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The Impact of Physical Activity on Digestive System Diseases

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ABSTRACT

Introduction: Digestive system diseases, including IBD, and GERD, are prevalent health concerns worldwide. Physical activity, widely acknowledged for its health benefits, has emerged as a promising area of research for its potential in mitigating symptoms and influencing risk factors associated with digestive system diseases. This study aims to critically assess existing evidence on the role of physical activity in the prevention, symptom management, and progression of prevalent digestive disorders.

Materials and Methods: A systematic review of pertinent studies was conducted through comprehensive searches in databases including PubMed, NCBI and Google Scholar. The data were sourced from clinical and experimental studies, evaluated for methodological rigor, participant characteristics, and therapeutic outcomes.

State of knowledge: The analysis demonstrated that physical activity can exert beneficial effects on digestive health through mechanisms such as enhanced gut motility, reduced inflammation, and increased microbiota diversity. Moderate-intensity aerobic exercise was associated with reduced risk and symptom improvement in patients with IBS and IBD, while high-intensity exercise showed variable effects, with potential symptom exacerbation in certain cases. Additionally, exercise correlated with a lower incidence of GERD, likely due to benefits in weight management. Despite these positive associations, inconsistencies in study design and exercise protocols underscore the need for standardized guidelines on physical activity tailored to specific digestive conditions.
Conclusions: Physical activity appears to play a beneficial role in managing and potentially preventing certain digestive system diseases. While moderate exercise shows promise in symptom alleviation and risk reduction, further research is necessary to establish clear, condition-specific exercise recommendations.

Keywords: “physical activity”, “digestive system disease”, “chronic inflammation”

INTRODUCTION

Physical activity offers broad health benefits, and its different types affect the body in various ways. There are different variations of physical activity:

Aerobic exercise (running, cycling, swimming) – moderate-intensity activities that make the heart and lungs work harder. It helps improve endurance and cardiovascular health. Aerobic training promotes fat burning and enhances the body’s oxygen efficiency.

Anaerobic exercise (sprints, interval training) – high-intensity activity where the body works in an anaerobic state. This type of training increases strength, anaerobic endurance, and speed.

Strength training (weightlifting, bodyweight exercises) – focuses on increasing muscle strength and building muscle mass. It improves overall fitness, induces muscle hypertrophy, stability, and also helps boost metabolism.

Physical activity improves circulation, reducing the risk of cardiovascular diseases such as hypertension and coronary artery disease. It also increases blood vessel elasticity and regulates cholesterol levels [1]. Exercise supports immune functions by increasing the production of immune cells. Moderate effort has a positive effect, whereas overly intense and prolonged training can temporarily lower immunity [2]. On the other hand, physical activity can influence metabolism through epigenetic changes that affect inflammation and metabolic processes. These changes can lead to personalized metabolic responses and may reduce the risk of metabolic diseases like obesity and diabetes, highlighting the importance of exercise in metabolic health [3]. What’s more, regular exercising helps burn calories, supporting the maintenance of healthy body weight. It also influences appetite regulation and reduces the risk of obesity and metabolic diseases, such as type 2 diabetes [4]. An additional benefit is the reduction of depression, anxiety and overall psychological distress symptoms [5].

In order to further dive into the therapeutic properties of exercise, this review analyzes the correlations between physical activity and gastrointestinal diseases.

MATERIALS AND METHODS

The study conducted a comprehensive literature review with data analysis on the effects of physical activity on gastrointestinal diseases. Searches were carried out in databases such as PubMed, NCBI, and Google Scholar using the following keywords: "physical activity," "digestive health," "chronic inflammation," and "gastrointestinal diseases". The empirical data were sourced from clinical and experimental studies which were critically evaluated in terms of the applied methodology, participant population, and therapeutic outcomes.

STATE OF KNOWLEDGE

1. The Impact of Physical Activity on Digestive System

Physical activity is undeniably one of the most important factors influencing human health. It has been proven that physical activity reduces the risk of developing 35 conditions, such as obesity, metabolic syndrome, insulin resistance, and heart failure [6]. Among these conditions are also gastrointestinal disorders, including colon cancer, diverticulitis, and gallbladder diseases [6]. This highlights the significant role of physical activity in the prevention of gastrointestinal diseases.

The impact of physical activity on the gastrointestinal tract manifests in several ways. Firstly, it affects the diversity of gut microbiota [7]. The gut microbiome, comprising billions of microbial species, appears to influence most aspects of human health [7]. The diversity of the gut microbiome has been shown to be important, with significant reductions in diversity observed in diseases such as Crohn’s disease, certain cancers, and type 1 diabetes [7, 8, 9]. Numerous studies have revealed differences in the gut microbiome diversity between athletes and people with a sedentary lifestyle [7, 10, 11, 12]. These studies found greater microbiota diversity among athletes [7, 10, 11, 12]. In one study, Clarke et al. not only detected greater diversity in the microbiota of professional rugby players compared to a sedentary control group but also noted that athletes had a higher number of short-chain fatty acid (SCFA) metabolic pathways, which help regulate metabolism and the immune system, reducing the risk of diseases such as rectal cancer [7, 11, 13]. Additionally, Petersen et al. found an increased presence of Prevotella in the microbiota, which has been linked to enhanced branched-chain amino acid (BCAA) regeneration, important for muscle recovery [7, 12].

The gut microbiota is an integral component of the gut-brain axis (GBA) [14]. The GBA, as a complex communication network connecting the gut and brain, incorporates immune, neural, and hormonal communication pathways [15]. The influence of gut microbiota on the GBA is multimodal and includes modulation of the immune system, as well as regulation of the production of molecules and metabolites that impact both the nervous and hormonal systems [15]. Additionally, the gut microbiota plays a role in the maturation of microglia [16] and in the development of the amygdala [16,17]. The positive effects of physical activity, especially aerobic exercise, on the diversity of gut microbiota appear to bring tangible benefits in terms of neurological health [18].

There are numerous reports confirming the positive impact of physical activity on various gastrointestinal diseases [6, 13, 19]. In a study by M. Sadeghian et al., the risk of

developing irritable bowel syndrome (IBS) was observed in 5,000 residents of Iran. The findings indicated that the risk of developing this condition was 27% higher in sedentary individuals compared to those who were physically active [19].

Similarly, the American Institute for Cancer Research states that the risk of developing colon cancer is 19% lower in people with the highest level of physical activity compared to those with the lowest [20]. Moreover, a systematic review by M. Zhang et al. noted that physical activity lasting over 30 minutes, more than three times a week, was inversely correlated with gastroesophageal reflux disease (GERD) [21].

However, it is essential to remember the potential negative effects of physical activity on the gastrointestinal tract [22]. The severity of these effects varies between individuals and can cause a broad spectrum of symptoms, from mild gastrointestinal discomfort to severe ischemia of the gastrointestinal tract (such as hemorrhagic gastritis, hematochezia, and intestinal ischemia) [22, 23]. This is due to the release of noradrenaline from nerve endings during physical exertion, which, upon binding to α-adrenergic receptors, causes constriction of visceral blood vessels, potentially reducing visceral blood flow by up to 80% [22]. This phenomenon can lead to symptoms such as nausea, vomiting, abdominal pain, and diarrhea [22, 24, 25]. Effective prevention of these symptoms seems to include dietary training and avoiding proteins, fats, fiber, and dairy products around the time of exercise, which ensures rapid gastric emptying and effective absorption of water and nutrients during exercise while maintaining perfusion of visceral vessels [22].

2. Gastroesophageal reflux disease

GERD is a condition characterized by bothersome symptoms and complications due to the backflow of stomach contents into the esophagus [26].

GERD is one of the most prevalent digestive disorders worldwide [26], affecting nearly half of all adults at some point in their lives [27]. It is a significant health issue because it reduces quality of life and is associated with notable morbidity [28].

The hallmark symptom of GERD is heartburn - a burning sensation in the chest that moves toward the mouth, caused by acid reflux. Heartburn often comes with a sour taste at the back of the mouth, sometimes accompanied by regurgitation [29]. GERD is also a frequent cause of non-cardiac chest pain [30,31].

Alarm symptoms include difficulty swallowing (dysphagia) and painful swallowing (odynophagia), which may signal serious complications such as strictures, ulcers, or malignancy. Additional warning signs include anemia, bleeding, and weight loss [32]. In those cases, upper endoscopy is recommended.

Risk factors for GERD include advanced age, higher body mass index (BMI), smoking, anxiety, depression and reduced physical activity in the workplace [33,34]. Recreational physical activity generally helps prevent GERD, though it may increase symptoms if done immediately after eating [33,35].

Effective treatment of GERD has been linked to major improvements in quality of life, including reduced physical pain, increased energy, better physical and social functioning, and enhanced emotional health [29].

Obesity is closely linked to physical inactivity and significantly raises the risk of GERD [36,37]. Increased body weight contributes to elevated intra-abdominal pressure and decreased lower esophageal sphincter (LES) pressure, both of which can lead to GERD [37].

While combating obesity-induced GERD through physical activity and thus achieving a lower BMI is a non-brainer, the potential protective effect of exercise against GERD also applies broadly, regardless of weight status. Physical activity also shows an increased protective effect against GERD prevalence in older adults and smokers [29].

Individuals who engaged in physical activity had a 26% lower risk of experiencing symptomatic GERD and a 20% lower risk of developing GERD compared to those with the lowest levels of physical activity . Additionally, each 30-minute increase in exercise per week was linked to an 8% decrease in the risk of GERD [38]. Adding 1,000 daily steps was associated with a lower prevalence of GERD [39]. A meta-analysis by Chuting Yu et al. also indicated that low-intensity aerobic activities like walking, cycling, and yoga may provide protective effects against GERD [38].

The scientists from the Department of Gastroenterology at the Changhai Hospital speculate about the precise mechanisms behind this effect [38]. First, exercising may reduce GERD risk through its anti-inflammatory properties [40]. However, acute exercise does lead to the release of muscle-derived cytokines, which might contribute to GERD symptoms [40]. Second, regular physical activity may help prevent reflux by strengthening the crural diaphragm, a key component in preventing reflux [41], as highlighted by Sinderby et al [42]. Finally, working out is linked to a reduced risk of depression and lower stress levels [43,44], which may indirectly decrease GERD prevalence through the influence of gut-brain peptides [45].

3. Celiac Disease

Celiac disease is a chronic autoimmune disorder that affects both children and adults, impacting approximately 1.4% of the global population. The disease is triggered by gluten intake in genetically predisposed individuals, specifically those with the presence of particular HLA class II genes on chromosome 6. A strong genetic link has been observed in individuals with Celiac disease who carry the HLA-DQ2 haplotype (over 90% of cases) or HLA-DQ8 (around 5% of cases) [46, 47]. Celiac disease may present with a variety of clinical symptoms or remain asymptomatic. Its symptoms can be challenging to diagnose, as they may be masked by other conditions such as microscopic colitis, IBS, or inflammatory bowel diseases (IBD) [48].

Below are the results of studies examining the relationship between physical exercise and celiac disease.

In a study conducted by Martínez-Rodríguez A et al., 28 women were randomly assigned to one of four groups: 1) a group following a gluten-free diet and participating in a strength-training program 3–4 times a week; 2) a group following only a gluten-free diet; 3) a control group of patients without dietary restrictions; and 4) a control group of healthy participants. Before the study began, quality of life was assessed using the WHOQOL-BREF (World Health Organization Quality of Life Brief Version) questionnaire, covering four

domains. Additionally, measurements of body weight, height, BMI, lean body mass, body fat percentage, and dominant hand grip strength were taken.

The study lasted 12 weeks, after which the same parameters were reassessed. No statistically significant changes in BMI were observed.

Changes in quality of life were also not statistically significant, although the group following both the diet and exercise program showed improvements across all domains of the WHOQOL-BREF questionnaire. In the group adhering only to the diet, improvements were seen in two out of four domains.

In the group combining diet and exercise, significant changes in body composition were observed: a decrease in body fat percentage ($p < 0.001$) and an increase in lean body mass ($p = 0.003$). Additionally, there was an improvement in isometric grip strength in the dominant arm [49].

In another study conducted by Dowd AJ. et al. 41 participants were assigned to one of two groups: an intervention group (20 participants), which performed high-intensity interval training (HIIT+) twice weekly, and a control group (21 participants). The interval training consisted of 14 intervals of 30 seconds at 90% of maximum heart rate (HRmax), with 2-minute rest periods at 50% HRmax between intervals. Additionally, the intervention group received health education.

After the 12-week intervention, assessments were conducted on 14 participants, who ended research in the intervention group and 11 in the control group, with a follow-up evaluation 3 months later (13 participants in the intervention group and 10 in the control group). Parameters evaluated included among others BMI, quality of life, self-compassion, gastrointestinal symptoms (using the Gastrointestinal Symptom Rating Scale, GSRS), adherence to a gluten-free diet (CDAT – Coeliac Dietary Adherence Test).

Post hoc analysis indicated that the intervention group experienced improvements in quality of life, gastrointestinal symptoms, and self-compassion. Quality of life improvements in this group were sustained over the 3-month follow-up period. At the end of the study, all participants reported increased compliance with maintaining a gluten-free diet [50].

While physical activity can enhance the quality of life for individuals with celiac disease, it may pose challenges for those involved in competitive sports. Following a gluten-free diet often requires athletes to find alternative products that ensure sufficient caloric intake and nutritional value. Athletes with celiac disease may struggle with emotional issues such as depression, as well as neurological problems related to improper nutrition and hormonal imbalances. Additionally, a fear of eating can exacerbate their health issues, making it difficult to maintain healthy eating habits and potentially leading to eating disorders. Celiac disease is also associated with extra-intestinal symptoms such as anemia (affecting 10–70% of patients) and reduced bone mineral density, with conditions such as osteopenia or osteoporosis affecting 10–20% of patients. This highlights the need for individualized treatment. Additionally, calcium supplementation to counter bone mineral loss poses further challenges, as lactose intolerance may accompany Celiac disease, requiring calcium sources that are lactose-free [51, 52].

4. Irritable Bowel Syndrome

IBS is a chronic gastrointestinal disorder affecting the small and large intestine, characterized by abdominal pain and changes in bowel movement patterns [53]. Until 2016, IBS was considered a disease with no organic or biochemical cause, but this concept now seems unlikely [53]. According to the Rome IV criteria, it has since been classified as a condition referred to as a gut-brain axis interaction disorder. [54].
The most significant factors in the development of the disease are visceral hypersensitivity, altered mucosal and immune function, the previously mentioned gut-brain interactions, and, in particular, the gut microbiota as a critical factor [55].

Physical exercise can help patients with IBS by influencing the gut microbiome and modulating the immune system [56,57]. The type of physical activity is not insignificant. Irregular, exhausting, or prolonged training has a negative impact on the gut microbiota. Therefore, regular and low-intensity physical activity is recommended [58].

Dysbiotic microbiota is linked to inflammation and various diseases, including asthma, type 2 diabetes, obesity, IBS, and IBD. Physical exercise affects the gut microbiome in various ways, including by increasing the production of SCFAs, which can then be used as substrates for energy metabolism. Additionally, SCFAs serve as mediators of the gut-brain axis [58]. Physical activity supports and enhances the diversity of gut microbiota by stimulating the growth of "beneficial" bacteria, such as *Bifidobacterium* and *Lactobacillus*. These bacteria can aid in strengthening mucosal immunity, improve the function of the gut barrier, and help maintain microbial balance, which positively affects the overall condition of the body and its ability to defend against pathogens. Physical activity also helps improve the Bacteroidota/Bacillota phyla ratio, allowing for better weight control [58].

According to the work of Kumail K. Motiani et al. [59], in which 26 people with prediabetes or diabetes (prediabetic, n = 9; type 2 diabetes, n = 17) were studied to assess whether sprinting and continuous moderate-intensity training affect gut metabolism and microbiota. Both types of training reduced intestinal inflammatory markers (tumor necrosis factor-α, lipopolysaccharide binding protein). Additionally, the training positively influenced changes in the microbiome composition by reducing the Firmicutes/Bacteroidetes ratio and reducing the Clostridium and Blautia genus.

The trial by Johannesson et al. [60] directly examines the impact of physical activity on the symptoms of IBS. The research group consisted of 102 patients, who were randomly assigned to either the physical activity group or the control group (no changes were made). In total, 38 patients in the control group and 37 patients in the physical activity group completed the study. The proportion of patients with increased symptom severity was higher in the control group compared to the physical activity group. It was concluded that increased physical activity reduces gastrointestinal complaints in IBS.

The gut microbiome also influences immune response. This study by Edgar Tavares-Silva et al. [61] assessed the effect of probiotic supplementation on monocyte functionality in 27 marathon runners, who were randomly assigned to a placebo group and a probiotic group (PRO). The results showed that probiotic supplementation increased the phagocytic capacity of monocytes after 30 days. However, these effects did not persist after the marathon, suggesting a temporary impact of probiotics on immunity during intense training.

5. Inflammatory Bowel Disease

The role of physical activity in preventing gastrointestinal diseases includes a crucial focus on inflammatory bowel diseases, such as Crohn's disease (CD) and ulcerative colitis (UC) [62]. These conditions are characterized by chronic, recurrent inflammation of the intestines [62].

Symptoms of these diseases include a range of gastrointestinal issues (diarrhea, abdominal pain, urge to defecate, rectal bleeding), extraintestinal manifestations (peripheral arthritis, axial spondyloarthropathy), and numerous systemic effects, such as anxiety, depression, fatigue, and sleep disturbances [63, 64]. The prevalence of IBD continues to rise, posing a global healthcare challenge [62].

Physical activity reduces the risk of CD [65] and improves the quality of life in patients with IBD, as confirmed by various studies [63, 66]. In one such study, Marwan SM Al-Nimer et al. examined interactions between physical activity, IBD, and myokines, focusing specifically on serum irisin levels [66]. Irisin, a myokine released during muscle contractions in exercise, can also serve as an anti-inflammatory biomarker to assess physical activity in IBD patients [66]. Researchers found that irisin, through its anti-inflammatory action, improves health outcomes for IBD patients and may help overcome physical activity barriers in these patients [66].

Similarly, Suja P. Davis and colleagues conducted an integrated literature review from September 2019 to March 2020, examining physical activity and exercise in adults with IBD. Following an in-depth analysis, they concluded that physical activity provides numerous health benefits for IBD patients, including improved quality of life, better IBD symptom management, mental health benefits, and a reduced risk of developing inflammatory bowel diseases [63].

There are reports suggesting that physical exercise may increase the expression of regulatory T lymphocytes, reduce immunoglobulin secretion through the negative regulation of helper T lymphocytes 1, and increase the production of the anti-inflammatory cytokine IL-10 [67,68], thereby positively influencing the ongoing inflammatory process in the course of IBD. At the level of adipose tissue, it also contributes to lowering the levels of several pro-inflammatory cytokines, such as IL-1, IL-16, and tumor necrosis factor (TNF). Additionally, it may promote the M2 macrophage phenotype (i.e., their anti-inflammatory phenotype) and counteract oxidative stress [67,69]. This would suggest a beneficial action profile of physical activity in the course of IBD.

6. Constipation

Physical activity plays a crucial role in promoting gastrointestinal health, particularly through enhancing motility and addressing issues such as constipation. Constipation is a prevalent gastrointestinal disorder characterized by infrequent bowel movements and difficulty in passing stools. Exercise contributes to the efficiency of gastrointestinal motility through several key mechanisms, such as increasing blood flow to the intestines, stimulating the muscles of the gastrointestinal tract, and influencing the gut microbiota.

Research indicates that physical activity improves gastrointestinal health by enhancing colonic transit time. For example, Molina-Molina and Baccetto observed that individuals who

engage in regular exercise experience improved bowel function, which is attributed to increased peristalsis - the wave-like muscle contractions that move food through the digestive tract [70]. Specifically, moderate-intensity aerobic exercises, such as walking or cycling, have been shown to be particularly beneficial in stimulating bowel movements and reducing the incidence of constipation [71].

One of the primary mechanisms by which physical activity enhances gastrointestinal motility is increasing blood circulation to the abdominal region. This increase in blood flow facilitates nutrient absorption and the movement of digestive contents, thus accelerating intestinal transit [70].

Another important pathway through which physical activity affects gastrointestinal health is through its impact on the gut microbiota. Pan et al. demonstrated that exercise-induced changes in microbiota composition significantly improved motility in individuals with chronic constipation [72]. Furthermore, physical activity, particularly aerobic exercises like brisk walking, cycling, and jogging, has been associated with beneficial changes in the gut microbiome, creating an environment conducive to better digestive function [73].

In terms of specific types of physical activities that are effective in combating constipation, aerobic exercises such as brisk walking, jogging, and cycling have proven particularly beneficial. These activities stimulate the abdominal muscles and improve blood circulation to the gut, thereby supporting regular bowel movements. Additionally, moderate-intensity exercises like yoga and stretching have been shown to reduce constipation by promoting relaxation and relieving tension in the abdominal area, which can also facilitate the peristaltic action required for bowel movements [74,75].

Studies indicate that sustained physical activity, rather than sporadic exercise, yields the most significant benefits for gastrointestinal health. For instance, a systematic review and meta-analysis found that regular aerobic exercise improved colonic transit time, which is crucial for individuals dealing with chronic constipation, as evidenced by a systematic review of nine randomized controlled trials involving 680 participants. The analysis found that exercise increased the likelihood of symptom improvement by nearly 100% (relative risk of 1.97) and that aerobic exercise was especially effective, with a relative risk of 2.42. Incorporating at least 180 minutes of moderate aerobic activity weekly can enhance colonic transit time and overall gastrointestinal motility [73]. This body of evidence underscores the necessity of incorporating both aerobic and moderate-intensity physical activities into daily routines to maintain optimal gastrointestinal motility and prevent conditions like constipation.

7. Nonalcoholic fatty liver disease

Nonalcoholic fatty liver disease (NAFLD) is a liver condition associated with metabolic dysfunction and is marked by steatosis in over 5% of liver cells, typically linked to obesity and type 2 diabetes, in the absence of high alcohol intake. Originally coined as non-alcoholic steatohepatitis (NASH) in 1980, NAFLD remains a diagnosis largely by exclusion. NAFLD varies widely in severity and progression, from simple steatosis to inflammation and liver injury, with fibrosis severity being key for prognosis [76]. Hepatocellular injury defining NAFLD is caused by an overload of primary metabolic substrates (glucose, fructose, and fatty

acids) in the liver, which redirects fatty acids into pathways that lead to cellular damage and an impaired response to injury [77]. NAFLD due to its pathogenesis can progress into nonalcoholic steatohepatitis (NASH), cirrhosis and hepatocellular carcinoma [78].

Physical activity has been proven to have a beneficial effect on NAFLD by reducing hepatic fat, hepatic injury, even without reducing weight. Even lower levels of activity or simply avoiding a sedentary lifestyle may positively impact NAFLD, highlighting the importance of staying active.

Both aerobic exercise and resistance training offer similar benefits for NAFLD improvement. While there is a dose-response relationship, meaning higher activity levels have greater benefits, the optimal intensity and dose remain unclear, so universal exercise recommendations aren't established. Instead, exercise should be customized based on individual health, comorbidities, and fitness capacity [79].

St. George et al. [80] A study was conducted on a group of 141 patients diagnosed with NAFLD. The authors analyzed how physical activity impacts the liver's function. At baseline, individuals with low fitness had higher weight, BMI, waist circumference, fasting blood glucose, insulin, and HOMA-IR (homeostatic model assessment for insulin resistance) scores compared to fitter subjects. Regardless of initial fitness, those who improved their fitness over three months experienced greater weight reduction and showed trends of improvement in waist circumference, ferritin, HOMA-IR, 2-hour insulin, and LDL cholesterol. They also had significant increases in physical activity and walking minutes per week. Among those starting with low fitness, those who enhanced, showed the most substantial improvements in liver enzymes and other metabolic markers.

Jin et al. [81] demonstrates in a study among potential living liver donors with NAFLD (median age 33 years) that lifestyle modifications, particularly exercise and dietary changes are significant in reducing hepatic steatosis among non-obese individuals with non-alcoholic fatty liver disease (NAFLD). Out of the 120 participants, 103 (85.8%) showed improvement in steatosis, as verified by follow-up liver biopsies. The mean reduction in steatosis was precisely 21.3% after a median duration of 10 weeks of lifestyle intervention. Significant predictors of steatosis improvement included an initial higher level of steatosis, a total cholesterol reduction of at least 10%, and a weight reduction exceeding 5%. These findings provide valuable evidence for the potential of lifestyle interventions to significantly reduce liver fat content, supporting non-pharmacological approaches for managing NAFLD in non-obese patients.

Current physical activity recommendations for individuals with NAFLD includes minimum exercise requirements of at least 150 minutes of moderate-intensity exercise or 75 minutes of vigorous-intensity exercise per week. Doubling the recommended minimal requirements (300 minutes of moderate-intensity and 150 minutes of vigorous-intensity exercises) proven to provide more extensive health benefits [82].

8. Digestive system cancers

Digestive system cancers (DSCs) pose serious worldwide healthcare problems. As a group they're a predominant cause of death related to cancer disease. Among them we can distinguish the most important ones such as rectum cancer, colon cancer, gastric cancer, liver

cancer, esophageal cancer and pancreatic cancer [83, 84]. Based on previous years, a study by Tadeusz Dyba et al. provided an estimate of cancer diagnosis and their mortality for 2020 in Europe: 520.000 cases of colorectal cancer (CRC) which ranked it in the top three most common diagnosed cancer among men and women, what's more the report included predicted death cases of colorectal cancer (250.000) and pancreatic cancer (130.00) [83]. In western countries CRC is responsible for 10% of cancer related mortality [85]. With the concerning number of DSCs' cases and mortality there is a need for further research regarding risk factors, prevention and treatment.

One of the risk factors of digestive system cancers are physical inactivity and obesity [86]. Many researchers emphasize correlation between sedentary lifestyle, physical exercise and the risk of cancer. The term "sedentary lifestyle" is defined by activities that are below 1,5 of Metabolic Equivalent of Task (MET) <1,5 MET [87]. Examples are: sitting, lying. MET is used to indicate intensity of an activity. It means how much oxygen is consumed while sitting while resting [88]. Some authors suggest that physical activity of moderate and vigorous intensity can decrease colorectal cancer [89]. Márcio de Almeida Mendes et. Al define moderate physical activity by >4.9 METs and vigorous by >6.8 METs [88]. Christine M Friedenreich et al. showed in their study that exercise has a strong prevention impact on colon cancer, esophageal adenocarcinoma, gastric cancer and moderate influence on pancreatic cancer. [86] Other research indicated 24% risk reduction of colon cancer by physical training [90]. I-Min Lee et al. conducted a study which revealed that 10% of colon cancer cases worldwide could be eliminated if society changed its lifestyle from inactive to active [91]. Another worth mentioning risk of CRC are colon polyps. Physical exercise was shown to decrease the risk of colon polyps up to 16% [90]. Liver cancer also can be influenced by sport, many researchers agree that high (more than 3 hours of workout per week) and moderate (2-3 hours per week) physical exercise can decrease not only the risk of liver cancer but also its mortality [92].

What's worth mentioning is that regular physical workout has a positive impact on weight loss and obesity reduction [93]. Many studies showed that obesity is one of the main risk factors of DSCs such as liver cancer [94], pancreatic cancer [95, 96], colorectal cancer [85], esophageal cancer [97] and gastric cancer [98].

CONCLUSIONS

Physical activity demonstrates significant potential in managing and preventing various digestive system diseases, including IBS, IBD, and GERD. The evidence suggests that regular physical activity positively influences gut motility, reduces inflammation, and enhances gut microbiota diversity, all of which contribute to improved digestive health.

Moderate-intensity aerobic exercise has shown particular promise in alleviating symptoms and reducing the risk of digestive disorders, especially in patients with IBS and IBD. Individuals who engage in regular moderate physical activity report improvements in symptoms such as bloating, pain, and discomfort, leading to better overall disease management. In contrast, the impact of high-intensity exercise on digestive health remains unclear. While some studies report benefits, others indicate that high-intensity activity may exacerbate symptoms, particularly for those with IBS or IBD. This inconsistency highlights

the need for caution and individualized recommendations when considering high-intensity exercise for patients with digestive disorders.

Exercise has also been linked to a lower incidence of GERD, likely due to its role in weight management. Regular physical activity helps maintain a healthy weight, which can alleviate GERD symptoms and improve the overall quality of life for affected individuals. However, despite the promising correlations, variations in study designs and exercise protocols underscore the need for standardized guidelines regarding physical activity for specific digestive conditions.

Ultimately, these findings emphasize the importance of incorporating physical activity into a holistic treatment approach for digestive disorders. While medical interventions remain essential, lifestyle modifications, particularly regular exercise, should be promoted as part of a comprehensive strategy aimed at improving both symptom management and long-term health outcomes. Further research is needed to refine our understanding of the mechanisms through which physical activity affects digestive health, identify optimal exercise types and intensities, and develop tailored exercise programs for specific conditions.

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