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Establishing Safe Thresholds to Improve Exercise Capacity in Collegiate Athletes with Inflammatory Bowel Disease (IBD): A Critically Appraised Topic

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Clinical Scenario: Inflammatory Bowel Disease (IBD) can present several challenges to athletic participation due to unpredictable disease activity and uncontrollable systemic symptoms that severely impact daily activities, and limit exercise/sports participation. Limited studies and a lack of standardized guidelines for physical activity (PA) and exercise are additional barriers for patients. Limited sources have determined that exercise interventions of low-to-moderate intensity are safe and feasible for IBD patients. In theory, such interventions could promote improvements in exercise capacity and overall well-being. **Focused Clinical Question:** Is there evidence to suggest that established safe exercise-intensities promote improvements in exercise capacity in collegiate athletes (18-24 years of age) with IBD? **Clinical Bottom Line:** Aerobic exercise, resistance training, and combined exercise promotes improvements in cardiorespiratory fitness, muscle function, and body composition changes in the general IBD patient population. For patients with mild disease activity, low-impact aerobic exercises at 60-80% maximum HR and resistance exercises with no added resistance or resistance bands appear to be more suitable.[38-39,43-45] For patients with inactive disease, aerobic exercises at 5-7/10 RPE or 65-80% maximum HR that involve activities with slightly more impact and resistance exercises with weight machines at up to ≥70% 1RM may be utilized.[40-41,46] The exercise interventions reflect lower intensities than what collegiate athletes would be accustomed to, limiting the applicability of these findings specifically for collegiate athletes with IBD. However, there may be underlying practical implications for athletic trainers to use these exercise thresholds for gradually returning athletes to sport specific activities following resolution of disease activity. **Strength of Recommendation:** According to the Oxford Centre of Evidence-Based Medicine, there is variable evidence (ranging from level 4 to level 2 evidence) that suggests low-to-moderate aerobic and resistance exercise to be feasible and effective in promoting improvements in exercise capacity in IBD patients. **Key Words:** *Inflammatory Bowel Disease (IBD), exercise, physical activity, exercise capacity, Ulcerative Colitis (UC), Crohn's Disease (CD), collegiate athletes, sports participation, sport.*

CLINICAL SCENARIO

Crohn's Disease (CD), Ulcerative Colitis (UC), and Indeterminate Colitis (IC) are forms of Inflammatory Bowel Disease (IBD), a complex auto-immune disorder of the GI tract. IBD is unpredictable in nature and varies in presentation and severity among each patient. IBD patients often experience intestinal symptoms and extra-intestinal manifestations (EIMs) that can significantly reduce exercise capacity.[1] Cohen & Shirin identified several primary mechanisms that may limit exercise capacity in IBD patients: decreased muscle function, sarcopenia, metabolic bone disease, and fatigue which is reported to be prevalent in 53-76% of patients with active disease and 15-54% of patients with inactive disease.[1] Several studies have observed factors that reduced exercise capacity in both pediatric/adolescent and adult IBD patients, including but not limited to low muscle mass, low functional capacity (e.g., 6-minute walk test [6MWT] distance, lower extremity mobility), low physical activity (PA) levels, low anaerobic capacity and power, low aerobic capacity, and low muscle strength and endurance.[2-9] There is a clear need for exercise interventions that do not exacerbate symptoms and inflammatory markers, and promote improvements in exercise capacity.

Improving exercise capacity in IBD patients may reduce limitations to exercise/sports participation, reduce risk of injury, and promote improvements in general health/well-being.

There is little information available for athletic trainers on managing collegiate athletes with IBD. However, several cross-sectional studies have identified the impact of IBD on exercise/sports participation in adult and pediatric/adolescent populations, some of which included IBD patients who competed in college and professional level sports.[10,11] A cohort of NFL players with IBD (n = 5, prevalence: 1 in 1,853 athletes) has also been recently published.[1] In general, IBD patients report impairments in sports/exercise participation and fitness levels, with primary limitations including but not limited to disease activity, intestinal symptoms, musculoskeletal EIMs, fatigue, and poor quality of life (QOL).[10-17] Several anecdotal sources detail experiences from athletes with IBD who have competed at higher levels, such as at the collegiate, professional, and Olympic levels.[18-27] Like the example of the NFL cohort, these sources show that it is possible to compete at high levels with IBD, but there are many challenges that must be navigated to allow continued competition. Athletes report challenges such as severe abdominal pain, weight loss and malabsorption, fatigue, and even frequent hospitalizations due to disease complications (see Table 1).[18-27]Another common issue reported by both athletic IBD patients and the general IBD patient population is the significant lack of guidance from healthcare professionals regarding exercise and physical activity, particularly following disease complications or surgery.[10,17-18] While standardized management strategies are seemingly absent, the one prevalent factor across all anecdotal sources of athletes with IBD is that an individualized approach and communication with care staff is essential (see Table 1).[18-27] These resources confirm that this population of athletes is indeed present, and that further research is needed to set the foundation for best practices.

There is an absence of standardized exercise guidelines for IBD patients, especially regarding high-intensity exercise and during periods of symptomatic disease; this is concerning for athletic trainers who may encounter collegiate athletes with IBD, and must navigate the return-to-play process following a disease flare-up or surgery. Based on findings from a preliminary literature review, most sources support that exercise interventions of low-to-moderate intensity are safe, feasible, and effective in promoting overall health benefits in IBD patients, primarily those with inactive disease and mild disease activity.[28-32] Few studies have shown high-intensity intermittent exercise and high-intensity interval training (HIIT) to be considered safe/feasible in pediatric/adolescent and adult IBD patients with inactive and mild disease activity.[31,32] In a scoping literature review on the effects of structured PA in IBD patients (≥ 18 years of age), Eckert et al. included seven randomized controlled trials (RCTs) and six quasi-experimental designs published between 1999 and 2017; the studies had varying levels of evidence, and most had limited methodology.[33] Eckert et al. concluded with limited evidence that low-to-moderate intensity PA is safe for IBD patients with inactive and mild-to-moderate disease activity.[33] Eckert et al. additionally suggested that exercise should follow the frequency, intensity, time, type (FITT) guidelines, and include combined endurance and resistance training for at least 30-minutes/day for three times/week at an intensity between 60-80% of maximum heartrate.[33] In theory, these types of interventions could promote improvements in exercise capacity in IBD patients. For example, Lee et al. found associations between increased engagement in moderate to vigorous PA (defined as ≥ 977

Source (Ref #)	Type of IBD	Sport	Disease Characteristics	Management Strategies/Suggestions
18	CD	Track & Field (Qualified for an Olympic team)	Frequent hospitalizations, prolonged time to diagnosis, inhibiting pain/discomfort, challenges in navigating training times during flare-ups	Maintain energy levels with meal replacements, maintain consistent habits (e.g., optimized eating and sleeping, taking medication, engaging in physical therapy and training) Advice for clinicians: Advocate for athletes, establish effective communication between athletes and other support staff, recognize that athletes require individualized disease management and training approaches
19	UC	Pure Elite Pro (Professional fitness model - weightlifting)	Extreme abdominal pain, weight loss, bloody stools, urgency, frequent hospitalizations, failed medications, surgery/stoma, frailty/weakness post-surgery and long recovery period, challenges in navigating safe training exercises (confidence issues), stoma blockages	Listen to the body, wear adequate support garments, experiment to find foods and exercises that work, find supportive care staff
20	CD	Basketball (Collegiate level - NCAA)	Extreme abdominal pain, weight loss, challenges/limitations to sports participation due to disease activity/symptoms	Participating in sports allows for a sense of normalcy, promotes social health, and teaches self-management behaviors
21	UC	Basketball (High School level - national and international travel)	Systemic inflammation affecting the joints and eyes, delayed healing with orthopedic injuries, stress exacerbates inflammation, urgency, side effects from medications	Maintain muscle strength, adequate sleep and hydration, establish communication with coaches and support staff, make proper food choices, consume smaller frequent meals, practice stress management techniques, recognize signs of flare-ups and take proper management steps
22	UC	Speed Skating (Qualified for spot on Olympic Talent Squad)	Severe abdominal pain, urgency, difficulty with training and competition during periods of active disease, lack of sleep, urgency, fatigue, pain, frequent hospitalizations, fear of muscle loss/weakness due to disease complications, anxiety and depression, eventually had to transition out of competition	Follow a well-balanced diet, maintain adequate hydration, get regular lab work, maintain activity levels as body can tolerate (even during periods of active disease)
23	UC	Baseball (Professional level)	Weight loss, multiple surgeries ("J-pouch"), physical symptoms, negative mental effects	Use a personal mantra to help during health challenges, community outreach to connect with other patients and caregivers about IBD
24	CD	Golf (Professional level)	Significant weight loss, loss of muscle and fat mass, bowel obstruction, inability to run and lift weight (e.g., carry bag) – too much impact on the gut, aggressive treatment plan to return health to normal	Follow a simple/healthy diet, nutritional supplements, avoid trigger foods, physical therapy (initially had to perform aquatic therapy to reduce impact)

25	CD	Canoeing/Kayaking (Olympic level)	Disease activity resulted in inability to train for a couple of seasons	N/A
26	CD	Softball (Collegiate level - NCAA)	Fatigue, abdominal pain, stress exacerbated symptoms, reduced athletic capacity, prolonged time to diagnosis – lack of support from multiple physicians, severe iron-deficiency anemia, medically retired after first year of competition but returned for last year after disease remission	Establish open communication with coaches and teammates, conditioning modifications, rest as needed, advocate for self, learn about diagnosis and available resources, discover individualized management approaches
27	CD	Baseball (Professional level)	Persistent pain for several months, prolonged time to diagnosis, weight loss, susceptibility to illness/infection, uncertainty of performance ability	Do not be afraid to seek care

Table 1. Characteristics of IBD in Collegiate, Professional, and Elite Athletes

to ≥ 2337 counts per minute measured via accelerometry) and muscle function in pediatric CD patients (ages 8-21 years).[34] Lee et al. emphasized a need for future studies to evaluate the efficacy of exercise interventions in improving muscle function in this population of patients who are vulnerable to body composition and muscular deficits due to the disease.[34] This critically appraised topic is intended to appraise studies that use exercise thresholds that are already established as safe (e.g., low-to-moderate intensity) in IBD patients and determine their effectiveness in improving exercise capacity. Athletic trainers could potentially use this information as a guide in the management of collegiate athletes following resolution of a disease flare-up.

FOCUSED CLINICAL QUESTION

Is there evidence to suggest that established safe exercise-intensities promote improvements in exercise capacity in collegiate athletes (18-24 years of age) with IBD: That is to say, can establishing an athlete's safe threshold be used to address factors that limit exercise capacity and help reestablish performance levels while reducing the risk of symptom exacerbation in response to a sudden increase in training load, intensity, and volume?

SEARCH STRATEGY

An electronic search was performed during a preliminary literature review in the Spring of 2021 and again in the Summer/Fall of 2021. The search terms used were:

- **P**atient/client group: College-age IBD patients (18-24 years of age) (IBD OR CD OR UC AND collegiate athletes OR sports participation OR sport)
- **I**ntervention/assessment: Exercise interventions with intensities that have been established as safe (exercise OR physical activity OR exercise capacity)
- **C**omparison: None
- **O**utcome: Exercise capacity (exercise OR physical activity OR exercise capacity)

Sources of Evidence Searched
Resources were identified from the following sources:

- *EBSCOhost*
- *PubMed*
- *Google Scholar*
- Review of reference lists and hand searches

Inclusion/Exclusion Criteria
Studies were given precedence if they met the following criteria:

- Included IBD patients (CD, UC, or both) who were at least 18 years of age and older.
- Included exercise intervention(s) at a safe intensity threshold (as determined by previous literature), for example, moderate-intensity endurance training, high-intensity interval/intermittent training, and/or resistance training.
- Included and analyzed measure(s) of exercise capacity, such as body composition changes, functional capacity, cardiovascular fitness, aerobic capacity, and/or muscle strength and endurance.
- Was a randomized controlled trial (RCT), case-control study, or cohort study.
- Peer-reviewed and had publication within the last 10 years (between 2011 to 2021).
- Published in English.

EVIDENCE QUALITY ASSESSMENT
The Physiotherapy Evidence Database (PEDro) scale was used to examine the validity of included randomized controlled trials; scores were achieved by adding the ratings (zero to one) of the second through tenth items on the scale, with a maximum score being 10.[35] The University of Bern's Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was used to examine the validity of included case-control or cohort studies; scores were achieved by adding the ratings (zero to one) of all 22 items on the scale, with a maximum score being 22.[36] For this critically appraised topic, two readers reviewed and appraised the validity of the included articles, and afterwards discussed individual appraisals and determined the quality of each study. Levels of evidence were determined for each study according to the Oxford Centre for Evidence Based Medicine (OCEBM) 2011 Levels of Evidence.[37]

Summary of Search, Best Evidence Appraised, and Key Findings
A preliminary search of the literature identified 40 studies pertaining to IBD and exercise, sports participation, or physical activity. After a review of abstracts, 14 studies were found to specifically focus on the effects of exercise interventions in IBD patients, of which only seven included measures on exercise capacity and thus were considered for inclusion. Characteristics of each study are described in Appendix A. Of the seven studies considered for inclusion, there were four RCTs, two case-control studies, and one pilot cohort study.[38,40,42-46] Three of the RCTs included only CD patients, and one of the case-control studies included only female IBD patients.[38,42,43,45] Three studies included patients who had inactive or mild disease activity.[38,43,45] Two studies included only patients with inactive disease.[40,46] One study included both patients with inactive and active disease but did not specify the severity in patients with active disease.[44] One study did not report disease activity of the patients.[42] All studies observed improvements in at least one measure of exercise capacity: Examples include improvements in body composition, cardiorespiratory fitness, muscle function, and bone health.[38,40,42-46] The most common exercise interventions used for IBD patients were aerobic training and resistance training:

- Two studies only used aerobic training interventions, both of which included patients with inactive or active disease.[38,44] Bottoms et al. conducted a secondary data analysis on a feasibility trial that evaluated HIIT and moderate-intensity continuous training (MICT) separately in CD patients (with inactive or mild disease activity): One of the outcome measures included peak power (Wpeak), which was found to have significantly improved in the HIIT group.[38] Mählmann et al. used an aerobic training intervention in pediatric and adolescent IBD patients (with inactive or active disease, but severity of disease activity was not classified): Functional exercise capacity was measured via the 6MWT, and significant positive effects were found with significant increases in 6MWT distance and perceived intensity in patients with active disease, patients with inactive disease, and healthy controls.[44]
- Two studies only used resistance training interventions.[42,43] de Souza et al. assessed maximal isometric quadriceps strength and quadriceps 1RM in female IBD patients (disease activity not reported): Significant improvements in muscle strength were found without changes in thigh circumference that would suggest the occurrence of hypertrophy.[42] Jones et al. examined the effects of combined impact and resistance training on upper and lower body strength/endurance and bone mineral density (BMD) in CD patients (with inactive or mild disease activity): Significant improvements in muscle function and bone health were found.[43]
- Three studies used both aerobic and resistance training interventions.[40,45,46] Cronin et al. and van Erp et al. combined aerobic and resistance training in an intervention for IBD patients (both only included patients with inactive disease).[40,46] Cronin et al. assessed body composition changes and cardiorespiratory fitness, and found significant improvements in both muscle mass and estimated VO_2 max.[40] Likewise, van Erp et al. assessed maximum power and maximum oxygen uptake, and found significant improvements in cardiorespiratory fitness.[46] Seeger et al. evaluated the effects aerobic training and resistance training separately in CD patients (with inactive or mild disease activity): Lower extremity strength and handgrip strength were measured, and it was found that both interventions promoted significant improvements in muscle strength.[45]

Table 2 details the thresholds and additional characteristics of the interventions used in the studies.[38,40,42-46] The findings support that both low-to-moderate aerobic and resistance training exercise interventions promote improvements in various aspects of sports performance. In addition to physical improvements, several studies observed psychosocial benefits in IBD patients in response to selected exercise interventions, such as improvements in quality of life (QOL), health related quality of life (HRQOL), fatigue, and sleep quality.[42,43,44,46] IBD patients can have a higher risk of psychosocial issues (e.g., stress, anxiety and depression, fatigue), some of which can persist with inactive disease.[43,44,46] Promoting psychosocial benefits in addition to improving exercise capacity is important for supporting the overall well-being of patients, and for encouraging maintenance of healthy behaviors.

Source (Ref #)	Intervention	Participant Disease	Activity Intervention Threshold/Characteristics
38, 39	Aerobic training: HIIT & MICT (cycle ergometers); both interventions were 3x/week for 12-weeks	Inactive or mild	HIIT: 5-minute warm-up @ 15% Wpeak, ten, 1-minute work periods @ 90% Wpeak with 1-minute rest periods @ 15% Wpeak interspersed, and 3-minute cool-down @ 35% Wpeak MICT: 5-minute warm-up @ 15% Wpeak, 30-minute conditioning phase @ 35% Wpeak, and 3-minute cool-down @ 15% Wpeak
40, 41	Combined aerobic & resistance training: 8-week supervised program; both portions of the intervention were performed 3x/week	Inactive	Aerobic training portion: Jogging @ 5-7/10 RPE with gradual progression in duration Resistance training portion: Seven weight-machine exercises performed at a minimum of 3x8 reps @ 70% 1RM with gradual progression by 15-20%
42	Supervised progressive resistance training program consisting of two, 20-minute sessions/week for 8-weeks	Not reported	Leg extensions (weight-machine) starting at 3x12 @ 50% maximum load (first 4-weeks) and increasing to 80% (final week)
43	Combined impact & resistance training program consisting of three nonconsecutive 60-minute sessions/week for 26-weeks; initially supervised, but gradually transitioned to self-managed sessions	Inactive or mild	5-minute warm-up (pulse-raising exercises and dynamic stretching), 50-minute main-conditioning phase (impact & resistance exercises), and 5-minute cool-down (static stretches) Impact Exercises: Jump-roping (5-minutes) and multi-directional jumps (2-3x10-15 reps) Resistance Exercises: 8-10 exercises (targeting the upper body, lower body, and trunk) performed for 2-3x10-15 reps with either no added resistance or resistance bands
44	Aerobic training: 8-week intervention via an exergame for 30-minutes/day for 5-days/week	Inactive or active (severity not specified)	Participants instructed to maintain an intensity of 60-80% maximum HR
45	Aerobic & resistance training (separate groups): Both interventions completed at least 3x/week for 12-weeks	Inactive or active	Aerobic Training: Single 30-minute session of self-selected exercises at an intensity of 60-80% maximum HR Resistance Training: Single 30-40-minute session of 12 exercises (e.g., push-ups, sit-ups) performed without weight-machines or added resistance for 2-3 sets for each exercise with gradually increasing repetitions
46	Combined aerobic & progressive resistance training: Personalized exercise program consisting of three, 1-hour sessions/week for 12-weeks	Inactive	Aerobic training portion: 30-minutes @ 65-80% maximum HR, performed on an exercise bike, cross-trainer, or treadmill Resistance training portion: 30-minutes consisting of two circuits of weight machine exercises (e.g., lateral pull-down, seated row, back extension, chest press, leg extension, leg press, leg curl, and abdominal crunch) performed for 15-20 reps at 40-60% 1RM

Table 2. Intervention Thresholds

CLINICAL BOTTOM LINE

Overall, there is variable evidence, ranging from level 4 evidence to level 2 evidence, that suggests aerobic exercise, resistance exercise, and combined exercise interventions are effective in improving exercise capacity in the general IBD patient population. Improvements include cardiorespiratory fitness and muscle function, as well as positive changes in body composition that would positively influence sports performance and reduce the risk of injury. For patients with active disease (primarily mild activity), lower-impact aerobic exercises, such as activities on a cycle ergometer, performed at a low-to-moderate intensity (e.g., 35-90% wPeak, 60-80% maximum HR) and resistance exercises performed using either no added resistance or resistance bands at lower repetitions (e.g., 2-3x10-15 reps) appears to be more suitable.[38-39,43-45] For patients with inactive disease, it appears that aerobic exercises of at least moderate-intensity (e.g., 5-7/10 RPE, 65-80% maximum HR) that involve slightly more impact, such as activities like jogging and running, may be utilized; additionally, it appears that resistance exercises performed on weight-machines with higher repetitions and load (e.g., 2-3x8-20, up to ≥70% 1RM) may also be utilized.[40-41,46] However, it is crucial to understand that each patient will require individualized approaches and will have individualized tolerance levels; decisions should be made based on athletic trainers' best clinical judgment and based on responses and abilities of the individual athlete.

IMPLICATIONS FOR PRACTICE, EDUCATION, AND FUTURE RESEARCH

While most of the studies demonstrated acceptable validity, the results must be interpreted with caution, and conclusions should be made using best clinical judgment. Most of the RCTs were either pilot or feasibility studies, and all the included studies had small sample sizes, which limits the generalizability of the findings. Furthermore, most studies only included either patients with inactive disease or mild disease activity. Future large-scale studies that evaluate the effects of exercise interventions on patients with active disease are clearly needed. Emerging research initiatives launched by the Crohn's and Colitis Foundation have begun to focus on interventions to better support IBD patients' outcomes and QOL, specifically dietary interventions combined with factors such as physical activity.[47] This transition to a focus on multifaceted interventions for IBD patients is promising, but it is clear that more research is needed that focuses specifically on exercise interventions for an athletic population. Another limitation is a clear absence of evaluation of trunk muscle function; this is concerning for several reasons. IBD extends beyond intestinal symptoms and malnutrition. Inflammation in the intestinal tissue often results in malabsorption, which in turn can lead to a loss of muscle and fat mass that severely impacts patients' functional ability. Surgical procedures, such as bowel resections and stomas, are commonly required in IBD patients due to complications from disease activity; per the Crohn's and Colitis Foundation, approximately 33% of UC patients and 70% of CD patients will eventually require surgery.[48] This can significantly decrease patients' aerobic capacity and muscle function. Trunk function plays a vital role in the ability to perform basic tasks as well as in athletic performance, and there are several tests that could be administered to assess trunk strength and endurance.[49] Future studies should evaluate trunk function in IBD patients to determine if a need for intervention exists and/or if risk of injury is apparent.

While all studies used an age-range that would include college-aged participants, the average age of the patients included in the studies were either older or younger than collegiate athletes (an average difference of approximately 10 to 28 years). Furthermore,

the exercise interventions used in the included studies were primarily of low-to-moderate intensity (with exception to one intervention that involved HIIT), as described in Table 2: The studies that included patients with active disease used lower impact aerobic exercises at low-to-moderate intensities ranging from 60-80% maximum HR (or 35-90% Wpeak for cycle ergometer interventions) with session lengths of about 30-minutes performed 3-5x/week for up to 8-12 weeks, and resistance exercises with either no added resistance or resistance bands at low repetitions (2-3x10-15) for about 8-12 exercises performed approximately 3x/week for up to 26 weeks; the studies that included patients with only inactive disease were the only two to use a combination of aerobic and resistance training, with the aerobic portion involving activities with slightly more impact at intensities of either 5-7/10 RPE or 65-80% maximum HR and the resistance portion involving weight machine exercises for 2-3x8-20 reps at up to ≥70% 1RM, in session lengths of about 60-minutes performed 3x/week for up to 8-12 weeks.[38-46] These thresholds are similar to the suggestions provided by Eckert et al. and recommendations from the American College of Gastroenterology (ACG) who suggest that CD patients regularly engage in daily PA (e.g., walking for 10-20 minutes/day) for symptom and stress relief.[33,50] In the case of each of these examples, such exercise suggestions may be suitable workloads for the general IBD patient population, but these reflect lower intensities and frequencies than what collegiate athletes would be accustomed to, limiting the applicability of these findings specifically for collegiate athletes with IBD. However, there may be underlying practical implications regarding the use of these types of exercise interventions in collegiate athletes with IBD following a disease flare-up.

Recommendations for Athletic Trainers

Athletic trainers who encounter collegiate athletes with IBD should establish prior knowledge regarding the care and management of the disease. IBD is complex, unpredictable, and requires a multifaceted management approach as well as effective communication and collaboration between the athletic trainer, athlete, and disease management specialist(s). From the primary author's personal experience with IBD and based on suggestions from the anecdotal sources presented in Table 1, some general suggestions for athletic trainers include regularly checking-in on athletes' health status, encouraging athletes to document patterns of disease flare-ups through journaling, and having recommendations for generalized flare-up (active inflammation) management - such as acetaminophen as needed for pain (not NSAIDs), encouraging adequate hydration and nutrition, eating soft/bland foods, using stress/anxiety management techniques, and making referrals as necessary.

Specific to sports participation, the following are key considerations for athletic trainers regarding the care of athletes with IBD:

- It is necessary to be observant of athletes' performance levels when their disease is in remission, and recognize the negative impact that disease activity can have on athletes (as evident from the anecdotal sources presented in Table 1). This may require intervention following resolution of a flare-up. It is also important to understand that while medication can help resolve symptoms and active inflammation, some symptoms and EIMs can persist after patients achieve remission. This is where individualized exercise interventions that utilize established safe thresholds can play a vital role in helping patients reestablish normal performance levels and safely return to sports participation.
- The American College of Sports Medicine (ASCM) recommends that

patients with chronic inflammatory diseases limit PA during periods of acute inflammation – refraining from high-intensity exercise and engaging in low-to-moderate intensity activities as tolerated.[51] When collegiate athletes with IBD present with a flare-up, it may be necessary to restrict sports participation until disease activity is controlled. Once a flare-up is resolved, combined low-to-moderate aerobic and resistance training can be initiated to address limitations in exercise capacity (as in Table 2).

- The exercise thresholds used in studies that included IBD patients with active disease, such as low-impact aerobic exercises at 60-80% maximum HR and/or resistance exercises with no added resistance or resistance bands, may be a safer starting point to assess athletes' tolerance levels immediately following recovery from a flare-up.[38-39,43-45] These thresholds could also be used for modifying activity when patients are in a stage of mild-disease activity as a means of allowing for continued participation and for minimizing losses.
- The exercise thresholds used in studies that included IBD patients with inactive disease, such as aerobic exercises at 5-7/10 RPE or 65-80% maximum HR that involve activities with slightly more impact and resistance exercises with weight machines at up to ≥70% 1RM, may be beneficial as a means of initiating gradual progressions after athletes have demonstrated a tolerance for the low impact, low-to-moderate intensity exercises.[40-41,46] Depending on athletes' individual tolerance and abilities, impact activities may also need to be gradually introduced to reduce the stress on the body and risk of symptom exacerbation. Progressions back to sport specific activities can be gradually introduced once performance levels are reestablished. Ultimately, athletic trainers will need to develop individualized management approaches and make adjustments based on best clinical judgment and according to athletes' individual levels of tolerance and abilities.

These considerations may help ensure that athletes are ready to return to normal activities, reduce the risk of injury, and reduce the risk of symptom exacerbation in response to a sudden increase in training load, intensity, and volume.

CAT Kill Date: April 2024

All CATs have an expiration date after which it is recommended that the topic and findings are revisited.[52]

REFERENCES

1. Cohen D., Shirin H. Inflammatory bowel disease: Its effects on physical activity, sports participation, and athletes. *Curr Sports Med Rep.* 2021; *20*(7): 359-365. doi: 10.1249/JSR.0000000000000860
2. Bryant RV., Ooi S., Schultz CG., Goess C., et al. Low muscle mass and sarcopenia: Common and predictive of osteopenia in inflammatory bowel disease. *Aliment Pharmacol Ther.* 2015; *41*: 895-906. doi:10.1111/apt.13156
3. Mählmann L., Gerber M., Furlano RI., et al. Psychological wellbeing and physical activity in children and adolescents with inflammatory bowel disease compared to healthy controls. *BMC Gastroenterol*. 2017; *17*: 160. https://doi.org/10.1186/s12876-017-0721-7
4. Otto JM., O'doherty AF., Hennis, PJ., et al. Preoperative exercise capacity in adult inflammatory bowel disease sufferers, determined by cardiopulmonary exercise testing. *Int J Colorectal Dis*. 2012; *27*: 1485-149. https://doi.org/10.1007/s00384-012-1533-4
5. Ploeger HE., Takken T., Wilk B., Issenman RM., Sears R., Suri S., Timmons BW. Exercise capacity in pediatric patients with inflammatory bowel disease. *J Pediatr*. 2011; *158*(5): 814-819. https://doi.org/10.1016/j.jpeds.2010.10.020
6. van Langenberg DR., Della Gatta P., Warmington SA., Kidgell DJ., Gibson PR., Russel AP. Objectively measured muscle fatigue in crohn's disease:

Correlation with self-reported fatigue and associated factors for clinical application. *J Crohn's Colitis*. 2014; *8*(2): 137-146. https://doi.org/10.1016/j.crohns.2013.07.006

7. Vogelaar L., van den Berg-Emons R., Bussmann H., Rozenberg R., Timman R., van der Woude CJ. Physical fitness and physical activity in fatigued and non-fatigued inflammatory bowel disease patients. *Scand J Gastroenterol*. 2015; *50*(11): 1357-1367. doi: 10.3109/00365521.2015.1046135
8. Werkstetter KJ., Ullrich J., Schatz SB., Prell C., Koletzko B., Koletzko S. Lean body mass, physical activity and quality of life in paediatric patients with inflammatory bowel disease and in healthy controls. *J Crohns Colitis*. 2012; *6*(6); 665–673. https://doi.org/10.1016/j.crohns.2011.11.017
9. Zaltman C., Braulio VB., Outeiral R., Nunes T., de Castro CLN. Lower extremity mobility limitation and impaired muscle function in women with ulcerative colitis, *J Crohn's Colitis*. 2014; *8*(6): 529-535. https://doi.org/10.1016/j.crohns.2013.11.006
10. Gatt K., Schembri J., Katsanos KH., et al. Inflammatory bowel disease [IBD] and physical activity: A study on the impact of diagnosis on the level of exercise amongst patients with IBD. *J Crohns Colitis*. 2019; *13*(6): 686–692. https://doi.org/10.1093/ecco-jcc/jjy214
11. Marchioni Beery RM., Li E., Fishman LN. Impact of pediatric inflammatory bowel disease diagnosis on exercise and sports participation: Patient and parent perspectives. *World J Gastroenterol.* 2019; *25*(31): 4493-4501. https://doi.org/10.3748/wjg.v25.i31.4493
12. Greenley RN., Naftaly JP., Walker RJ., Kappelman MD., Martin CF., Schneider KL. Sports participation in youth with inflammatory bowel diseases: The role of disease activity and subjective physical health symptoms. *Inflamm Bowel Dis.* 2018; *24*(2): 247-253. https://doi.org/10.1093/ibd/izx057
13. Plevinsky J., Wojtowicz A., Poulopoulos N., Schneider K., Greenley R. Perceived impairment in sports participation in adolescents with inflammatory bowel diseases: A preliminary examination. *J Pediatr Gastroenterol Nutr.* 2018; *66*(1): 79-83. doi: 10.1097/MPG.0000000000001633
14. Chan D., Robbins H., Rogers S., Clark S., Poullis A. Inflammatory bowel disease and exercise: Results of a crohn's and colitis UK survey. *Frontline Gastroentrol*. 2014; *5*(1): 44–48. https://doi.org/10.1136/flgastro-2013-100339
15. DeFilippis EM., Tabani S., Warren RU., Christos PJ., Boswoth BP., Scherl EJ. Exercise and self-reported limitations in patients with inflammatory bowel disease. *Dig Dis Sci*. 2016; *61*: 215-220. https://doi.org/10.1007/s10620-015-3832-4
16. Tew GA., Jones K., Mikocka-Walus A. Physical activity habits, limitations, and predictors in people with inflammatory bowel disease: A large cross-sectional online survey. *Inflamm Bowel Dis. 2016; 22*(12): 2933-2942. doi: 10.1097/MIB.0000000000000962
17. Russel S. Physical activity and exercise after stoma surgery: Overcoming the barriers. *Br J Community Nurs*. 2017; *26*(5): S20-S26. https://doi-org.ezproxy.bgsu.edu/10.12968/bjon.2017.26.5.S20
18. Treasure A. Competing at the top level with crohn's disease. *Br J Sports Med*. 2020; *54*(6): 365–366. https://doi.org/10.1136/bjsports-2019-100807
19. Wright Z. (2017). Returning to the gym with a stoma: A patient's perspective. *Br J Nurs.* 2017; *26*(5): S28 S29. https://doi.org/10.12968/bjon.2017.26.5.S28
20. Bigger than Basketball. Nick's story. Available at: http://www.biggerthanbasketball.org/living-with-ibd/nicks-story
21. Brighton L. Improve Care Now. Athletes and IBD. Published June 18, 2019. https://www.improvecarenow.org/athletes_and_ibd
22. Crohn's and Colitis Canada. Being an elite athlete with inflammatory bowel disease. Published August 25, 2016. https://crohnsandcolitis.ca/News-Events/News-Releases/Being-an-elite-athlete-with-inflammatory-bowel-dis

23. Gut It Out Foundation. Our Mission. Available at: https://www.gutitoutfoundation.org/about

24. Ross H. PGA Tour. Lebioda's battle with crohn's disease. Published February 27, 2019. https://www.pgatour.com/beyond-the-ropes/2019/02/26/hank-lebiod-battle-with-crohns-disease.html
25. Team USA. Carrie Johnson. Available at: https://www.teamusa.org/Athletes/JO/Carrie-Johnson.aspx
26. Whittemore R. Crohn's and Colitis Young Adults Network. Crohn's in college: perspectives from a former DI student athlete. Published July 22, 2020. https://www.ccyanetwork.org/news/crohns-in-college-perspectives-from-a-former-d1-student-athlete

27. Pickman B. Sports Illustrated. Orioles all-star Cedric Mullins reveals crohn's disease diagnosis. Published February 2, 2022. https://www.si.com/mlb/2022/02/02/cedric-mullins-crohns-disease-diagnosis-orioles?fbclid=IwAR2zUqH6yX7-akzRoTSntzfcI_gEDx_DSQyrzSsHhiBo6mBbs1oYW-x3mpk
28. Klare P., Nigg J., Nold J., et al. The impact of a ten-week physical exercise program on health-related quality of life in patients with inflammatory bowel disease: A prospective randomized controlled trial. *Digestion*. 2015; *91*(3): 239-247. https://doi.org/10.1159/000371795
29. Lamers CR., de Roos NM., Bongers C., et al. Repeated prolonged moderate-intensity walking exercise does not appear to have harmful effects on inflammatory markers in patients with inflammatory bowel disease. *Scand J Gastroentrol*. 2021; *56*(1): 30–37. https://doi.org/10.1080/00365521.2020.1845791
30. Legeret C., Mählmann L., Gerber M., et al. Favorable impact of long-term exercise on disease symptoms in pediatric patients with inflammatory bowel disease. *BMC Pediatrics*. 2019; *17*: 297. https://doi.org/10.1186/s12887-019-1680-7
31. Ploeger H., Obeid J., Nguyen T., et al. Exercise and inflammation in pediatric crohn's disease. *Int J Sports Med*. 2012; *33*(8): 671-679. doi: 10.1055/s-0032-1304323
32. Tew GA., Leighton D., Carpenter R., et al. High-intensity interval training and moderate-intensity continuous training in adults with crohn's disease: A pilot randomized controlled trial. *BMC Gastroenterol.* 2019; *19*. https://doi.org/10.1186/s12876-019-0936-x
33. Eckert KG., Abbasi-Neureither I., Köppel M., Huber G. Structured physical activity interventions as a complementary therapy for patients with inflammatory bowel disease - a scoping review and practical implications. *BMC Gastroenterol.* 2019; *19*(1): 115. https://doi.org/10.1186/s12876-019-1034-9
34. Lee D., Lewis JD., Shults J., et al. The association of diet and exercise with body composition in pediatric crohn's disease. Inflamm Bowel Dis. 2018; 24(6): 1368-1375. https://doi.org/10.1093/ibd/izy024
35. Cashin AG., McAuley JH. (2020). Clinimetrics: Physiotherapy evidence database (PEDro) scale. *J Physiother*. 2020; *66*(1): 59. https://doi.org/10.1016/j.jphys.2019.08.005
36. von Elm E., Altman DG., Egger M., et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Int J Surg*. 2014; *12*(12): 1495–1499. https://doi.org/10.1016/j.ijsu.2014.07.013
37. Howick J., Chalmers I., Glasziou P., et al. The oxford 2011 levels of evidence. Oxford Center for Evidence-Based Medicine. Available at: http://www.cebm.net/index.aspx?o=5653
38. Bottoms L., Leighton D., Carpenter R., et al. Affective and enjoyment responses to 12 weeks of high intensity interval training and moderate continuous training in adults with crohn's disease. *PLOS ONE.* 2019; *14*(9). https://doi.org/10.1371/journal.pone.0222060
39. Tew GA., Carpenter R., Seed M., et al. Feasibility of high-intensity interval training and moderate-intensity continuous training in adults with inactive or mildly active crohn's disease: study protocol for a randomised controlled trial. *Pilot Feasibility Stud*. 2017; *13*. https://doi.org/10.1186/s40814-017-0133-z
40. Cronin O., Barton W., Moran C., et al. Moderate-intensity aerobic and resistance exercise is safe and favorably influences body composition in patients with quiescent inflammatory bowel disease: A randomized controlled cross-over trial. *BMC Gastroenterol.* 2019; *19*(29). https://doi.org/10.1186/s12876-019-0952-x
41. Cronin O., Barton W., Skuse P., et al. A prospective metagenomic and metabolomic analysis of the impact of exercise and/or whey protein supplementation on the gut microbiome of sedentary adults. *mSystems*. 2018; *3*(3). doi:10.1128/mSystems.00044-18
42. de Souza Tajiri GJ., de Castro CL., Zaltman C. Progressive resistance training improves muscle strength in women with inflammatory bowel disease and quadriceps weakness. *J Crohns Colitis*. 2014; *8*(12): 1749–1750. https://doi.org/10.1016/j.crohns.2014.09.001
43. Jones K., Baker K., Speight RA., Thompson NP., Tew GA. Randomised clinical trial: Combined impact and resistance training in adults with stable crohn's disease. *Aliment Pharmacol Ther*. 2020; *52*(6): 964-975. https://doi.org/10.1111/apt.16002
44. Mählmann L., Gerber M., Furlano RI., et al. Aerobic exercise training in children and adolescents with inflammatory bowel disease: Influence on psychological functioning, sleep and physical performance – an exploratory trial. *Ment Health Phys Act*. 2017; *13*: 30-39. https://doi.org/10.1016/j.mhpa.2017.09.002

45. Seeger WA., Thieringer J., Esters P., et al. Moderate endurance and muscle training is beneficial and safe in patients with quiescent or mildly active crohn's disease. *J United Eur Gastroent*. 2020; *8*(7): 804–813. https://doi.org/10.1177/2050640620936383

46. van Erp LW., Roosenboom B., Komdeur P., et al. Improvement of fatigue and quality of life in patients with quiescent inflammatory bowel disease following a personalized exercise program. *Dig Dis Sci.* 2021; 66: 597–604. https://doi-org.ezproxy.bgsu.edu/10.1007/s10620-020-06222-5

47. Hurtado-Lorenzo A., Honig G., Heller C. Precision nutrition initiative: Toward personalized diet recommendations for patients with inflammatory bowel diseases. *Crohns Colitis 360*. 2020; *2*(4): 1-7. https://doi.org/10.1093/crocol/otaa087

48. Crohn's and Colitis Foundation. The facts about inflammatory bowel diseases. https://www.crohnscolitisfoundation.org/sites/default/files/legacy/assets/pdfs/ibdfactbook.pdf. Published November 2014.

49. Juan-Recio C., López-Plaza D., Barbado Murillo D., García-Vaquero MP., Vera-García FJ. Reliability assessment and correlation analysis of 3 protocols to measure trunk muscle strength and endurance. *J Sports Sci*. 2017; *36*(4): 357-364. doi:10.1080/02640414.2017.1307439

50. Lichtenstein GR., Rubin DT. American College of Gastroenterology (ACG). Inflammatory Bowel Disease: Crohn's disease. Reviewed June 2019. https://gi.org/topics/inflammatory-bowel-disease/#tabs2

51. Riebe D., Ehrman JK., Liguori G., Magal M., eds. *ACSM's Guidelines for Exercise Testing and Prescription.* 10th ed. Wolters Kluwer; 2018.

52. McKeon PO., McKeon JM. Introducing new manuscript formats for IJATT: Critically appraised topics. *IJATT.* 2014; *19*(4): 1-2. doi:10.1123/ijatt.2014-0068