NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

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

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

**UTNIK, Martyna, BAJUR, Patrycja, CZERECZON, Wiktor, DZIAŁOWY, Maksymilian, and USZKO, Milena. The Impact of Performance Supplements on Irritable Bowel Syndrome-like Gastrointestinal Distress in Athletes. Quality in Sport. 2026;53:69931. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.53.69931**

**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: 17.03.2026. Revised: 21.03.2026. Accepted: 22.03.2026. Published: 30.03.2026.**

# The Impact of Performance Supplements on Irritable Bowel Syndrome-like Gastrointestinal Distress in Athletes

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## ABSTRACT

**Background.** Athletes frequently experience gastrointestinal (GI) disturbances overlapping with Irritable Bowel Syndrome (IBS). Performance supplements—including carbohydrate gels and beverages, protein powders, creatine, caffeine-based pre-workouts, probiotics, prebiotics, and buffering agents—can mechanistically exacerbate or attenuate these symptoms.

**Aim.** To summarize human data (2021–2026) regarding the effects of performance and recovery supplements on IBS-like symptoms in athletes, identifying mechanistic themes and research gaps.

**Material and methods.** This narrative review synthesized evidence from PubMed and Scopus, including observational studies and clinical trials.

**Results.** No identified trials recruited athletes with Rome-defined IBS, though a high prevalence of IBS-like symptoms was documented. Multi-strain Lactobacillus or Bifidobacterium probiotics showed small-to-moderate reductions in symptom severity in several randomized trials. Conversely, prebiotics and high-FODMAP (Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols) sports products were linked to increased lower-GI burden. Experimental data indicated higher symptom rates with solid carbohydrates compared to gels or beverages at equivalent dosages. Sodium bicarbonate remains strongly associated with GI discomfort, despite novel hydrogel delivery systems. Emerging "gut-supportive" supplements (e.g., collagen peptides, multi-ingredient fermented whey) showed neutral acute effects or preliminary, uncontrolled chronic improvements.

**Conclusions.** Supplement effects are highly dependent on FODMAP content, osmolality, and underlying GI vulnerability. Multi-strain probiotics and low-FODMAP carbohydrate strategies demonstrate the most consistent potential for symptom reduction. High-priority research should focus on rigorously phenotyped athletes with confirmed IBS and head-to-head trials of low- vs. high-FODMAP formulations.

**Keywords:** Irritable bowel syndrome, exercise-induced gastrointestinal syndrome, sports nutrition supplements, probiotics, prebiotics, FODMAP, endurance athletes, sodium bicarbonate, protein supplements, carbohydrate gels

## 1. Introduction

GI complaints are highly prevalent among athletes, particularly within endurance and ultra-endurance populations. Symptoms such as abdominal pain, bloating, nausea, diarrhea, constipation, and fecal urgency are frequently reported during both training and competition [1,2,3,4,5,6]. Large-scale surveys indicate that approximately one-quarter to one-half of recreational and competitive runners, as well as team-sport athletes, experience significant GI symptoms. These symptoms are often of sufficient severity to impair both athletic performance and general well-being [2,5,6]. Symptom patterns commonly include lower GI manifestations—such as bloating, abdominal pain, loose stools, and fecal urgency—that closely

resemble the clinical presentations of IBS and other functional bowel disorders [5,7,8]. However, in the majority of sport-specific studies, these manifestations are captured as "exercise-associated gastrointestinal symptoms" (Ex-GIS) or within the broader framework of "exercise-induced gastrointestinal syndrome" (EIGS), typically without the application of formal IBS phenotyping [7,9,10].

In parallel, the use of performance- and recovery-oriented sports nutrition supplements has become ubiquitous in both elite and recreational sports. Athletes frequently consume carbohydrate gels and electrolyte drinks, protein powders, caffeine-based pre-workout formulations, creatine, and buffering agents (e.g., sodium bicarbonate), alongside a growing array of "gut-focused" products such as probiotics, prebiotics, bovine colostrum, collagen, and fermented whey [1,7,9,11,12,13]. Many of these products are mechanistically poised to modulate GI function. Concentrated carbohydrate solutions and gels can increase luminal osmolality, thereby drawing fluid into the intestinal lumen; furthermore, when these products are rich in fructose or sugar alcohols, they contribute substantial FODMAP loads [5,8,9,11]. Protein supplements—frequently dairy-based, sweetened, and ingested in large boluses—may delay gastric emptying and increase colonic fermentation. Observational data suggest a higher prevalence of GI complaints among regular users of these products [2]. Classic ergogenic aids, such as sodium bicarbonate, are well recognized for inducing bloating, nausea, and diarrhea. Recent research indicates that although novel hydrogel-based delivery systems improve pharmacokinetics, they do not entirely eliminate GI discomfort [9,11,14].

Conversely, several supplements are promoted as strategies to protect or support intestinal integrity under the physiological stress of exercise. Randomized controlled trials (RCTs) and systematic reviews suggest that multi-strain Lactobacillus and Bifidobacterium probiotics may modestly reduce the frequency and severity of GI symptoms in specific athlete cohorts, most notably among endurance runners and cyclists [15,16,17,18,19]. Other functional agents—including bovine colostrum, glutamine, specific phenolic compounds, collagen peptides, and fermented whey—have been evaluated for their capacity to attenuate markers of intestinal damage and permeability. In certain instances, these agents have also been shown to improve subjective GI comfort; however, findings remain heterogeneous and are frequently constrained by small sample sizes and suboptimal experimental controls [9,12,13,20,21]. Prebiotic interventions, despite their robust microbiota-modulating potential, have not consistently

translated into reductions in exercise-induced GI symptoms among either elite or recreational endurance athletes [19,22,23,24].

Historically, the majority of research in this field has framed outcomes as Ex-GIS or EIGS, focusing primarily on mechanistic endpoints—such as intestinal fatty acid-binding protein (I-FABP), the lactulose:rhamnose ratio, endotoxemia, and cytokine concentrations—rather than on IBS or IBS-like symptom constructs *per se* [9,10,12,21,24]. More recently, validated instruments—such as the Gastrointestinal Symptom Rating Scale (GSRS) and structured Ex-GIS questionnaires—have been applied within team-sport and endurance cohorts. These tools have revealed a high burden of both chronic GI complaints and exercise-triggered symptoms that are phenotypically similar to IBS [2,3,4,6,20]. Concurrent advances in sports nutrition have highlighted that many commonly utilized products—including popular carbohydrate gels, beverages, and bars—contain high concentrations of FODMAPs. Consequently, these products may be particularly problematic for athletes with underlying IBS or heightened visceral hypersensitivity [5,8]. Despite these findings, there has been no comprehensive synthesis in the 2021–2026 literature evaluating how contemporary performance and recovery supplements—as they are utilized in practice by athletes—relate specifically to IBS and IBS-like GI outcomes.

The present review aims to address this gap by: summarizing recent human data regarding the effects of sports nutrition supplements on IBS and IBS-like GI symptoms among athletes and recreationally active individuals, distinguishing supplements that appear to alleviate symptoms from those that more commonly exacerbate them, with specific focus on formulation characteristics—such as FODMAP content, osmolality, dosage, and timing and identifying critical methodological limitations and research priorities for future trials. These priorities include the necessity for formal IBS phenotyping, head-to-head comparisons of low- versus high-FODMAP formulations, and the evaluation of real-world "stacked" supplement use on GI outcomes.

## 2. Supplements and GI Symptom Expression

### 2.1. Probiotic Supplements

The current evidence regarding probiotic supplementation in high-performance sports suggests that while benefits exist, they are often nuanced and population-specific. For instance, a 90-day multi-strain probiotic intervention in elite male road cyclists demonstrated a reduction in the incidence and severity of GI symptoms over a competitive season compared to a placebo.

However, these effects were characterized as modest and were not observed consistently across all symptom categories [15]. Similarly, long-distance runners who utilized a multi-strain probiotic for a three-month period reported a lower incidence of constipation and improvements in subjective GI health and overall well-being. Notably, these effects were most pronounced among female participants [16]. Conversely, when examining EIGS under controlled physiological stress, a four-week probiotic intervention (*Pediococcus acidilactici* and *Lactobacillus plantarum*) in endurance runners performing treadmill exercise in the heat did not significantly alter GI symptoms, permeability markers, or microbiota composition compared to a placebo [25]. A broad synthesis of RCTs and systematic reviews indicates that multi-strain *Lactobacillus* and *Bifidobacterium* formulations yield small-to-moderate reductions in GI symptom frequency and severity among endurance athletes. These benefits are particularly evident for individuals experiencing a combination of chronic and exercise-related symptoms [15,16,17,18,19,26]. It is imperative to note that these effects are not consistent across all strains or contexts; for example, at least one high-quality RCT demonstrated no significant symptomatic benefit [25]. However, a 2025 meta-analysis encompassing 26 trials found that while there was no global effect of supplementation on GI symptoms, a moderate beneficial effect was observed specifically for probiotics (Hedges' $g \approx -0.62$; borderline significance) [26]. For an athlete predisposed to IBS, this body of work supports the administration of a multi-strain *Lactobacillus* and *Bifidobacterium* formulation for a minimum of 8–12 weeks as a plausible, albeit not guaranteed, strategy to mitigate IBS-like symptoms during training and competition. Athletes should anticipate modest symptom attenuation rather than complete resolution and must recognize that strain selection and intervention duration are critical determinants of efficacy [15,16,17,19,26].

### 2.2. Prebiotic Supplements

Evidence regarding prebiotic supplementation across diverse athletic cohorts suggests limited efficacy for GI symptom management. In elite rugby union—a high-intensity collision and team sport—a 24-week galactooligosaccharide (GOS) prebiotic intervention failed to convincingly reduce the incidence or severity of GI symptoms compared to a placebo, notwithstanding observed alterations in specific immune markers [22]. Similarly, a 12-week study comparing β-galactooligosaccharides (β-GOS) to maltodextrin in recreational endurance athletes found no significant or consistent reduction in exercise-induced GI distress. This pilot study was characterized as small and underpowered, demonstrating only marginal trends toward improved

subjective comfort [23]. Under conditions of exertional heat stress, an eight-week high-dose prebiotic protocol (16 g/d) utilized during a three-hour heat-stress run (60% $VO_2$max, 30°C) did not attenuate the severity of EIGS, feeding intolerance, or markers of intestinal permeability [24].

A comprehensive systematic review of prebiotics, probiotics, and synbiotics in healthy and active adults concluded that no consistent improvements in GI permeability or symptoms occur while at rest. During exercise, only modest, strain- or dose-specific benefits were observed; prebiotics, in particular, failed to reliably mitigate EIGS [19]. These findings highlight a significant discrepancy between the theoretical mechanisms of prebiotics and their practical application within athletic settings. Despite their popularity and plausible microbiome-strengthening mechanisms, prebiotics have not demonstrated robust symptomatic relief among athletes. Furthermore, these substrates may increase the fermentable load within the GI tract, which can be particularly problematic for individuals predisposed to IBS. At present, for an athlete experiencing IBS-like symptoms, prebiotics represent a higher-risk, lower-evidence intervention compared to probiotics.

### 2.3. Protein-Based Supplements

The market for "gut-friendly" functional proteins has expanded significantly, although clinical evidence remains equivocal. In a study involving 50 athletes with self-reported GI complaints (compared to a control group of 21 asymptomatic individuals), baseline GSRS scores and general well-being were significantly lower in the symptomatic cohort [20]. A three-week intervention utilizing a multi-ingredient fermented whey product within this symptomatic cohort was associated with reduced GI complaints and specific taxonomic shifts in the microbiota. However, the study lacked a concurrent control group, making it difficult to differentiate these outcomes from a placebo effect or simple regression to the mean [20]. While these findings suggest a potential benefit for chronic IBS-like complaints, causality remains unestablished. In contrast, collagen peptides have been evaluated under more rigorous experimental conditions. A randomized, controlled crossover trial utilizing 10 g/d of collagen peptides for seven days—including a pre-exercise bolus administered before a 70-minute high-intensity run—found no significant reduction in exercise-induced GI symptoms or markers of intestinal damage compared to a placebo [21]. Importantly, collagen supplementation did not exacerbate symptoms, indicating favorable GI safety at these specific dosages. Real-world data from collegiate sports further underscore a strong correlation between protein supplementation

and digestive distress. Among 44 Division I American football athletes, 61% reported at least one GI symptom in daily life, while 52% reported complaints specifically during exercise [2]. Within this cohort, 41% utilized protein supplements; notably, these users reported a significantly higher prevalence and severity of GI complaints compared to non-users [2]. This finding represents one of the most distinct indications that standard sports protein supplements—which are frequently whey-based and often contain lactose, high-FODMAP sweeteners, or substantial bolus dosages—are associated with IBS-like symptoms within team-sport environments.

The impact of protein supplementation on GI function ranges from neutral to deleterious, contingent upon the specific formulation and dosing strategy utilized. Ingredients such as lactose, specific FODMAPs, artificial sweeteners (particularly polyols), and added functional fibers are plausible causal contributors to IBS-like symptoms. This is particularly evident in athletes with high baseline protein intakes and pre-existing visceral hypersensitivity [2]. Regarding functional products marketed with "gut-health" claims, the data are currently limited. Fermented whey shows potential but lacks rigorous controlled validation; conversely, collagen appears neutral, offering no specific benefit for EIGS while causing no additional distress [21].

For athletes predisposed to IBS, priority should be given to the meticulous selection of protein sources and excipients. Prioritizing low-lactose or lactose-free isolates, low-FODMAP sweeteners, and moderate bolus dosages—while strictly avoiding polyols (sugar alcohols)—represents a more evidence-based strategy than relying solely on "gut-supportive" marketing claims.

### 2.4. Carbohydrate Supplements

The delivery format of carbohydrate (CHO) sources significantly influences GI outcomes during exercise. A systematic review comparing whole foods to supplemental sources—such as gels and beverages—found that while performance outcomes remained comparable across formats, GI symptoms were generally more prevalent when consuming solid foods at equivalent CHO loads [27]. Furthermore, during a high-intake "gut-challenge" protocol (90 g/h of CHO during a two-hour run), athletes with a history of EIGS exhibited significantly lower feeding tolerance and appetite compared to asymptomatic counterparts, despite achieving comparable performance levels [3]. This highlights that an athlete's baseline GI sensitivity serves as a critical modulator of their capacity to tolerate high CHO loads during exertion.

The specific composition of sports nutrition products often parallels the dietary triggers identified in clinical IBS. A large-scale study of 430 endurance athletes revealed that many individuals habitually consume high-FODMAP diets, with a substantial portion of that fermentable load derived specifically from sports-specific formulations. Laboratory analysis of common gels, beverages, and bars identified high concentrations of fructose, fructo-oligosaccharides (FOS), and polyols—ingredients categorized as "IBS-unfriendly" by clinical standards. Crucially, the study demonstrated that higher FODMAP intake directly correlated with a greater prevalence of lower GI symptoms, such as abdominal pain, bloating, and diarrhea, strongly mirroring the symptomology observed in IBS patients [5].

Recent academic syntheses continue to reinforce the nexus between dietary fermentable carbohydrates and athletic performance. A 2026 narrative review concluded that high-FODMAP intake, particularly when delivered via specialized sports formulations, increases the risk of acute intestinal distress. Conversely, implementing short-term low-FODMAP strategies during the peri-exercise period has been shown to attenuate GI symptom severity in the majority of athletes studied. However, the review also cautioned that the long-term impacts of sustained low-FODMAP adherence on systemic health and the gut microbiota remain unestablished and necessitate further investigation [8].

CHO supplementation represents a "double-edged sword" for the competitive athlete: while essential for sustaining performance during high-intensity exertion, these substrates serve as primary drivers of IBS-like symptoms when characterized by high FODMAP concentrations, elevated osmolality, or substantial bolus dosages. For individuals predisposed to IBS, the current body of evidence supports two primary interventions. First, athletes should prioritize low-FODMAP, multiple-transportable carbohydrate (MTC) sources—such as specific glucose-fructose ratios—delivered in gel or aqueous form rather than solid bars or whole foods when targeting high exogenous oxidation rates [5,8,9,27]. Second, clinical success likely necessitates individualized "gut-training" protocols integrated with strategic, short-term low-FODMAP adjustments during the lead-up to key competitive events [9,8,28].

### 2.5. Buffers and High-Risk Ergogenics: Sodium Bicarbonate as a Case Study

Sodium bicarbonate is a well-established ergogenic aid; however, its practical application is frequently constrained by significant GI distress. In a randomized crossover study, well-trained cyclists ingested 0.3 g/kg of sodium bicarbonate utilizing two distinct delivery modalities: a

novel carbohydrate hydrogel-based mini-tablet system and conventional encapsulated formulations [14]. Researchers monitored GI symptoms utilizing a Visual Analogue Scale (VAS) over a 300-minute period at rest. Although the hydrogel system was found to elevate blood bicarbonate concentrations more effectively than the encapsulated format, it did not significantly attenuate GI discomfort [14]. These findings suggest that the physiological burden of the bicarbonate ion itself—rather than the delivery mechanism—may serve as the primary driver of GI distress. Systematic and narrative reviews further concur that buffering agents frequently induce bloating, nausea, and diarrhea, particularly at the performance-optimizing dosages of 0.2–0.3 g/kg typically utilized by athletes [9,11].

For athletes with IBS or heightened GI sensitivity, sodium bicarbonate remains a high-risk ergogenic aid that can trigger or markedly exacerbate symptoms. The evidence indicates that even novel delivery systems fail to fully mitigate the potential for GI distress, as the underlying osmotic and metabolic challenges persist [14]. For individuals who still intend to utilize buffering agents, mitigation strategies—such as implementing lower dosages, adopting a multi-stage dosing protocol over several hours, or utilizing enteric-coated formulations—may be advisable. However, for high-risk athletes, total avoidance of these agents during competitive events remains the most prudent course of action. It is essential to acknowledge that these recommendations are primarily extrapolated from general tolerability studies, as specific clinical trials evaluating sodium bicarbonate efficacy and safety within the IBS-athlete population are currently non-existent.

### 2.6. Creatine, caffeine “pre-workouts”, and BCAA/EAA mixes

The landscape of sports nutrition is dominated by ergogenic aids such as creatine, caffeinated pre-workout formulations, and branched-chain or essential amino acid (BCAA/EAA) blends, all of which remain mechanistically plausible contributors to IBS-like symptoms. The pathophysiological basis for these GI disturbances typically involves alterations in gastric motility, the creation of high osmotic pressure within the intestinal lumen leading to water influx, and the pharmacological effects of secondary excipients like artificial sweeteners or polyols. Despite these theoretical foundations, the academic literature spanning the 2021–2026 period reveals a significant lacuna in clinical evidence; specifically, there are no high-quality, randomized controlled trials conducted among athletic populations that isolate these supplements to investigate GI symptomology as a primary endpoint. Current understanding is largely extrapolated from general tolerability statements or derived from complex, multi-

ingredient study designs where the specific impact of an individual compound is obscured by the synergistic or confounding effects of other ingredients. Consequently, most evidence regarding the gut-disrupting potential of these substances is found within broad systematic reviews rather than targeted clinical interventions [9,11,13].

## 3. The GI Symptom Burden in Athletes

Observational research reveals a significant correlation between habitual supplement consumption and the prevalence of GI symptoms among athletes. In collegiate American football, players report a high GI symptom burden, with protein supplement users showing a notably higher frequency of complaints [2]. Similarly, endurance and ultra-endurance athletes experience high rates of Ex-GIS and IBS-like symptoms. These athletes frequently self-report identifying or modifying their intake of carbohydrate gels, drinks, caffeine, nitrates, and probiotics to manage distress [4,6,29]. Despite these challenges, many athletes eschew formal low-FODMAP or structured gut-training protocols, relying instead on informal trial-and-error methods [4,29].

Beyond physical discomfort, athletes with chronic GI complaints demonstrate diminished wellbeing, lower psychological scores, and altered microbiota compared to asymptomatic peers [20]. This reinforces the clinical significance of athletic GI distress, which remains functionally similar to IBS even without a formal diagnosis. Although these cross-sectional data do not infer causation, they confirm that performance supplements are deeply entwined with the real-world experience of IBS-like symptoms in athletic populations.

## 4. The Intersection of Exertion Intensity, Supplementation, and IBS-Like Symptoms in Athletes

Athletes and fitness enthusiasts frequently turn to dietary and performance supplements to enhance their physical capabilities and training outcomes [30]. However, the severity of GI distress in these populations is often directly proportional to the intensity of physical exertion; while low- to moderate-intensity activity can actually alleviate chronic IBS symptoms by improving gut motility, high-intensity training frequently provokes acute, IBS-like symptoms such as diarrhea, bloating, and heartburn [31,32,33]. To manage this exercise-induced GI distress, athletes must carefully monitor their dietary habits and the specific performance supplements they consume. Clinical evidence suggests that targeted dietary modifications—such as adopting a low-FODMAP diet or avoiding common GI triggers like excessive caffeine,

dairy products, alcohol, and high-lipid foods—can significantly alleviate these exertion-linked symptoms [34,35]. Because intense physical activity already places significant physiological stress on the gastrointestinal tract, ensuring that fitness supplements do not introduce additional dietary triggers is crucial for maintaining both gut health and optimal athletic performance [30, 34, 31].

## 5. Gaps and Future Research Perspectives

Future research design must address existing gaps by incorporating formal IBS and functional GI disorder phenotyping using the Rome criteria to stratify athlete cohorts. RCTs should directly compare high- versus low-FODMAP formulations of common products like gels and protein powders specifically within IBS-like populations. It is also necessary to isolate pre-workout ingredients, caffeine, and creatine as experimental variables with standardized GI outcomes. Rather than studying supplements in isolation, research should model real-world "stacking" behaviors—such as the simultaneous use of caffeine, carbohydrate gels, protein, and bicarbonate—to reflect actual athletic practice. Such studies must systematically control for background dietary FODMAP load, the use of NSAIDs or other medications, and external modulators like training load, environmental heat, and psychological stress, all of which significantly influence symptom expression.

## 6. Conclusions

This review of human trials conducted between 2021 and 2026 evaluates the impact of performance-enhancing supplements on IBS and IBS-like symptomology in athletic populations. It is important to note that the preponderance of current literature focuses on EIGS rather than clinically diagnosed, Rome-defined IBS [1,2,3,4,5,6,15,16,20,25]. Among the interventions evaluated, multi-strain probiotics incorporating Lactobacillus and Bifidobacterium species demonstrate the greatest therapeutic potential, yielding a modest reduction in symptom severity for chronic or mixed GI complaints. However, these clinical outcomes remain highly strain-specific, and their efficacy may be attenuated or negated by the physiological demands of exertional heat stress [15,16,17,18,19,26]. Conversely, prebiotics such as GOS have failed to demonstrate consistent clinical benefits and may potentially increase the fermentable load within sensitive individuals, thereby exacerbating osmotic pressure and luminal distension [19,22,23,24].

CHO supplementation represents a significant trigger for GI distress, as a substantial number of commercial gels and bars are characterized by high-FODMAP concentrations. Research indicates that higher habitual intake of these specific formulations correlates with a greater prevalence and severity of lower GI symptoms [5,8]. Solid food sources typically induce greater GI discomfort compared to liquid formulations; consequently, short-term low-FODMAP strategies implemented during the peri-exercise period are recommended to mitigate these ergogenic risks [18,27]. Protein supplementation—specifically whey-based formulations containing lactose or high-FODMAP sweeteners—is similarly associated with an increased symptom burden within team-sport cohorts [2]. While fermented whey may offer potential relief, collagen peptides appear gastrointestinally neutral—neither attenuating nor exacerbating the symptoms associated with EIGS [20,21].

Buffering agents, specifically sodium bicarbonate, remain highly problematic for sensitive athletes; they frequently induce bloating and diarrhea regardless of whether they are administered via standard encapsulated formats or novel hydrogel delivery systems [9,11,14]. The synthesis of this evidence suggests that the most efficacious approach for athletes predisposed to IBS involves an 8–12 week course of multi-strain probiotics, coupled with a transition to low-FODMAP, gel-based carbohydrate strategies [8,9,28]. Ultimately, because high-intensity physical exertion inherently provokes acute gastrointestinal distress, adopting these modifications is critical for managing the compounded physiological stress placed on the gut [31,32,33]. Furthermore, athletes must rigorously audit their broader supplementation routines and dietary habits to eliminate additional triggers—such as excess caffeine, dairy, and high-lipid ingredients—ensuring that performance aids do not inadvertently sabotage both gut health and athletic output [30,34,35]. Future research is required to explicitly evaluate athletes with formal clinical IBS diagnoses and to investigate the cumulative GI risk associated with "stacking" multiple ergogenic aids—such as caffeine, protein, and buffering agents—simultaneously.

**Disclosure**

**Author's contribution**

**Conceptualization** – Martyna Utnik

**Formal analysis** – Martyna Utnik, Patrycja Bajur, Milena Uszko

**Investigation** – Wiktor Czereczon, Milena Uszko

**Data curation** – Maksymilian Działowy, Patrycja Bajur

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**Writing – review and editing** – Patrycja Bajur, Milena Uszko

**Visualization** – Wiktor Czereczon, Maksymilian Działowy

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

**Funding statement:** No applicable.

**Institutional review board statement:** Not applicable.

**Informed consent statement:** Not applicable.

**Data availability statement:** The authors confirm that the data supporting this study are available in the article's references.

**Conflict of interest:** Authors declare no conflict of interest.

**References**

1. Ryan, T., E. Daly, and L. Ryan. 2023. "Exploring the Nutrition Strategies Employed by Ultra-Endurance Athletes to Alleviate Exercise-Induced Gastrointestinal Symptoms—A Systematic Review." Nutrients 15. https://doi.org/10.3390/nu15204330

2. Wardenaar, F. C., K. D. Schott, A. Mohr, C. P. Ortega-Santos, and J. E. Connolly. 2023. "An Exploratory Study Investigating the Prevalence of Gastrointestinal Symptoms in Collegiate Division I American Football Athletes." International Journal of Environmental Research and Public Health 20. https://doi.org/10.3390/ijerph20156453

3. Martinez, I. G., J. Biesiekierski, C. Rauch, and R. J. S. Costa. 2024. "Feeding Tolerance to a Running Gut-Challenge Protocol: a Cross-Sectional Exploration." International Journal of Sports Medicine 46: 510 - 524. https://doi.org/10.1055/a-2541-2821

4. Scrivin, R., R. J. S. Costa, F. Pelly, D. Lis, and G. Slater. 2022. "An exploratory study of the management strategies reported by endurance athletes with exercise-associated gastrointestinal symptoms." Frontiers in Nutrition 9. https://doi.org/10.3389/fnut.2022.1003445

5. Killian, L., J. Muir, J. Barrett, N. Burd, and S. Lee. 2021. "High Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols (FODMAP) Consumption Among Endurance Athletes and Relationship to Gastrointestinal Symptoms." Frontiers in Nutrition 8. https://doi.org/10.3389/fnut.2021.637160

6. Zhao, X., Y. Chen, X. Li, W. Wen, J. Zhang, and J. Qiu. 2025. "Gastrointestinal symptoms among recreational long distance runners in China: prevalence, severity, and contributing factors." Frontiers in Nutrition 12. https://doi.org/10.3389/fnut.2025.1589344

7. Ribichini, E., G. Scalese, A. Cesarini, C. Mocci, N. Pallotta, C. Severi, and E. Corazziari. 2023. "Exercise-Induced Gastrointestinal Symptoms in Endurance Sports: A Review of Pathophysiology, Symptoms, and Nutritional Management." Dietetics. https://doi.org/10.3390/dietetics2030021

8. Kołodziejczyk, A., W. Staśkiewicz-Bartecka, and M. Kardas. 2026. "The Role of FODMAPs in Sports Nutrition: A Narrative Review and Clinical Implications." Nutrients 18. https://doi.org/10.3390/nu18020239

9. Costa, R. J. S., S. Gaskell, K. Henningsen, N. A. Jeacocke, I. G. Martinez, A. Mika, V. Scheer, et al. 2025. "Sports Dietitians Australia and Ultra Sports Science Foundation Joint Position Statement: A Practitioner Guide to the Prevention and Management of Exercise-Associated Gastrointestinal Perturbations and Symptoms." Sports Medicine (Auckland, N.z.) 55: 1097 - 1134. https://doi.org/10.1007/s40279-025-02186-6

10. Gaskell, S., C. Rauch, and R. Costa. 2021. "Gastrointestinal Assessment and Therapeutic Intervention for the Management of Exercise-Associated Gastrointestinal Symptoms: A Case Series Translational and Professional Practice Approach." Frontiers in Physiology 12. https://doi.org/10.3389/fphys.2021.719142

11. Wilson, P. B. 2021. "Sport supplements and the athlete's gut: a review." International Journal of Sports Medicine. https://doi.org/10.1055/a-1704-3086

12. Chantler, S., A. Griffiths, J. Matu, G. Davison, A. Holliday, and B. Jones. 2022. "A systematic review: Role of dietary supplements on markers of exercise-associated gut damage and permeability." PLoS ONE 17. https://doi.org/10.1371/journal.pone.0266379

13. Bazarewicz, J., G. Adaśko, M. Świda, C. Kubuj, U. Mazur, P. Ogonowska, D. Dmowski, A. Michalska, J. Waszak, and M. Siwik. 2025. "Functional Supplements for Managing Exercise-Induced Gastrointestinal Distress: A Focused Review for Athletes." Quality in Sport. https://doi.org/10.12775/qs.2025.45.66517

14. Gough, L. A., and S. A. Sparks. 2024. "The Effects of a Carbohydrate Hydrogel System for the Delivery of Bicarbonate Mini-Tablets on Acid–Base Buffering and Gastrointestinal Symptoms in Resting Well-trained Male Cyclists." Sports Medicine - Open 10. https://doi.org/10.1186/s40798-024-00684-x

15. Schreiber, C., S. Tamir, R. Golan, A. Weinstein, and Y. Weinstein. 2021. "The effect of probiotic supplementation on performance, inflammatory markers and gastro-intestinal symptoms in elite road cyclists." Journal of the International Society of Sports Nutrition 18. https://doi.org/10.1186/s12970-021-00432-6

16. Smarkusz-Zarzecka, J., L. Ostrowska, J. Leszczyńska, and U. Cwalina. 2022. "Effect of a Multi-Strain Probiotic Supplement on Gastrointestinal Symptoms and Serum Biochemical Parameters of Long-Distance Runners: A Randomized Controlled Trial." International Journal of Environmental Research and Public Health 19. https://doi.org/10.3390/ijerph19159363

17. Łagowska, K., J. Bajerska, S. Kamiński, and C. D. Bo'. 2022. "Effects of Probiotics Supplementation on Gastrointestinal Symptoms in Athletes: A Systematic Review of Randomized Controlled Trials." Nutrients 14. https://doi.org/10.3390/nu14132645

18. Heimer, M., M. Teschler, B. Schmitz, and F. Mooren. 2022. "Health Benefits of Probiotics in Sport and Exercise - Non-existent or a Matter of Heterogeneity? A Systematic Review." Frontiers in Nutrition 9. https://doi.org/10.3389/fnut.2022.804046

19. Rauch, C., A. Mika, A. McCubbin, Z. Huschtscha, and R. J. S. Costa. 2022. "Effect of prebiotics, probiotics, and synbiotics on gastrointestinal outcomes in healthy adults and active adults at rest and in response to exercise—A systematic literature review." Frontiers in Nutrition 9. https://doi.org/10.3389/fnut.2022.1003620

20. Wardenaar, F. C., A. E. Mohr, C. P. Ortega-Santos, J. Nyakayiru, C. Kersch-Counet, Y. Chan, A. Clear, J. Kurka, K. D. Schott, and R. G. N. Seltzer. 2024. "Explorative Characterization of GI Complaints, General Physical and Mental Wellbeing, and Gut

Microbiota in Trained Recreative and Competitive Athletes with or without Self-Reported Gastrointestinal Symptoms." Nutrients 16. https://doi.org/10.3390/nu16111712

21. Taylor, G. S., A. Leonard, J. C. Y. Tang, R. Dunn, W. Fraser, N. Virgilio, J. Prawitt, E. Stevenson, and T. Clifford. 2022. "The effects of collagen peptides on exercise-induced gastrointestinal stress: a randomized, controlled trial." European Journal of Nutrition 62: 1027 - 1039. https://doi.org/10.1007/s00394-022-03051-2

22. Parker, C., K. Hunter, M. Johnson, G. Sharpe, G. R. Gibson, G. Walton, C. Poveda, B. Cousins, and N. Williams. 2023. "Effects of 24-week prebiotic intervention on self-reported upper respiratory symptoms, gastrointestinal symptoms, and markers of immunity in elite rugby union players." European Journal of Sport Science 23. https://doi.org/10.1080/17461391.2023.2216657

23. Gough, L. A., A. Weldon, C. Clark, A. Young, C. J. Roberts, N. D. Clarke, M. Brown, and R. Williams. 2025. "The Effects of 12-Week Prebiotic Supplementation on General Wellness and Exercise-Induced Gastrointestinal Symptoms in Recreationally Trained Endurance Athletes: A Triple-Blind Randomised Controlled Pilot Trial." Nutrients 17. https://doi.org/10.3390/nu17213390

24. Rauch, C., K. Henningsen, I. G. Martinez, P. Young, A. Mika, Z. Huschtscha, A. McCubbin, R. Henry, D. Anderson, and R. J. S. Costa. 2025. "The Effects of Prebiotic Supplementation on Markers of Exercise-Induced Gastrointestinal Syndrome in Response to Exertional Heat Stress." International journal of sport nutrition and exercise metabolism: 1-18. https://doi.org/10.1123/ijsnem.2024-0127

25. Lennon, S., T. Lackie, A. Miltko, Z. C. Kearns, M. Paquette, R. Bloomer, A. Wang, and M. v. d. Merwe. 2024. "Safety and Efficacy of a probiotic cocktail containing P. acidilatici and L. plantarum for gastrointestinal discomfort in endurance runners: Randomized Double-Blinded Crossover Clinical Trial." Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme. https://doi.org/10.1139/apnm-2023-0449

26. Aitkenhead, R., M. Waldron, G. E. Conway, K. Horner, and S. M. Heffernan. 2025. "The Influence of Dietary Supplements on Exercise-Induced Gut Damage and Gastrointestinal

Symptoms: A Systematic Review and Meta-Analysis." Nutrients 17. https://doi.org/10.3390/nu17030443

27. Reynolds, K. M., T. Clifford, S. Mears, and L. James. 2022. "A Food First Approach to Carbohydrate Supplementation in Endurance Exercise: A Systematic Review." International journal of sport nutrition and exercise metabolism: 1-15. https://doi.org/10.1123/ijsnem.2021-0261

28. Mlinaric, J., and N. Mohorko. 2025. "Nutritional strategies for minimizing gastrointestinal symptoms during endurance exercise: systematic review of the literature." Journal of the International Society of Sports Nutrition 22. https://doi.org/10.1080/15502783.2025.2529910

29. Ryan, T., E. Daly, and L. Ryan. 2024. "Carbohydrate beliefs and practices of ultra-endurance runners in Ireland for gastrointestinal symptom management." Frontiers in Nutrition 11. https://doi.org/10.3389/fnut.2024.1408101

30. TURJAKA, Arbëresha, AMETI, Vullnet, TURJAKA, Bujar and MEMISHI, Shpresa. Reasons for application of dietary supplements in fitness. Pedagogy and Psychology of Sport. Online. 20 October 2020. Vol. 6, no. 4, pp. 20-28. [Accessed 17 March 2026]. DOI 10.12775/PPS.2020.06.04.002. https://doi.org/10.12775/PPS.2020.06.04.002

31. ZDEBSKI, Paweł, DMOWSKA, Dominika, MIERNICZEK, Mateusz, MIERNICZEK, Maria, BILIŃSKA, Aleksandra, GLOC, Ewa, ZAŁĘSKI, Daniel, RYMSKA, Karolina, LEWANDOWSKI, Mikołaj and KRZESIMIR KUŚWIK, Maciej. High-Intensity vs. Low-Intensity Exercise in the Management of Irritable Bowel Syndrome. Journal of Education, Health and Sport. Online. 11 January 2026. Vol. 86, p. 67698. [Accessed 17 March 2026]. DOI 10.12775/JEHS.2026.87.67698. https://doi.org/10.12775/JEHS.2026.87.67698

32. MĄSIOR, Magdalena Natalia, KAPLER, Marta, KOTUŁA, Jacek and ZINKOW, Karolina. The Impact of physical activity on gastrointestinal health and prevention and treatment of common gastrointestinal diseases: Irritable Bowel Syndrome and Inflammatory Bowel Diseases. Quality in Sport. Online. 23 September 2024. Vol. 22, p. 54667. [Accessed 17 March 2026]. DOI 10.12775/QS.2024.22.54667. https://doi.org/10.12775/QS.2024.22.54667

33. MACHAŁA-ĆWIKŁA, Ewelina, ŁAPIŃSKA, Urszula, ZDZIEBŁO , Piotr, ĆWIKŁA, Piotr, MACHAŁA, Kamila, SZELĄG, Kacper, MACHALA, Dominika, KUJAWSKI, Antoni, ZUZAK, Andrzej Paweł and ZDZIEBŁO, Katarzyna. Effect of physical activity on the severity of irritable bowel syndrome (IBS) symptoms. Quality in Sport. Online. 17 July 2024. Vol. 16, p. 52921. [Accessed 17 March 2026]. DOI 10.12775/QS.2024.16.52921. https://doi.org/10.12775/QS.2024.16.52921

34. KACZYŃSKA, Agnieszka, WIETESKA, Małgorzata, STANICKI, Paweł and SZARPAK, Julita. Irritable bowel syndrome dietary modifications - what to forbid and what to recommend?. Journal of Education, Health and Sport. Online. 1 August 2020. Vol. 10, no. 8, pp. 72-77. [Accessed 17 March 2026]. DOI 10.12775/JEHS.2020.10.08.008. https://doi.org/10.12775/JEHS.2020.10.08.008

35. GĄBKA, Ilona, DALMATA, Weronika, DĄBROWSKI, Jan, SZARPAK, Julita and LIPIEC, Marta. Irritable bowel syndrome - pathophysiology, diagnosis, treatment. The role of low FODMAP diet. Journal of Education, Health and Sport. Online. 5 September 2022. Vol. 12, no. 9, pp. 469-476. [Accessed 17 March 2026]. DOI 10.12775/JEHS.2022.12.09.054. https://doi.org/10.12775/JEHS.2022.12.09.054