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INNOVATIVE APPROACHES IN IBS MANAGEMENT: THE ROLE OF PHYSICAL ACTIVITY AND WEARABLE TECHNOLOGIES

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ABSTRACT

Irritable bowel syndrome (IBS) is a chronic functional gastrointestinal disorder characterized by disturbances in intestinal motility, alterations in gut microbiota, visceral hypersensitivity, and dysregulation of the gut-brain axis. In recent years, interest has increased in the potential role of physical activity as a supportive, non-pharmacological intervention for symptom management, particularly in individuals who engage in recreational exercise.

This review aims to summarize current evidence on the association between physical activity and IBS symptoms, with a focus on physiological mechanisms, stress-related pathways, and the integration of wearable health technologies.

Relevant publications, including clinical trials, systematic reviews, and meta-analyses published between 2016 and 2025, were identified through PubMed, Scopus, and Google Scholar. Studies examining gastrointestinal physiology, neuroendocrine responses to exercise, and digital monitoring tools were included.

Findings suggest that regular exercise promotes intestinal peristalsis, supports microbial diversity, and reduces low-grade inflammation through immune modulation. Physical activity also contributes to lowering cortisol levels and balancing neurotransmitter activity within the gut–brain axis. Moderate-intensity activities, such as walking or cycling, appear particularly beneficial in alleviating gastrointestinal and psychological symptoms. Furthermore, wearable devices-including fitness trackers, smartwatches, and HRV monitors-offer opportunities to personalize exercise regimens by capturing real-time physiological data and correlating it with symptom fluctuations.

In conclusion, moderate and consistent physical activity shows promise as an adjunctive therapeutic approach in IBS management. The incorporation of wearable technologies facilitates individualized treatment strategies and underscores the need for continued interdisciplinary research in this rapidly evolving field.

KEYWORDS

IBS, Physical Activity, Exercise-Induced Stress, Microbiota, Wearable Technology, HRV

CITATION

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Introduction

Irritable bowel syndrome (IBS) represents one of the most prevalent functional gastrointestinal disorders worldwide, characterized by chronic abdominal discomfort and altered bowel habits in the absence of detectable structural abnormalities. Current epidemiological data indicate that this condition affects approximately 3.8% of the global population, making it a significant clinical concern that substantially impacts healthcare systems and patients' quality of life [1]. The diagnostic conceptualization of IBS has undergone substantial evolution over the past decades, reflecting advances in our understanding of its complex nature. This diagnostic journey commenced with the establishment of the Manning criteria in 1978, which identified key symptomatic patterns, and has progressed through successive refinements of the internationally recognized Rome Criteria. The most recent iteration, the Rome IV Criteria published in 2016, introduced more stringent diagnostic parameters that emphasize a positive diagnosis based on specific symptom patterns rather than merely excluding other conditions [2].

According to the current Rome IV diagnostic framework, IBS is formally defined as”a functional bowel disorder (FBD) in which recurrent abdominal pain is associated with defecation or a change in bowel habits. Disordered bowel habits are typically present (e.g., constipation, diarrhea, or a mix of constipation and diarrhea), as are symptoms of abdominal bloating/distention. Symptom onset should occur at least 6 months before diagnosis and symptoms should be present during the last 3 months" [3]. This definition highlights the chronic nature of the disorder and establishes clear temporal parameters for diagnosis, ensuring consistency in both clinical practice and research settings.

The diagnostic criteria have subsequently been operationalized into a classification system that categorizes patients into four distinct subtypes based on their predominant stool pattern as evaluated through the Bristol Stool Form Scale. These subtypes include: IBS with constipation (IBS-C), characterized by hard or lumpy stools; IBS with diarrhea (IBS-D), featuring loose or watery stools; IBS with mixed bowel habits (IBS-M), where patients experience alternating constipation and diarrhea; and unclassified IBS (IBS-U), which encompasses patients who meet diagnostic criteria but whose symptoms cannot be consistently categorized into the other subgroups [2, 3]. This subtyping approach has important clinical implications, as it enables more targeted therapeutic interventions tailored to the specific manifestation of the disorder in individual patients.

The pathophysiological underpinnings of IBS remain incompletely elucidated, though current evidence points to a multifactorial etiology involving dysregulation of the gut-brain axis. This complex bidirectional communication system between the central nervous system and the enteric nervous system appears to malfunction in IBS patients, leading to characteristic symptoms through several interconnected mechanisms. These include visceral hypersensitivity (heightened perception of normal intestinal activity), altered gastrointestinal motility, abnormal secretion, and disturbances in central processing of gut sensations. Multiple risk factors contribute to this dysregulation, including specific dietary components that may trigger symptoms, previous gastrointestinal infections that can initiate long-term changes in gut function, increased intestinal permeability allowing enhanced antigen exposure, quantitative and qualitative alterations in the gut microbiota composition, chronic psychological stress, comorbid anxiety and depression, and certain genetic polymorphisms that may predispose individuals to developing the disorder [4, 5].

Given the functional nature of IBS and the frequently limited efficacy of pharmacological approaches, there is growing interest in non-pharmacological management strategies that address the underlying pathophysiological mechanisms. Among these approaches, physical activity has emerged as a potentially valuable therapeutic modality that may influence multiple aspects of the disorder [6, 7]. Regular exercise has been shown to modulate gut motility, reduce systemic inflammation, normalize stress responses, and positively influence the composition of the gut microbiota - all mechanisms relevant to IBS pathophysiology. However, the evidence regarding its efficacy remains somewhat inconsistent, particularly when considering specific population subgroups such as recreational athletes.

This population presents unique characteristics that may modify the relationship between physical activity and gastrointestinal symptoms. Recreational athletes typically engage in structured exercise regimens that exceed general physical activity recommendations, often combining different training modalities and intensities. Their nutritional strategies frequently involve specialized diets aimed at optimizing performance and recovery, which may include high intake of certain carbohydrates, proteins, and supplements that could potentially trigger gastrointestinal symptoms. Additionally, they experience distinct psychosocial stressors related to performance expectations, competition anxiety, and time commitments that may influence gut-brain axis functioning. The physiological stress of intense exercise itself can induce transient gastrointestinal symptoms through splanchnic hypoperfusion during vigorous activity, release of gastrointestinal hormones, and mechanical jostling of the digestive organs – effects that might interact complexly with pre-existing IBS pathophysiology [8, 9].

Therefore, this article aims to comprehensively examine the role of physical activity in the management of IBS specifically among recreational athletes, addressing the unique considerations relevant to this population. The investigation will pay particular attention to modern assessment methodologies, including wearable technology for objective monitoring of physical activity parameters, electronic symptom diaries for real-time tracking of gastrointestinal complaints, and novel biomarkers that might provide insights into the exercise-IBS relationship. By synthesizing existing evidence and identifying knowledge gaps, this work seeks to contribute to more personalized management approaches for active individuals suffering from this complex disorder.

Research materials and methods

This narrative review was conducted on the basis of scientific literature published between 2016 and 2025, providing a contemporary and comprehensive perspective on the subject matter. Articles were systematically retrieved from major biomedical databases, including PubMed, Scopus, and Google Scholar, using a carefully selected set of keywords and phrases such as *Irritable Bowel Syndrome*, *physical activity*, *gut-brain axis*, *HRV* and *wearable technology*. This search strategy was designed to ensure a broad yet targeted coverage of the most relevant publications in the field.

The inclusion criteria were deliberately focused on high-quality evidence, namely meta-analyses, randomized controlled clinical trials, and narrative or systematic review articles that specifically investigated

the effects of physical activity on IBS symptomatology, intestinal physiology, and stress-related neuroendocrine responses. Studies that did not meet these criteria - in particular those addressing exclusively pharmacological interventions or organic gastrointestinal pathologies - were excluded from the analysis to maintain a clear focus on functional disorders and non-pharmacological therapeutic approaches.

The scope of the analysis encompassed several interrelated thematic areas:

Physiological effects of exercise on gut function (motility, microbiota, inflammation),

The gut-brain axis and neuroendocrine regulation under physical stress,

The use of wearable devices for symptom tracking and personalized intervention.

All data were reviewed qualitatively, enabling the identification of the principal mechanisms involved and the potential clinical applications of exercise-based interventions, with particular emphasis on recreationally active individuals diagnosed with IBS.

Discussion

Mechanisms of the impact of physical activity on the gastrointestinal system

Although the amount of scientific evidence suggesting that physical activity exerts a significant impact on the proper functioning of the gastrointestinal tract continues to grow, it must be emphasized that the biological mechanisms underlying this phenomenon remain only partially understood. Current research most frequently points to two major and closely interconnected pathways: on the one hand, enhanced intestinal motility, and on the other, modulation of the gut microbiota composition. Nevertheless, the precise magnitude of these effects, their reproducibility across different study populations, as well as a definitive confirmation of their causal nature, remain incompletely clarified. This highlights the need for further mechanistic research specifically designed to explore these complex interactions.

Aerobic exercise, as well as low- to moderate - intensity physical activity, has been consistently shown to accelerate intestinal transit through stimulation of physiological peristalsis. This acceleration is associated with a reduction in symptoms such as constipation and bloating. Mechanically, this effect is explained by the enhancement of rhythmic contractions of the smooth muscle within the intestinal wall, which facilitates a more efficient propulsion of luminal contents along the entire gastrointestinal tract.

An equally important component of this relationship is the effect of regular physical activity on the gut microbial ecosystem. Evidence indicates that consistent exercise increases microbial species diversity and promotes the growth of beneficial bacterial genera, including Lactobacillus, Bifidobacterium, and Faecalibacterium. These microbial changes lead to increased production of short-chain fatty acids (SCFAs), most notably butyrate, which plays a crucial role in maintaining mucosal barrier integrity and ensuring adequate immune communication within the gut. However, it is important to note that very intense or prolonged exercise, particularly when performed without sufficient recovery periods, may transiently reduce bacterial richness and disturb gut homeostasis [8-10].

The role of the gut-brain axis and stress

Referring to the previously discussed influence of physical activity on gut microbiota diversity, it is equally important to consider the substantial role of psychological stress, which is one of the major factors disrupting gut microbial homeostasis [11, 12]. Central to this discussion is the gut-brain-microbiota axis, a complex bidirectional network linking psychological processes, the central and autonomic nervous systems, the immune system and the gastrointestinal tract with its metabolically, immunologically, and neuroendocrinologically active microbiota, via complex and not fully elucidated communication pathways [11, 12].

Importantly, the proper development and maturation of the hypothalamic–pituitary–adrenal (HPA) axis are partially dependent on a balanced intestinal microbiota [11]. This relationship underscores the pivotal role of gut flora in the development and functioning of the central nervous system and in the organism’s adaptation to stress [11, 13]. In line with this reasoning, exposure to chronic stress is associated with altered microbial composition, reduced diversity, and increased intestinal permeability [11, 13], which in turn activates the immune system and induces a state of low-grade inflammation. Concurrently, stress increases plasma corticosterone levels and decreases noradrenaline concentrations in the brain, resulting in altered synaptic transmission and modulation of emotion-regulating brain regions [13, 14].

Physical activity is widely regarded as a non-pharmacological intervention that mitigates the effects of psychological stress [15] and supports proper HPA axis regulation, potentially improving the course of IBS [16].

A 2022 meta-analysis by Len De Nys et al. demonstrated that regular physical activity significantly reduces cortisol levels (SMD [95% CI] = -0.37) and improves sleep quality, thereby supporting more effective regulation of the HPA axis [17]. Studies by Carly J. Wood et al. further confirmed that both exposure to physical activity and high physical fitness are associated with a blunted cortisol response to psychosocial stress, such as that induced by the Trier Social Stress Test (TSST) [18]. On a neurobiological level, Peng Xue et al. have shown that exercise enhances the secretion of endorphins, serotonin, dopamine and brain-derived neurotrophic factor (BDNF), all of which contribute to greater psychological resilience, long-term HPA axis regulation and reduced maladaptive stress responses [19].

However, it is important to emphasize that intense physical activity may induce a transient increase in cortisol levels, which at first glance appears counterproductive in this context. Nonetheless, as noted by Basso & Suzuki, this acute cortisol response may have a buffering and adaptive effect, ultimately reducing the organism's response to subsequent stressors. The inhibitory mechanisms underlying this phenomenon are believed to involve structures such as the hippocampus and prefrontal cortex [20].

Review of clinical studies on physical activity and IBS symptoms

Findings from randomized clinical trials and meta-analyses conducted between 2016 and 2024 suggest that regular physical activity - particularly moderate-intensity aerobic exercise and mind–body practices such as yoga and tai chi - may offer significant relief for individuals with IBS.

In one randomized pilot trial, 20 women diagnosed with mild to moderate IBS participated in a six-week exercise program involving treadmill walking for 30 minutes, three times per week. The intervention group showed a significant reduction in IBS symptom severity ($p \leq 0.001$) and an improvement in quality of life ($p = 0.001$), whereas no such improvements were observed in the control group [21].

A systematic review of 14 randomized controlled trials (total n = 683) examined various forms of physical activity, including yoga, walking/jogging, tai chi, and qigong. All interventions resulted in statistically significant improvements in gastrointestinal symptoms, although the methodological quality of the studies varied, and the overall risk of bias was considered moderate [22, 23].

In addition, a controlled study combining online yoga sessions with probiotic supplementation (31 participants over six weeks) demonstrated improvements in physical condition, a reduction in harmful gut bacteria such as *Klebsiella*, and a significant enhancement in quality of life as measured by the IBS-QOL questionnaire ($p < 0.05$) [16].

Emerging observational data further indicate that moderate-intensity physical activities—such as brisk walking, cycling, swimming, and yoga - may offer the most consistent therapeutic benefit for IBS patients. These effects are likely mediated through an interplay of physical, psychological, and gut microbiota-related mechanisms [9].

A recent review published in *Nutrients* (2023) analyzed the physiological mechanisms through which exercise influences IBS symptomatology. Findings from the SEPAHAN cohort (The Study on the Epidemiology of Psycho-Alimentary Health and Nutrition) which included over 5, 000 participants, showed that engaging in regular physical activity for at least 12 weeks led to a reduction in constipation-related symptoms and improved general gut comfort. However, no significant improvement in overall quality of life was observed [24, 25]. Two longitudinal studies from Sweden, with follow-up periods of 12 months and an average of 5.2 years respectively, demonstrated that moderate to vigorous physical activity - such as walking, cycling, and aerobics performed for 20 to 60 minutes, three to five times per week - significantly reduced the severity of gastrointestinal symptoms, improved overall well-being, and decreased levels of anxiety and depression compared to control groups [24].

Similarly, a smaller 2016 study found that yoga helped alleviate somatic complaints, while regular walking eased gastrointestinal discomfort and emotional tension. Notably, walking produced more stable long-term benefits, likely due to higher adherence and consistency of exercise [24, 26].

A qualitative study by Johannesson et al. (2018) aimed to explore how individuals with IBS perceive the effects of physical activity on their symptoms and daily functioning. The study involved 15 adults with a long-standing diagnosis of IBS [27]. The authors highlighted that the effectiveness of exercise in mitigating symptoms such as abdominal pain, bloating, and irregular bowel habits is highly dependent on the patient's individual experience. This underlines the importance of a flexible and personalized approach when recommending physical activity in clinical practice. Although current findings are promising, the overall quality of evidence remains moderate due to methodological heterogeneity and relatively small sample sizes across studies [27, 28].

Clinical research on the effects of physical activity on IBS symptoms is continuously expanding, with new studies regularly contributing valuable insights. Ongoing monitoring of emerging evidence and further development of tailored exercise interventions are essential to optimize treatment strategies for IBS patients.

The use of modern devices to monitor the impact of physical activity on IBS symptoms

One of the most notable emerging therapeutic approaches in recent years is biofeedback, which is defined as a structured process that enables individuals to gradually acquire the ability to regulate selected physiological functions - such as heart rate, muscle tension, respiration, or heart rate variability - by receiving continuous, real-time feedback from specialized monitoring devices. Through the visualization or auditory presentation of these signals, patients are given the opportunity to recognize subtle physiological changes occurring in their bodies and to consciously modify them using targeted behavioral or relaxation techniques. In this way, biofeedback transforms normally unconscious biological processes into parameters that can be actively controlled, with the overarching goal of reducing maladaptive stress responses and improving overall physical as well as mental well-being [29].

Recent studies indicate that heart rate variability biofeedback (HRV-BFB) may represent an effective adjunctive method for managing IBS. Regular HRV-BFB training has been shown to enhance parasympathetic activity while reducing sympathetic drive, which in turn alleviates psychological stress and gastrointestinal symptoms. In a study conducted by Minjoz et al., short daily HRV-BFB sessions significantly reduced stress levels and sympathetic reactivity in patients with IBS [30]. Furthermore, a systematic review by Pereira et al. demonstrated that HRV-BFB training lasting at least six weeks can improve autonomic nervous system functioning and consequently reduce symptoms of functional gastrointestinal disorders [31]. Additionally, a meta-analysis conducted by Sadowski et al. confirmed that individuals with IBS exhibit reduced high-frequency HRV components, reflecting impaired parasympathetic regulation and dysfunction of the gut-brain axis [32].

In recent years, increasing attention has been directed toward the integration of biofeedback techniques with wearable technology devices worn on the body such as fitness bands, smartwatches, rings, or sensor-equipped shirts. These tools enable continuous, non-invasive monitoring of physiological parameters including heart rate, HRV, skin temperature, muscle tension and activity levels [33, 34]. Such monitoring allows for real-time assessment of gut-brain axis function and identification of moments of autonomic imbalance, which often precede the onset of gastrointestinal symptoms [33, 34]. By integrating data from wearable devices with mobile applications, users can access detailed reports regarding physiological responses, stress levels and the effectiveness of various interventions, such as physical activity. This facilitates individualized, evidence-based functional therapy.

In the context of recreational athletes, it is particularly noteworthy that the integration of wearable devices and biofeedback technologies provides a highly valuable tool for safely tailoring the intensity, duration, and overall parameters of physical activity to the individual psychophysiological status of persons diagnosed with IBS. By continuously monitoring physiological responses and providing immediate feedback, these tools enable a dynamic and responsive approach to exercise management, which helps to prevent unintended exacerbation of gastrointestinal symptoms that could arise from inappropriate training loads.

This personalized, real-time feedback allows individuals to modulate their activity in accordance with their current physiological state, thereby minimizing the risk of iatrogenic symptom aggravation and supporting a more balanced interaction between exercise and gut function. Consequently, there exists a clearly identifiable need for the systematic development of individualized exercise programs that effectively incorporate biometric data obtained from wearable technologies. Such programs hold considerable potential to play a pivotal role in the future creation of functional therapeutic protocols, specifically designed for patients with IBS who maintain physically active lifestyles and may contribute to optimizing both health outcomes and quality of life in this population.

Conclusions

In summary, there is a definitive and pressing need to move beyond generic exercise advice for individuals with Irritable Bowel Syndrome (IBS) and instead develop highly personalized programs. The condition's hallmark is its variability; symptom presentation and severity differ drastically from one person to another. Consequently, patient response to physical activity is equally diverse, with some tolerating vigorous exercise while others require gentle, mindful movement to avoid exacerbating their gastrointestinal distress. This heterogeneity demands a tailored approach that carefully considers each individual's unique symptoms, triggers, and current fitness level.

The advancement of digital health tools, particularly sophisticated mobile applications, holds significant promise for revolutionizing this personalized care. These apps can facilitate the detailed monitoring of the dynamic interaction between physical activity, diet, stress, and gastrointestinal symptoms in real-time. This data-driven approach allows for continuous feedback and adjustment of exercise regimens, optimizing their benefits while minimizing risks. Furthermore, effectively managing the complex nature of IBS necessitates robust interdisciplinary collaboration. Gastroenterologists, physiotherapists with expertise in gut-directed therapy, and sports psychologists must work together to address the full spectrum of physical and psychological facets of the condition.

An especially promising and emerging frontier for future research involves the gut microbiome. Investigating its potential role as a predictive biomarker for exercise response could unlock a new level of personalization. Understanding how an individual's unique microbial composition influences and is influenced by physical activity may provide crucial insights for designing even more effective therapeutic interventions. Although this field of study is still in its early stages, it represents a compelling direction for deepening our understanding of the intricate relationship between movement and gut health.

Disclosure

Conceptualization: NN, MS, GS
Methodology: MS, NN, MK, MC
Software: MC, MK
Validation: KF, AT
Formal analysis: MS, JG, AA
Investigation: NN, AL, MS, MK
Resources: KF, AT, AA
Data curation: MC, GS, JG
Writing – original draft preparation: NN, MS, AL
Writing – review and editing: KF, AT, GS
Visualization: MC, MK
Supervision: NN, KF
Project administration: AL, GS

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