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Internet-Based Telecare and Bibliotherapy Delivery of Acceptance and Commitment Therapy for Reducing Anxiety and Depression in Breast Cancer Patients: A Randomized Controlled Trial

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ABSTRACT

Objective: To compare the effectiveness of Internet-based acceptance and commitment therapy (iACT) and bibliotherapy-based ACT (bACT) in reducing anxiety and depression among women with breast cancer.

Methods: In this three-arm randomized controlled trial, 99 participants were recruited from three oncology centers in Iran and randomly assigned to iACT, bACT, or a control group ($n = 33$ each). Interventions lasted 6 weeks with a 4-week follow-up. The Beck Anxiety Inventory and Beck Depression Inventory-Short Form were used to assess outcomes at baseline, post-intervention, and follow-up. Data were analyzed using generalized estimating equations (GEE).

Results: The iACT group showed significantly greater reduction in depression and anxiety than the control group at post-intervention and follow-up (all $p < 0.001$, except for post-intervention anxiety in iACT group was $p = 0.001$). The bACT group showed delayed but significant improvement in anxiety at follow-up ($p > 0.001$), but not in depression. Between-group comparisons revealed superior outcomes for iACT over bACT in both anxiety and depression post-intervention, though the difference in anxiety diminished by follow-up.

Conclusions: Internet-based ACT was more effective than bACT or standard care in reducing anxiety and depression in breast cancer patients. These results support the broader use of guided Internet-based ACT interventions in oncology settings.

Trial Registration: Iranian Registry of Clinical Trials: IRCT20231209060301N1

1 | Introduction

Cancer is a complex and potentially life-threatening disease characterized by the uncontrolled growth of abnormal cells. These cells can invade nearby tissues and, in more advanced stages, spread to distant organs through metastasis—one of the main causes of cancer-related mortality [1]. Among various types, breast cancer (BC) is the most prevalent malignancy in women, with approximately 2.3 million new cases reported worldwide in 2022, making it the second most common cancer overall after lung cancer [2]. Although early-stage BC is usually not fatal, as the disease progresses into more advanced stages, metastasis may occur, when malignant cells spread beyond the primary tumor to distant organs, significantly increasing the risk

of death [1]. Although advances in early detection and treatment have improved survival rates, many BC survivors continue to face long-term physical and psychological challenges [3].

In addition to its medical effects (e.g., disease-related physical symptoms and side effects of treatment), BC has major psychological consequences. Psychological distress (i.e., cancer-related emotional suffering and worries) including anxiety and depression is particularly prevalent. Studies indicate that up to 25% of cancer patients experience depression after diagnosis; however, this figure is likely underestimated due to symptom overlap with cancer-related fatigue [4]. According to biopsychosocial model, cancer-related psychological distress arises from the interplay of biological vulnerabilities, psychological processes, and social or contextual factors, and the emotional and cognitive factors also play a critical role [4, 5]. A BC diagnosis often evokes feelings of fear, despair, and emotional distress, threatening one's identity, values, and goals in life [6]. The symbolic and emotional significance of the breast can intensify these reactions, leading to increased psychological vulnerability [7]. In addition, factors such as maladaptive coping mechanisms, limited social or healthcare support, changes in body image, chronic pain, and the persistent fear of recurrence all contribute to long-term emotional distress [4].

More severe physical symptoms, poorer treatment adherence, and a worse overall prognosis are all linked to psychological distress in cancer patients [8]. Depression, in particular, has been associated with a higher risk of suicide and systemic inflammation, which may worsen long-term health outcomes [4, 7]. Nevertheless, mental health difficulties in cancer patients frequently remain unrecognized or untreated, pointing to the need for integrated psychological interventions within cancer supportive care [4].

Anxiety is common among women with BC, and it may persist long after treatment. It often arises from uncertainty about the future, fears of recurrence, and changes in body image and one's sense of femininity [9]. This anxiety can affect follow-up care, compromise quality of life, and affect treatment decisions. While some patients manage by regularly visiting the doctor and undergoing repeated diagnostic tests, others may avoid medical appointments due to emotional distress [10]. Studies show that suppressed coping mechanisms in this population cause not to report the anxiety. Meta-analyses report an overall global prevalence of anxiety in BC patients at around 41.9%, with significantly higher rates in developing countries like Iran, where it reaches 65.5% [11, 12]. Early detection and psychological intervention are crucial to enhance the well-being and recovery of BC patients given the effects of psychological distress on adherence to treatment, hospitalization, and general outcomes.

BC patients often have unmet psychological needs, while oncologists frequently face time constraints that limit their ability to manage these concerns [6]. Psychological support is primarily provided during acute treatment phases, which is referred to ongoing medical treatments for BC, such as chemotherapy, radiotherapy, surgery, hormonal therapy, or other physician-directed pharmacological treatments, while long-term survivors often struggle with persistent emotional distress, including fatigue, depression, and anxiety [7]. Rising patient numbers, a lack of mental health specialists, geographic restrictions, and the high cost of therapy are further obstacles to traditional psychological support [13, 14]. These challenges necessitate the development of cost-effective and accessible psychological interventions that can be integrated into routine cancer care.

One promising approach is the stepped-care model, which provides interventions based on the severity of psychological distress [15]. This model incorporates self-help strategies, such as bibliotherapy and Internet-based therapies, in early intervention stages, to reduce the burden on healthcare systems while maintaining treatment accessibility [14]. Self-help interventions may be delivered through books, online programs, or mobile applications, and can be either guided or unguided, with therapist-supported formats generally showing stronger effects [16].

Healthcare providers also play a key role in delivering psychological support to cancer patients. Although their work was once centered mainly on medication management, their responsibilities have expanded to include psychological assessment, counseling, and psychoeducation, allowing them to bridge the gap in mental health service provision within oncology care [17].

Internet-based therapies, usually inspired by in-person sessions, combine psychoeducation and key psychological skills with useful exercises. Comparatively to unguided programs, guided interventions—where patients get therapist support—have shown more success [16]. With the growing interest in telecare among cancer patients, healthcare providers can use Internet-based approaches to deliver psychological support. However, the effectiveness of these interventions in reducing anxiety and depression remains a topic of debate [18]. Outcomes often differ depending on cancer type, patient demographics, and the underlying psychological approach, with most studies based on cognitive-behavioral therapy (CBT) or mindfulness-based approaches [19].

Bibliotherapy, another self-help approach, is widely used for improving mental health in various conditions, including cancer, addiction, grief, and other psychological disorders. It is easily accessible and often can be used independently by patients [20]. According to some studies, bibliotherapy could be an effective supplementary therapy for cancer patients experiencing anxiety and depression [19]. However, evidence regarding its overall efficacy remains inconclusive, as variations in self-help books may contribute to inconsistent research outcomes, making it difficult to generalize its effectiveness [21].

CBT is the dominant approach in psycho-oncology interventions, but third-wave therapies, such as acceptance and commitment therapy (ACT), may offer additional advantages. Unlike CBT, which focuses on changing negative thoughts, ACT promotes psychological flexibility by encouraging patients to accept distressing emotions while continuing to engage in personally meaningful activities [22]. Given the high prevalence of depression and anxiety among BC patients, identifying the most effective and sustainable intervention is essential.

Although evidence for Internet-based ACT and ACT-based bibliotherapy is growing across different patient groups, their comparative effectiveness in reducing psychological distress among BC patients is still unclear. Understanding which intervention offers greater long-term benefits is particularly important given the increasing reliance on digital healthcare

solutions, and as many patients continue to face barriers to accessing conventional therapy. This study aims to assess the effect of guided Internet-based ACT against bibliotherapy on reducing depression and anxiety in BC patients, providing insights into their effectiveness and potential for broader implementation in oncology care.

2 | Methods

2.1 | Study Design

This study was a 3-arm randomized controlled trial (RCT) designed to examine the effects of ACT delivered through bibliotherapy and an Internet-based intervention on anxiety and depression in BC patients.

2.2 | Participants and Recruitment

The study population comprised BC patients receiving care at Shahid Baghaei 2, Golestan, and Shafa Hospitals, affiliated with Ahvaz Jundishapur University of Medical Sciences (AJUMS). This study was approved by the research and ethics committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1402.468) on 2 December 2023. After that, the trial was registered in the Iranian Registry of Clinical Trials (IRCT). Eligible participants were identified and approached in the oncology wards. The researcher explained the study objectives and procedures in detail, and individuals who met the inclusion criteria and expressed interest in participating were asked to provide written informed consent prior to enrollment.

2.3 | Eligibility Criteria

Participants were eligible for inclusion if they were female, aged 18 years or older, literate in Persian (reading and writing), and diagnosed with BC by a certified oncologist. Additional inclusion criteria were interest in participating in the study, ability to provide written informed consent, access to a phone and short messaging service, access to a computer and/or smartphone with daily Internet connectivity, and physical and cognitive capacity to engage in the intervention. Cognitive capacity to participate in the intervention was assessed informally through a combination of researcher observation, brief clinical interviews, and collateral information. During the initial screening, the first author spoke directly with participants—and when available, with accompanying family members—to ensure that they were able to understand study instructions, engage with written materials, and follow the weekly procedures. Additional information regarding patients' cognitive status was obtained through routine clinical observation in the oncology unit, review of medical records, and inquiries with nursing staff. No formal neurocognitive assessment was administered.

Participants were also required to have a stable dose of psychotropic medications, if any, for at least 3 months prior to the study. Information regarding the use of psychotropic medication was obtained through participant self-report during the eligibility screening. Participants were asked whether they were currently under psychiatric care and whether they were taking any psychotropic medication. For those who reported medication use, an additional question assessed whether their dosage had remained stable for at least 3 months prior to enrollment, in line with common recommendations for minimizing confounding effects in psychological intervention trials. No external verification (e.g., medical records) was sought.

Those meeting the above criteria and presenting with mild to moderate levels of anxiety (Beck Anxiety Inventory score: 8–25) or depression (Beck Depression Inventory-Short Form score: 5–15) were included. Exclusion criteria comprised nonadherence to treatment protocols or irregular attendance at intervention sessions, incomplete questionnaire responses at any assessment stage, newly emerging physical or psychological conditions that could interfere with study participation (e.g., hospitalization or need for other psychiatric treatments), lack of access to required digital devices or Internet connectivity, voluntary withdrawal from the study for any reason, changes in medical diagnosis or treatment affecting study engagement (e.g., progression to advanced-stage cancer or other severe illnesses), and inability to complete assessments or failure to meet the cognitive requirements of the study.

2.4 | Intervention

The study followed a parallel-group experimental design with pre-intervention (T0), post-intervention (T1), and 4-week follow-up (T2) assessments.

2.4.1 | Bibliotherapy Group (Bibliotherapy-Based ACT [bACT])

Participants received either a printed or electronic version of the self-help book *Living Your Life with Cancer through Acceptance and Commitment Therapy: Flying over Thunderstorms*. The book provided structured psychoeducational content based on ACT principles, covering key areas such as understanding the psychological impact of cancer, rebuilding a meaningful life after diagnosis, practicing self-care, and moving forward. Participants were instructed to complete self-directed exercises and read approximately 40 pages per week for six weeks. They could go over chapters again whenever they wanted and had unrestricted access to the book.

Compliance with the weekly reading assignment (40 pages per module) and completion of the accompanying exercises were monitored primarily through participant self-report. At the start of each week, participants received a reminder outlining the expected reading section and were asked to confirm whether they had completed the assigned pages and exercises. Participants' occasional questions, comments, or submitted reflections also served as indirect indicators of engagement and adherence to the material. No formal tracking system (e.g., digital log monitoring) was implemented; however, this approach aligns with standard practice in low-intensity, self-guided ACT interventions, where adherence is typically assessed through self-report and periodic check-ins. At the beginning of the intervention, participants received a telephone briefing to familiarize them with the book structure and study expectations. Weekly follow-up calls were conducted to provide guidance, encourage adherence, and address queries. All telephone contacts were conducted by the first author, who is trained in ACT principles and responsible for implementing the study procedures. The purpose of these brief weekly calls was to provide reminders about the study schedule, clarify instructions for the upcoming module, and verify completion of the previous week's reading and exercises. The calls

followed a consistent but nonscripted structure, focusing on engagement and procedural guidance rather than therapeutic processing. No audio recordings were made; however, brief notes were taken after each call to document participant progress. Participants were asked not to share study materials until the intervention had been completed.

2.4.2 | Internet-Based ACT Group (iACT)

Participants in this group had smartphone access. The intervention was delivered using a structured format derived from the same standardized ACT self-help manual employed in the bibliotherapy arm. The online materials closely followed the sequence of the original book, which provides a predefined progression of concepts, experiential exercises, and illustrative examples. To adapt the content for digital delivery, brief clarifications and minor expansions were added where needed; however, the therapeutic structure and core components remained fully consistent with the source manual. No specialized app or web-based therapeutic system was developed; instead, materials were distributed weekly through secure messaging platforms (WhatsApp, Telegram, Eitaa, and Rubika). To ensure accessibility, Internet packages were provided if needed. Each session included a prerecorded audio lesson to standardize delivery and accommodate patients who could not join live due to treatment schedules or personal constraints. The structure of each session included a review of the previous session's assignments, clarification of previously discussed concepts, presentation of new therapeutic content, practice of new ACT exercises, and assignment of weekly tasks. A psychiatric nurse facilitated discussions, responded to patient inquiries, and provided guidance in both group and private chat settings. Participants were encouraged to share their experiences and ask questions about the intervention content.

2.4.3 | Control Group (CG)

The CG received standard hospital care throughout the study period, with no additional psychological intervention. After completing the T2 assessment, they were given the option to participate in either of the ACT interventions. Data collection followed the same protocol as the intervention groups.

2.5 | Outcome Measures

Depression was assessed using the 13-item Beck Depression Inventory-Short Form (BDI-S) [23], and anxiety was measured with the 21-item Beck Anxiety Inventory (BAI) [24]. Both instruments are self-report measures with well-established validity and reliability in clinical and research settings. Depression severity was categorized as follows: 0–4 indicating no depression, 5–7 mild, 8–15 moderate, and 16–39 severe. Anxiety severity was classified as 0–7 minimal, 8–15 mild, 16–25 moderate, and 26–63 severe. The questionnaires were primarily completed by the patients themselves. However, in certain cases where assistance was needed (e.g., due to reading difficulties or emotional distress), the researcher provided guidance to ensure accurate and complete responses. Depression and anxiety were assessed in all three study groups at three time points: before the intervention (T0), immediately after the 6-week intervention (T1), and 4 weeks after the end of the intervention (T2).

2.6 | Statistical Analysis

Descriptive statistics were reported using frequencies (percentages) for categorical variables and mean ± standard deviation (SD) for continuous variables. Between-group comparisons were performed using ANOVA or Kruskal–Wallis tests for continuous variables and Chi-square tests for categorical variables. Normality was assessed using the Shapiro–Wilk test. All analyses were conducted based on the Intention-to-Treat (ITT) principle, whereby all randomized participants were included in the final analysis regardless of protocol adherence or study completion. ITT is a standard method in clinical trials that enhances the validity of findings by including all randomized individuals, regardless of adherence or completion [25, 26]. Changes in outcome measures over time (T0, T1, and T2) were analyzed using generalized estimating equations (GEE), a robust method for handling correlated repeated measures data and accommodating missing values. All statistical analyses were performed using SPSS and R (geepack package). A p value < 0.05 was considered statistically significant. The CopyMean method was used to impute missing data [27, 28].

3 | Results

According to the CONSORT flowchart (Figure 1), out of 262 patients with BC, 164 met the initial eligibility criteria. Following screening, 62 declined to participate and 3 were excluded due to loss of contact, resulting in 99 participants who were randomly assigned to three groups. During the study, some attrition occurred (3 in the bibliotherapy group, 2 in the Internet-based group, and 2 in the CG).

3.1 | Demographic and Clinical Characteristics

According to Table 1, there were no significant differences between the groups regarding age ($F(2.96) = 2.355$, $p = 0.10$), time since diagnosis ($\chi^2(2) = 0.248$, $p = 0.884$), marital status ($\chi^2(2) = 1.451$, $p = 0.484$), educational level ($\chi^2(1) = 0.141$, $p = 0.707$), and employment status (Fisher's exact test, $p = 0.680$). This indicates that the study groups were homogeneous in terms of these characteristics.

3.2 | Depression

The mean depression score in the Internet-based group at the baseline was 18.52 ± 6.09; post-intervention, it decreased to 12.06 ± 3.50; and at follow-up, it further decreased to 9.18 ± 3.74. In the bibliotherapy group, the mean depression score at the baseline was 17.21 ± 5.08; post-intervention, it dropped to 15.70 ± 3.54; and at the follow-up, it was 13.88 ± 3.50. In the CG, the mean depression score at the baseline was 18.56 ± 5.52. Post-intervention, it decreased to 17.52 ± 4.25, and at the follow-up, it was 16.70 ± 4.28. In Figure 2, the trend of changes in the depression variable in individuals with BC across the study groups (Internet-based, bibliotherapy, and control) over the study period (before intervention, immediately after intervention, and 4 weeks after intervention) is shown graphically.

At the baseline, the depression variable in the bibliotherapy and Internet-based groups was lower than in the CG, but there was no statistically significant difference between the groups at the baseline (p values were 0.289 and 0.966, respectively).

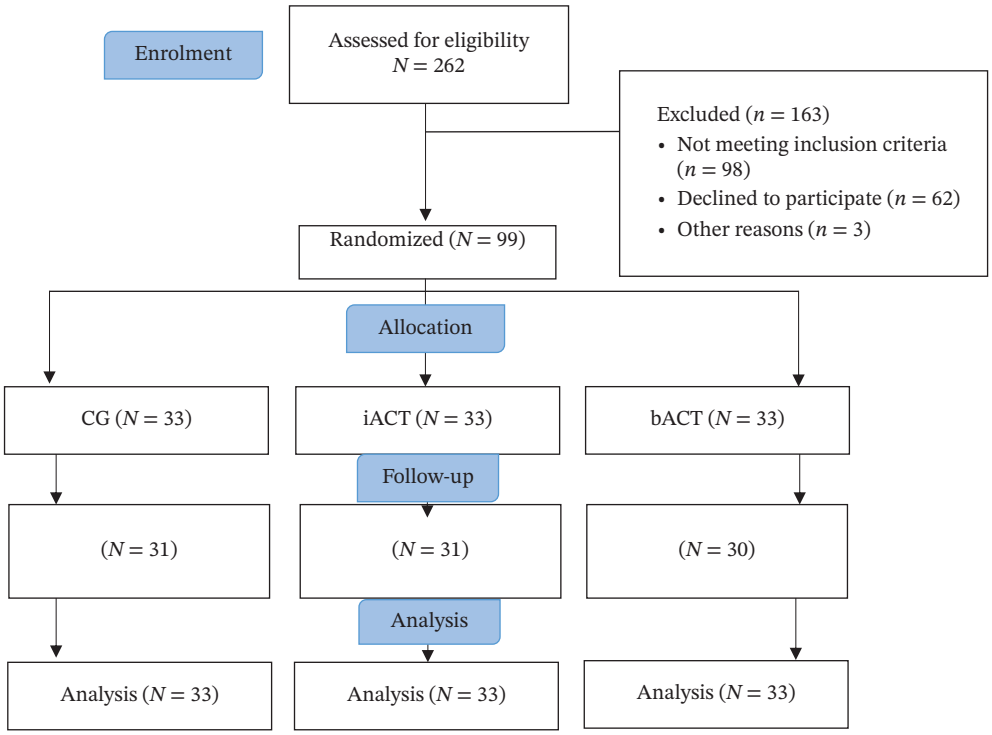

FIGURE 1 | CONSORT flow diagram.

The depression variable dropped in the post-intervention relative to the start of the study, but this drop was not statistically significant ($\beta = -1.06$, p value $= 0.302$). Comparatively, in the follow-up, the depression variable dropped from the baseline, but once more, this change was not statistically significant ($\beta = -1.88$, p value $= 0.122$).

TABLE 1 | Demographic and clinical characteristics of patients with breast cancer in the study groups (Internet-based [iACT], bibliotherapy-based [bACT], and control [CG]).

Variable		Group			*p* value	Test statistic
		CG ($n = 33$)	bACT ($n = 33$)	iACT ($n = 33$)		
Age (year)	Minimum	35	35	34	0.10*	F (2, 96) = 2.355
	Maximum	54	54	54		
	Mean	42.06	44.76	42.82		
	sd	4.82	5.88	4.85		
Time of disease diagnosis (month)	Minimum	1	1	1	0.884**	χ^2(2) = 0.248
	Maximum	16	14	18		
	Mean	5.39	5.09	6		
	sd	3.82	3.56	4.75		
Marital status	Married	24 (72.73%)	28 (84.85%)	26 (78.79%)	0.484***	χ^2(2) = 1.451
	Single	9 (27.27%)	5 (15.15%)	7 (21.21%)		
Educational level	Elementary	4 (12.12%)	4 (12.12%)	2 (6.06%)	0.707****	χ^2(1) = 0.141
	High school	26 (78.79%)	24 (72.73%)	26 (78.79%)		
	University	3 (9.09%)	5 (15.15%)	5 (15.15%)		
Employment status	Unemployed	4 (12.12%)	1 (3.03%)	2 (6.06%)	0.680*****	
	Worker	7 (21.21%)	4 (12.12%)	3 (9.09%)		
	Employee	5 (15.15%)	7 (21.21%)	6 (18.18%)		
	Military	0	1 (3.03%)	3 (9.09%)		
	Housewife	13 (39.39%)	15 (45.45%)	16 (48.48%)		
	Self-employed	4 (12.12%)	5 (15.15%)	3 (9.09%)		

*Analysis of variance (ANOVA).
**Kruskal–Wallis test.
***Chi-square test.
****Chi-square test for trend.
*****Fisher's exact test.

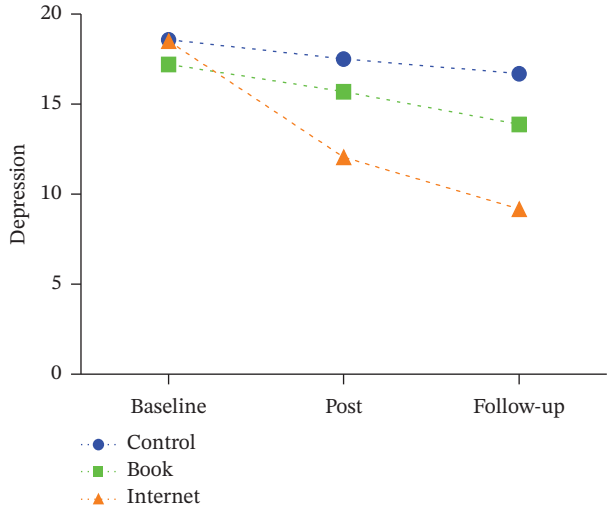

FIGURE 2 | Trend chart of changes in the depression in individuals with breast cancer across the study groups over the study period.

In the post-intervention, depression in the bibliotherapy group was lower than in the CG, but there was no statistically significant difference between these two groups (p value = 0.46, β = 0.780). However, in the post-intervention, depression in the Internet-based group was significantly lower than in the CG (p value < 0.001, $\beta = -5.39$).

In the follow-up, depression in the bibliotherapy group was lower than in the CG, but there was no statistically significant difference between these two groups (p value = 0.40, $\beta = -1.46$). On the other hand, in the follow-up, depression in the Internet-based group was significantly lower than in the CG (p value < 0.001, $\beta = -7.46$). Overall, the difference between depression in the CG and either the bibliotherapy or Internet-based groups was greater in the follow-up compared to the baseline.

The GEE model results showed that depression in the bibliotherapy group was significantly higher than that in the Internet-based group in the post-intervention (p value = 0.003, $\beta = 4.94$). Furthermore, in the follow-up, depression in the bibliotherapy group was significantly higher than that in the Internet-based group (p value < 0.001, $\beta = 6$). Overall, the difference between the bibliotherapy and Internet-based groups was greater in the follow-up than in the baseline (Table 2).

3.3 | Anxiety

The mean anxiety score in the Internet-based group at the baseline was 23.33 ± 7.36; after the intervention, it decreased to 13.42 ± 4.89; and 4 weeks after the intervention, it further decreased to 8.91 ± 3.80. In the bibliotherapy group, the mean anxiety score at the baseline was 23.27 ± 6.39; after the intervention, it dropped to 17.76 ± 5.53; and 4 weeks after the intervention, it was 12.30 ± 3.79. In the CG, the mean anxiety score before the intervention was 24.24 ± 7.05; after the intervention, it decreased to 22.42 ± 7.55; and 4 weeks after the intervention, it was 21.82 ± 6.70. In Figure 3, the trend of changes in the anxiety variable in individuals with BC across the study groups (Internet-based, bibliotherapy, and control) over the study period (before intervention, after intervention, and 4 weeks after intervention) is shown graphically.

The results show that at baseline, the anxiety variable was lower in the bibliotherapy and Internet-based groups compared to the CG, but there was no statistically significant difference between these groups before the intervention (p values were 0.552 and 0.603, respectively).

The results indicate that the anxiety variable decreased in the post-intervention compared to the start of the study, but this decrease was not statistically significant ($\beta = -1.82$, p value = 0.280). Similarly, in the follow-up, the anxiety variable decreased compared to the baseline, but again, this decrease was not statistically significant ($\beta = -2.42$, p value = 0.159).

The results show that in the post-intervention, the anxiety variable was lower in the bibliotherapy group compared to the CG, but there was no statistically significant difference between these two groups during this period ($\beta = -3.70$, p value = 0.056). In the same period, the anxiety variable was significantly lower in the Internet-based group compared to the CG ($\beta = -8.09$, p value = 0.001).

The results indicate that in the follow-up, the anxiety variable was lower in the bibliotherapy group compared to the CG ($\beta = -8.54$, p value > 0.001). Also, in the follow-up, the anxiety variable was much lower in the Internet-based group than in the

TABLE 2 | The results of the GEE for examining the effects of study groups on the depression variable over the study period.

Variable	Main effects (group and time) and interaction effect (group* time)		β	SE	CI 95%	Test statistic χ^2 (1)	p value*
Depression	Group$	Bibliotherapy	−1.36	1.29	(−3.88, 1.16)	1.12	0.289
		Internet-based	−0.06	1.41	(−2.82, 2.70)	0.002	0.966
	Time&	Post-intervention	−1.06	1.03	(−3.08, 0.96)	1.06	0.302
		Four weeks after intervention	−1.88	1.22	(−4.26, 0.50)	2.39	0.122
	Group* time‡	Bibliotherapy* After intervention	−0.46	1.59	(−3.57, 2.66)	0.08	0.78
		Internet-based* After intervention	−5.39	1.51	(−8.36, −2.43)	12.72	< 0.001
		Bibliotherapy* 4 weeks after intervention	−1.46	1.73	(−4.84, 1.93)	0.71	0.40
		Internet-based* 4 weeks after intervention	−7.46	1.68	(−10.75, −4.16)	19.68	< 0.001

Note: β: regression coefficient, SE: standard error of β.
Abbreviation: CI, confidence interval.
$The control group is defined as the reference category for the group variable.
&The time before intervention is defined as the reference category for the time variable.
‡The control group and time before intervention are defined as the reference categories for the group and time variables, respectively.
*p value based on the results of generalized estimating equations (GEE).

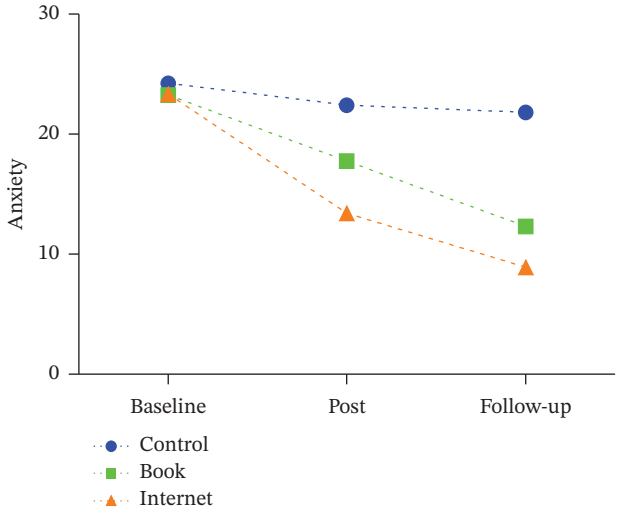

FIGURE 3 | Trend chart of changes in the anxiety in individuals with breast cancer across the study groups over the study period.

CG ($\beta = -12$, p value > 0.001). Overall, the difference in anxiety between the CG and either the bibliotherapy or Internet-based groups was greater in the follow-up compared to the baseline.

The results of the GEE model showed that anxiety in the bibliotherapy group was significantly higher than in the Internet-based group in the post-intervention ($\beta = 4.39$, p value $= 0.020$). The analysis also showed that anxiety in the bibliotherapy group was higher than in the Internet-based group in the follow-up ($\beta = 3.45$, p value $= 0.087$), but there was no statistically significant difference between the two groups during this period. Overall, the difference in anxiety between the bibliotherapy and Internet-based groups was less in the follow-up compared to the post-intervention (Table 3).

4 | Discussion

This study aimed to evaluate the effectiveness of ACT delivered through bibliotherapy and an Internet-based intervention on anxiety and depression in BC patients. The results demonstrated that both interventions reduced anxiety and depression; however, the Internet-based intervention (iACT) yielded significantly greater improvements compared to the bibliotherapy group (bACT) and the CG (CG). No significant changes were observed in the CG, confirming the efficacy of ACT-based interventions.

Regarding anxiety reduction, while both bACT and iACT groups exhibited a decline in anxiety levels, the reduction in the bACT group was statistically significant only at follow-up.

This superior outcome of iACT group may be attributed to direct interaction with psychiatric nurses, immediate feedback, and higher engagement in online sessions. On the other hand, members of the bACT group valued the freedom of self-paced learning, but their anxiety was not much changed from the CG. Conversely, participants in the bACT group appreciated the flexibility of self-paced learning, yet their anxiety reduction was not significantly different from the CG.

Similarly, in depression reduction, both intervention groups showed improvement; however, the iACT group exhibited significantly greater reductions than both the bACT and CGs. This finding underscores the effectiveness of real-time support and guided interventions in alleviating depressive symptoms.

The findings align with prior studies emphasizing the role of technology-driven psychological interventions in reducing distress among cancer patients. Recent research highlights the effectiveness of mobile applications and online platforms in managing anxiety and depression, supporting the growing integration of digital solutions in cancer care [29, 30].

A study by Ghanbari et al. investigated the impact of mobile-based psychoeducational interventions on anxiety and self-esteem in women with BC. Their findings demonstrated significant anxiety reduction in the intervention group, reflecting the anxiety reduction observed in the iACT group of the present study [31]. Similarly, Bandani-Susan et al. reported that mobile-based interventions, such as SMS reminders, effectively reduced fatigue and body image concerns in BC survivors, reinforcing the potential of digital tools in enhancing psychological well-being [32].

Regarding bibliotherapy, the present study revealed limited efficacy in reducing anxiety and depression only at follow-up. Similar findings have been reported in studies such as Jalilzadeh and Aghaj, which demonstrated positive but variable effects of

TABLE 3 | The results of the GEE for examining the effects of study groups on the anxiety variable over the study period.

Variable	Main effects (group and time) and interaction effect (group* time)		β	SE	CI 95%	Test statistic χ^2 (1)	p value*
Anxiety	Group$	Bibliotherapy	−0.97	1.63	(−4.17, 2.23)	0.353	0.552
		Internet-based	−0.91	1.75	(−4.33, 2.52)	0.271	0.603
	Time&	Post-intervention	−1.82	1.68	(−5.12, 1.48)	1.165	0.280
		Four weeks after intervention	−2.42	1.72	(−5.80, 0.95)	1.99	0.159
	Group* Time‡	Bibliotherapy* After intervention	−3.70	1.93	(−7.48, −0.09)	3.660	0.056
		Internet-based* After intervention	−8.09	2.34	(−12.68, −3.50)	11.930	0.001
		Bibliotherapy* 4 weeks after intervention	−8.54	2.24	(−12.93, −0.16)	14.605	< 0.001
		Internet-based* 4 weeks after intervention	−12	2.24	(−16.38, −7.62)	28.83	< 0.001

Note: β: regression coefficient, SE: standard error of β.
Abbreviation: CI, confidence interval.
$The control group is defined as the reference category for the group variable.
&The time before intervention is defined as the reference category for the time variable.
‡The control group and time before intervention are defined as the reference categories for the group and time variables, respectively.
*p value based on the results of generalized estimating equations (GEE).

bibliotherapy on resilience and psychological distress in cancer patients [33, 34]. These differences may result from variations in book content, patient engagement levels, and individual reading preferences.

On an international level, Abd El-Fattah et al. assessed a WhatsApp-based educational program for elderly BC patients and found that mobile interventions significantly improved self-efficacy and reduced distress [35]. Their findings align with the present study, as the iACT group demonstrated significant anxiety and depression reduction, highlighting the effectiveness of digital support interventions. However, in contrast to the persistent anxiety reduction in Abd El-Fattah's study, our findings suggest that the impact of online interventions on anxiety may diminish over time, emphasizing the need for long-term follow-up and continued engagement.

Furthermore, Lichiello et al. investigated an Internet-based psychological intervention for young adults with cancer, revealing improvements in psychological flexibility and anxiety reduction [36]. Their findings are consistent with the present study, supporting the effectiveness of digital interventions in reducing cancer-related distress.

Similar to the present study, Keenan examined bibliotherapy using an ACT-based self-help book and reported more control over the illness and improved coping mechanisms [21]. Although bibliotherapy was beneficial in both studies, the magnitude of its effect was lower compared to interactive interventions, such as iACT.

Psychological theories of learning, social support, and behavioral involvement help to understand the better effectiveness of Internet-based ACT interventions over bibliotherapy. Dynamic content delivery, real-time feedback, and guided exercises in interactive online programs improve cognitive and emotional processing—key processes in ACT [37, 38]. These platforms often include multimedia tools and structured modules that promote sustained attention, motivation, and experiential learning, fostering deeper internalization of therapeutic skills. Additionally, the interactive nature of iACT enables personalized support and a sense of connectedness, which aligns with Bandura's social learning theory, emphasizing the role of observational learning and modeling in behavior change [39, 40].

Conversely, bibliotherapy usually lacks immediacy, feedback, and interpersonal interaction even if it helps raise awareness and offer cognitive tools. It demands higher levels of self-discipline and cognitive resources, which can be challenging for individuals experiencing emotional distress or cancer-related fatigue. According to the self-determination theory, autonomy and relatedness are central to sustained behavior change, and interactive interventions may better satisfy these psychological needs than passive reading materials [41, 42]. Furthermore, iACT programs often combine elements of behavioral activation and mindfulness in a structured, interactive format, which can reduce avoidance and improve psychological flexibility—core components in managing anxiety and depression among cancer patients [43].

Taken together, these results imply that the higher impact of Internet-based ACT may result from its capacity to improve engagement, personalize care, and provide continuous reinforcement, so making it a more effective modality for supporting mental health in BC patients.

4.1 | Implications for Clinical Practice

The results of this study have application for including digital psychological interventions into cancer treatment. Particularly for patients with geographic, financial, or time-related constraints, Internet-based interventions—which have great accessibility, flexibility, and cost-effectiveness—can be reasonable substitutes for conventional psychological support. Moreover, ACT-based treatments—online or in self-help forms—can strengthen coping strategies and psychological resilience in BC patients. Online interventions' long-term viability, however, calls more research since symptom reduction may not last without ongoing support. Although bibliotherapy is still a reasonably cheap and easy technique, patient involvement and comprehension will affect its efficacy. Future studies should investigate hybrid models combining periodic online therapist support with self-help resources to improve therapy adherence and efficacy. Also, findings highlight the need for oncology nurses and psychologists to integrate ACT-based interventions as part of routine supportive care. Training programs for healthcare staff can enhance their ability to deliver psychological support in both online and self-help formats.

Beyond clinical practice, these findings also have implications for health policy and cultural adaptation. Integrating psychological care into oncology services requires institutional support and national health policies that recognize the mental health needs of cancer patients as a component of holistic care. In middle-income countries such as Iran, digital and bibliotherapy-based ACT interventions can serve as accessible and cost-effective options, particularly in settings with limited access to mental health professionals.

Moreover, cultural sensitivity should be emphasized when delivering ACT programs. Concepts such as acceptance, mindfulness, and values-based living can be aligned with patients' spiritual beliefs and cultural norms to enhance engagement and treatment relevance. Future research should focus on developing culturally tailored and targeted interventions that address specific subgroups—such as patients with high distress, those undergoing advanced treatment, or individuals with limited digital literacy—to maximize the benefits of ACT-based telecare and bibliotherapy in diverse populations.

4.2 | Limitations and Future Research

This study has several limitations. First, the sample was drawn from a single region and consisted only of women with BC, which may limit the generalizability of the findings to other cancer types, male patients, or populations with different sociocultural backgrounds.

Second, there may have been bias introduced into the results due to differences in patient adherence, especially within the bibliotherapy group. Third, a more thorough comprehension of the acceptability and contextual relevance of the intervention is limited by the lack of qualitative data on patient experiences and preferences.

Fourth, the study relied on self-reported measures, which are subject to recall bias and social desirability effects. Furthermore, although follow-up phone calls were made to enhance adherence, we could not fully control the extent to which participants completed all exercises or applied the techniques in their daily lives.

Finally, the relatively short follow-up period limited our ability to evaluate the long-term sustainability of treatment effects. Future studies with larger and more diverse samples, objective outcome measures, and longer follow-up periods are needed to confirm and extend these findings.

5 | Conclusion

This study provides strong evidence for the effectiveness of Internet-based ACT interventions in reducing anxiety and depression among BC patients. While bibliotherapy demonstrated positive effects, it was less impactful than the interactive online approach. Importantly, the Internet-based intervention not only led to significant improvements post-intervention but also showed sustained effects at 4 weeks follow-up, suggesting its potential for long-lasting mental health benefits. Given the growing integration of digital health solutions, incorporating technology-driven psychological interventions into routine oncology care may enhance mental health outcomes and improve patient well-being. Future research should explore the long-term durability of these effects, hybrid intervention models, and patient-centered digital mental health strategies in cancer care.

Author Contributions

Niloufar Baghelani, Mojtaba Miladinia, Mina Jahangiri, and Kourosh Zarea designed the study protocol. Mina Jahangiri conducted the statistical analysis. All authors contributed to conceptualization, data interpretation, and visualization. Niloufar Baghelani drafted the initial version of the manuscript. Kourosh Zarea, Mojtaba Miladinia, and Mina Jahangiri contributed to the critical review and final approval of the manuscript. Kourosh Zarea and Mojtaba Miladinia coordinated all aspects of the clinical trial.

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Disclosure

The funder had no role in the design, execution, analysis, or reporting of the study.

Ethics Statement

This study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1402.468). Written informed consent was obtained from all participants before enrollment. An independent ethics committee representative monitored the study process to ensure adherence to ethical standards.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the corresponding author upon reasonable request.

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