

See “An integrative review of physical activity in adults with inflammatory bowel disease” on page 43-52.

Supplementary Table 1. Details of the Reviewed Articles

Author (year)	Study type	Sample & settings	Country	Methods	Main findings
Artom et al. (2017) <sup>14</sup>	Cross-sectional study	Adults with IBD (n = 182) (active disease = 45, remission = 128 in those without ostomy)	UK	Exercise was measured as < 30 or > 30 minutes of aerobic exercise per week. Fatigue was measured using IBD-F.	64% participated in aerobic exercise > 30 minutes/week ↑ Levels of fatigue in those who engaged in < 30 minutes of aerobic exercise per week (P=0.01).
Aluzaitė et al. (2019) <sup>15</sup>	Cross-sectional study	Adults with IBD (n = 113) (active disease = 70, remission = 43)	New Zealand	PA was measured using IPAQ. Fatigue was measured using BFI and MFI.	51% of participants engaged in moderate levels of PA and 35% engaged in high levels of PA Physical (P=0.04) and mental (P=0.006) fatigue lowered with ↑ PA.
Cabalzar et al. (2019) <sup>37</sup>	Case control study	CD patients (CD cases = 26, control = 20) All participants with moderate to severe disease in clinical remission with infliximab	Brazil	Each participant wore a triaxial accelerometer around the waist for 12 hours/day during waking hours for 4 consecutive days to determine PA. The Baecke questionnaire was used to measure PA. Peripheral muscle strength was assessed by handgrip strength using a hydraulic dynamometer. QOL was evaluated using SF-36 and IBDQ.	No difference found between participants with CD and controls in terms of physical activity. No association found between physical activity and QOL.
Chae et al. (2016) <sup>16</sup>	Descriptive study	CD = 59, UC = 61 Statistics on disease activity were not reported.	South Korea	Exercise was measured using GLTQ and attitudes toward exercise were measured using a different questionnaire.	Adults with IBD participated in mild form of exercise: 103 minutes of exercise per week. The majority reported that exercise is beneficial (80.5%) and pleasant (57.7%), and preferred more information (76.5%) on exercise programs.
Chan et al. (2014) <sup>17</sup>	Descriptive study	UC = 422, CD = 496 Statistics on disease activity were not reported.	UK	A sport and fitness survey was used to elicit responses on exercise habits, fitness levels, barriers to exercise, and the influence of IBD on exercise.	32% were exercising daily. 50% reported that IBD influenced their fitness. Participants reported benefits of exercise, such as improvement in general well-being, energy, sleep, and ability to manage IBD symptoms and weight control. Lack of time, fatigue, constraints regarding toilet access, health concerns, pain, and financial constraints were reported as barriers to fatigue.

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Supplementary Table 1. Continued

Author (year)	Study type	Sample & settings	Country	Methods	Main findings
Cronin et al. (2019) <sup>32</sup>	Randomized cross over trial for 8 weeks	Exercise group = 13, control group = 7 IBD patients in remission	Ireland	Subjects in the exercise group participated in a combination of moderate intensity aerobic and resistance exercise program X 8 weeks under the supervision of a gym instructor. Primary outcomes: body composition (fat mass, bone mass, and lean tissue), measured by DEXA, and cardio respiratory fitness, measured by VO <sub>2</sub> max. Secondary outcomes: disease activity scores, QOL, anxiety and depression scores, cytokine profiles, CRP levels, and gut microbiome diversity levels.	Participants in the exercise program had positive body composition changes: ↓ total body fat % ( $P=0.022$ ) and ↑ in total lean tissue mass compared to non-exercise group ( $P=0.003$ ). Exercise group participants had improved VO <sub>2</sub> max ( $P=0.03$ ). No significant improvements in disease activity scores, QOL, anxiety and depression scores, or cytokine or CRP levels between the exercise and non-exercise participants. ↑ in α diversity of gut microbiome in both exercise and control groups.
Crumbok et al. (2008) <sup>30</sup>	Pilot cross-sectional study	Adults with CD (n = 17) Disease activity was measured using the bowel dimensional score of IBDQ; median score was 54.7 (range, 24–66).	USA	PA was measured using IPAQ, stress was measured using PSS, QOL was measured using IBDQ, and disease activity was measured using the bowel dimensional score of IBDQ.	The majority of the participants (52.9%) were engaged in high levels of PA. Direct correlation between PA and QOL ( $r=0.55$ , $P=0.02$ ). No significant association was noted between stress, disease activity, and PA.
DeFilippis et al. (2015) <sup>18</sup>	Cross-sectional study	CD = 140, UC = 87 IBD in remission	USA	Demographic data Four questions were asked to elicit responses on exercise history, and a "talk test" was used to categorize exercise as sedentary, light, moderate, or vigorous. Disease activity was measured by HBI. Biomarkers: CRP and fecal calprotectin.	Walking, running, weight lifting, cycling, and yoga were the most common types of exercises reported. 186 participants were regularly engaged in exercise, and 51% were involved in moderate intensity exercise. No difference in CRP, calprotectin values & disease activity among the sedentary, light, moderate, and vigorous exercise groups. Fatigue was the main reported reason for exercise limitation, followed by joint pain, embarrassment, weakness, abdominal pain, urgency, and bowel incontinence.
Gatt et al. (2019) <sup>19</sup>	Cross-sectional study	CD = 100, UC = 58 (diagnoses within the prior 18 months were included in the study) Statistics on disease activity were not reported.	Greece, Cyprus, Malta, Hungary, and Israel	Exercise before and after IBD diagnosis was measured using GLTQ. Fatigue was measured using the FACIT scale.	Participants reported of the influence of exercise on symptom control (45.8%), ↓ in relapse rates (41.3%), and ↑ QOL (79.4%) ↓ GLTQ scores in both CD and UC after IBD diagnosis ( $P=0.002$ ). No association between fatigue and GLTQ scores.
Hlavaty et al. (2013) <sup>20</sup>	Case control study	CD = 190, UC = 148, control = 355 Statistics on disease activity were not reported.	Slovakia	Participants were asked 44 questions, such as socioeconomic status and exposure to environmental risk factors, including frequency of childhood PAs and activities at present.	The environmental risk factors that ↑ the risk of CD and UC include infrequent PA (< 2 sporting activities per week) in childhood, and history of breastfeeding < 6 months.

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Supplementary Table 1. Continued

Author (year)	Study type	Sample & settings	Country	Methods	Main findings
Holik et al. (2019) <sup>21</sup>	Cross-sectional study	CD = 114, UC = 198 Majority of the participants (66% of CD & 60% of UC) had inactive disease.	Croatia	Three groups were elicited regarding mild (30-minute walk), moderate (bicycle ride and gardening), and intensive (hard manual work, sports) PA by self-report. Disease activity was measured by HBI for CD and by the Mayo index for UC.	Overall, 85% of participants with inactive IBD and 67% of the participants with active IBD were engaged in daily PA. PA was connected to the inactive IBD status.
Jones et al. (2015) <sup>22</sup>	Prospective study	CD = 1,308, UC = 549 Adults with IBD in remission	USA	Exercise was measured using GLTA. Disease activity was measured via SCDAI for CD and SCCAI for UC.	↑ Exercise had protective effect on adults with CD in remission and ↓ risk of active CD ( $P=0.02$ ).
Khalili et al. (2013) <sup>23</sup>	Prospective cohort study	CD = 284, UC = 363 Statistics on disease activity were not reported.	USA	Questions were asked about the average time per week engaged in PAs. A MET value was given to each activity based on previously set criteria.	↑ PA lowered the risk of CD (for the trend, $P=0.007$ ).
Klare et al. (2015) <sup>33</sup>	RCT	Intervention = 15, control = 15 IBD patients in remission or mild disease activity	Germany	The intervention group engaged in supervised moderate intensity running 3 times/week × 10 weeks. QOL was measured using IBDQ before and after the intervention. Biomarkers, such as CRP and fecal calprotectin, were measured before and after intervention.	Improvement in QOL scores in the participants of the running program compared to the controls ( $P=0.001$ ). No difference in biomarkers noted between the intervention and control groups.
Lykouras et al. (2017) <sup>34</sup>	Pilot study	10 Adults with inactive IBD, 8 adults with active IBD	Greece	Spirometry, lung diffusion capacity, CPET, VO <sub>2</sub> max, and VCO <sub>2</sub> max were measured between the 2 groups.	No difference in spirometry, lung diffusion capacity, CPET, VO <sub>2</sub> max, or VCO <sub>2</sub> max were found between the groups.
Mack et al. (2010) <sup>24</sup>	Cross-sectional study	CD = 479, UC = 637 Statistics on disease activity were not reported	Canada	PA during leisure time was monitored using 21 activities listed in the PA monitor questionnaire. Then, PA was categorized into inactive, moderately active, and active categories.	Participants with CD (58%) and UC (53.6%) were both engaged in insufficient PA levels. Walking, gardening, swimming, and bicycling were the most commonly reported PAs.
McNelly et al. (2016) <sup>40</sup>	Pilot RCT with 2 × 2 factorial design	Adults with IBD patients in remission (n = 52)	UK	Exercise advice and omega 3 supplement × 12 weeks. Each patient had a consultation with the researchers and an exercise trainer for 15 minutes on week 1. Patients were instructed to increase PA to >30% based on a personalized goal and to document the details of their achievements in a diary. Patients were helped with goal setting each week for 12 weeks to address exercise barriers. For less active individuals, swimming, walking and simple gym routines were advised; those already engaged in exercise were advised to extend their activities. Fatigue was measured by IBD-F. QOL was measured by IBDQ and EuroQOL. Anxiety and depression were measured using HADS.	↓ Fatigue scores in those who received exercise advice compared to those who received the exercise placebo. No change in anxiety, depression, or QOL.

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Supplementary Table 1. Continued

Author (year)	Study type	Sample & settings	Country	Methods	Main findings
Nathan et al. (2013) <sup>29</sup>	Case series study	CD = 10, UC = 1 Statistics on disease activity were not reported	UK	Exercise was measured using GLTQ.	Participants were primarily engaged in low intensity exercise. Participants engaged in walking, running, swimming, cycling, karate, and yoga. Participants reported no advice from health care providers regarding exercise.
Ng et al. (2015) <sup>25</sup>	Case control study	CD = 186, UC = 256, control = 940 Statistics on disease activity were not reported	Asia and Australia	The IOIBD questionnaire with 87 questions on environmental factors was used.	Daily exercise lowered the risk of development of CD.
Ng et al. (2007) <sup>31</sup>	Pilot RCT	Adults with CD Intervention = 16, control = 16 Participants with CD in remission or mild disease activity	Canada	The intervention group completed low intensity walking (unsupervised) × 30 minutes' × 3 times/week for 3 months. Each participant wore a pedometer and heart monitor during exercise. All participants completed IPAQ, IBDQ, the IBD stress index, and HBI before and after the intervention.	Statistically significant improvement in QOL, disease activity, and stress scores between the participants of the walking program and control groups ( $P < 0.05$ ).
de Souza Tajiri et al. (2014) <sup>26</sup>	Pilot study	148 Female IBD patients with quadriceps weakness Statistics on disease activity were not reported	Brazil	Offered progressive quadriceps resistance training 2 times/week × 8 weeks. Quadriceps strength and QOL (using IBDQ) were measured at baseline and post exercise.	Improvement in QOL and quadriceps strength ( $P < 0.0001$ ) noted between baseline and post exercise.
Taylor et al. (2018) <sup>27</sup>	Cross-sectional study	Adults with IBD (n = 242) 60% had IBD in remission and 40% had active IBD	USA	Measured PA using IPAQ; vigorous intensity, moderate intensity, walking, and sitting were recorded. The sum of moderate to vigorous PA was computed to calculate MVPA. QOL was measured using SF-36.	↑ QOL with ↑ volumes of MVPA (> 150 min/week, $P < 0.001$ ) and ↑ walking (> 60 min/week, $P < 0.01$ ).
Tew et al. (2016) <sup>28</sup>	Cross-sectional study	CD = 446, UC = 413 Disease activity varied from remission to mild, moderate and severe disease Online data collection	UK	PA was elicited using IPAQ. Anxiety and depression was measured using HADS. Fatigue was measured using the IBD-F.	Walking was the most common PA reported. Abdominal pain, fatigue, joint pain, active disease, and ↑ bowel urgency limited PA engagement. An association noted between PA, depression, disease activity, and exercise barriers scores ( $P < 0.01$ ) in adults with CD and PA, depression and age ( $P < 0.01$ ) in adults with UC.
Tew et al. (2019) <sup>36</sup>	Pilot RCT	CD in remission or mildly active = 36 Three groups: 1. HIIT (n = 13) 2. MICT (n = 12) 3. Control (n = 11)	UK	Supervised HIIT and MICT were provided to participants using the leg cycle for 12 weeks. Cardiorespiratory fitness was measured using $VO_2$ max. Disease activity was measured by CDAI. Fatigue was measured by IBD-F. QOL was measured by IBDQ and EuroQOL. Anxiety and depression were measured using HADS.	Mean ↑ in peak oxygen uptake ( $VO_2$ max) in the HIIT group followed by the MICT group compared to the control group. ↓ In fatigue, anxiety and depression in the HIIT, MICT and control groups ↑ QOL only in the MICT group.

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Supplementary Table 1. Continued

Author (year)	Study type	Sample & settings	Country	Methods	Main findings
van Langenberg and Gibson (2014) <sup>41</sup>	Longitudinal assessment	CD = 86	Australia	Fatigue was measured using FIS. Participants were asked about the introduction of vitamin B <sub>12</sub> , antidepressants, initiation of regular exercise, and dietary modifications.	The commencement of a regular exercise program resulted in improvement in physical fatigue ( $P=0.04$ ) in the follow-up assessment.
van Langenberg et al. (2015) <sup>38</sup>	Cross-sectional study	CD = 48, healthy controls = 30	Australia	Each participant (CD) wore an accelerometer around the waist for 24 hours/day (including sleep but excluding bathing, swimming, and showering) for 7 consecutive days. Sleep was measured using PSQI. Anxiety and depression were measured using HADS. Fatigue was measured using FIS. Disease activity was determined by HBI $\geq 5$ , CRP $>3$ mg/L, and fecal calprotectin $>100$ $\mu\text{g/g}$ .	Impaired PA parameters among the CD group compared to control ( $P<0.01$ ). Lower vitamin D <sub>3</sub> , indication of systemic inflammation (CRP $>3$ ), longer CD duration, and presence of fatigue were independently associated with lower PA.
Wiestler et al. (2019) <sup>39</sup>	Cross-sectional study	Active CD = 24, CD in remission = 25 Active UC = 15, UC in remission = 26	Germany	Each participant wore a biaxial accelerometer around the upper arm for 24 hours/day (including sleep but excluding swimming and showering) for 7 consecutive days. QOL was measured by IBDQ. Disease activity was measured by HBI or SCCAI.	Accelerometrically determined PA was significantly associated with QOL and disease activity. PA was higher among CD and UC participants in remission.
Zaltman et al. (2013) <sup>35</sup>	Case control study	UC patients Cases = 23, control = 23 Statistics on disease activity were not reported	Brazil	Body composition (fat free mass and fat mass) was evaluated by bioelectrical impedance analysis. Muscle strength was assessed by evaluating the non-dominant handgrip strength using a hand dynamometer. A digital chronometer measured lower extremity functional performance (sit up test to check the ability to rise from a chair and gait speed to check walking velocity with a trainer). The Baecke questionnaire was used to measure PA.	No difference on body composition between the cases and the controls. $\downarrow$ Lower limb strength and $\downarrow$ muscle strength among females with UC compared to the controls. PA had a protective effect against a reduced gait speed.

IBD, inflammatory bowel disease; IBD-F, IBD Fatigue scale; PA, physical activity; IPAQ, International Physical Activity Questionnaire; BFI, brief fatigue inventory; MFI, multifactorial fatigue inventory; CD, Crohn's disease; QOL, quality of life; IBDQ, Inflammatory Bowel Disease Questionnaire; SF-36, Short Form 36; UC, ulcerative colitis; GLTQ, Godin Leisure Time Questionnaire; DEXA, dual energy X-ray absorptiometry; VO<sub>2</sub> max, maximum oxygen uptake; CRP, C-reactive protein; PSS, perceived stress scale; HBI, Harvey-Bradshaw index; FACIT, functional assessment of chronic illness therapy; GLTA, Godin leisure time activity index; sCDAI, short Crohn's Disease Activity Index; SCCAI, simple clinical colitis activity index; MET, metabolic equivalent task; RCT, randomized control trial; VCO<sub>2</sub>, maximum CO<sub>2</sub> production; CPET, cardiopulmonary exercise test; HADS, hospital anxiety and depression scale; IOIBD, International Organization of IBD; MVPA, moderate to vigorous physical activity; HIIT, high-intensity interval training; MICT, moderate-intensity continuous training; FIS, fatigue impact scale; PSQI, Pittsburg sleep quality index;  $\uparrow$ , increased;  $\downarrow$ , decreased.