



# Aerobic exercise training in children and adolescents with inflammatory bowel disease: Influence on psychological functioning, sleep and physical performance – An exploratory trial



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## ABSTRACT

People with Inflammatory Bowel Disease (IBD) are at risk for mental health issues, poor sleep quality and limited engagement in physical activity (PA). Standard treatment consists of immune modulating pharmaceuticals though evidence is growing that aerobic exercise training (AET) could serve as an adjuvant option to reduce disease symptoms and improve mental health. The aim of the present exploratory trial was to investigate possible AET effects on psychological functioning, symptoms of depression, sleep and physical activity in paediatric patients with IBD.

Twenty-one paediatric patients with IBD and 23 gender- and age-matched healthy controls (HC) were assessed. The IBD group was further split into a “remission-group” (IBD-RE;  $n = 14$ ) and an “active disease group” (IBD-AD;  $n = 7$ ). All participants completed an 8-week AET exergame intervention reaching 60–80% of maximum heart rate for 5 days per week. At baseline and after 8 weeks, psychological functioning, depressive symptoms, objective sleep EEG, subjective sleep and objective and subjective PA were assessed.

AET improved the exercise capacity of all participants. Self-reported fitness and daily physical activity increased in IBD-AD, but not in IBD-RE and HC. No improvements were observed for psychological functioning, depressive symptoms or subjective sleep. Objective sleep improved, deep sleep increased, light sleep decreased, and in the IBD-AD group the number of arousals after sleep onset decreased. Descriptively, the IBD-AD group reported lower psychological functioning and poorer subjective sleep quality.

Among paediatric patients with IBD and healthy controls, an exergaming intervention has the potential to improve exercise capacity, self-reported fitness, daily physical activity, and aspects of objective sleep. Results suggest that children and adolescents in an active state of IBD are at increased risk of poor psychological functioning and poor sleep quality.

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## 1. Introduction

Inflammatory bowel diseases are among the most common chronic inflammatory diseases in the developed world and affect approximately 0.5–1.0% of the population during their lifetime (Russel, 2000). The term Inflammatory Bowel Disease (IBD) covers

two major forms of chronic intestinal inflammation, Crohn's disease and ulcerative colitis, as well as atypical phenotypes (Levine et al., 2013). Exact causes are still unclear but seem to include a combination of immunological, genetic and environmental factors (Bishop, Lemberg, & Day, 2014). The disease is characterized by recurrent cycles of remission and exacerbation.

In at least 20% of IBD patients, the disease is already apparent during childhood or adolescence, and this tendency is increasing, especially among Western populations (Russel, 2000). These young patients are confronted with the burden of lifelong disease management at an age when self-identity and psychosocial development is challenging (Mikocka-Walus, Knowles, Keefer, & Graff, 2016). Unsurprisingly, adolescents with IBD frequently report discomfort and vulnerability, view themselves as different, and feel a loss of control over their lives and futures (Chouliaras et al., 2017; Nicholas et al., 2007).

As a result of the complex burden of disease, children and adolescents with IBD have an increased risk of displaying a broad variety of issues related to psychological functioning, sleep and inactivity. First, young people with IBD have a significantly increased vulnerability to psychiatric disorders when compared to healthy controls (Chouliaras et al., 2017; De Boer, Grootenhuys, Derkx, & Last, 2005; Mackner & Crandall, 2005; Vaisto, Aronen, Simola, Ashorn, & Kolho, 2010). The rate of depression may be as high as 25%, particularly among those with active IBD, a rate higher than for adolescents with other chronic diseases (Greenley et al., 2010; Mikocka-Walus et al., 2016). Therefore, the presence of severe IBD, accompanied by highly disruptive symptoms, increases psychological distress and the likelihood of depression. Second, sleep disturbances have been reported as a frequent issue in IBD (Kinnucan, Rubin, & Ali, 2013; Werkstetter et al., 2012). While restoring sleep is strongly associated with physical, cognitive and psychological wellbeing, poor or disordered sleep is related to impairment of cognitive and psychological functioning and worsened physical health (Brand & Kirov, 2011). Third, children and adolescents with IBD feel restricted and discouraged by their disease and tend to a sedentary lifestyle (Narula & Fedorak, 2008; Werkstetter et al., 2012). Insufficient levels of physical activity (PA) result in maladaptation of the body, while sufficient PA has the potential to prevent and delay chronic disease risk factors and inflammatory processes (Booth, Roberts, & Laye, 2012). In the context of IBD, current theories describe ways in which PA may have beneficial impacts on exercise capacity, anti-inflammatory processes, metabolic adaptations that may stimulate growth and development, mental health, stress management and sleep quality (Bilski, Mazur-Bialy, Wierdak, & Brzozowski, 2013).

The current first-line treatment for IBD consists of monoclonal antibody therapy directed against the tumor necrosis factor- $\alpha$  (anti-TNFs) (Jossen & Dubinsky, 2016; Scott & Lichtenstein, 2016). Psychotherapeutic interventions seem to have the potential to reduce symptoms of depression among paediatric patients with IBD (Keerthy et al., 2016), though no evidence has so far been found for benefits of psychological and psychotherapeutic interventions in adult patients with IBD (Timmer et al., 2011). Another line of treatment involves regular exercising.

As regards the influence of physical activity interventions on patients with IBD, so far two systematic reviews have been published (Narula & Fedorak, 2008; Packer, Hoffman-Goetz, & Ward, 2010), from which five unique papers were identified (D'Inca et al., 1999; Elsenbruch et al., 2005; Gupta, Khera, Vempati, Sharma, & Bijlani, 2006; Loudon, Corroll, Butcher, Rawsthorne, & Bernstein, 1999; Ng et al., 2015). All of these studies were case-control studies in adult populations investigating the effect of moderate cycling (D'Inca et al., 1999), low-intensity walking (Loudon et al., 1999; Ng et al., 2015), yoga (Gupta et al., 2006) and an

intervention including stress management training, moderate exercise, Mediterranean diet, behavioral techniques and self-care strategies (Elsenbruch et al., 2005). Compared to control conditions, interventions led to stress reduction and to subjective improvements in symptoms. Further, exercise had the potential to improve subjective quality of life, while the impact on immune markers remained unclear. Next, in line with previous findings, there have been two additional intervention studies with adult patients (Gerbarg et al., 2015; Klare et al., 2015). Klare et al. (2015) compared the influence on adult patients with IBD of a 10-week low-intensity physical activity-program (three times per week) with a control condition and observed improvements in health-related quality of life in both conditions, while no changes in biomarkers such as inflammatory markers were observed. Gerbarg et al. (2015) investigated the impact on adult patients with IBD of a 26-week Breath-Body-Mind workshop as compared to a control condition. The intervention included breathing techniques, far-East meditation and movement techniques (e.g., Aikido, Qigong), and regular exercising at home. Of particular note, the control condition involved an educational seminar; thus, group interaction, time spent with the study staff, and expectations were equivalent across conditions. The main results were that, compared to the control condition, symptoms of anxiety, depression, and perceived stress, and inflammatory markers decreased in the intervention condition.

Finally, Werkstetter et al. (2012) compared a paediatric sample of 39 six to twenty year olds with IBD ( $n = 26$  in remission;  $n = 13$  in a mild active disease) to 39 gender- and aged-matched controls and observed that, compared to controls, participants with IBD had a lower grip strength and a shorter mean duration of physical activity per week; however, these differences were specific to female patients with mild disease. No differences were found for quality of life, sleep duration, or energy intake.

To summarize, from the two reviews (Narula & Fedorak, 2008; Packer et al., 2010) and the two recent studies (Gerbarg et al., 2015; Klare et al., 2015) it turned out that these studies have involved only adult patients with IBD in either a remitted or mildly active state of disease. Further, control conditions with one exception (Gerbarg et al., 2015) have not controlled for social interactions, time spent with the study staff, or expectations. Last, sleep has been an outcome variable and subjectively assessed in only one study. Most importantly, no intervention and case-control research was performed among children and adolescents with IBD. This is astonishing, as in about 20% of IBD patients, the illness emerges already during childhood. The only case examining physical activity among children and adolescents was a comparative cross-sectional study by Werkstetter et al. (2012). Accordingly, with the present exploratory trial, study we aimed to fill these gaps. We assessed children and adolescents with IBD in both an active and a remitted state; we undertook an intervention study examining the effect of physical activity (more specifically: exergaming); the control condition was such to exclude methodological biases; we assessed psychological functioning, sleep (both subjectively and objectively), physical activity performance, and exercise capacity.

Several studies have reported a positive influence of physical activity on both subjective and objective sleep among healthy adolescents and adults (Chennaoui, Arnal, Sauvet, & Leger, 2015; Kalak et al., 2012; Lang et al., 2013, 2016), but there is no equivalent study involving paediatric patients with IBD. Accordingly, a further aim of the present exploratory trial was to shed more light on this issue.

Given the encouraging results obtained for adult patients with IBD, the following four exploratory research questions were formulated. First, on the basis of previous findings (Gerbarg et al., 2015; Josefsson, Lindwall, & Archer, 2014; Kalak et al., 2012; Narula & Fedorak, 2008; Packer et al., 2010), we investigated

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