

Ethnic- and Race-Specific Variations in Carcinoma Microbiomes: A Review

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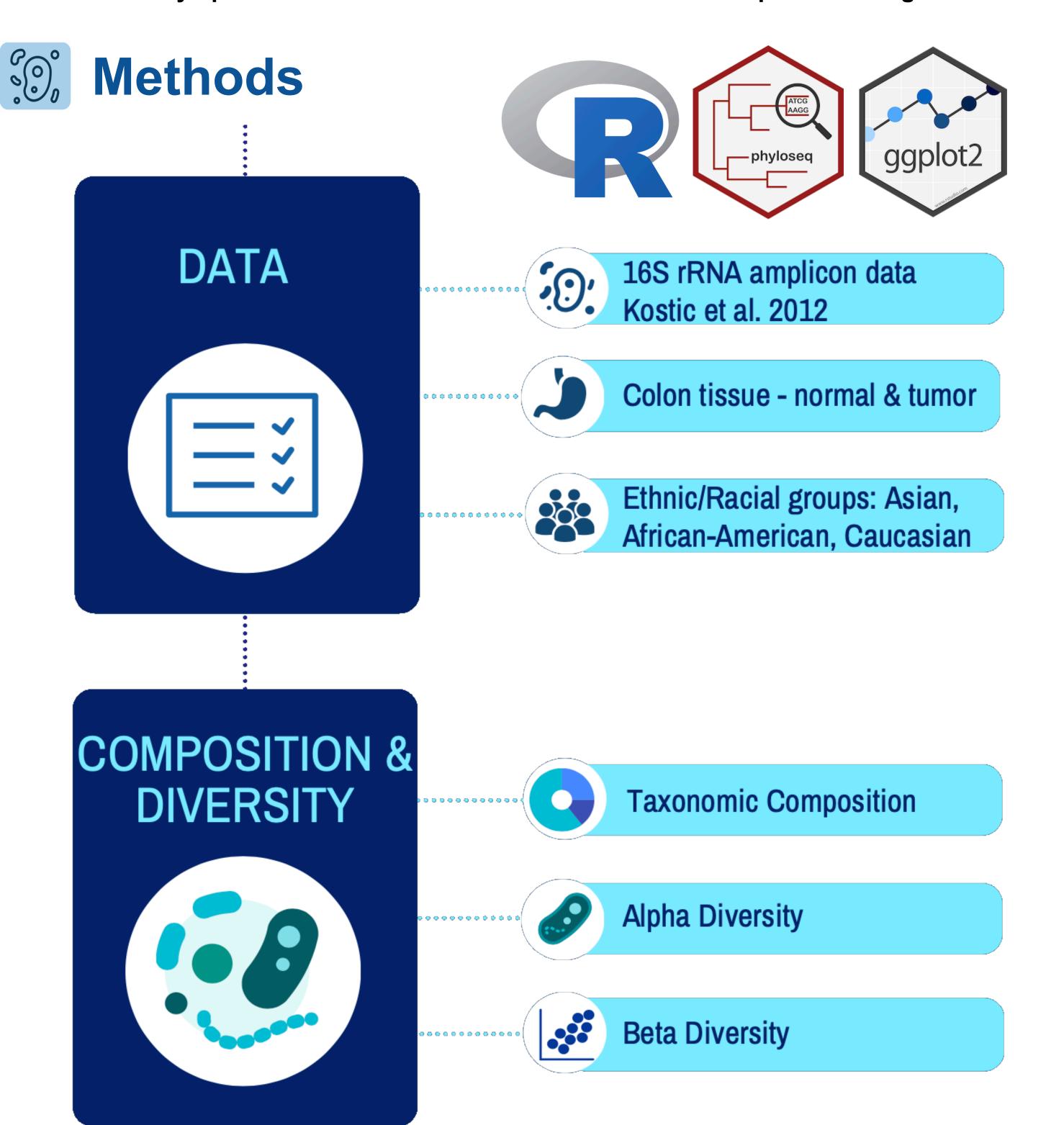




- The human microbiome is the microbial ecosystem associated with the human body, which greatly impacts human physiology and health.
- With the advancement of next-generation sequencing technologies, human microbiome research has become a fast-growing field, which provides a deeper understanding of complex microbial communities associated with the development and progression of human disease.
- Recent studies have shown that microbiota differences related to disease (e.g., cancer) often also vary with regards to race and ethnicity. These findings call for further research looking into the potential role of the human microbiome in ethnic- and racial related health disparities. Ethnic and racial health disparities are generally driven by a multitude of complex factors (e.g., socioeconomic, psychosocial, dietary, genetic, biological, environmental), which potentially also impact racial and ethnicity-specific signatures in microbiome composition and diversity.

Study Objectives

- Cancer is among the leading causes of death worldwide and former research indicated that incidence rates show clear racial/ethnic health disparities.
- Here, we review research on carcinoma microbiomes studied across different human races and ethnicities, including our case study on microbiome samples associated with colon cancer tissue collected across several ethnic and racial groups. Ethnicity- and race-specific carcinoma microbiome patterns have so far been described in colon, breast, lung, gastric, pancreatic, rectal and urogenital cancer patients.
- Our review explores race- and ethnicity-specific differences in carcinoma microbiomes and also highlights the need to conduct more extensive race and ethnicity-specific microbiome profiling in a diverse cancer patient population, which would greatly contribute to the development of future race- and ethnicity-specific biomarkers and microbiome-based therapeutic strategies.



Carcinoma Microbiomes across Race and Ethnicity

Literature Review 15 papers (breast cancer, n = 3; cervical cancer, n = 1; rectal **Breast Cancer** and colon cancer, n = 10; gastric cancer, n = 1)

Significance

- According to the WHO, breast cancer is the most
- common cancer type among women worldwide Approximately, 1 in 8 in the US women will go on to develop breast cancer within their lifetime
- While incidence rates vary with age, studies have shown African American women are more likely to die from breast cancer at every age.

Main Findings

- Enrichment of Fusobacteria, consistent with research of malignant colon cancers, has been
- A recent study found significant increase in the abundance of genus Ralstonia in the tumor microbiomes of African-American women compared to Caucasian women.

Gastric Cancer

Significance

- Gastric or stomach cancer remains to get little attention in the US, despite being defined by racial and ethnic disparities in the US.
- Gastric cancer disproportionally affects non-White racial and ethnic minority groups in the US, especially non-Hispanic African-Americans.

Main Findings

 Within the European-descendant background, a low microbial diversity in cancer cases was accompanied by a decrease in the abundance of Rhodococcus, Phyllobacterium and Staphylococcus, which was counterbalanced by the increase in Bacillus, Enterobacter, Fusobacterium and Sutterella.

Cervical Cancer

Significance

- Cervical cancer is the most common human papillomavirus (HPV)-related malignancy.
- In the United States, cervical cancer is more prevalent in Hispanic and African American women, compared to other races or ethnicities.

Main Findings

- Lactobacillus dominance decreased with the severity of cervical neoplasm
- Abnormal vaginal pH, Hispanic ethnicity and the severity of cervical neoplasm was significantly associated with depletion of Lactobacilli.

Colorectal Cancer

- cancer in both men and women in the US and accounts for 9% of all cancer-related deaths
- Incidence rates in the US show clear racial/ethnic disparities. for colorectal cancer with the incidence and mortality rate being higher in African Americans.

Main Findings

- A study found Bacteroidetes to be more abundant in AAs than
- in CAs, and a decreased overall microbiome diversity in AAs. In another study, AAs had higher abundances than CAs of
- Faecalibacterium and Bacteroides in carconomic tissue Hester et al. study found increased abundance of Firmicutes bacteria in AAs than in CAs, with enriched Ruminococcaceae

Our results **Taxonomic Composition of Healthy & Tumor Colorectal Microbiomes**

Case Study Colon Cancer

Fig 1. Taxonomic composition of colorectal microbiomes associated with healthy and tumor tissue profiled by bacterial phylum, race and

Beta Diversity Assessment of Healthy and

Tumor Colorectal Tissue Samples

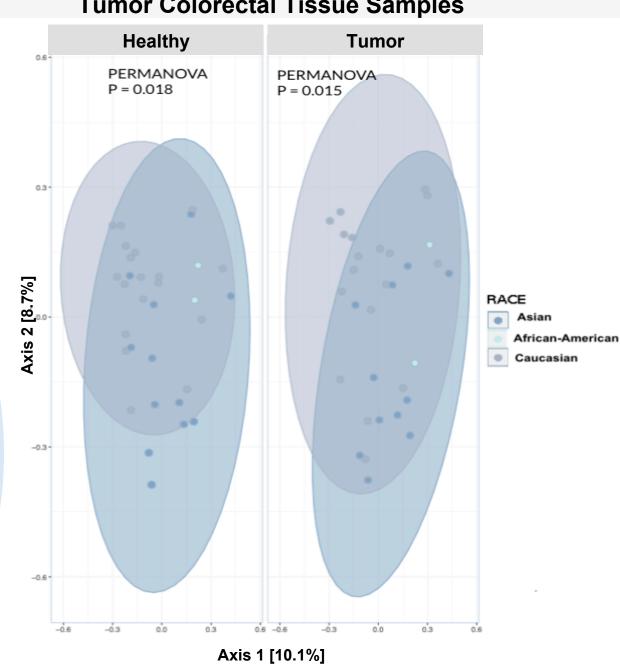


Fig 2. Beta diversity was assessed via PCoA of Bray-Curtis

Significance

- Vaginal cancer is the fifth most diagnosed cancer among women in the US.

Vaginal Cancer

- Hispanic women have the highest incidence of vaginal cancer of all ethnic groups (decreased healthy Lactobacilli and increased unhealthy sneathia). Main Findings

- Lactobacilli play a major role in regulating vaginal pH and creating an acidic environment hostile to microbes responsible for diseases like Trichomoniasis and bacterial vaginosis. Women with lactobacilli-dominant vaginal microbiomes are more likely to prevent or clear human papillomavirus infections.
- Sneathia were more abundant in women with HPV infection. pre-cancer and cervical cancer. • Prevotella species are often associated with bacterial vaginosis
- and cervicitis, while vaginal bacterial communities dominated by Lactobacillus gasseri are correlated with incr. clearance of HPV infection.

distances among healthy and tumor tissue samples collected from patients of different races and ethnicities.

- Significance: Cancer health disparities are an urgent issue worldwide since minority and underserved populations are disproportionately affected. In the US, large differences in cancer incidence and mortality exist between different ethnic and racial groups, with African-Americans, American Indians, and Hispanic Americans most affected.
- Findings: Various studies have shown that microbiome composition and/or diversity are causatively linked to cancer predisposition and development. Microbiome dysbiosis may cause a higher cancer risk and a modified cancer therapy response. Ethnic- and race-specific cancer microbiome signatures were described in the breast, colon, stomach, cervix, etc. Although health disparities are not attributable to a single factor and require multidisciplinary research efforts, differences in microbiota between different races and ethnicities represent a novel way to understand potential drivers of cancer health disparities. Currently, we are still at the beginning to understand how the microbiome contributes to disparities in cancer risk and survival and further studies are urgently needed.
- Future Directions: We recommend conducting large studies which also include sufficient sample sizes from minority populations. It would be also beneficial to collect patient data on various other factors, such as lifestyle, socioeconomic status, education etc. Microbiome-centered diagnostics and therapeutics represent powerful new ways towards understanding and treating cancer. Microbiome profiling is an apt tool for cancer risk assessment, diagnostics in early-stage cancer detection and continuous tracking of tumor progression. Furthermore, biomarker screening can inform cancer treatment protocols by optimizing existing treatment strategies and through microbiome-centered therapeutics. Integrating ethnicity- and race-specific microbiome-based approaches into cancer medicine creates unprecedented opportunities to capitalize on a cutting-edge and constantly evolving field of research which aims to improve medical precision and patient survival.

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