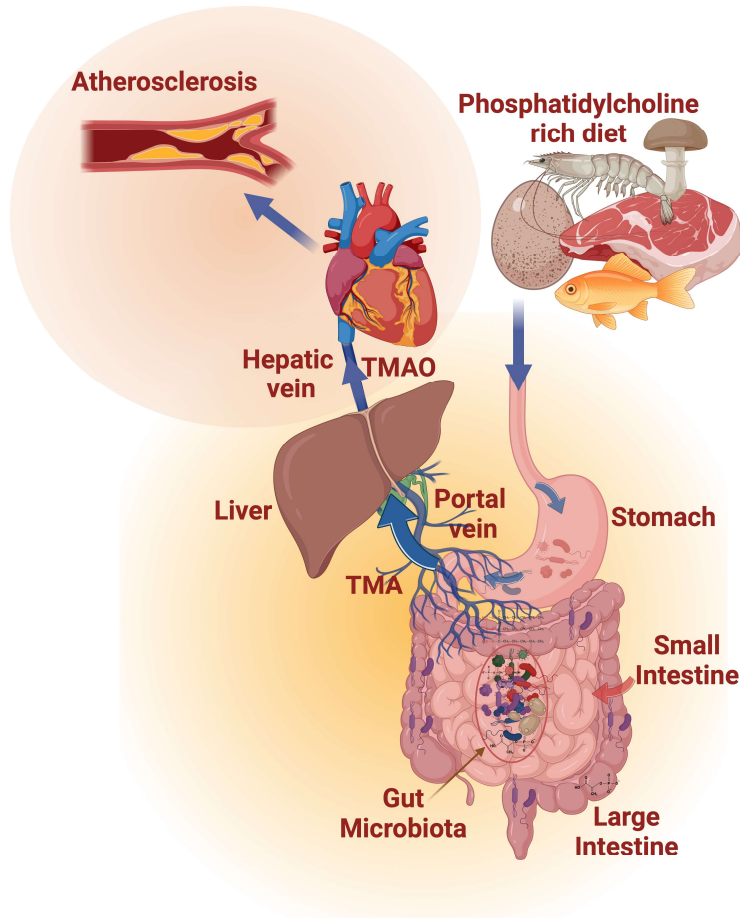
Ayushi Purohit <sup>1</sup>, Bharti Kandiyal <sup>1</sup>, Shakti Kumar <sup>1</sup>, Agila Kumari Pragasam <sup>1</sup>, Parul Kamboj <sup>1</sup>, Daizee Talukdar <sup>1</sup>, Jyoti Verma <sup>1</sup>, Vipin Sharma <sup>1</sup>, Soumalya Sarkar <sup>1</sup>, Dinesh Mahajan <sup>1</sup>, Rajni Yadav <sup>2</sup>, Riya Ahmed <sup>3</sup>, Ranjan Nanda <sup>3</sup>, Madhu Dikshit <sup>1</sup>, Sanjay K Banerjee <sup>4</sup>, Shalimar <sup>5</sup>, Bhabatosh Das <sup>1</sup>

Affiliations + expand  
PMID: 38313048 PMCID: PMC10837629 DOI: 10.1016/j.isci.2023.108764

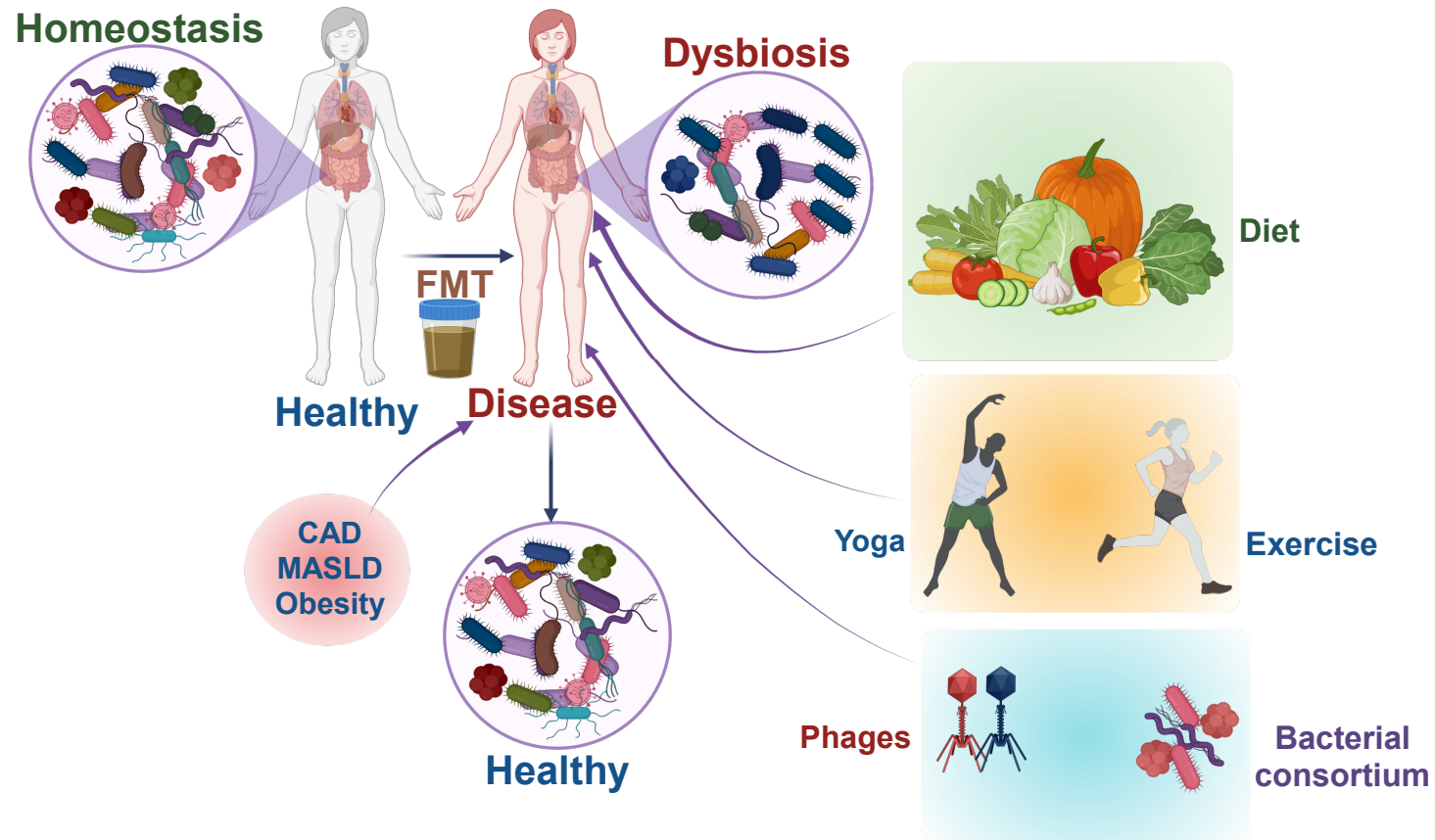
- **Healthy (n=20)**
- **Obese (n=17)**
- **NAFLD (n=10)**



# Gut microbiome, dietary metabolism of TMA and heart failure



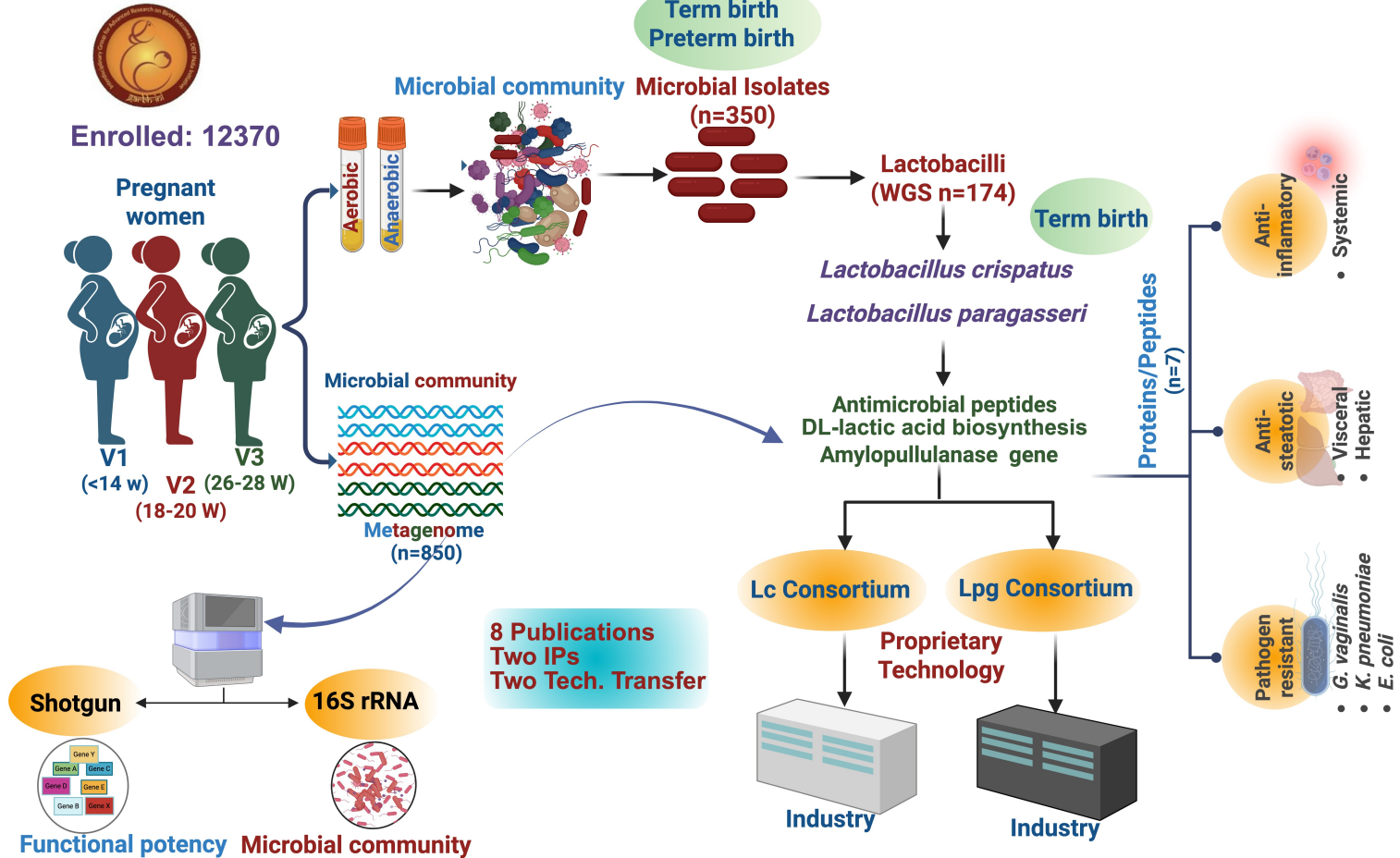
# Microbiome-Targeted Therapeutic Strategies



***Beneficial microbes that lose dominance or are **depleted in disease** may confer health benefits and represent promising candidates for therapeutic development***

# From Lab to Life: Vaginal Microbiome Insights by BRIC-THSTI

## GARBH-INi Cohort



# Widely Used Probiotics in India



**Strain: BC1**  
**Source: Vaginal isolate,**  
**Italy**



**Source: Faecal isolate, Italy**



**Strain: LJe52**  
**Source: Qinghai old yogurt,**  
**China**



**Source: Human Breast milk,**  
**(South Korea)**



**Source: Lactobacilli,**  
**Vinatura Pvt. Ltd. (USA)**



**Lactobacillus casei Shirota**  
**(Yakult, Japan)**



**L. rhamnosus GG**  
**(Culturelle, Canada)**



**VSL#3**  
**(Actial Farmaceutica Srl, Italy)**

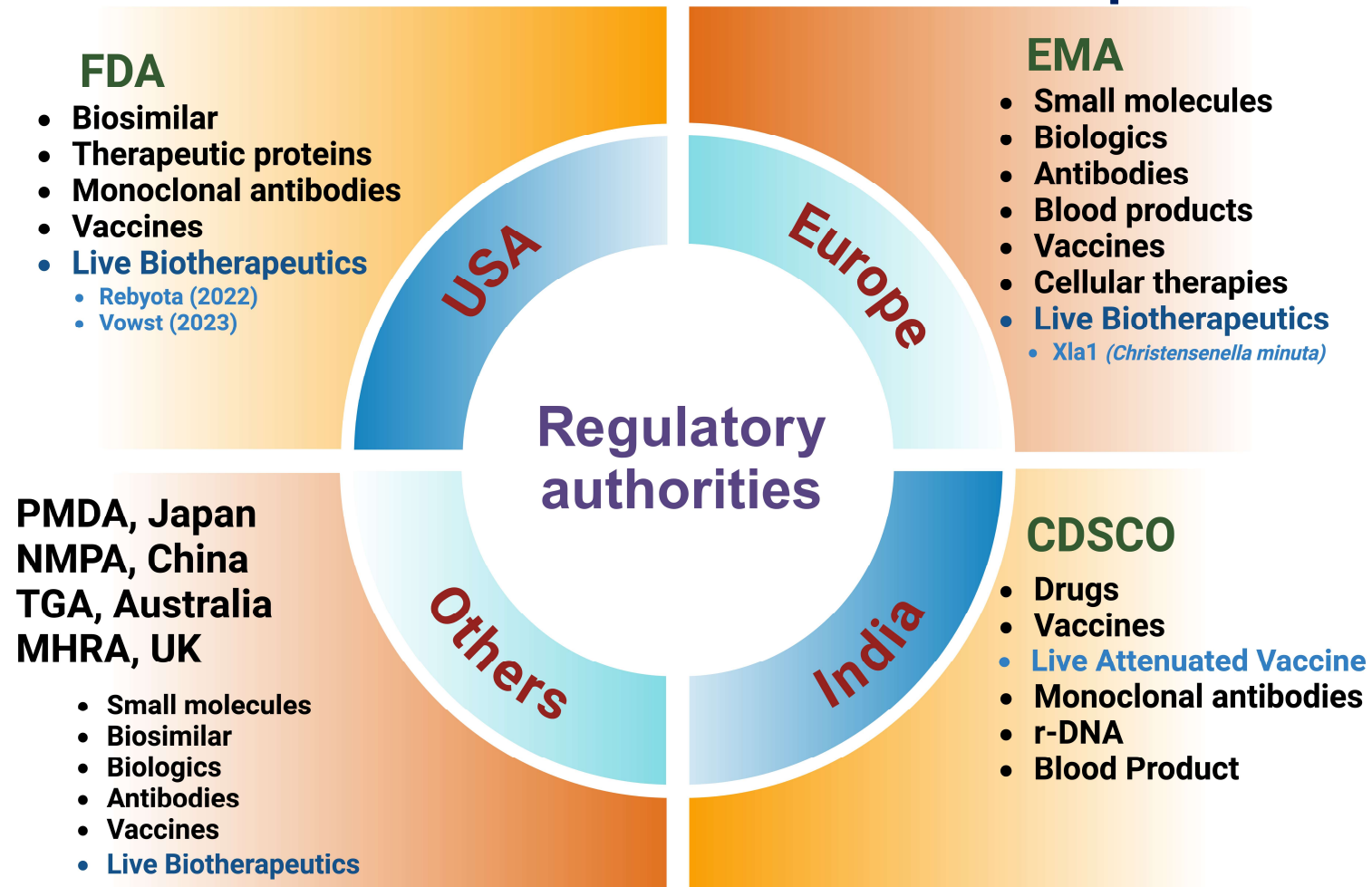


**Streptococcus, Clostridium,**  
**Bacillus (Japan)**  
**(Allianz Biosciences Pvt Ltd, India)**



- **L. rhamnosus GG (Finland)**
- **L. plantarum (Germany)**
- **L. fermentum (Germany)**
- **L. gasseri (Japan)**
- **L. acidophilus (USA)**
- **L. paracasei (Italy)**
- **S. boulardii (Indonesia)**

# Human Microbiome base Live Biotherapeutics



# Conclusion

- The healthy Indian gut microbiome is characterized by **Firmicutes dominance**, with substantial contributions from Bacteroidota and Actinobacteria, indicating a population-specific microbial signature.
- Comparative analyses reveal that the gut microbiome composition of Danish and Japanese populations is markedly distinct from that of the Indian population, highlighting strong **geographic and lifestyle influences** on microbial ecology.
- Gut **microbiome dysbiosis** promotes microbial translocation and systemic inflammation, thereby exacerbating the development and progression of **MASLD, cancers, cardiometabolic, and inflammatory diseases**.
- Beneficial microbes enriched in healthy individuals represent promising candidates for the development of next-generation **microbiome-based biotherapeutics**.

## Preface

1. Live Biotherapeutics: Emerging Trends and Future Directions in Microbial Therapy
2. Live Biotherapeutics and Nutraceuticals: Exploring the Differences and Synergies
3. Recombinant Live Biotherapeutics and Synthetic Biology: Recent Advancement and Perspective
4. Artificial Intelligence (AI) in microbiome-directed biotherapeutics development
5. Clinical Applications of Live Biotherapeutics: Current Trends and Future Prospects
6. Advancements in Technology for Developing Recombinant Live Biotherapeutics
7. Recombinant Live Biotherapeutics: A New Frontier in Peptide Drug Biosynthesis and Precision Delivery
8. Recombinant Live Biotherapeutics Against Chronic Metabolic Diseases: Challenges and Opportunities
9. Faecal Microbiota Transplantation in Liver Diseases: Therapeutic Potential and Associated Risks
10. Bacteriophage based live biotherapeutics: A novel approach to tackle drug resistant infectious diseases
11. The Human Reproductive Tract Microbiome: A Novel Source of Live Biotherapeutics
12. Recent Advances of Microbial Medicine to Prevent and Treat Cardiovascular Disease
13. Microbiota-derived metabolites in intestinal immune disorders
14. Live Biotherapeutics in Cancer Therapy
15. Live Biotherapeutics in the Clinic: Regulatory Pathways, Market Dynamics, and Future Trends

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PROGRESS IN  
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Translational Science

220

LIVE BIOTHERAPEUTICS: ADVANCING  
MICROBIAL MEDICINE

DAS

2026



VOLUME 220

# PROGRESS IN Molecular Biology and Translational Science

## LIVE BIOTHERAPEUTICS: ADVANCING MICROBIAL MEDICINE

Edited by  
**BHABATOSH DAS**



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# Funding Acknowledgements

भारत सरकार  
GOVERNMENT OF INDIA

विज्ञान और प्रौद्योगिकी मंत्रालय  
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BLOCKCHAIN FOR  
**IMPACT**

BFI BIOME NETWORK



# ट्रांसलेशनल स्वास्थ्य विज्ञान एवं प्रौद्योगिकी संस्थान

## Thanks For Your Attention

