

Home-Based Exercise Program After Rectal Cancer Surgery: Changes in Bowel Habits, Quality of Life, and Depression

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ABSTRACT

Surgery for rectal cancer can be followed by persistent bowel symptoms, impaired quality of life, and psychological distress. This study explored short-term changes in patient-reported bowel symptom burden, health-related quality of life, and depressive symptoms after a home-based exercise program.

This prospective single-arm pre-post study included 74 adult rectal cancer survivors who had undergone low anterior resection, completed temporary stoma closure, and were at least 24 months post-surgery. A physical therapist provided individualized in-hospital exercise instruction, followed by a 4-week home-based pelvic floor and core exercise program. Weekly telephone follow-up was used to support continuity and address exercise-related problems. Patient-reported outcomes were measured at baseline and at the end of the program using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC QLQ-C30), the EORTC Quality of Life Questionnaire Colorectal Cancer Module 29 (EORTC QLQ-CR29), and the Beck Depression Inventory (BDI).

Seventy-four participants completed baseline and follow-up assessments. Patient-reported symptom burden decreased significantly after the 4-week program. The QLQ-C30 symptom-burden composite decreased from 61.32 ± 5.25 to 57.04 ± 4.62 , and the QLQ-CR29 bowel symptom-burden composite decreased from 63.73 ± 4.33 to 57.78 ± 5.39 . BDI total score also decreased from 28.66 ± 4.62 to 22.42 ± 4.81 . All pre-post comparisons were statistically significant ($p < 0.001$).

A 4-week home-based pelvic floor and core exercise program was associated with lower bowel symptom burden and depressive symptom scores in rectal cancer survivors. Because this was a single-arm study with short-term follow-up, the findings should be considered preliminary. Controlled studies with longer follow-up are needed.

Keywords: Rectal cancer, Low anterior resection syndrome, Pelvic floor exercise, Core exercise, Exercise therapy, Quality of life, Depression, Survivorship

Introduction

Advances in rectal cancer surgery, neoadjuvant treatment, and post-operative care have improved survival outcomes. However, recovery after rectal cancer treatment involves more than oncological control alone. Many survivors develop bowel dysfunction, particularly after sphincter-preserving surgery such as low anterior resection. This symptom complex is commonly referred to as low anterior resection syndrome (LARS). Increased stool frequency, urgency, clustering, flatus or stool leakage, and a feeling of incomplete evacuation can interrupt daily routines, limit social

participation, and reduce confidence to leave home. For some patients, these symptoms extend far beyond the early postoperative period and become a long-term survivorship issue rather than a transient surgical consequence.

The consequences of these symptoms are not only physical. Psychological distress related to the cancer diagnosis, treatment burden, altered bowel habits, and concerns about social functioning may also be experienced by rectal cancer survivors. Furthermore, depressive symptoms can influence perception of symptoms, coping capacity, and adherence to self-management strategies. This is why rehabilitation after surgery for rectal cancer

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needs to focus not only on bowel function, but also quality of life and emotional wellbeing.

Exercise-based rehabilitation is increasingly gaining attention in the field of cancer survivorship care. However, bowel dysfunction in rectal cancer survivors often calls for more specific strategies than physical activity. Pelvic floor muscle training may help improve continence control and coordination of pelvic floor function. Core exercises may support trunk stability, pelvic control, and functional movement during activities of daily living. A home-based program including these components may provide a feasible and available rehabilitation option, particularly for patients requiring ongoing support after completion of surgical treatment and stoma closure.

While this approach is clinically relevant, there is little evidence of simple home-based programs combining pelvic floor and core exercises following rectal cancer surgery. Current studies tend to be predominantly focused on bowel symptoms, have heterogeneous populations of colorectal cancer patients, or examine rehabilitation strategies in settings that may not be easily transferable to routine survivorship care. Moreover, few studies have reported the combined burden of bowel-related symptoms, health-related quality of life, and depressive symptoms in the same cohort of rectal cancer survivors.

This prospective single-arm pre-post study investigated short-term changes in patient-reported bowel symptom burden, health-related quality of life, and depressive symptoms after a 4-week physiotherapist-led home-based pelvic floor and core exercise program in adults who had undergone low anterior resection for rectal cancer, completed temporary stoma closure, and were at least 24 months post-surgery at enrollment. Pre- and post-program outcomes were assessed using validated patient-reported questionnaires.

Materials and Methods

Study Design and Setting: This is a prospective single-arm pre-post study examining short-term changes in patient-reported outcomes after a 4-week home-based pelvic floor and core exercise program in rectal cancer survivors. The study was performed at a university hospital in Türkiye from October 2025 to November 2025.

Ethical approval and consent to participate: The study protocol was approved by the local

ethics committee (Approval No: 2024/72, 11 June 2024). All participants provided written informed consent before participation. The study was conducted in accordance with the Declaration of Helsinki.

Subjects: Participants were adult rectal cancer survivors who had low anterior resection for rectal cancer, had completed temporary stoma closure, and were at 24 months or more after surgery at the time of enrollment. Participants also had to be clinically stable and able to safely undertake a home-based exercise program.

Baseline questionnaires were completed before the start of the exercise program. Follow-up questionnaires were administered at the end of the 4-week program, within a ± 1 -week window. Questionnaires were checked for completeness during each assessment. The final analysis included only subjects with complete baseline and follow-up data, and no missing values were imputed.

Criteria for Inclusion: Participants were eligible if they met the following inclusion criteria:

- ≥ 18 years of age
- Previous anterior resection for rectal cancer
- Completed temporary stoma closure prior to enrollment
- At least 24 months have passed since the surgery
- Ability to safely participate in a home-based exercise program
- Provision of written informed consent

Exclusion Criteria: Exclusion criteria included:

- Medical contraindication to exercise
- An acute clinical condition that would preclude safe participation
- Failed to complete the scheduled assessments
- Missing baseline or follow-up questionnaire data

Exercise Program: Prior to starting the home-based program, each participant was given individual instruction by a licensed physical therapist. The exercises were demonstrated in a face-to-face setting, and the participants practiced the exercises under supervision until they could perform the movements correctly and independently.

The program was then continued at home for 4 weeks. Participants were asked to complete three sessions per day. Each session included pelvic floor muscle training, glute bridge, posterior pelvic tilt, and cat-cow exercise.

The exercise protocol was prescribed as follows:

- Pelvic floor muscle training: 10 repetitions per session, holding for 5 seconds each contraction
- Glute bridge: 10 repetitions per session, hold each repetition for 5 seconds
- Posterior pelvic tilt: 10 reps/session; hold for 5 seconds
- Cat–cow exercise: 10 repetitions per session

All exercises were performed 3 times daily, every day, for 4 weeks.

During the home phase, weekly telephone follow-up was conducted by the study team to answer questions, reinforce correct exercise performance, and assess adherence. Adherence was evaluated by participant self-report during these telephone contacts. No exercise diary, wearable device, or objective monitoring tool was used.

Assessment Tools and Outcomes: All questionnaires were completed at the study center. Baseline assessments were completed prior to the exercise program and follow-up assessments were completed at the end of the 4-week program, within a ± 1 -week window. The same assessment tools were used at both time points in order to make within-participant pre-post comparisons.

EORTC QLQ-C30: Cancer-related health-related quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC QLQ-C30). Scores were converted to a 0–100 scale according to the EORTC scoring manual. Higher scores indicate better status on global health and functional scales, and higher scores on symptom scales indicate a greater symptom burden. (1,2)

EORTC QLQ-CR29: Colorectal cancer-specific symptoms and functioning were assessed using the EORTC Quality of Life Questionnaire Colorectal Cancer Module 29 (EORTC QLQ-CR29). The main interest in this study was in bowel-related symptom items and domains, including stool frequency, urgency, gas or stool leakage, soiling and abdominal discomfort. Scores were re-coded to a 0-100 scale based on EORTC scoring methods, with higher scores indicative of greater symptom burden. (3,4)

Beck Depression Inventory: Depressive symptoms were assessed using the 21-item Beck Depression Inventory (BDI). Total scores range from 0 to 63, with higher scores indicating more severe depressive symptoms. (5,6)

End points: The primary endpoint was change in bowel-related symptom burden from baseline to follow-up as assessed by the EORTC QLQ-CR29. Secondary endpoints were changes in the EORTC

QLQ-C30 symptom-burden composite score and the BDI total score.

Patient-reported symptoms were summarized using composite symptom-burden scores. For descriptive and comparative purposes, selected items and domains of symptoms were averaged and transformed using the standard EORTC 0-100 transformation to generate summary composite scores. The QLQ-C30 composite score reflected overall cancer-related symptom burden, and the QLQ-CR29 composite score reflected bowel-related symptom burden following rectal cancer surgery. Higher composite scores were associated with a greater symptom burden. These composite scores are not intended to replace the validated individual EORTC domain scores, but to provide an overall summary of symptom burden over time.

Statistical Analysis: Continuous variables are shown as mean $\pm$ SD. Skewness and kurtosis values were used to evaluate the distribution of each outcome. Paired-sample t tests were used to compare baseline and follow-up scores, because these values were within acceptable limits for normal distribution.

The results are reported as mean values, standard deviations, mean differences, and p-values. All tests were two-tailed, and statistical significance was set at $p < 0.05$. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

Results

Table 1 shows the skewness and kurtosis of the baseline and follow-up outcome scores. The values of the distributions were within the predefined acceptable range, which justified the use of paired-sample t tests for within-participant pre-post comparisons.

SE, standard error. Skewness and kurtosis values were within the predefined acceptable range for all baseline and follow-up outcome scores.

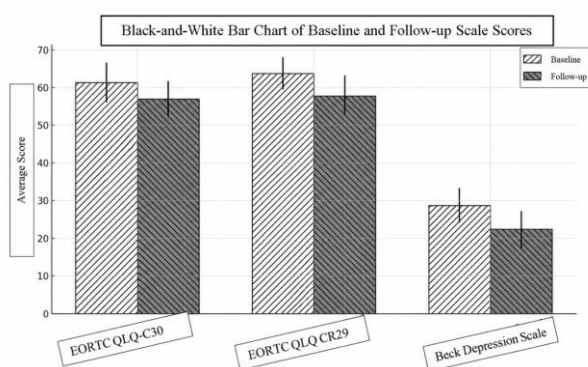
Table 2 shows the baseline and follow-up scores for the EORTC QLQ-C30 symptom-burden composite, EORTC QLQ-CR29 bowel symptom-burden composite, and BDI total score. Seventy-four participants completed both baseline and follow-up assessments. All three patient-reported outcome scores decreased after the 4-week home-based program. The reduction of symptom-burden composite of EORTC QLQ-C30 was from 61.32 ± 5.25 to 57.04 ± 4.62 , and the reduction of EORTC QLQ-CR29 bowel symptom-burden was

Table 1: Skewness and Kurtosis Values of Baseline and Follow-Up Scale Scores

Scales	Skewness	SE	Kurtosis	SE
Baseline EORTC QLQ-C30	0.473	0.279	0.214	0.552
Follow-up EORTC QLQ-C30	0.345	0.279	0.543	0.552
Baseline EORTC QLQ-CR29	-0.235	0.279	-0.408	0.552
Follow-up EORTC QLQ-CR29	0.084	0.279	-0.047	0.552
Baseline BDI total score	0.153	0.279	-0.630	0.552
Follow-up BDI total score	0.399	0.279	-0.609	0.552

Table 2: Comparison of Baseline and Follow-Up Outcome Scores (n=74)

Scales	Baseline	Follow-up	Mean difference	p
	Mean±SD (Min-Max)	Mean±SD (Min-Max)		
EORTC QLQ-C30	61.32±5.25 (51.59-75.40)	57.04±4.62 (46.83-69.05)	-4.28	p<0.001*
EORTC QLQ-CR29	63.73±4.33 (55.17-71.55)	57.78±5.39 (46.55-69.83)	-5.95	p<0.001*
BDI total score	28.66±4.62 (21.00-38.00)	22.42±4.81 (15.00-34.00)	-6.24	p<0.001*

**Fig. 1.** Baseline and follow-up mean scores for the EORTC QLQ-C30 symptom-burden composite, EORTC QLQ-CR29 bowel symptom-burden composite, and BDI total score. Error bars represent standard deviations. Higher EORTC composite scores indicate greater symptom burden, and higher BDI scores indicate more severe depressive symptoms.

from 63.73±4.33 to 57.78±5.39. The BDI total score also decreased from 28.66±4.62 to 22.42±4.81. Pre-post comparisons were all statistically significant (p<0.001).

Note: EORTC QLQ-C30 and EORTC QLQ-CR29 values represent composite symptom-burden scores. Higher scores indicate greater symptom burden. Negative change values indicate a reduction in symptom burden. For the BDI total score, higher scores indicate more severe depressive symptoms.

Mean scores at baseline and follow-up are presented in Figure 1.

Discussion

In this prospective single-arm pre-post study, patient-reported bowel symptom burden and depressive symptom scores were lower after a 4-week home-based pelvic floor and core exercise program. The results are clinically meaningful in the context of rectal cancer survivorship, but the magnitude of change should be interpreted within the limitations of the study design. Bowel dysfunction following rectal cancer surgery is seldom a purely physical complaint. Symptoms such as urgency, clustering, leakage, or incomplete evacuation may influence daily planning, comfort outside the home, and confidence in social participation. Thus, even small improvements in symptom burden may be of practical importance to patients.

The intervention employed in this study was intentionally simple. Each participant received individual instruction by a physical therapist in hospital and continued the exercises at home with weekly telephone follow-up. This structure may be important in routine practice where long-term supervised rehabilitation is not always possible. A brief educational session with a home-based program may be a pragmatic model for patients who require ongoing support after surgery and

stoma closure. However, without a control group, no solid conclusion can be drawn about causality. The observed changes may reflect the intervention, but they may also be influenced by attention from the study team, patient motivation, regression to the mean, or other unmeasured factors.

Our findings are consistent with previous studies assessing pelvic floor rehabilitation after rectal cancer surgery. Asnong et al. in a multicenter randomized trial reported greater improvement in LARS category after pelvic floor muscle training compared with usual care at 4 and 6 months. They also reported early improvement in specific bowel symptoms, including frequency of bowel movements and leakage of solid stool. However, there were no significant differences in wider quality-of-life outcomes between groups. This difference is relevant for the present study. Rehabilitation using pelvic floor-based interventions may be more directly reflected in bowel-specific symptoms, whereas global quality-of-life measures may need longer follow-up, larger samples, or additional psychosocial components to show measurable change. (7)

Ofluoglu et al. observed a similar pattern in patients undergoing low anterior resection with diverting ileostomy. Pelvic floor muscle training was associated with lower LARS scores and lower rates of major LARS in their study. There was no significant difference in EORTC QLQ-C30 scores, but improvements were seen in EORTC QLQ-CR29 domains, particularly fecal incontinence. This finding supports the hypothesis that measures of outcome specific to the rectum may be more sensitive to pelvic floor rehabilitation than generic cancer quality-of-life scales. This interpretation is supported by the reduction in the QLQ-CR29 bowel symptom-burden composite in the present study. (8)

Similarly, other studies on rehabilitation suggest the same trend. Zhang and Wang reported favorable results after pelvic floor rehabilitation in patients undergoing anus-preserving surgery for rectal cancer, especially in rectal cancer-specific domains measured with the EORTC QLQ-CR29. The reduction in the QLQ-CR29 bowel symptom-burden composite in the present study is in line with this trend. Taken together, these findings suggest that disease-specific measures may be more sensitive to clinical changes after pelvic floor-based rehabilitation than more generic quality-of-life instruments. However, direct comparison between studies is still limited, because the intervention components, the follow-

up duration and the outcome definitions were not uniform. (9)

This study should also be seen in the wider context of stepwise rehabilitation of bowel dysfunction after rectal cancer surgery. Harji et al. described the BOREAL program, a structured pathway for bowel rehabilitation after total mesorectal excision, and reported a reduction in major LARS at follow-up. Our intervention was shorter and less complex and consisted of only home-based pelvic floor and core exercises rather than a multi-component bowel rehabilitation program. However, both approaches respond to the same clinical need: patients often need structured support after surgical recovery, particularly when bowel symptoms persist after stoma closure. (10)

Current management concepts for LARS are based on individualized, stepwise care. Dulskas et al. described treatment options ranging from conservative measures to pelvic floor rehabilitation and biofeedback depending on symptom severity and patient needs. Likewise, Rosen et al. emphasized the significance of systematic screening and structured treatment pathways following sphincter-preserving rectal surgery. From this perspective, the home-based program tested in our study could be positioned as a low-intensity early rehabilitation option. It is not designed to replace more advanced interventions, but it may be of value for selected patients who can learn the exercises safely and continue them independently at home. (11,12)

This interpretation is consistent with broader reviews of LARS management. Sharp et al. reviewed the available treatment options, including pharmacotherapy, pelvic floor rehabilitation, transanal irrigation, and neuromodulation, stressing the need to individualize treatment based on the patient's predominant symptoms. A home-based pelvic floor and core exercise program is unlikely to be sufficient for all patients, especially those with severe leakage, major clustering, or complex anorectal dysfunction. However, it could be a practical starting point for survivorship care, as it is low cost, does not require specialist equipment and can be delivered following a brief supervised teaching session. (13)

The place of such a program among available LARS treatments should be interpreted cautiously. Yu et al. reported that transanal irrigation was the most effective short-term intervention for LARS in Bayesian network meta-analysis, and pelvic floor rehabilitation also ranked favorably. We

utilized a simple program compared to many structured rehabilitation protocols and did not include biofeedback, irrigation, or device-based monitoring. Thus, the short-term changes observed should be regarded as preliminary support for a home-based strategy that is accessible rather than as evidence of superiority over other LARS treatments. (14)

More intensive, pelvic floor-focused interventions may have broader physiological consequences. Wang et al. studied pelvic floor biofeedback therapy after sphincter-preserving rectal surgery and reported lower LARS scores, improved anorectal pressure parameters, and better quality-of-life outcomes compared to standard care. Our intervention did not include biofeedback and was less intensive. This complicates direct comparison but also reflects a potential practical advantage: a simple home-based program may be easier to implement in the routine follow-up, especially in centers with limited access to specialized pelvic floor rehabilitation. (15)

It is also important to understand that post-operative bowel dysfunction is not purely behavioral or muscular. Anorectal dysfunction is frequent after rectal cancer surgery, and the severity of the symptoms may be associated with the extent of surgery, as shown by Kupsch et al. This serves as a useful reminder that exercise-based rehabilitation cannot fully reverse all the anatomical, neurological, or treatment-related contributors to bowel dysfunction. In this sense, the present program should be considered as supportive rehabilitation. It may help patients to improve control, confidence and symptom control but should not be presented as a definitive treatment for all postoperative bowel symptoms. (16)

Keane et al. emphasized that LARS is not simply a list of bowel symptoms, but a condition which can significantly impact the quality of life after rectal resection. This perspective justifies the use of patient-reported outcomes in the current study. We sought to assess both rectal-specific bowel symptoms and broader symptom burden to capture changes that may be relevant to patients' everyday functioning rather than focusing only on isolated clinical symptoms. (17)

The reduction in Beck Depression Scale scores observed in our study is also consistent with the broader literature regarding exercise and colorectal cancer survivorship. Kim et al. found that a 12-week home-based exercise program increased physical activity in colorectal cancer survivors and may have benefits for quality of life and

psychological health. While their intervention was not designed to address rectal cancer-specific bowel dysfunction, it does support the idea that structured home-based exercise may influence both physical and emotional outcomes during survivorship. (18)

Similar patient-centered benefits have been reported with other lifestyle interventions. Ho et al. showed that interventions in diet and physical activity may influence quality of life and depression in colorectal cancer survivors. Their intervention was different to ours in that it was not a pelvic floor rehabilitation program, but relevant as it suggests that structured behavioural support in survivorship may have psychological as well as physical effects. Therefore, the reduction in depressive symptom scores in the current study may reflect not only changes in bowel symptom burden, but also the supportive structure of the program, patient engagement and the sense of active self-management. (19)

Additional support for this interpretation is provided by systematic reviews of exercise interventions in colorectal cancer survivors. Singh et al. reported that exercise interventions are generally feasible and safe in this population and may lead to improvements in outcomes such as quality of life, fatigue, aerobic capacity, and depression. Zhou et al. similarly showed that interventions on physical activity and lifestyle dietary habits may improve health-related quality of life and general health outcomes. While our program focused on pelvic floor and core exercises rather than general aerobic or resistance training, the reduction in depressive symptom scores is consistent with this wider survivorship exercise literature. (20,21)

Another study by Abdul Razak et al. indicated improvements in quality of life, functional capacity, fatigue, and depression in colorectal cancer survivors in a Pilates-based exercise program. Pilates is not the same as the pelvic floor and core exercise program used in the present study, but both approaches involve structured, repeated movement and may help patients to rebuild confidence in bodily control following treatment for cancer. Caution is needed when interpreting this comparison because of differences in study design, intervention content, and outcome assessment; however, it adds to the large literature relating to the importance of exercise-based rehabilitation in colorectal cancer survivorship. (22)

Rehabilitation of the pelvic floor after rectal cancer surgery is still an emerging field. There is

continued interest in the best timing, content, delivery method, and long-term effects of pelvic floor-based interventions, as indicated by recent and ongoing trial protocols such as CARRET and CONTICARE. Other studies are exploring combination approaches, such as biofeedback combined with electrical stimulation. These results indicate that a standardized rehabilitation pathway has not yet been established for all patients with bowel dysfunction after rectal cancer surgery. In this context, the present findings should be considered as preliminary support for a simple low-resource home-based program that may be suitable for selected survivors and should be further tested in controlled studies. (23-25)

In conclusion, the present findings contribute to the growing evidence that rehabilitation after rectal cancer surgery should be patient-centered and symptom-directed. The main strength of this study is its pragmatic design: the program was short, home-based, and was aided by a teaching session by a physiotherapist and weekly telephone follow-up. This structure may be applicable for routine survivorship care, especially in settings with limited access to specialized pelvic floor rehabilitation. At the same time, the findings should be seen as hypothesis-generating, as the study was not designed to compare this program with usual care, biofeedback, transanal irrigation, or other established LARS management strategies.

Limitations: This study has some limitations. First, the single-arm pre-to-post design is limited for causal inference. The improvements found after the program cannot be attributed solely to the exercise intervention, as there is no control group. Other possible factors influencing the results could be patient motivation, increased interaction with the study team, natural variability, or changes in daily habits.

Second, this was a single-center study with a small number of patients. The follow-up period was short, as outcomes were measured only at the end of the 4-week program. Therefore, it remains unclear whether the observed changes are durable. Third, compliance was evaluated by patient self-report during weekly telephone contacts. No exercise diary or objective monitoring technique was used. The study was also based on patient-reported outcomes and did not incorporate any anorectal physiology testing such as manometry or balloon expulsion testing. The composite symptom-burden scores were also calculated from selected EORTC symptom items and domains and should be considered as summary measures and not as individually validated scales. Exercise-

related adverse events, increased pain, and problems leading to discontinuation were not systematically recorded, which should also be considered when interpreting the findings.

Finally, we did not analyze some factors that may influence postoperative bowel function, such as surgical details, neoadjuvant treatment, baseline LARS severity, time since stoma closure, and comorbidities. Future controlled studies with longer follow-up are needed to assess these factors and to help identify which patients are most likely to benefit from this type of home-based program.

In this prospective single-arm pre-post study, a 4-week home-based pelvic floor and core exercise program was associated with lower patient-reported bowel symptom-burden scores and lower depressive symptom scores in rectal cancer survivors. These findings suggest that this program may represent a feasible supportive rehabilitation option, especially in settings with limited access to supervised pelvic floor rehabilitation.

The study was limited by the lack of a control group and short-term follow-up, and therefore the findings should be considered exploratory. Larger controlled studies with more prolonged follow-up are required to evaluate the clinical significance of this approach, to elucidate the longevity of the observed changes and to identify the patient groups most likely to benefit.

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