Original Article

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Effects of Low- to Moderate-Intensity Aerobic Exercise on Constipation Patients using Long-term Stool Laxatives

Chih-I Chen[1,4,6], Po-Jui Ko[2,4], Tai-Been Chen[5], San-Nan Yang[3,4], Pei-Ling Wu[3,4,], Yung-Ning Yang[3,4,*], Yu-Shen Chen[3,4,*]*

Objective: Constipation is a common problem in Taiwan. In addition to the need of regular laxatives for severe constipation, people with poor bowel habits experience psychological stress and an elevated risk of anal diseases (hemorrhoids or anal fistula). We aimed to evaluate the relationship between physical activity and constipation.

Methods: In this prospective cohort study, participants performed low- to moderate-intensity aerobic exercise thrice per week for > 30 minutes per session with a maximum heart rate > 130 beats per minute according to the American College of Sports Medicine guidelines. Thirty-two participants were recruited, and the intensity of their exercise was measured using electronic portable devices. Of the 23 participants, 11 were excluded due to incomplete data.

Results: No changes in body mass or body weight were observed after 12 weeks of exercise. The average daily step count was 7856.6 in week 1 and 8437.5 in week 12 ($p = 0.169$). Laxative use was significantly lower after week 12 of exercise ($p < 0.001$).

Conclusions: Our findings suggest that low- to moderate-intensity aerobic exercise could reduce the frequency of laxative use. We observed a significant negative relationship between the average step count and the frequency of laxative use per week, suggesting that regular daily activity may relieve constipation.

Key words: constipation, aerobic exercise, laxatives

Introduction

Chronic constipation is a common problem in the adult population. The reported prevalence of constipation is 2.6% – 26.9% worldwide.[1] Another study reported that the prevalence of constipation in adults older than 60 years is approximately 33% and the overall prevalence among adults of any age is approximately 16%.[2] Constipation has a broader definition that encompasses a myriad of symptoms including hard stools and the feelings of incomplete evacuation, abdominal discomfort, bloating, distention, excessive straining, a sense of anorectal blockage during defecation,

From the [1]Division of Colon and Rectal Surgery, Department of Surgery, [2]Division of Pediatric Surgery, Department of Surgery and [3]Department of Pediatrics, E-Da Hospital; [4]School of Medicine, [5]Department of Medical Imaging and Radiological Sciences and [6]Department of Information Engineering, I-Shou University, Kaohsiung, Taiwan (*signifies equal contribution compared to the corresponding author)

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Address reprint request and correspondence to: Yu-Shen Chen, Department of Pediatrics, E-Da Hospital, No. 1, Yida Road, Jiaosu Village, Yanchao District, Kaohsiung 82445, Taiwan
Tel: 886-7-615-0011, E-mail: peiling0420@gmail.com

and a need for manual maneuvers.[1,3] However, the pathophysiological mechanisms of constipation are complex and not completely understood.[4]

Several factors can cause constipation. It is considered to be associated with a low transit time of bowel movements and can be difficult to treat; however, sports and increased physical activity may improve bowel movements.[5] Vigorous physical activity reportedly increases colorectal motility, and physically fit people have a lower incidence of constipation.[6,7] Physical activity in healthy subjects may stimulate colorectal motility, thereby reducing colonic transit time.[8] In contrast, prolonged physical inactivity is an etiology of chronic constipation.[9] Some studies have indicated that regular physical exercise can improve bowel movements, especially in the elderly population[10-13]; however, others have shown that exercise does not play a role in the management of chronic constipation.[13,14] Constipation also affects up to 30% people in Western countries and considerably impacts the quality of life.[9,15]

Chronic constipation leads to psychological stress and increases the risk of anal complications such as hemorrhoids or anal fissure. Besides, chronic constipation also has significant negative effects on the quality of life.[16,17] The ROME IV criteria[31] are currently the most widely used to diagnose chronic idiopathic constipation (Table 1). The criteria incorporate straining, hard stools, a sensation of incomplete evacuation of bowel movements, and the frequency of stool passage to evaluate and diagnose constipation-related diseases. However, it seems difficult to define the severity of chronic constipation.

Table 1. Rome IV diagnostic criteria for functional constipation.[31]

Rome IV diagnostic criteria for functional constipation
Presence of 2 two or more of the following:
- Straining in at least 25% of bowel movements.
- Hard stools in at least 25% of bowel movements.
- Sensation of incomplete evacuation in at least 25% of bowel movement.
- Manual maneuvers to facilitate defecation in at least 25% of bowel movements.
- Fewer than 3 bowel movements per week.

Patients with chronic constipation may benefit from a lifestyle change first by using medications, such as oral stool softeners, prokinetics, secretory agents, and trans-anal irrigation.[18] The symptoms can be alleviated by an increased intake of fiber and fluids that can reduce colonic transit time.[19] Additionally, healthy subjects who perform moderate physical activity for about one hour per day may reduce the colonic transit time to improve constipation.[8,14] According to the American College of Sports Medicine (ACSM) guidelines, low- to moderate-intensity aerobic exercise three times per week for more than 30 minutes each session with a maximum heart rate > 130 beats per minute is recommended.[20] However, it is difficult to monitor heart rate during exercise. Therefore, there should be an easier and correct way to evaluate the quality and quantity of exercise to treat constipation, respectively.

This study aimed to find a method using an electronic portable device to measure and define exercise quantity. Exercise could help patients with chronic constipation reduce the frequency of laxative use. Here we provide a possible method that uses steps as an index to monitor exercise quantity to treat chronic constipation.

Materials and Methods

This study was conducted from January to December 2017. Thirty-two participants between the ages of 20 and 70 years were recruited for this study. Participants were considered eligible if they were diagnosed with chronic constipation with laxative use.

All participants fulfilled the Rome IV diagnostic criteria for functional constipation (Table 1), with the presence of two or more of

the following: (i) straining in at least 25% of bowel movements; (ii) hard stools in at least 25% of bowel movements; (iii) sensation of incomplete evacuation in at least 25% of bowel movements; (iv) manual maneuvers to facilitate defecation in at least 25% of bowel movements; and (v) fewer than three bowel movements per week.

Patients with malignancy, and/or chronic diseases (e.g. diabetes, hypertension), or who were taking other medications in addition to stool laxatives, were excluded from this study.

Study design and intervention

All participants performed intensive aerobic exercises for 12 consecutive weeks. The exercise program for this study followed the ACSM guidelines, which consist of low- to moderate-intensity aerobic exercise at least three times per week for more than 30 minutes each session with a maximum heart rate of more than 130 beats per minute.[20] Each participant was asked to download a software program developed by Beijing Xiaomi Technology Company to their mobile phones; this functioned as the electronic portable device. The following records were collected weekly through the software program and submitted to the project manager. The records were as follows: (i) body weight; (ii) number of exercise sessions; (iii) maximum heart rate during exercise; (iv) total exercise time; (v) average time of each exercise, (vi) average daily step count; (vii) average number of stool softeners taken; and (viii) average sleep time per day. All data were recorded for 12 weeks.

An electronic portable devices (Xiaomi Mi Band 2) were provided for each participant to record the exercise parameters, including step count, heart rate, and sleeping time. Ethical approval for this study was granted by the Institutional Review Board of the E-Da hospital (EMRP-107-016).

Outcome measures

Several tools were used to assess bowel function, including the Patient Assessment of Constipation-Symptoms.[22] These scores included symptoms such as discomfort in the abdomen or with bowel movements or painful bowel movements to evaluate constipation severity. These assessments were based on each patient's subjective data. Because all participants were taking laxatives, the frequency of stool laxatives used each week was the primary outcome measure.

Statistical analysis

The data were explored for descriptive analysis of the parameters of measurement (i.e.,

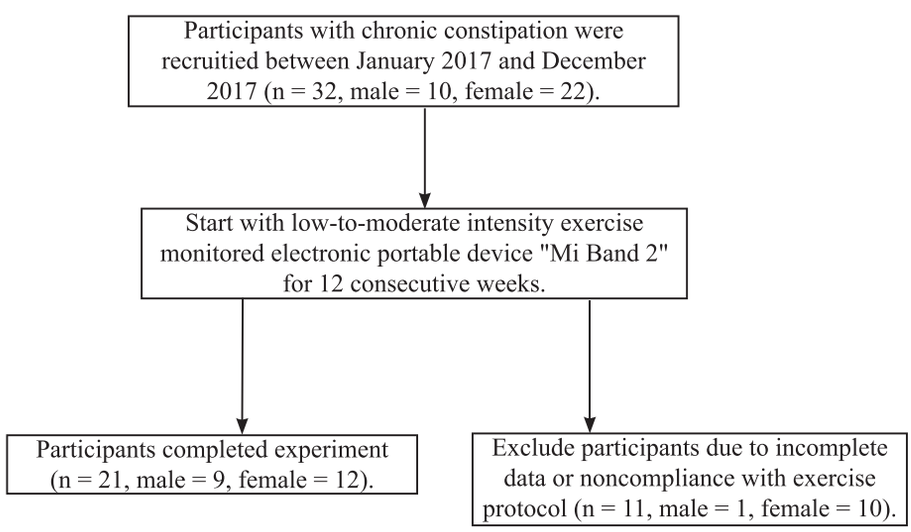

Fig. 1 Description of the participants enrolled or excluded in this study.

Table 2. Clinical characteristics of the participants in the first and twelfth weeks.

	1st week			12th week			*p* value
	Mean	Median	SD	Mean	Median	SD	
Age (years)	38.1	34.5	12.6	38.1	34.5	12.6	-
Body mass index (kg/m^2)	23.9	22.9	4.2	23.7	22.6	4.2	0.421
Body weight (kg)	65.4	60.8	14.2	64.7	60.3	13.9	0.433
Frequency of exercise (times per week)	2.9	3.0	1.0	2.9	3.0	1.1	0.500
Maximum heart rate (beats per minute)	137.5	139.0	19.8	137.7	133.5	19.9	0.489
Maximum exercise time / session (min)	53.6	36.0	44.3	50.1	40.0	29.6	0.378
Average exercise time / session (min)	33.4	30.0	14.1	35.8	31.6	14.5	0.288
Average step count	7856.6	7656.0	2628.5	8789.8	8437.5	3810.4	0.169
Frequency of stool laxative use per week	2.2	2.1	1.2	0.6	0.0	0.8	< 0.001
Average sleeping time per day (min)	421.3	420.0	56.5	407.6	403.0	53.0	0.200

variables) including mean, median, standard deviation (SD), standard error of the mean (SEM), and the minimum and maximum. Time plots were used to investigate the significance of variations in the measurements. The regression model was utilized to create and estimate the relationship between sleeping time and frequency of medication use as well as that between average step count and frequency of medication use. p values < 0.05 was considered statistically significant.

Results

Of the 21 participants included in this study, 11 were excluded due to incomplete data or their incompliance with the exercise protocol (Fig. 1).

The clinical characteristics of the participants in the first and twelfth weeks are summarized in Table 2. The mean age was 36.8 = 12.6 years. The mean body mass index in the first week was 23.9 ± 42 kg/m^2, while that in the twelfth week was 23.7 ± 42 kg/m^2 (p = 0.421). The was no significant decrease in body weight which was 65.4 ± 14.2 kg in the first week and 64.7 ± 13.9 kg in the twelfth week (p = 0.433); The average daily step count increased from the first week (7856.6 steps) to the twelfth week (8437.5 steps); however, the difference was not statistically significant (p = 0.169; Fig. 2). Other parameters, such as exercise frequency, maximum heart rate during exercise, maximum exercise duration per session, average exercise duration per session, and average sleeping time per day, did not show a statistically significant difference between the first and twelfth weeks. However, the frequency of stool laxative use per week dropped significantly from the first to the twelfth week (2.2 versus 0.6, respectively; p < 0.001) (Fig. 3).

Assessment of daily physical activity and constipation

A significant negative relationship was observed between the frequency of stool laxatives used per week and the weekly average step count (Fig. 4).

Assessment of sleeping quality and the bowel function subsection

Conversely, we did not observe a significant relationship between the frequency of stool laxative use per week and sleep time per day (Fig. 5).

Discussion

In the current study, we discovered that low- to moderate-intensity aerobic exercise can decrease laxative consumption. Besides, we discovered a trend between the average daily step count walked daily and the frequency of laxative use. Our results suggest that regular daily activity can improve constipation. However, average sleep time was not associ-

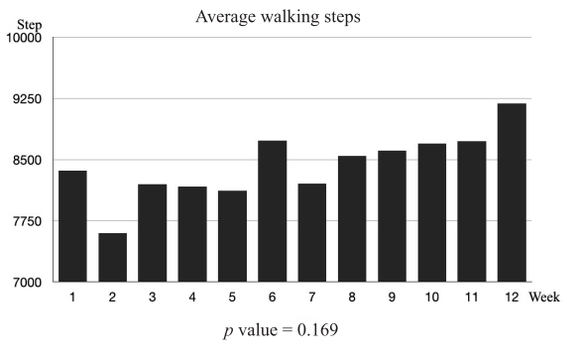

Fig. 2 The average daily step counts from the first week to the twelfth week.

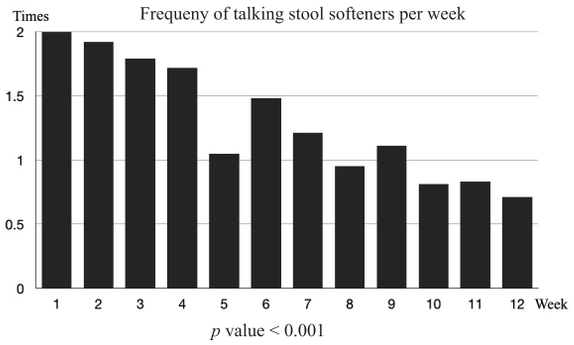

Fig. 3 Frequency of taking stool softeners per week.

ated with constipation.

The etiology of constipation is often multi-factorial, including psychological and physiological conditions.[23] In addition to age, risk factors for chronic constipation include female,[15] physical inactivity, low education level, low income, concurrent medication use, and depression.[20,24] Conditions associated with constipation include endocrine or metabolic disorders, neurologic disorders,[25] myogenic disorders, and medication use. Clinically, physicians have difficulty effectively treating patients with long-term constipation without using medication. Moreover, patients with long-term constipation usually have a poor quality of life due to abdominal distention, colic, and poor appetite. Quality of life can worsen if anal diseases such as hemorrhoids and anal fissures occur. Regular exercise and lifestyle changes are considered an initial therapeutic approach to primary constipation regardless of etiology,[4] while obesity is positively related to constipation.[26] However, the degree of regular exercise that can improve constipation remains controversial. Both high- and moderate-intensity exercise can help reduce body weight[27] and improve sleep quality.[28,29] There are complex relationships and interactions among exercise, body weight, lifestyle, and sleep quality.

High-intensity exercise is difficult to maintain in most people's daily lives, especially in the elderly population. The present study was conducted to provide evidence that exercise could improve constipation and to evaluate the degree of exercise to be applied in clinical practice. Owing to the advances in science and modern technology, we used electronic wearable devices to monitor the physical activity of the participants so that we could analyze the relationship between daily step count and average sleep time of the study subjects.

While this study used the frequency of laxative use to assess improvements in constipation, it may also be used clinically to assess the degree of constipation. Nonetheless, it showed that low- to moderate-intensity aerobic exercise can improve constipation. We also observed that a higher average daily step count reduced the frequency of laxatives taken. On the other hand, we did not observe a relationship between sleep and constipation, contrary to the findings of previous studies.[29]

Exercise itself not only can improve intestinal peristalsis directly but it can also help in the development of a positive attitude through constructive changes in lifestyle that improves constipation.[29,30]

Although the results of this study are supportive of our hypothesis, several important issues require addressing. First, we requested each participant to set aside time for low- to moderate-intensity aerobic exercise, but we could not monitor and verify the accuracy of their weekly reports. Second, some participants may have intentionally or unintentionally reduced the dose or frequency of stool softener use after being recruited into the

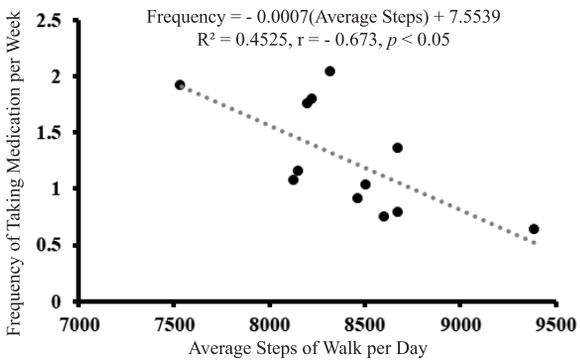

Fig. 4 Relationship between frequency of taking medication per week and average step count per day.

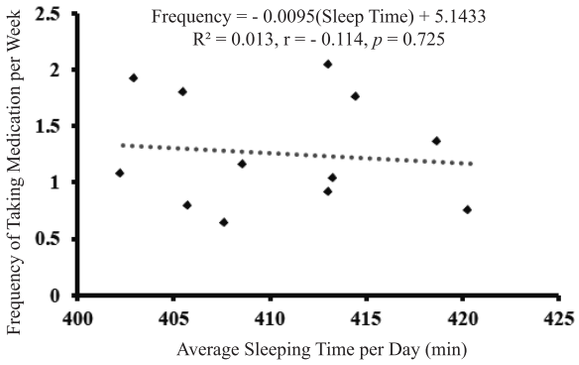

Fig. 5 Relationship between frequency of taking medication per week and sleep time.

study. Third, electronic wearable devices are not always accurate, especially when measuring sleeping time. It is necessary to use more accurate electronic portable devices, such as a professional heart rate recorder, in the future. Fourth, the kinds of laxatives as well as daily fluid and fiber intake were not recorded. Additionally, although the best way to conduct the persent study would have been gathering all participants together to exercise for a correct record of the relevant data, it was infeasible for modern people with a tight daily schedule.

Conclusions

In this study, we observed the impact of physical activity on constipation in patients who took long-term stool softeners for the condition. By following the exercise program in the study three times per week for more than 30 minutes with a maximum heart rate of more than 130 beats per minute, the participants could gradually reduce the frequency of medicine use and improve their constipation. This can be a treatment option with fewer side effects for patients who are clinically diagnosed with long-term constipation. Aerobic exercise is also an option to manage constipation, but not every patient has the time and determination to perform high-intensity aerobic exercise in their daily lives. Our study is the first to confirm that even low- to moderate-intensity aerobic exercise can improve constipation and has high feasibility for patients, encouraging them to live a healthy life.

Conflicts of Interest

The authors declare no conflicts of interest.

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