

The Effect of Probiotics and Fecal Transplantations on Crohn's Disease Symptoms

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Abstract

The effect of probiotics and fecal transplantations on Crohn's disease symptoms was investigated to determine which of these treatments is more effective in treating Crohn's disease. A systematic literature review was conducted to establish whether either probiotics or fecal transplantations can provide an alternative treatment to the accepted forms of treatment, including antibiotics and surgery. The relationship between the occurrence of Crohn's disease and the prevalence of major phyla in the gut microbiota of patients was investigated to demonstrate a connection between a bacterial imbalance in the gut microbiota and Crohn's disease. Data was analyzed from peer-reviewed papers. T-tests conducted on that data indicated that probiotics do not have a statistically significant effect on inducing remission, while fecal transplantations do. It was concluded that fecal transplantations have a greater effect on Crohn's disease symptoms than probiotics.

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Introduction

Crohn's disease is a chronic inflammatory bowel disease that causes inflammation in the gastrointestinal (GI) tract and can lead to symptoms such as abdominal pain, diarrhea, weight loss, anemia, and fatigue. There is currently no cure, however standard treatments include antibiotics, immunomodulators, and surgery, depending on disease severity. The gut microbiota is the community of microorganisms that is enclosed within the GI tract that contributes to life-sustaining functions, such as protecting against pathogens, helping the immune system, and contributing metabolic functions. Patients with Crohn's disease have a lower fecal microbial diversity as Crohn's disease can cause certain phyla in the gut microbiota to become less prevalent, which can lead to dysbiosis or other health problems. Probiotics and fecal transplantations are two alternative treatments for Crohn's disease that attempt to treat the disease by manipulating the gut microbiota. Probiotics are live microorganisms that improve the diversity of the gut microbiota, helping microbiome functions and causing anti-inflammatory effects. Fecal microbiota transplantations involve transplanting fecal bacteria from a donor into a recipient via a stool sample. This can help restore the normal bacterial composition of their gut microbiota and improve their metagenomic diversity, which has been shown to improve intestinal health.

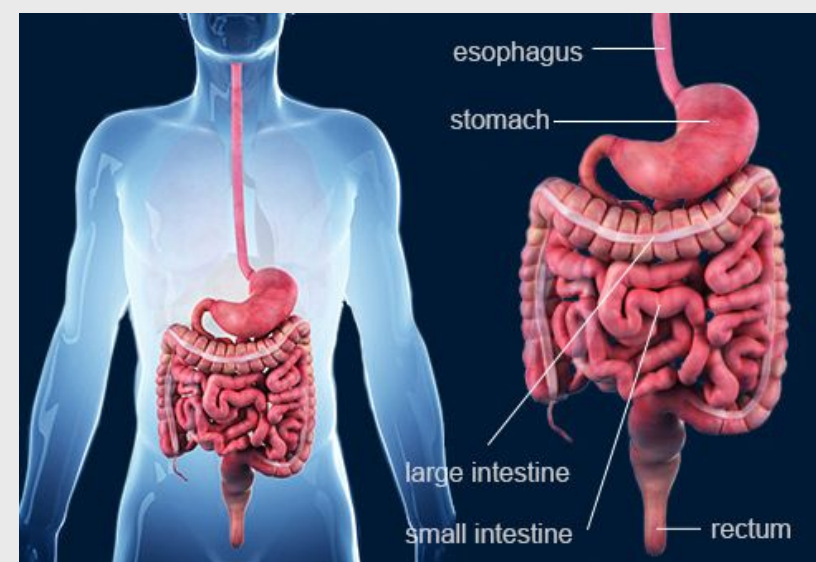


Figure 1. Diagram of the parts of the body affected by Crohn's disease

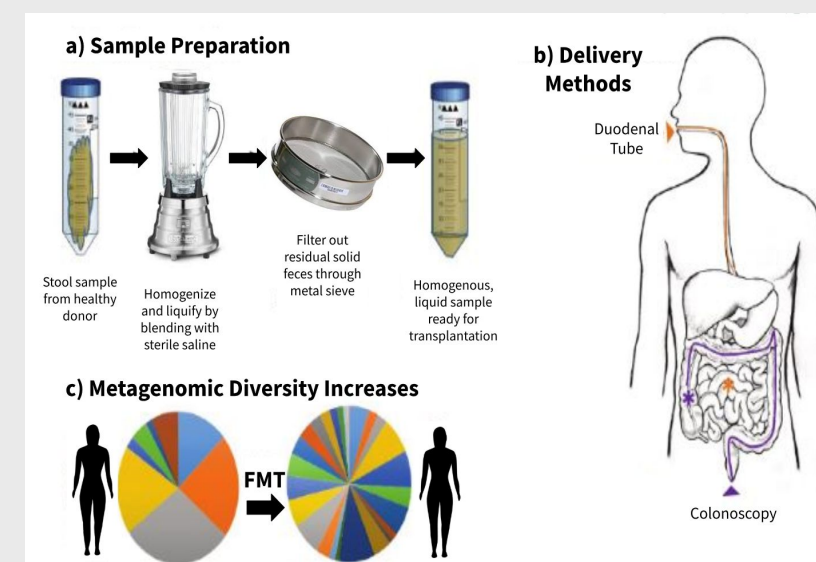


Figure 2. Figure depicting the process of a fecal transplantation

Methods

Systematic Literature Review

- Only peer-reviewed papers that were published before 2000
- Databases searched: Science Direct, PLOS, Pubmed, NCBI, Google Scholar, Research Gate, EbscoHost, JSTOR
- Analyzed papers with data on probiotics and fecal transplantations inducing remission in Crohn's disease patients
- Remission defined by the absence of symptoms, using the Crohn's Disease Activity Index (CDAI), 6 weeks after treatment
- Bacterial compositions identified using 16s rRNA gene sequencing
- T-tests were run to compare the remission rates in patients who either underwent a fecal transplantation or a probiotic treatment

Purpose

The purpose of this study was to evaluate the efficiency of manipulating the gut microbiota by incorporating healthy bacteria into the gut microbiota with fecal transplantations and probiotic intake in order to treat Crohn's disease. Currently, Crohn's disease has no cure, so this study looked at ways to minimize some of the symptoms in order to help patients live a healthier, more functional life.

Research Question & Hypothesis

Research Question: Do fecal transplantations have a greater effect on the symptoms of Crohn's disease than probiotics?
Alternative Hypothesis: Fecal transplantations have a greater effect on the symptoms of Crohn's disease than probiotics
Null Hypothesis: Fecal transplantations do not have a greater effect on the symptoms of Crohn's disease than probiotics.

Results

A paired two-sample t-test was run to determine the statistical significance of fecal transplantations on inducing remission in Crohn's disease patients. The t-test was paired because the data compared the same patients before and after the treatment. The P value of 0.00019 was compared with the significance value of 0.05.

An unpaired two-sample t-test assuming unequal variance was used to examine the discrepancies between the effects of a probiotic and placebo treatment on inducing remission in Crohn's disease patients. The t-test was unpaired assuming unequal variance because the probiotic group and the placebo group were two different groups of patients and the number of patients and impact of the probiotics and placebo varied. The P value used from the t-test was 0.62.

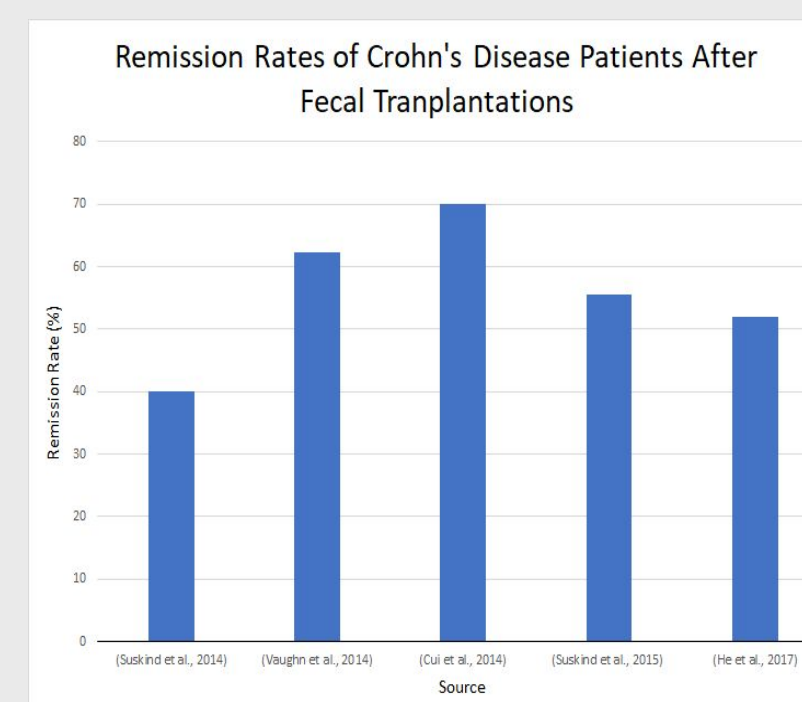


Figure 3. Graph depicting the remission rates of Crohn's disease patients after they underwent a fecal transplantation. Prior to the treatment, none of the patients were in remission.

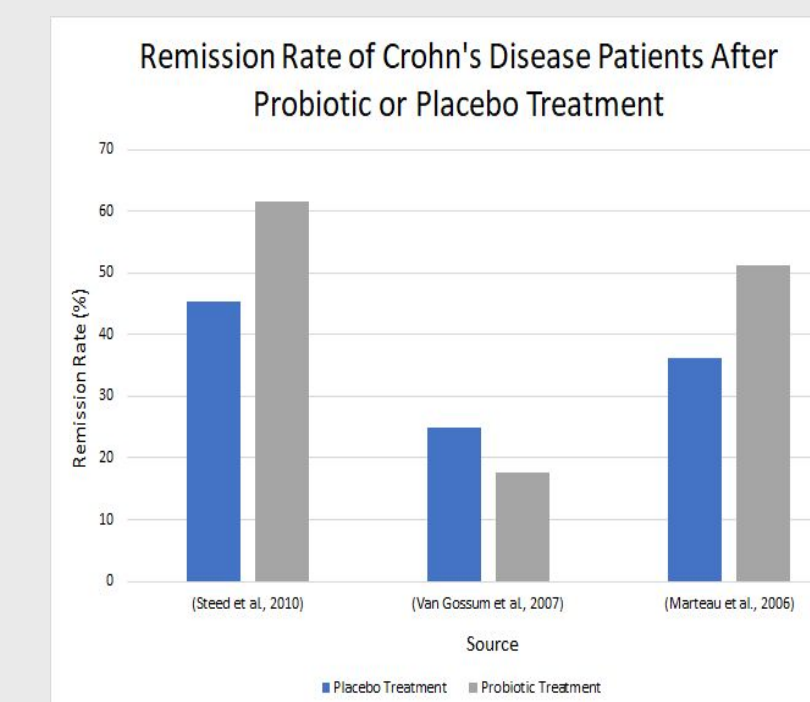


Figure 4. Graph of the remission rates of Crohn's disease patients from three controlled studies after they underwent a probiotic or placebo treatment.

Discussion

For the t-test on fecal transplantations, the P value of 0.00019 was compared with the significance value of 0.05. The P value is the probability that the null hypothesis is correct, so a low P value reveals that there is a low probability that the null hypothesis is correct. Since the P value is undoubtedly lower than the significance value, the null hypothesis was rejected.

For probiotics, the P value of 0.62 was extracted from the t-test and compared with a significance value of 0.05. Due to the high P value, it can be revealed that probiotics do not have a statistically significant capability of inducing remission in patients.

These results may have occurred due to fecal transplantations being able to more effectively and efficiently restore the gut microbial balance of patients, when compared with probiotics. The restoration of the balance would have caused the inflammation within the GI tract to become less severe or even diminish. Since symptoms occur due to inflammation, the decline of inflammation would cause symptoms to become more infrequent or decline to the point in which patients could have been considered to be in remission. Thus, fecal transplantations appear to have more success when it comes to inducing remission because they can boost proper microbial functions, which reduces inflammation of the GI tract and mitigates symptoms of Crohn's disease.

Conclusion

The null hypothesis was rejected, meaning that the data suggested that fecal transplantations are a more effective treatment for Crohn's disease than probiotics. Although probiotics are adequate in some patients, they are not adequate in all patients. These two forms of treatment can be used as a minimally invasive form of treatment for Crohn's disease in some cases, but they can only help ease some of the symptoms, not fully cure the disease. Since disease severity differs within patients and all patients respond to treatments differently, it can not be concluded whether one treatment can cure the disease in all patients.

Further Work

More research and clinical trials are required to optimize the effects of both probiotics and fecal transplantations. Using fecal transplantations and probiotic supplements is a relatively new form of treatment for Crohn's disease, so there is no formal standard treatment method for them and their long term side effects are relatively unknown. It is also unclear whether these forms of treatment can help patients remain in remission over the course of multiple years after they received the treatment.