

Synopsis

Title: Investigating the Role of Gut and Reproductive Tract Microbiomes in Human Infertility

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Background & Rationale

Infertility is a rising public health concern in India, affecting approximately 27.5 million couples. Despite advancements in fertility treatments, the impact of microbiomes on reproductive health remains underexplored. Gut and reproductive tract microbiomes are known to influence hormonal regulation, immune response, inflammation, and metabolic functions, all of which are vital for fertility. However, Indian public health frameworks like Ayushman Bharat and the RCH Programme do not currently incorporate microbiome-based approaches. This study emphasizes the need to include microbiome modulation in infertility prevention and treatment.

Objectives

General:

To investigate the role of gut and reproductive tract microbiomes in the development, progression, and management of human infertility.

Specific:

1. To review the structure and functions of the gut microbiome.
2. To understand reproductive health trends and infertility in India.
3. To examine the causes and mechanisms of dysbiosis.
4. To compare gut and reproductive microbiomes.
5. To identify links between gut dysbiosis and infertility.
6. To analyze the effect of dysbiosis on female reproductive disorders.
7. To analyze the effect of dysbiosis on male reproductive disorders.
8. To explore interventions such as probiotics, dietary changes, and FMT.

Key Findings

- **Gut microbiota** contributes to digestion, immunity, hormone balance, and metabolism.
- **Dysbiosis** disrupts these functions, leading to leaky gut, immune dysregulation, and hormonal imbalances.
- There is a **gut-reproductive axis**, where gut microbiome influences reproductive organs.
- **Female infertility** is associated with PCOS, endometriosis, implantation failure due to gut imbalance.
- **Male infertility** is linked with reduced sperm quality, testicular inflammation, and hormonal dysfunction caused by gut dysbiosis.
- **Gut microbiome** is more diverse, while the **reproductive tract** is dominated by Lactobacillus species.
- Use of **16S rRNA sequencing** enables microbial identification and potential clinical diagnostics.

Recommendations

1. Implement **microbiome screening** in fertility clinics.
2. Launch **public health awareness** campaigns on gut-reproductive health links.
3. Integrate microbiome studies into **national health programs**.
4. Conduct more **India-specific clinical research**.
5. Develop **microbiome-based treatments** (probiotics, prebiotics, FMT).
6. Encourage **multidisciplinary collaboration** across medical specialties.
7. Incorporate **diet and lifestyle counselling** in fertility care.
8. Promote **policy support** and funding for microbiome innovations in line with SDG-3.

Conclusion

This dissertation establishes a scientific basis for integrating microbiome research into reproductive healthcare. Modulating gut and reproductive microbiomes offers a non-invasive, cost-effective, and personalized solution to infertility. The findings align with Sustainable Development Goal 3: ensuring healthy lives and promoting well-being for all by 2030. Future public health and clinical strategies must prioritize microbiome health to enhance reproductive outcomes.