NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

**Quality in Sport. eISSN 2450-3118.**

**Journal Home Page**
**https://apcz.umk.pl/QS/index**

**TROJNAR, Karolina Maria, ŻMIGRODZKA, Anna, PRZEPIÓRA, Agnieszka, ORŁOWSKA, Maria, KOZŁOWSKA, Jana, SANOCKA, Maria, WIELOGÓRSKA, Agnieszka, CZERNIC-GOŁAWSKA, Klaudia, KAMIŃSKA, Agnieszka, FALANA, Joanna, KWIATKOWSKA, Anna, TROJNAR, Gabriela, and BATTSENGEL, Urantuya. How Exercise Affects Gut Bacteria and Stomach Problems – A Summary Review. Quality in Sport. 2026;54:70881. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.54.70881**

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). 
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 14.04.2026. Revised: 21.04.2026. Accepted: 22.04.2026. Published: 26.04.2026.

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# How Exercise Affects Gut Bacteria and Stomach Problems – A Summary Review

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**ABSTRACT**
**Background:** The human gastrointestinal tract contains a large community of microorganisms, known as the gut microbiota. Their metabolic and immunological functions influence host physiology. Disruption of this community, called dysbiosis, contributes to many gastrointestinal disorders. Physical activity is increasingly recognized as a lifestyle factor that can alter microbial composition and function.

**Aim.** This review summarizes current evidence on the effects of physical activity on gut microbiota and assesses the clinical relevance of these changes for patients with irritable bowel syndrome (IBS), small intestinal bacterial overgrowth (SIBO), and functional constipation.

**Material and methods.** A narrative study was conducted using literature from PubMed, MEDLINE, and Google Scholar. Studies published between 2018 and 2025, including clinical intervention trials, cross-sectional studies, and animal experiments, were included.

**Results.** Moderate aerobic exercise often boosts the diversity of gut microbes and increases the number of butyrate-producing bacteria, such as *Akkermansia muciniphila*, *Faecalibacterium prausnitzii*, and *Bifidobacterium* spp. The alterations result in reduced intestinal inflammation, increased stool concentrations of short-chain fatty acids, and faster intestinal transit. Structured exercise regimens have been demonstrated to significantly reduce symptoms of IBS and chronic constipation. Intense exercise may reduce stomach motility and increase gut permeability in certain individuals, although there is limited controlled data on SIBO.

**Conclusions.** Regular moderate exercise represents a low-cost, accessible adjunct to conventional management of common gastrointestinal disorders. Standardized clinical protocols and longer follow-up studies are still needed before definitive exercise prescriptions can be established.

**Keywords:** gut microbiota, physical activity, exercise, irritable bowel syndrome, SIBO, constipation, short-chain fatty acids, dysbiosis

## 1. Introduction

Few parts of the body are as microbiologically rich as the gut. Packed with an estimated 100 trillion microorganisms — bacteria, archaea, fungi, and viruses alike — the gastrointestinal tract harbors a population that matches, or possibly surpasses, the entire number of cells making up the human body [5]. Experts in this area use two main terms. 'Gut microbiota' means the living microorganisms found in the gut. 'Gut microbiome' is a wider term that covers these microbes, their genes, and the roles they play in the body. The sheer breadth of influence this internal ecosystem has on human health led some scientists to describe it as a "forgotten organ"—a label that captures just how significant, yet historically overlooked, this community truly is [21].

The process of gut colonization starts at birth, or very close to it. In the earliest days of life, the newborn gut is dominated by Proteobacteria and Actinobacteria. As infants transition to solid foods and their immune systems gradually mature, these are largely replaced by Firmicutes and Bacteroidetes — the same bacterial groups that predominate in the adult gut. By the time a child reaches two to three years of age, their gut microbial profile closely mirrors that of a grown adult [5; 22]. The trajectory of this development is shaped by a range of early-life factors, including the mode of delivery at birth, infant feeding practices, exposure to antibiotics, and overall hygiene conditions — all of which can leave a lasting imprint on the composition of the gut microbiota [14].

In adults, the gut microbiota is shaped by diet, medications, stress, and physical activity. Disruption of this balance, called dysbiosis, can cause metabolic syndrome, obesity, inflammatory bowel disease, and gut disorders like IBS and SIBO [27; 17]. These conditions are common and often serious. Most are treated with drugs that address symptoms rather than the underlying microbial causes.

Clarke et al. (2014) found that professional rugby players have much greater gut microbial diversity than people who are less active. This discovery led to more research on how exercise affects the gut microbiome. Later studies show that regular physical activity can change the gut microbiome [26], boost short-chain fatty acid production [18], and influence how the gut and brain communicate [26; 18]. On the other hand, exercising too much or too hard may weaken the gut barrier [26], which can cause digestive problems. These findings are especially important for athletes [8] and are helping to shape exercise-based ways to support gut health [18].

Given this context, this review first brings together evidence on how physical activity affects the gut microbiota, then explores three gut disorders in which microbes play a key role: IBS, SIBO, and functional constipation.

Research Objective: to summarize current evidence on the impact of physical activity on gut microbiota composition and its role in the management of irritable bowel syndrome, small intestinal bacterial overgrowth, and functional constipation.

Research problems: Does regular physical activity modify gut microbiota composition and diversity in a clinically meaningful way? Can exercise-induced microbial changes contribute to symptom relief in functional gastrointestinal disorders?

Research Hypotheses: regular moderate-intensity exercise increases gut microbial diversity and SCFA production, thereby improving intestinal barrier function, reducing inflammation, and alleviating symptoms of functional gastrointestinal disorders.

## 2. Research materials and methods

Participants

This study is a narrative review; no human participants were recruited. The analyzed material consisted of peer-reviewed publications identified through systematic database searches.

Procedure / Test protocol / Measure / Instruments

A narrative review of the literature was conducted using PubMed, MEDLINE, and Google Scholar databases. The search covered publications from 2008 to 2025. The following keywords were used in various combinations: physical activity, exercise, gut microbiota, gut microbiome, irritable bowel syndrome, SIBO, constipation, short-chain fatty acids, dysbiosis. Original research articles, systematic reviews, and meta-analyses in English were included. Studies were selected based on relevance to the review objectives, methodological quality, and recency of findings.

2.3.1. Statistical software.

Statistical processing was not applicable to this study, as it constitutes a narrative review of existing literature rather than an original empirical investigation.

### 2.3.3. Statistical methods

No primary statistical analysis was performed. The review relied on qualitative synthesis of findings reported in the included publications. Where available, quantitative data from meta-analyses and randomized controlled trials – including effect sizes, relative risks, and p-values – were cited directly from the original sources.

## 3. Research results

### 3.1. Gut microbiota and its functions

Propionate travels to the liver and helps make glucose. Acetate moves into the bloodstream and is used to make fats and cholesterol. Butyrate is the main energy basis for cells lining the colon and can affect gene activity by blocking histone deacetylases [12]. Besides these roles, short-chain fatty acids (SCFAs) also activate G-protein-coupled receptors (GPR41 and GPR43) on certain gut cells, which trigger the release of peptide YY (PYY) and glucagon-like peptide-1 (GLP-1). These hormones help regulate appetite and the rate at which food moves through the gut [26].

The gut microbiota plays an important role in regulating the immune system. Friendly bacteria help T regulatory (Treg) cells develop and keep a balance between pro- and anti-inflammatory signals. The stability of Treg cells in the colon is closely linked to butyrate acting through GPR receptors [25]. The microbiota also produces B-group vitamins and vitamin K, helps modify bile acids, and prevents harmful bacteria from taking hold by producing bacteriocins and competing for space on the gut lining [20].

The gut–brain axis is a two-way communication approach between the gut and the brain, and its importance in health is now well recognized. This system works through nerve signals, the hypothalamic-pituitary-adrenal (HPA) axis, and chemicals made by the body [20]. Gut bacteria can produce or modify substances such as gamma-aminobutyric acid (GABA), serotonin precursors, and short-chain fatty acids, all of which affect mood, stress, and gut pain [9]. When the gut–brain axis is disrupted, often due to an unhealthy gut microbiome, it plays a key role in conditions like irritable bowel syndrome (IBS) and other gut disorders [17; 11].

Dysbiosis, or an unhealthy gut microbiome, can be caused or worsened by antibiotics, low-fiber diets, ongoing stress, lack of exercise, and certain diseases [11]. Its effects go beyond the gut. People with obesity, type 2 diabetes, inflammatory bowel disease, and colorectal cancer often have less diverse gut microbes and different metabolite patterns [26]. Finding ways to prevent or reverse dysbiosis is an important goal in preventive medicine.

The landmark observation that athletes have a more diverse gut microbiota than sedentary individuals dates to Clarke et al. (2014). They analyzed fecal samples from 40 professional rugby players and two age- and sex-matched control groups. The athletes showed 22 distinct bacterial phyla — more than either of the control groups. This diversity correlated with both dietary protein intake and circulating creatine kinase, a marker of exercise load. Although the study was cross-sectional and confounded by diet, it opened the door to further studies of the exercise–microbiota relationship.

Metagenomic analysis by Barton et al. (2018) extended these findings to the functional level. Rugby players showed higher mean abundance in 29 of 34 metabolic pathway categories compared with sedentary subjects. They also had substantially elevated fecal concentrations of acetate, propionate, butyrate, and valerate (all $p < 0.001$). This implies that exercise does not simply alter microbiota composition. It changes what these microorganisms actually do [4].

Recent evidence on direct experimental support for these associations have also come from intervention-based studies. Allen et al. (2018) enrolled lean and obese adults in a supervised six-week aerobic exercise program, collecting fecal samples both before and after the intervention to measure shifts in short-chain fatty acid (SCFA) concentrations [2]. Among lean participants, butyrate, acetate and propionate levels increased markedly during the program [2]. This enhancement was correlated to significantly higher fecal abundance of well-known butyrate producing bacteria like Roseburia spp., Lachnospira spp., Clostridiales spp., and Faecalibacterium spp. [2]. These effects suggest that exercise has the potential to change microbial communities involved in SCFA biosynthesis [2]. Obese participants showed a smaller response. This suggests that a person's metabolic status affects their gut microbiota. Three types of bacteria are especially important in exercise research. Akkermansia muciniphila, the main member of the Verrucomicrobia phylum, breaks down intestinal mucin and is associated with better gut barrier function. This bacterium is more commonly found in physically active people than in those who are not [19]. Faecalibacterium prausnitzii, an important butyrate producer in the Firmicutes group, helps reduce inflammation by lowering IL-2 and interferon-gamma levels and raising IL-10. Individuals with irritable bowel syndrome (IBS) and inflammatory bowel disease often have lower levels of this bacterium, but exercise may help restore those levels. Regular exercise may also increase Bifidobacterium spp. and Lactobacillus spp., which help produce SCFAs, support the mucosal immune system, and block harmful microbes [19; 26].

Looking at broader groups of bacteria, the Firmicutes-to-Bacteroidetes (F/B) ratio is higher in people with obesity and metabolic diseases, but it usually goes down with regular moderate exercise. This is mostly because Bacteroidetes increase [10]. Animal studies also show that exercise changes the gut microbiota in different ways. However, the exact changes depend on the type of exercise, diet, and genetics, which makes it hard to compare results across studies [26].

A 2023 review of 32 exercise studies [10] found that over half of human trials did not show a significant change in alpha-diversity. When diversity increased, it was usually measured using the Shannon index. Animal studies more often showed changes in diversity, but these changes were not always in the same direction. In metabolites, regular exercise increased the number of SCFA-producing bacteria, especially Coprococcus, Dorea, Roseburia, Paraprevotella, and Allobaculum. Still, the actual changes in SCFA levels in human studies were small. These mixed results show that future research needs more consistent exercise protocols, better dietary controls, and longer study periods.

### 3.2. Effects of physical activity on gut microbiota

The idea that athletes have a more diverse gut microbiota than sedentary individuals was first brought into sharp focus by Clarke et al. (2014), who examined fecal samples from 40 professional rugby players alongside two age- and sex-matched control groups. The athletes displayed 22 distinct bacterial phyla — a figure notably higher than either control group [8] — and this microbial richness correlated positively with both dietary protein intake and circulating creatine kinase levels, a recognized marker of exercise load [8]. While the cross-sectional design and dietary confounders limited the conclusions that could be drawn, the study effectively opened the door to what has since become a thriving area of investigation [19].

Barton et al. (2018) took these findings a step further through metagenomic analysis, moving beyond taxonomy to explore what gut microbes actually do. Compared with sedentary subjects, rugby players showed higher mean abundance across 29 of 34 metabolic pathway categories [4], along with substantially elevated fecal concentrations of acetate, propionate, butyrate, and valerate (all $p < 0.001$) [4]. The key takeaway was that exercise does not merely determine which microorganisms populate the gut — it also shapes their functional output [4; 19].

Recent intervention studies have provided robust experimental evidence supporting these observations. Allen et al. (2018) monitored lean and obese adults during a supervised six-week aerobic exercise program and measured fecal short-chain fatty acid (SCFA) levels before and after. Among lean participants, concentrations of butyrate, acetate, and propionate increased significantly [3], along with a rise in established butyrate-producing bacteria, including Roseburia spp., Lachnospira spp., Clostridiales spp., and Faecalibacterium spp. [3]. In contrast, individuals with obesity showed a weaker response, suggesting that baseline metabolic status may influence the adaptability of gut microbiota to exercise [19].

Within the broader landscape of exercise-microbiota research, three bacterial taxa have consistently stood out as especially significant [19; 26]. *Akkermansia muciniphila*, the most prominent member of the Verrucomicrobia phylum, participates in the degradation of intestinal mucin [19] and is closely linked to the maintenance of a healthy gut barrier [19]; its relative abundance tends to be markedly greater in physically active people than in those who lead sedentary lives [19]. *Faecalibacterium prausnitzii*, widely regarded as one of the principal butyrate-producing members of the Firmicutes phylum [19], supports gut homeostasis through a well-documented anti-inflammatory mechanism — reducing the output of IL-2 and interferon-gamma while simultaneously encouraging IL-10 secretion [19]. This finding is important because this type of bacteria is usually found in smaller amounts in someones with irritable bowel syndrome (IBS) or inflammatory bowel disorder [26]. Evidence that exercise can help bring its levels back up in the gut is therefore useful for treatment [26]. Other bacteria that react to exercise, like Bifidobacterium spp. and Lactobacillus spp., are also found in higher amounts in people who exercise regularly [19]. These bacteria help make short-chain fatty acids (SCFAs), support the gut's immune system, and help keep harmful gut bacteria in check [19; 26]. More generally, the Firmicutes-to-Bacteroidetes (F/B) ratio, which is often higher in people with obesity and related health problems [10], tends to go down in people who exercise moderately on a regular basis [10]. This change seems to happen mostly because there are more Bacteroidetes, not fewer Firmicutes [10]. Animal studies show similar results, with exercise leading to changes in gut bacteria in different test models [26; 19]. However, the exact changes in bacteria depend a lot on the type and intensity of exercise, diet, and the animals' genetics [19], which makes it hard to get the same results in every study [26]. A 2023 review of 32 exercise studies found that most human trials, more than half, do not find any obvious change in alpha-diversity [10]. When diversity improved, the Shannon index was the most reliable measure of this change [10]. Animal studies were more likely to show changes in diversity caused by exercise [26], but even in these studies, there was no clear pattern [26; 19]. Exercise had its most consistent effect at the level of substances made by bacteria, encouraging the growth of SCFA-producing bacteria such as Coprococcus, Dorea, Roseburia, Paraprevotella, and Allobaculum [10]. However, the actual increases in SCFA levels measured in humans were usually small [3; 4]. The wide range of developments in this research suggests that future studies should focus on making exercise practices more equitable and on more closely controlling diet. Moreover, allowing sufficient time for changes in gut bacteria to become apparent [10].

### 3.3. Physical activity and gastrointestinal disorders

#### 3.3.1. Irritable bowel syndrome (IBS)

IBS ranks among the most widespread functional gastrointestinal conditions, with prevalence estimates ranging from 10 to 15% among adults worldwide [17]. Diagnostically, it is defined by recurrent abdominal pain that coincides with changes in bowel habit — stool frequency, consistency, or both — occurring without any underlying structural or organic pathology to account for the symptoms [17]. Its pathophysiology is multifactorial: altered gut motility, visceral hypersensitivity, increased intestinal permeability, immune activation, and – critically from the perspective of this review – gut dysbiosis each recreate a role. Systematic reviews comparing the fecal microbiota of IBS patients with healthy individuals consistently report lower abundance of *Faecalibacterium prausnitzii* and *Akkermansia muciniphila, along with* shifts in the proportion of *Proteobacteria* [17].

Exercise has been mentioned as an important method to effectively manage IBS considering it can treat a number of causes related to IBS [16]. A review by Li et al. (2024) reported in the journal Nutrients about studies in people affected by IBS who performed aerobic exercise, and found substantial improvement in the composition of gut bacteria as well as increase in concentrations of Lactobacillus and Bifidobacterium found in stool samples [16]. Changes to gut bacteria were observed to be related to more production of useful fatty acids, a fortified gut wall, and reduced inflammation in the body [16]. So, exercise also reduces the mental side of IBS, which is essential, since stress increases symptoms because of the synergy between gut and brain [11]. Real life findings provide support for these findings. Participants in a supervised six-week treadmill running program for people with IBS reported significantly lower IBS symptom scores in comparison to a group that didn't exercise. Another exercise program, with participants being measured in heart rate at 60 to 75 percent for at least 180 min a week, was associated with even stronger reductions in symptoms, in particular stomach pain and bloating, and improved fitness [16]. Walking techniques can also help reduce gastric distension, gas, and feelings of anxiety and depression in individuals suffering from IBS [16]. But it should come with a major caveat: strenuous exercise literally will make the symptoms of IBS worse than better and specifically, exercise that occurs around the time people are eating or during active IBS flares. But there is an important caveat: hard or intense exercise can aggravate rather than alleviate IBS symptoms, especially if it's done in the proximity to meals or during a painful flare-up. So your current doctors suggest doing gentle to moderate activities like walking, swimming, or cycling for 20 to 30 minutes at a time, three to five times a week, until you improve your intensity over time.

3.3.2. Small intestinal bacterial overgrowth (SIBO)

Small intestinal bacterial overgrowth (SIBO) happens when bacteria from the colon grow in the tiny intestine in large enough numbers to cause symptoms like bloating, gas, diarrhea, or malabsorption [6]. This usually occurs when the body’s normal controls over bacteria in the small intestine are weakened. These controls include the migrating motor complex (MMC), which moves bacteria along between meals, stomach acid, and the healthy structure of the digestive tract. If any of these are impaired, bacteria can accumulate and persist in the small intestine [6].

The hypothesis that exercise may provide therapeutic benefits for SIBO is biologically plausible. It is possible that exercise could help treat SIBO, but there is not much evidence yet. Physical activity can improve gut movement through nerve reflexes triggered by movement and changes in the nervous system [15]. Katagiri et al. (2025) found that a 20-minute walk led to more bowel sounds, which suggests increased intestinal activity, within one to two minutes after walking. If regular exercise induces movements in the small intestine similar to MMCs [15], it might help prevent the bacterial buildup seen in SIBO. Still, this effect has not been directly studied in people with SIBO [6].Long-distance runners with exercise-related gastrointestinal symptoms compared to non-athletic controls. Research has established that high-intensity endurance training can reduce blood flow to the mesenteric vessels, impair small intestinal transit during physical effort, and compromise the integrity of the gut barrier [25] — a cluster of effects that may, at least temporarily, generate conditions favorable to bacterial overgrowth in individuals who are already predisposed to the condition [25]. Adding to this concern, the field currently lacks any published controlled intervention studies that have directly evaluated exercise as a targeted therapeutic strategy for SIBO [6].

For patients with undersized intestinal bacterial overgrowth (SIBO), following eating has been found to be a healthy way of helping improve the patient's digestion, as is easy with current mainstay treatments like antibiotics and dietary modification [6; 15]. There are two lines of evidence that buttress the basis of the recommendation. Light post-meal movement may also promote normal propulsive passage through the small intestine [6], restoring the innate housekeeping role of the gut, a process that is often disrupted and dysregulated in SIBO and the central mechanism for bacterial accumulation [6]. Second, gentle movement has well-established effects on reducing stress [15], and this added benefit may be clinically valuable since greater levels of psychological stress may disrupt gut motility and worsen the symptom burden already experienced by SIBO patients [6; 15].

High-intensity exercise is different. It is known to disturb blood flow to the gut and weaken the gut barrier [25]. Because of this, vigorous exercise during an active SIBO episode may make the problem worse instead of better [25].

### 3.4. Potential mechanisms of action

In addition, exercise raises the microbial production of such neuroactive factors as GABA precursors and serotonin metabolites [11]; these influence emotional regulation and central pain processing [9].

Reinforcement of the intestinal barrier. SCFA-driven upregulation of tight junction proteins (claudin-1, occludin, ZO-1) and exercise-related reductions in mucosal inflammation together strengthen the epithelial barrier. Allen et al. (2017) showed that microbiota harvested from exercising mice and transplanted into germ-free recipients reduced colonic inflammation and attenuated the response to chemical colitis – evidence that exercise-remodeled microbiota carry intrinsic barrier-protective properties.

### 3.5. Clinical implications

This review shows that being active is an important way to help with gut problems without using medicine [1]. Unlike taking probiotics or following strict diets, exercise is simple, free, safe when not overdone, and good for your heart, muscles, and mental health [1]. Regarding the aforementioned irritable bowel syndrome (IBS), overwhelming evidence supports moderate exercise. For example, brisk walking or swimming for at least 150 minutes per week, divided into 3 to 5 sessions [16]. Walking and swimming are easy to get going, and most people can do them. It is better to increase the intensity of your exercise in small increments as you become more capable and more comfortable [16]. Exercise, in addition to a low-FODMAP diet and mental health support, can supplement regular IBS treatment because it also helps the gut and brain interact—like talk therapy [16]. Taking short daily walks of 20 to 30 minutes may help to reduce constipation and can encourage regular and easier bowel movements [1]. Yoga boosts nerve signals and the work of pelvic muscles, and qigong has assisted people in Asian countries [1]. Furthermore, this exercise shows people that they need to use laxatives less frequently, something important since people who use laxatives long-term may have problems [1].

For SIBO, the absence of controlled trial data precludes formal recommendations. Clinicians may reasonably suggest gentle post-prandial walks as a helpful measure for MMC function, while steering symptomatic patients away from vigorous endurance training until bacterial overgrowth has been adequately treated.

People’s microbiota respond differently to exercise. Factors such as baseline BMI, dietary fiber intake, age, sex, medications, and the makeup of their microbiota before starting all affect the results. Because of this, it is better to create personalized exercise plans, ideally with input from gastroenterologists, physiotherapists, and dietitians, rather than using a one-size-fits-all approach.

**4. Discussion**

The findings in this review confirm that physical activity is a meaningful modulator of gut microbiota composition, with effects beyond simple changes in bacterial abundance. The consistent enrichment of SCFA-producing taxa, particularly Faecalibacterium prausnitzii, Akkermansia muciniphila, and Bifidobacterium spp., in physically active individuals suggests that exercise favors microbial communities linked to mucosal integrity, immune regulation, and metabolic homeostasis. These observations align with evidence that lifestyle-based interventions targeting the gut microbiota can produce systemic physiological benefits comparable to some pharmacological approaches. The relationship between exercise intensity and gut health is important. Moderate aerobic training consistently promotes favorable changes in the microbiota, while high-intensity or prolonged endurance exercise may temporarily compromise intestinal barrier function because of reduced blood flow and increased epithelial permeability. This dose-response pattern has direct clinical implications. Patients with pre-existing gastrointestinal disorders should start exercise at low to moderate intensity and increase gradually, with medical supervision as needed. Further research is needed to distinguish between therapeutic and potentially harmful exercise loads, especially in IBS populations where visceral hypersensitivity may heighten exercise-induced gut discomfort.

The gut-brain axis is a key mechanism linking physical activity to functional gastrointestinal disorders. Exercise reduces HPA axis reactivity, lowers circulating cortisol, and decreases mast cell activation in the intestinal mucosa. These processes contribute to visceral hypersensitivity and altered motility in IBS. Improvements in psychological parameters such as anxiety and depression often accompany exercise-induced reductions in IBS symptoms, supporting the role of the gut-brain axis in clinical benefit. The overlap between the targets of cognitive-behavioral therapy and gut-directed hypnotherapy suggests that combining exercise with psychological interventions may have synergistic effects, though this has not yet been tested in adequately powered trials. Evidence on SIBO is the most limited of the three conditions examined in this review. The absence of controlled intervention studies means recommendations for SIBO patients must be extrapolated from general gut motility physiology and observational data in related conditions. The migrating motor complex, whose impairment is a central predisposing factor for SIBO, is sensitive to both autonomic tone and intestinal hormones such as motilin, both influenced by physical activity. Whether exercise can restore MMC function in SIBO patients, and whether any benefit would persist after exercise cessation, are questions that deserve dedicated research attention.

Functional constipation has the strongest evidence base of the three disorders. Meta-analyses show a 31% reduction in constipation risk with higher habitual physical activity, and mechanistic data indicate immediate bowel motility responses to even brief walking. The finding that gut motility increases within one to two minutes of walking, suggests exercise provides acute motility benefits without prolonged adaptation. This is especially relevant for hospitalized or mobility-limited patients, as even minimal ambulation may offer significant gastrointestinal benefits.

A key limitation of current research is the challenge of isolating the effects of exercise from confounding lifestyle factors, especially diet. Athletes and highly active individuals often consume more dietary fiber than sedentary controls, and fiber intake strongly influences the abundance of SCFA-producing bacteria. Future studies should include rigorous dietary controls or use within-subject crossover designs to accurately attribute changes in the microbiota to exercise. Using advanced multi-omics approaches, such as metagenomics, metatranscriptomics, and metabolomics, will be essential for understanding how exercise alters microbial function at the molecular level.

## 5. Conclusions

Physical activity modulates the gut microbiota in ways that are broadly consistent with improved gastrointestinal health. Regular moderate exercise increases microbial diversity, expands populations of SCFA-producing bacteria – including *Akkermansia muciniphila*, *Faecalibacterium prausnitzii*, and *Bifidobacterium* spp. – accelerates intestinal transit, attenuates mucosal inflammation, and supports the epithelial barrier through both direct microbial mechanisms and gut-brain connection pathways.

The leading clinical evidence to date is relevant to irritable bowel syndrome (IBS) and functional constipation: targeted aerobic exercise program intervention has led to significant decreases in symptom severity, and the mechanisms from which this is possible are becoming increasingly clear. For little intestinal bacterial overgrowth (SIBO), there is not yet enough information to make specific exercise recommendations, but moderate physical activity is generally considered safe. For all three conditions, people should be cautious with very intense exercise, since hard workouts can temporarily make the gut more leaky and alter blood flow, which might worsen symptoms. There are still no standard exercise plans that have been tested in large, high-quality studies focused on the gut bacteria. Future studies need to use advanced methods to study gut bacteria, track health outcomes, examine how exercise interacts with diet and probiotics, and identify the best types of exercise for different ages and levels of illness. Until we have more information, recommending regular moderate exercise as part of a healthy lifestyle for gut health is based on good, but still incomplete, scientific evidence.

**Disclosure**.

The authors report no conflicts of interest.

**Author Contributions:**

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All authors have read and agreed to the published version of the manuscript.

Funding. This research received no external funding.

AI statement. AI tools were used to assist in literature organization and language editing. All scientific content, interpretation, and conclusions remain the responsibility of the authors.

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