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**Feasibility and acceptability of a remote physical activity intervention coupled with short text messages in women with breast cancer and severe depressive or anxiety symptoms**

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Johan Caudroit, PhD<sup>1</sup>, Josyanne Lapointe, Msc<sup>2,3</sup>, Alain Steeve Comtois, PhD<sup>2</sup>, Ahmed Jérôme Romain, PhD<sup>3,4</sup>, Paquito Bernard, PhD\*<sup>5</sup>

<sup>1</sup>Laboratoire sur les vulnérabilités et l'innovation dans le Sport, Université Claude Bernard Lyon 1, Villeurbanne, France

<sup>2</sup>Physical activity sciences department, Université du Québec à Montréal, Montréal, QC, Canada

<sup>3</sup>Research Centre, University Institute of Mental Health in Montreal, Montreal, QC, Canada

<sup>4</sup>School of kinesiology and physical activity sciences. Faculty of Medicine. Université de Montréal, Montréal, QC, Canada

<sup>5</sup> Univ Rennes, Inserm, EHESP, IRSET (Institut de Recherche en Santé, Environnement et Travail) – UMR\_S 1085, Rennes, France

**Contact and ORCID**

JC, [johan.caudroit@univ-lyon1.fr](mailto:johan.caudroit@univ-lyon1.fr), 0000-0002-5994-1337

JL, [josyannelapointe@gmail.com](mailto:josyannelapointe@gmail.com)

ASC, [comtois.alain-steve@uqam.ca](mailto:comtois.alain-steve@uqam.ca), 0000-0002-6159-3220

AJR, [aj.romain@umontreal.ca](mailto:aj.romain@umontreal.ca), 0000-0003-1690-1375

PB, paquito.bernard@inserm.fr, 0000-0003-2180-9135

\*Corresponding author: Paquito Bernard. Univ Rennes, Inserm, EHESP, IRSET (Institut de Recherche en Santé, Environnement et Travail) – UMR\_S 1085, Rennes, France. [paquito.bernard@inserm.fr](mailto:paquito.bernard@inserm.fr)

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6

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9

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11

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## 1Abstract

2**Purpose.** To test the feasibility and acceptability of a remote physical activity (PA) intervention  
3coupled with motivational text messages among women experiencing severe depressive and/or anxiety  
4symptoms during or after breast cancer (BC) treatment.

5**Methods and materials.** A three-phase-single-case experimental study design (16-week) was  
6conducted among 18 women diagnosed with BC reporting high levels of depressive and anxiety  
7symptoms. Our intervention included behaviour change techniques (BCTs) and 2 to 3 supervised PA  
8sessions per week, for at least 30 minutes, coupled with 4 to 7 weekly personalized text messages.

9Feasibility (satisfaction and drop-out rates), acceptability (participation rates, therapeutic alliance, and  
10qualitative data), fidelity (quality of BCTs delivered), and the efficacy on PA level and physical fitness  
11were assessed.

12**Results.** Participants expressed high satisfaction and reported an excellent working alliance with their  
13kinesiologist. Notably, there was a very high participation rate (90%) along with a low dropout rate  
14(11%). However, only 3 patients significantly increased their PA post-intervention.

15**Conclusion.** This study highlighted the importance to personalize remote PA interventions for women  
16with BC and severe depressive or anxiety symptoms. The combination of a remote PA intervention with  
17daily text messages appears to be very suitable to increase their adherence.

18

19**Keywords.** Telerehabilitation, physical exercise, breast cancer, anxiety, depression, telemedicine, self-  
20paced intensity

## 11. Introduction

2Physical activity (PA) plays a crucial complementary role in breast cancer (BC) care by offering  
3numerous physical and psychological benefits during and after BC treatment [1]. Regular PA has been  
4shown to improve fitness, health-related quality of life, self-esteem, tolerance, and treatment adherence  
5while reducing fatigue for women diagnosed with a nonmetastatic BC during or after adjuvant cancer  
6therapy (chemotherapy or radiotherapy) [2]. Moreover, high post-diagnostic PA levels were associated  
7with lower mortality rates in women diagnosed with BC [3]. However, despite the benefits, adherence  
8to PA interventions is notably low (9-20%) [4,5]. One possible reason is that most PA interventions  
9used a “one-size-fits-all” approach, which fail to address the specific needs of women, thereby  
10increasing the risk of poor adherence and low acceptability [6]. Expert consensus and qualitative  
11investigations on PA modalities in women diagnosed with BC suggests that PA should be adapted to  
12their individual preferences [7]. In addition, previous studies indicated that a significant proportion of  
13women drastically reduce their PA level after completing exercise programs and return to their pre-  
14treatment PA behaviour and physical fitness after BC treatment [8]. Recent meta-analyses have  
15revealed that the combination of active components of intervention, such as behaviour change  
16techniques (BCTs), during supervised PA sessions coupled with personalized motivational and  
17educative short text messages increased PA adherence [9], including in BC [10,11].  
18The issue of PA adherence is especially relevant for women diagnosed with BC and severe depressive  
19and anxiety symptoms, 13.2% and 20% of the population, respectively [12,13]. High levels of  
20psychological distress are associated with lower adherence to BC treatments (i.e., radiotherapy,  
21chemotherapy or surgery), including PA adherence [4], as well as higher health-related costs and  
22impaired health-related quality of life in both, the short and long term [14]. Current treatments for  
23psychological distress (i.e., pharmacological and psychological interventions) can reduce symptom  
24intensity in women diagnosed with BC and moderate levels of depressive and anxiety symptoms, but  
25their respective effectiveness remains limited [15-17]. The American College of Sport Medicine

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1(ACSM)'s guidelines highlight that PA interventions are an evidence-based strategy to decrease the risk  
2of developing depressive or anxiety symptoms during or after BC treatment [18]. Meta-analyses have  
3highlighted that PA interventions effectively reduce depressive and anxiety symptoms both during and  
4after adjuvant therapies for BC (i.e., chemotherapy or radiotherapy) [2,19]. However, these studies  
5excluded women diagnosed with BC and severe psychological distress from their PA intervention,  
6therefore no evidence-based consensus has been established [20]. To date, a PA intervention for this  
7specific population has not yet been developed and investigated. Consequently, individualized PA  
8interventions [21], along with a clear and adapted methodology, should be proposed for women  
9diagnosed with BC and severe depressive and anxiety symptoms to ensure good adherence and  
10promote sustainable PA behaviour change. Our team specifically developed an intervention for this  
11population, combining a remote, tailored PA program supervised by a kinesiologist with weekly  
12motivational text messages over a 12-week period. This approach is grounded in ACSM  
13recommendations and incorporates personalized strategies, effective BCTs, and preferred PAs, modeled  
14for individuals with breast cancer and those experiencing psychological distress.  
15The primary aim of the present study was to evaluate the feasibility and acceptability of this PA  
16intervention for women diagnosed with a non-metastatic BC during or after adjuvant BC treatment and  
17severe levels of depressive or anxiety symptoms. The secondary aims were to assess the fidelity of  
18intervention delivery and investigate the potential effects of this intervention on PA level and physical  
19fitness.

## 202. Material and methods

### 212.1. Study design and setting

22The present study employed a single-case experimental design with daily Ecological Momentary  
23Assessments (EMAs). Single-case experimental design, which has garnered increasing interest in  
24oncology and PA research [22,23], appears well-suited to examine personalized interventions. An  
25intervention tailored at the individual level may be more effective than a one-size-fits-all approach [23]

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1because variations in cognition, affect, and behaviour may be undetected when using between-person  
2design [9]. This specific method assesses experimental manipulations at the individual level and  
3requires multiple measures of dependent variables facilitated by real-time monitoring technology. More  
4precisely, a three-phase design, A(2 weeks)- B(12 weeks)- A'(2 weeks), was implemented. Phase A  
5represented the pre-intervention baseline measures. Phase B represented the intervention phase with  
6personalized PA intervention coupled with daily text messages. Phase A' represented the post-  
7intervention follow-up period. EMAs were conducted throughout these phases. Following Phase A',  
8participants were invited to participate in a remote, individual, semi-structured interview to share their  
9opinions and feelings about the intervention. This study received approval from the Ethic Boards of the  
10Eastern Montreal Integrated University Health and Social Services Centre (2022-4319) and adheres to  
11the Single-Case reporting Guideline in behavioural Interventions [24] (see checklist in supplementary  
12file).

### 132.2 Participants and procedures

14Participants were recruited from Maisonneuve Rosemont or Santa Cabrini Hospitals (Montreal,  
15Canada). Flyers, outlined the study aims, inclusion criteria and contact information of the research  
16coordinator, were distributed through psycho-oncology consultations and shared to patients on the  
17psycho-oncology unit waitlist and on the oncology center's website and social networks. Potential  
18participants were screened by telephone and included if they: 1) were diagnosed with a non-metastatic  
19BC and currently completing treatment or completed treatment at least 3 months prior; 2) were  
20physically inactive (less than 150 minutes per week or Godin's questionnaire score < 23) [25]; 3) were  
21aged 18 to 65 years; 4) possessed a smartphone; 5) reported a high level of self-reported depressive  
22(Patient Health Questionnaire score > 15) [26] or anxiety symptoms (General Anxiety Disorder  
23questionnaire score > 15) [26].

24Participants were excluded if they: 1) reported a diagnosis of severe mental illness (i.e., schizophrenia,  
25bipolar, severe substance use disorders); 2) were unable to provide consent; 3) received a weekly

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2 psychological treatment from a clinician; 4) reported a major functional or physical disability; 5)  
3 answered positively to the PA Readiness Questionnaire. The consent form was sent via e-mail before  
4 the initial evaluation. Participants were remunerated \$150 CA upon study completion.

### 4 **4.2.3. Intervention development**

5 The characteristics of our PA intervention (frequency, session, intervention durations, and intensity)  
6 were based on the ACSM recommendations' [18] and results from previous meta-analyses on the  
7 effects of PA on depressive and anxiety symptoms among women diagnosed with BC [2,27,28].  
8 Furthermore, adherence to the ACSM recommendations highlights the importance of aligning PA  
9 interventions with patient's preferences and incorporating motivational strategies (Figure 1). Our  
10 intervention was designed to ensure a high adherence rate, induce changes in PA behaviour and to be  
11 personalized and reproducible. We adopted an evidence-based approach to identify effective BCTs,  
12 their modes and timing of delivery, and personalization strategies.

### 13 ***Physical activity intervention***

14 Participants had three supervised remote PA sessions from week 1 to 4. From week 5 to 12, participants  
15 had two supervised remote PA sessions, and had the choice between supervised or unsupervised  
16 sessions for the third weekly session (see supplementary files for more details on PA sessions  
17 schedule). The supervised PA sessions were structured as follows: 1) combination of counseling  
18 (implemented BCTs during supervised session are in Table 2) and aerobic exercise with resistance or  
19 yoga exercises (depending on participants' choice); 2) the session durations ranged from 30 (weeks 1-  
20 4) to 60 minutes (weeks 5-12), and actual durations were adaptable based on participants' self-reported  
21 fatigue level; 3) Effort intensity was self-selected by participants, guided by exercise physiologist's  
22 recommended daily intensity, which was explained using the rating of perceived exertion. Intensity  
23 progressively increased over the 12 weeks and varying between 1 and 8 (different for aerobics,  
24 resistance, yoga) on a scale of 10. Unsupervised PA sessions could be based on supervised sessions or  
25 personalized after discussions with the participant (e.g., 3 weekly walks of 15 minutes). Each

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1participant freely received a training kit including a yoga mat, elastic bands, and a suspension trainer.

2All intervention contents are in supplementary files.

### **3Remote physical activity intervention**

4Given that limited time and transportation are the most frequent organizational barriers to PA

5participation in women diagnosed with BC, we chose to implement a remote PA intervention.

6Participants and kinesiologists used any internet-connected device at their disposition (computer, tablet,

7smartphone) to attend the online sessions via Zoom. This mode of intervention is doable in BC context

8[29,30] and requires minimal technical skills [30].

### **9Personalization**

10Based on three reviews examining PA preferences in interventional contexts among women during and

11after BC treatment [7,31,32], preferences associated with social support, PA characteristics, and

12environmental context were selected. Each participant had the flexibility to engage in supervised

13remote PA sessions with a partner or friend of their choice, either in the same room or remotely.

14Participants could select the type (resistance or yoga), intensity, and duration of each session, as well as

15their preferred music playlist. After the first month of intervention, participants could choose whether

16the third weekly PA session was supervised or unsupervised [7]. Unsupervised sessions were

17collaboratively prepared with a kinesiologist, tailored to each participant's personal and environmental

18contexts.

### **19Behaviour change techniques**

20Systematic reviews have identified the most effective BCTs to promote PA among women diagnosed

21with BC or depressive and anxiety disorders [33,34]. Twelve BCTs were selected for our intervention

22(see details in Supplementary file). The delivery timing of BCTs was structured to primarily address

23initiation, adherence, and maintenance at the beginning, during, and at the end of the intervention,

24respectively [34]. Based on previous meta-analyses [9,10], BCTs were implemented during the

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1 supervised PA sessions, and were also used to develop personalized motivational and educative short  
2 text messages.

### **3 *Kinesiologist training***

4 Three student kinesiologists underwent 20 hours of training by the study principal investigator (PB)  
5 and the study coordinator (JL). These students had to have passed two courses in their PA sciences  
6 department: psychology of PA, and promotion of PA for health. PB has a solid clinical and academic  
7 experience in behaviour change in patients with cancer [35] and mental health diagnostics [36–38]. JL  
8 is working as kinesiologist, with adults with chronic illnesses for 8 years. She holds a master's degree  
9 in kinesiology, and developed a behaviour change intervention to promote PA for inactive adults [22].  
10 The training focused on BCTs, PA intervention implementation, therapeutic alliance development in the  
11 oncological context, safety of a remote PA intervention, and PA practices during BC treatment. An  
12 intervention manual was also provided to guide implementation.

### **13 *Short text messages***

14 Based on identified BCTs and ACSM recommendations [39], a first set of short text messages was  
15 developed to: 1) promote positive affects (e.g., using words such as happy, joyful, cool, great, fun); 2)  
16 promote the perception of gains (e.g., listing potential PA benefits); 3) use non-verbal information (e.g.,  
17 onomatopoeia, emoticons); 4) formulate very clear and simple information; and 5) provide links to  
18 resources for participants interested in learning more about PA. A pretest was carried out by inviting  
19 seven women with BC to provide feedback on message content and structure. A 1-hour workshop was  
20 conducted, featuring an initial 15-minute presentation of the study details. Subsequently, the workshop  
21 addressed a discussion covering the frequency of weekly message delivery, whether the communication  
22 was one-way (no replies) or two-way (allowing responses), as well as considerations of message  
23 context themes and forms. Following this workshop, the text messages were revised based on patients'  
24 feedback.

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1For this intervention, the text messages were unidirectional (no responses) and personalized according  
2to the following criteria: 1) participant's first name; 2) kinesiologist's first name; 3) delivery timing and  
34) use of formal or informal content, depending on each participant's preference. An example of text  
4messages associated with selected BCTs is presented in Table 1. All delivered text messages are  
5presented in supplementary files. During the intervention phase, each participant received 4 to 7 weekly  
6personalized text messages.

## **72.4. Measures**

### ***8Initial evaluation***

9Before the intervention, online questionnaires collected information on age, educational achievements,  
10marital status, income, number of children, date of diagnosis, treatments, current medications, and  
11history of cancer. Subjective social status was assessed with the MacArthur scale [42]. The 9-item  
12Patient Health Questionnaire (PHQ-9) and the 7-item Generalized Anxiety Disorder (GAD-7) are self-  
13reported questionnaires used to assess the severity of depression and anxiety, respectively, on a scale  
14ranging from 0 "not at all" to 3 "nearly every day" [26]. The respondent is asked to rate how often each  
15symptom occurred over the last 2 weeks. In line with the Canadian association of psychosocial  
16oncology recommendations [27], a score > 15, for the PHQ-9 and the GAD-7, is associated with a  
17severe level of depression, and severe anxiety disorder, respectively [26].

### ***18Feasibility***

19The feasibility of the intervention was assessed through two indicators. At the end of phase B, a  
20satisfaction questionnaire with three items [40], employing a Likert scale (0- Totally disagree to 5-  
21Totally agree), evaluated participant's satisfaction with the intervention. The items were: 1) would you  
22recommend this intervention to friends or family members?; 2) if you had the possibility to continue  
23the project, would you do it?; 3) did the project meet your expectations?. Participation (i.e., number of  
24participants meeting the inclusion criteria who accepted to participate) and dropout (i.e., number of

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1participants who started the PA intervention but further decide to withdraw or leave the study and did  
2not return) rates were also considered as indicators of feasibility.

3Acceptability was measured by the adherence rate to the remote PA intervention. An adherence rate  
4exceeding 60% or 80% was considered as good or very good, respectively [4]. Moreover, the 6-item  
5Therapeutic Alliance Questionnaire (TAQ) [43] was filled by participants during the intervention at  
6weeks 6 and 12 to evaluate the quality of their relationship with their kinesiologist. A constant or  
7improved therapeutic alliance score indicates good alliance quality.

8Treatment fidelity, defined as “the methodological strategies used to monitor and enhance the reliability  
9and validity of behavioural interventions” [40], was characterized by assessing the quality of BCTs  
10implementation. To this end, we recorded two randomly selected supervised sessions per participant.  
11Based on the coding strategy used by Thompson et al. [41], two researchers with expertise in behaviour  
12change (JL, PB) evaluated the implementation of BCTs via audio recording. Scores of 0 or 1 denoted  
13poor or no delivery of BCTs, while a score of 3 or more denoted a reasonable quality of intervention  
14delivery. Scores of 5 or 6 represented an excellent quality of delivery. Discrepancies in scores were  
15compared, and a consensus was reached through discussion.

### 16*Participant interviews*

17During an individual remote semi-structured interviews, participants were invited to share their  
18opinions, and experiences regarding the intervention. The interviews were conducted after the  
19intervention by the study coordinator (JL), who was not involved in supervised PA sessions. The  
20interviews were recorded and transcribed by the JL. A stand-alone narrative analysis was performed for  
21each participant. A combination of deductive (codes developed a priori) and inductive (codes developed  
22in the course of the analysis) approaches was used to explore the text within each transcript from a pre-  
23established list of themes (i.e., positive and negative experiences, perceived benefits and suggestions  
24for improvements) [44]. The coding process was iterative [44] (i.e., positive and negative experiences,  
25perceived benefits, and suggestions). Throughout the analysis, two narrative analytic levels (personal,

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1interpersonal) were utilized [44]. The coding process was iterative. Investigators (JC, PB) read the  
2transcripts several times, annotating which participants supported each theme and highlighted  
3particularly illustrative passages. One or two quotes from the transcripts were selected to represent the  
4three themes. These verbatim were chosen because the investigators agreed that they provided  
5particularly good illustrations.

### 6*Effectiveness*

7During the two weeks of phase A and A', participants were instructed to wear a waterproof wrist-worn  
8GENEAktiv accelerometer 24/7 validated for measuring low, moderate, and high intensity PAs [45].  
9Twice during phase B (first and last session), participants performed a push-up test, a modified Apley  
10scratch test, and a 30-second sit-to-stand. They are proven to be safe, reliable, and valid in an oncologi-  
11cal population [46]. The 30-second sit-to-stand test was used to assess function and lower limb  
12strength.

### 13**2.5. Statistical Analyses**

14The mean equivalence between TAQ scores was tested by computing an equivalence interval (i.e., +/-  
1520% of the mean of reference), and then compared with the confidence interval of the second  
16assessment of the therapeutic alliance [47]. PA data were analyzed with a Tau-U, a non-parametric test  
17providing effect size estimates [45]. The Tau-U coefficient was calculated for each participant and PA  
18variables (i.e., daily total of PA, daily time spent in moderate to vigorous PA). An effect size of less  
19than 0.20 can be interpreted as a small effect; 0.20-0.60 as a moderate effect; 0.60-0.80 as a large  
20effect; and 0.80 or above as a very large effect [48]. A paired sample t-test or Wilcoxon rank test was  
21used to test the intervention effectiveness on physical fitness performance outcomes, depending on data  
22distribution.

### 23**2.6 Transparency and openness.**

1The study protocol was registered a priori on OSF registries [49]. Analyses and graphics were  
2performed with R 4.3 and the *tidyverse*, *ggir*, *ggplot2*, and *scan* packages [50,51]. Data, open materials  
3and R scripts are available online [44].

### 43. Results

#### 53.1. Participants' enrollment

6Between 2022 May and 2023 June, 47 women were contacted to be assessed for eligibility and only 20  
7met the inclusion criteria, but two did not return our call (cf. Figure 2). Regarding the 18 participants  
8recruited, 10 were undergoing BC treatment and 8 were in the post BC treatment phase. Their mean age  
9was  $43.8 \pm 10$  years (ranging from 29 to 61 years), 39% were married, 50% had a college diploma and  
1067% were on sick leave. Among the 10 participants who were currently receiving BC treatment, 90%  
11had surgery, 10% had chemotherapy or hormonotherapy, and 20% radiotherapy. Among the 8  
12participants who completed BC treatment at least 3 months prior, all of them had a surgery and  
13chemotherapy treatment and 87.5% had radiotherapy (see Table 1 for more details). Regarding scores  
14on PHQ-9 and GAD-7, all participants experienced severe psychological distress (score  $> 15$  on, at  
15least, one scale) with 13 patients who had severe depressive disorders, one who had severe anxiety  
16disorders and four who had severe depressive and concomitant anxiety disorders.

#### 173.2. Feasibility

18Based on the questionnaires completed by 12 of the 18 participants, 92% (n= 11) of participants  
19reported they would recommend the project to a friend or a relative, 92% (n= 11) said they would want  
20to continue the project, and 100% (n= 12) reported that the project met their expectations. The  
21participation rate (18/20; 90%) was high and the drop-out rate (2/18; 11%) was low. Figure 2 illustrates  
22the recruitment flowchart. Adherence rates to EMAs ranged between 48% and 88%, with 8 participants  
23above 70%. A detailed description of PA sessions, EMAs adherence rates, and preferences for each  
24participant is available in supplementary file.

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1The global adherence rate to PA sessions was 85% (min 32%, max 100%). Sessions performed with a  
2partner accounted for 14% of supervised sessions (min 0, max 57%). After the aerobic exercises,  
3participants chose: 61 %, 29%, 6%, and 4% for resistance, yoga, both or other activities, respectively,  
4during their supervised sessions. After the fourth intervention week, women had the option to transform  
5one supervised PA session in a non-supervised PA session and only four women did so. They performed  
6between 1 and 4 unsupervised sessions weekly during the whole intervention. Regarding TAQ scores,  
7the confidence interval of the second measure (95% confidence interval [6.73-7.01]) enclosed the 20%  
8equivalence interval (+ /- 1.35 [5.4-8.1]), hence the two-score can be considered equivalent.

9Concerning fidelity treatment, the implementation scores of BCTs ranged from 2.3 (SD= 2.0) to 6 (SD=  
100) for behavioural practice/ rehearsal and social support (emotional) BCTs, respectively. The overall  
11mean was 4.4 (SD= 1.5). The respective score of each assessed BCTs is in supplementary file.

### 123.3. Participant interviews

13Among the 16 women who completed the entire PA intervention, 14 agreed to take part in an end-of-  
14program interview. Three themes emerged from the deductive and inductive analysis.

#### 15*Theme 1: Positive and negative experiences*

16All expressed a positive impression of the intervention. They identified the working alliance with their  
17kinesiologist and the personalized approach (e.g., self-paced intensity, session duration) as major deter-  
18minants of their adherence. Remote supervised sessions were perceived as enjoyable and interactive.  
19Most participants reported incorporating various types of PA (e.g., active transport) into their daily lives  
20and developing new routines (e.g., climbing stairs). None of the participants reported issues with the  
21use of their tablet or computer during training sessions. All participants endorsed positive views of re-  
22mote training as an effective solution to manage work- or family-related duties. Participants with chil-  
23dren at home highlighted that they performed some exercise with them.

24 « *I have more opportunities to do PA that do not require me to spend money or leave the*  
25*house. »*

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1 « *The intervention didn't only teach me how to do PA but also what to think about before*  
2*and after so that I can move. »*

3 « *She [kinesiologist] is human and is interested in me, and at the same time, she knows a*  
4*lot about how to train when you have a cancer. »*

### 5**Theme 2: Perceived benefits**

6Participants indicated that the intervention improved their global and physical self-esteem but also alle-  
7viated their depressive or anxiety symptoms and cancer-related fatigue. Some participants included  
8short PA tasks (yoga, outdoors walks with music) in their daily life as an effective solution to cope with  
9sad mood and low energy. Participants shared various skills that they found helpful in becoming active  
10(again) throughout the intervention. Many continued to implement goal setting on a weekly scale.

11 « *The more I saw what I could do, the more I wanted to do it, and the higher my self-es-*  
12 *teem... »*

13 « *I wanted to be the person I was before the diagnosis, but I understood my limits and the*  
14 *program enabled me to push back against them a little at my own pace and to be more*  
15 *realistic. Now, I am active but in a different way. »*

16 « *Physical activity became a way to regain control of/over myself. »*

### 17**Theme 3: Suggestions for improvement**

18Most participants believed the intervention should be followed by weekly or monthly booster sessions  
19with their kinesiologist (remote or in person). Participants endorsed mixed views of text messages re-  
20garding their PA behaviours. Some found them very supportive, particularly for shared resources and  
21motivational content. Others, however, reported concerns because they could not answer or exchange.  
22Some women suggested providing opportunities to perform supervised sessions with other study partic-  
23ipants after 4 or 6 weeks of intervention might be useful.

24 « *Some text messages have been really helpful, I have even shared some of them with my*  
25 *family to motivate them to train with me. »*

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#### 13.4. Effectiveness

2 Seven participants had pre- and post-accelerometer data. Three accelerometers have been lost  
3by participants or postal services. Two participants wore their accelerometer for only one day, making a  
4comparison with phase A' impossible. Three participants (id2, id4, id17) significantly increased their  
5PA daily level with small to very large effect. Id2 and id17 also significantly improved their daily level  
6of moderate to vigorous PA (with large effects). Two participants (id7, id8) significantly decreased her  
7daily moderate to vigorous PA. More details are in Table 4 and the supplementary file.

8 No significant differences were found pre- and post-intervention for the 30-second sit-to-stand  
9and modified Apley scratch tests. For the push-up test, 7 participants could not perform the pre-  
10intervention test and 6 the post-intervention test. Consequently, the planned statistical analysis was not  
11performed. Graphical representations of the results suggest a ceiling effect for the Apley scratch tests  
12(see supplementary file).

#### 13.4. Discussion

14The aim of the present study was to assess the feasibility and acceptability of a 12-week remote PA  
15intervention combined with short text messages for women during or after BC treatment experiencing  
16severe levels of depressive and/or anxiety symptoms. We also explored the fidelity of intervention  
17delivery and effects of intervention on PA and fitness.

18Overall, our intervention and tools assessment were highly feasible and acceptable. Our feasibility  
19criteria showed that participants were highly satisfied, reporting the intervention met their expectations,  
20and they would continue the intervention. This high level of satisfaction and feasibility was confirmed  
21by a very high participation rate and a low dropout rate during the intervention. These results present  
22better rates than previous studies examining the effects of exercise in oncological context [4] or among  
23adults with severe depressive symptoms [35]. The drop-out rate was similar to previous studies  
24conducting online supervised exercise interventions among cancer survivors [29,52,53] but these  
25interventions were shorter (8 weeks) and patients with mental health comorbidities were excluded

1

1[29,53]. Concerning our acceptability criteria, the adherence rate (85%) was very good compared to  
2exercise interventions carried out in the oncological context (~65%) [4] but similar with Wonder's  
3study [29]. In addition, our participants reported an excellent working alliance with their respective  
4kinesiologist, representing a notable result because: 1) working alliance has been identified as a major  
5determinant of psychosocial and exercise interventions' efficacy among adults with a cancer or with  
6severe mental disorder [54] and 2) it confirms a very good working alliance can also be developed  
7during a remote intervention [55].

8In terms of intervention effectiveness, an increase of total device-measured PA among three participants  
9was observed. This post-intervention improvement was also observed for two of these 3 participants,  
10indicating that their PA behaviour change is associated with more time spent in PAs with various  
11intensities. However, one participant decreased their PA post-intervention, which may be explained by  
12a possible measurement reactivity effect (i.e., changes in people's behaviour due to being measured as  
13part of a research project) [53] associated with device PA assessment during the phase A. This effect  
14has also been observed in previous single-case experimental studies [22]. Lastly, participants reported,  
15during their individual interviews, that our intervention had positive effects on self-esteem, cancer-  
16related fatigue, anxiety, and depressive symptoms. This is in line with previous trials examining the  
17effects of PA among patients diagnosed with BC but not mood or anxiety disorders [2,56].

18Some findings from our PA intervention should be highlighted. First, participants mostly selected  
19resistance exercises for the second part of their remote training sessions. This result is in line with  
20studies examining PA preferences among BC where resistance training is frequently reported after  
21walking [7]. However, this choice could be associated with lower mental health benefits for patients  
22because yoga related activities were associated with lower levels of depressive and anxiety symptoms  
23in comparison to resistance exercises. Indeed, a previous meta-analysis found that yoga based  
24interventions were associated with higher mental health benefits in comparison to resistance based  
25interventions in patients with BC [19]. Secondly, the participation rate of PA session performed with

1 someone (remote or not) was surprisingly low. Individual interviews suggested that some participants  
2 were uncomfortable with this option and the planning was perceived as a time-consuming task. Thirdly,  
3 no remarkable health or technical issues were mentioned during individual interviews. These factors  
4 did not affect the overall intervention fidelity, which was higher than previous behaviour change studies  
5 focusing on PA [41]. However, two BCTs obtained (i.e., behavioural practice/rehearsal and social  
6 support [practical]) the lowest scores, suggesting that their implementation requires more training of  
7 kinesiologists or more practical solutions accounting for the presence of severe depressive symptoms.  
8 The evidence-based approach (e.g., use of BCTs during the PA session and via text messages), patient-  
9 centered intervention (e.g., considering PA preferences), the use of distance-based methods for data  
10 collection (e.g., EMAs), and intervention delivery (e.g., offering remote PA sessions and supplying  
11 materials) are strengths of this study. The findings also demonstrate that a well-structured PA  
12 intervention, coupled with text messages, is efficient in terms of feasibility and acceptability for  
13 participants with severe depressive or anxiety symptoms, a population often excluded from  
14 interventional studies. Additionally, our participation and dropout rates illustrate a good collaboration  
15 for recruitment with care providers of psycho-oncology services and reinforce the idea that  
16 multidisciplinary approach is a major determinant of treatment involving among patients diagnosed  
17 with BC and mood or anxiety disorders [57]. Another strength of the present study was the assessment  
18 of intervention fidelity, which is rare in the literature but essential to understand significant or non-  
19 significant results produced by the intervention [58].

20 The present study also presents some methodological and interventional limitations. Given the small  
21 sample size, the results should be interpreted with caution. Moreover, missing accelerometer data is a  
22 major concern that could bias our findings regarding the impact of our intervention on PA level.  
23 Investigator-based strategies (calling part to encourage wearing monitors or providing incentives for  
24 monitor return) or participant-based strategies (keeping logs or placing reminders in prominent area at  
25 home) [59] could be useful for limiting accelerometer data loss. Although validated in the oncological

1

1context [46], our tools assessing physical fitness appeared to be unsuitable for our population with  
2severe depressive or anxiety symptoms. Other physical fitness tests, such as the modified sit and stand  
3test, the partial curl up test or the hand grip dynamometer test [29], should be considered in future  
4studies. Concerning the intervention, the absence of booster sessions after the 12 weeks of training was  
5reported during the individual interviews. Participants described them as a motivational support to stay  
6active and a review supported the interest of booster sessions in oncological context [60]. However,  
7these sessions should include specific BCTs such as relapse prevention or enhancing coping individual  
8skills [61]. Moreover, the perception of text messages was not perceived as helpful for all participants.  
9Future interventions may offer the possibility to adapt the frequency of text message delivery or stop  
10them during the intervention.

11In conclusion, this study is one of the first steps in the rigorous development of a remote PA  
12intervention coupled with short text messages for women diagnosed with BC and severe levels of  
13depressive or anxiety symptoms. This research highlights the important factors associated with  
14feasibility (e.g., recruitment methods) and acceptability (e.g., working alliance) that need to be  
15considered when developing PA interventions for this specific population.

16

17

## 1References

1. Kraschnewski JL, Schmitz KH. Exercise in the Prevention and Treatment of Breast Cancer: What Clinicians Need to Tell Their Patients. *Translational Journal of the American College of Sports Medicine*. 2017 August 1;2:92.
2. Carayol M, Bernard P, Boiché J, Riou F, Mercier B, Cousson-Gélie F, Romain AJ, Delpierre C, Ninot G. Psychological effect of exercise in women with breast cancer receiving adjuvant therapy: what is the optimal dose needed? *Ann Oncol*. 2013 February;24:291–300.
3. Cariolou M, Abar L, Aune D, Balducci K, Becerra-Tomás N, Greenwood DC, Markozannes G, Nanu N, Vieira R, Giovannucci EL, et al. Postdiagnosis recreational physical activity and breast cancer prognosis: Global Cancer Update Programme (CUP Global) systematic literature review and meta-analysis. *International Journal of Cancer*. 2023;152:600–615.
4. Bullard T, Ji M, An R, Trinh L, Mackenzie M, Mullen SP. A systematic review and meta-analysis of adherence to physical activity interventions among three chronic conditions: cancer, cardiovascular disease, and diabetes. *BMC Public Health*. 2019 May 24;19:636.
5. Coletta AM, Marquez G, Thomas P, Thoman W, Bevers T, Brewster AM, Hawk E, Basen-Engquist K, Gilchrist SC. Clinical factors associated with adherence to aerobic and resistance physical activity guidelines among cancer prevention patients and survivors. *PLoS One*. 2019;14:e0220814.
6. Schmitz KH, Campbell AM, Stuver MM, Pinto BM, Schwartz AL, Morris GS, Ligibel JA, Cheville A, Galvão DA, Alfano CM, et al. Exercise is medicine in oncology: Engaging clinicians to help patients move through cancer. *CA: A Cancer Journal for Clinicians*. 2019;69:468–484.
7. Wong JN, McAuley E, Trinh L. Physical activity programming and counseling preferences among cancer survivors: a systematic review. *Int J Behav Nutr Phys Act*. 2018 07;15:48.
8. Pinto BM, Ciccolo JT. Physical Activity Motivation and Cancer Survivorship. In: Courneya KS, Friedenreich CM, editors. *Physical Activity and Cancer*. Vol. 186. *Recent Results in Cancer Research*. Berlin, Heidelberg: Springer Berlin Heidelberg; 2010. pp 367–387. Available from: [http://link.springer.com/10.1007/978-3-642-04231-7\\_16](http://link.springer.com/10.1007/978-3-642-04231-7_16)

9. Smith DM, Duque L, Huffman JC, Healy BC, Celano CM. Text Message Interventions for Physical Activity: A Systematic Review and Meta-Analysis. *American Journal of Preventive Medicine*. 2020 January 1;58:142–151.
10. Gomersall SR, Skinner TL, Winkler E, Healy GN, Eakin E, Fjeldsoe B. Feasibility, acceptability and efficacy of a text message-enhanced clinical exercise rehabilitation intervention for increasing ‘whole-of-day’ activity in people living with and beyond cancer. *BMC Public Health*. 2019 June 3;19:542.
11. Singleton A, Raeside R, Partridge SR, Hayes M, Maka K, Hyun KK, Thiagalingam A, Chow CK, Sherman KA, Elder E, et al. Co-designing a Lifestyle-Focused Text Message Intervention for Women After Breast Cancer Treatment: Mixed Methods Study. *J Med Internet Res*. 2021 June 14;23:e27076.
12. Hashemi S-M, Rafiemanesh H, Aghamohammadi T, Badakhsh M, Amirshahi M, Sari M, Behnamfar N, Roudini K. Prevalence of anxiety among breast cancer patients: a systematic review and meta-analysis. *Breast Cancer*. 2020 March 1;27:166–178.
13. Pilevarzadeh M, Amirshahi M, Afsargharehbagh R, Rafiemanesh H, Hashemi S-M, Balouchi A. Global prevalence of depression among breast cancer patients: a systematic review and meta-analysis. *Breast Cancer Res Treat*. 2019 August;176:519–533.
14. Mausbach BT, Yeung P, Bos T, Irwin SA. Health care costs of depression in patients diagnosed with cancer. *Psycho-Oncology*. 2018;27:1735–1741.
15. Li M, Kennedy EB, Byrne N, Gérin-Lajoie C, Katz MR, Keshavarz H, Sellick S, Green E. Systematic review and meta-analysis of collaborative care interventions for depression in patients with cancer. *Psycho-Oncology*. 2017 May 1;26:573–587.
16. Ostuzzi G, Benda L, Costa E, Barbui C. Efficacy and acceptability of antidepressants on the continuum of depressive experiences in patients with cancer: Systematic review and meta-analysis. *Cancer Treatment Reviews*. 2015 September 1;41:714–724.
17. Xiao F, Song X, Chen Q, Dai Y, Xu R, Qiu C, Guo Q. Effectiveness of Psychological Interventions on Depression in Patients After Breast Cancer Surgery: A Meta-analysis of Randomized Controlled Trials. *Clinical Breast Cancer*. 2017 June 1;17:171–179.

18. Campbell KL, Winters-Stone KM, Wiskemann J, May AM, Schwartz AL, Courneya KS, Zucker DS, Matthews CE, Ligibel JA, Gerber LH, et al. Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc.* 2019 November;51:2375–2390.
19. Carayol M, Delpierre C, Bernard P, Ninot G. Population-, intervention- and methodology-related characteristics of clinical trials impact exercise efficacy during adjuvant therapy for breast cancer: a meta-regression analysis. *Psychooncology.* 2015 July;24:737–747.
20. Carvalho AF, Hyphantis T, Sales PMG, Soeiro-de-Souza MG, Macêdo DS, Cha DS, McIntyre RS, Pavlidis N. Major depressive disorder in breast cancer: A critical systematic review of pharmacological and psychotherapeutic clinical trials. *Cancer Treatment Reviews.* 2014 April 1;40:349–355.
21. Hefferon K, Murphy H, McLeod J, Mutrie N, Campbell A. Understanding barriers to exercise implementation 5-year post-breast cancer diagnosis: a large-scale qualitative study. *Health Education Research.* 2013 October 1;28:843–856.
22. Lapointe J, Comtois A-S, Romain A-J, Bernard P. The Transtheoretical model’s processes of change in the heart of a physical activity intervention: A series of n-of-1. *Psychology of Sport and Exercise.* 2023 July 1;67:102430.
23. Sequeira M, Pereira C, Alvarez M-J. Predicting Physical Activity in Survivors of Breast Cancer: the Health Action Process Approach at the Intrapersonal Level. *IntJ Behav Med.* 2023 December 1;30:777–789.
24. Tate RL, Perdices M, Rosenkoetter U, Shadish W, Vohra S, Barlow DH, Horner R, Kazdin A, Kratochwill T, McDonald S, et al. The Single-Case Reporting Guideline In BEhavioural Interventions (SCRIBE) 2016 Statement. *Phys Ther.* 2016 July;96:e1–e10.
25. Amireault S, Godin G, Lacombe J, Sabiston CM. Validation of the Godin-Shephard Leisure-Time Physical Activity Questionnaire classification coding system using accelerometer assessment among breast cancer survivors. *J Cancer Surviv.* 2015 September;9:532–540.
26. Canadian Association of Psychosocial Oncology. Pan Canadian Practice Guideline: Screening, Assessment and Care of Psychosocial Distress, Depression, and Anxiety in Adults with Cancer. Toronto; 2015.

27. Bernard P, Savard J, Steindorf K, Sweegers MG, Courneya KS, Newton RU, Aaronson NK, Jacobsen PB, May AM, Galvao DA, et al. Effects and moderators of exercise on sleep in adults with cancer: Individual patient data and aggregated meta-analyses. *Journal of Psychosomatic Research*. 2019 September;124:109746.
28. Gourlan M, Bernard P, Bortolon C, Romain AJ, Lareyre O, Carayol M, Ninot G, Boiché J. Efficacy of theory-based interventions to promote physical activity. A meta-analysis of randomised controlled trials. *Health Psychology Review*. 2016 January 2;10:50–66.
29. Wonders KY, Gnau K, Schmitz KH. Measuring the Feasibility and Effectiveness of an Individualized Exercise Program Delivered Virtually to Cancer Survivors. *Current Sports Medicine Reports*. 2021 May;20:271.
30. Sotirova MB, McCaughan EM, Ramsey L, Flannagan C, Kerr DP, O'Connor SR, Blackburn NE, Wilson IM. Acceptability of online exercise-based interventions after breast cancer surgery: systematic review and narrative synthesis. *J Cancer Surviv*. 2021 April;15:281–310.
31. Clifford BK, Mizrahi D, Sandler CX, Barry BK, Simar D, Wakefield CE, Goldstein D. Barriers and facilitators of exercise experienced by cancer survivors: a mixed methods systematic review. *Support Care Cancer*. 2018 March;26:685–700.
32. Livsey L, Lewis K. Breast cancer survivors' perceptions of participating in a supervised exercise intervention: An exploratory review of the literature. *Women Health*. 2018;58:1017–1036.
33. Grimmett C, Corbett T, Brunet J, Shepherd J, Pinto BM, May CR, Foster C. Systematic review and meta-analysis of maintenance of physical activity behaviour change in cancer survivors. *International Journal of Behavioral Nutrition and Physical Activity*. 2019 April 27;16:37.
34. Romain AJ, Bernard P. Chapter 10 - Behavioral and Psychological Approaches in Exercise-Based Interventions in Severe Mental Illness. In: Stubbs B, Rosenbaum S, editors. *Exercise-Based Interventions for Mental Illness*. Academic Press; 2018. pp 187–207. Available from: <http://www.sciencedirect.com/science/article/pii/B9780128126059000101>
35. Bernard P, Ivers H, Savard M-H, Savard J. Temporal relationships between sleep and physical activity among breast cancer patients with insomnia. *Health Psychol*. 2016;35:1307–1315.

36. Bernard PPN, Esseul EC, Raymond L, Dandonneau L, Xambo J-J, Carayol MS, Ninot GJ-MG. Counseling and exercise intervention for smoking reduction in patients with schizophrenia: a feasibility study. *Arch Psychiatr Nurs*. 2013 February;27:23–31.
37. Bernard P, Carayol M, Gourlan M, Boiché J, Romain AJ, Bortolon C, Lareyre O, Ninot G. Moderators of Theory-Based Interventions to Promote Physical Activity in 77 Randomized Controlled Trials. *Health Educ Behav*. 2017 April 1;44:227–235.
38. Bernard P, Ninot G, Cyprien F, Courtet P, Guillaume S, Georgescu V, Picot M-C, Taylor A, Quantin X. Exercise and Counseling for Smoking Cessation in Smokers With Depressive Symptoms: A Randomized Controlled Pilot Trial. *Journal of Dual Diagnosis*. 2015 October 2;11:205–216.
39. ACSM AC of S. ACSM’s Behavioral Aspects of Physical Activity and Exercise. Lippincott Williams & Wilkins; 2013.
40. Bellg AJ, Borrelli B, Resnick B, Hecht J, Minicucci DS, Ory M, Ogedegbe G, Orwig D, Ernst D, Czajkowski S, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health Psychol*. 2004 September;23:443–451.
41. Thompson TP, Lambert JD, Greaves CJ, Taylor AH. Intervention delivery fidelity assessment of a counseling-based intervention for promoting smoking reduction and increasing physical activity. *Health Psychol*. 2018 July;37:627–637.
42. Giatti L, Camelo L do V, Rodrigues JF de C, Barreto SM. Reliability of the MacArthur scale of subjective social status - Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *BMC Public Health* [Internet]. 2012 December [cited 2018 October 19];12. Available from: <http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-12-1096>
43. Falkenström F, Hatcher RL, Skjulsvik T, Larsson MH, Holmqvist R. Development and validation of a 6-item working alliance questionnaire for repeated administrations during psychotherapy. *Psychological Assessment*. 2015 March;27:169–183.
44. Wong G, Breheny M. Narrative analysis in health psychology: a guide for analysis. *Health Psychol Behav Med*. 6:245–261.

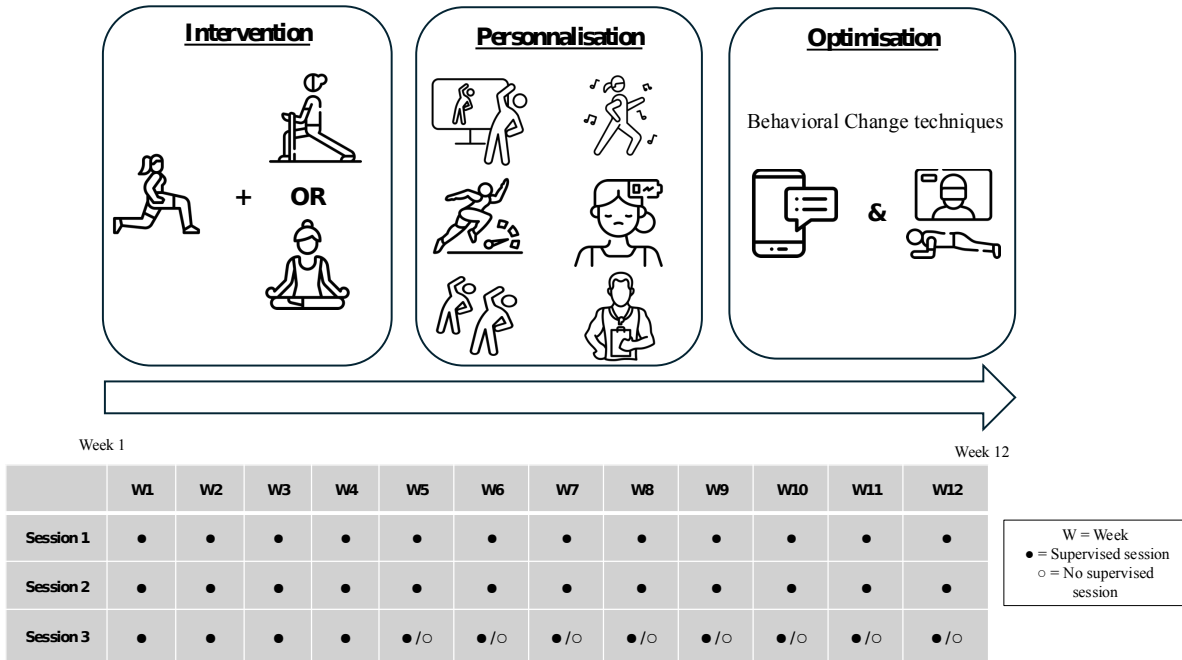
45. Esliger DW, Rowlands AV, Hurst TL, Catt M, Murray P, Eston RG. Validation of the GENEActiv Accelerometer. *Med Sci Sports Exerc.* 2011 June;43:1085–1093.
46. Bowman A, Denehy L, Benjema A, Crowe J, Bruns E, Hall T, Traill A, Edbrooke L. Feasibility and safety of the 30-second sit-to-stand test delivered via telehealth: An observational study. *PM&R.* 2023 January;15:31–40.
47. Rogers JL, Howard KI, Vessey JT. Using significance tests to evaluate equivalence between two experimental groups. *Psychological Bulletin.* 1993;113:553–565.
48. Brossart DF, Laird VC, Armstrong TW. Interpreting Kendall's Tau and Tau-U for single-case experimental designs Walla P, editor. *Cogent Psychology.* 2018 September 4 ;5.
49. Bernard P, Lapointe J, Caudroit J, Comtois, Lanovaz MJ. Effect of an adapted physical activity intervention in women with breast cancer and depressive or anxiety symptoms: A set of single case experimental studies combined with ecological momentary assessments. 2022 June 10. Available from: <https://osf.io/9sbjh>
50. Migueles JH, Rowlands AV, Huber F, Sabia S, Hees VT van. GGIR: A Research Community–Driven Open Source R Package for Generating Physical Activity and Sleep Outcomes From Multi-Day Raw Accelerometer Data. *Journal for the Measurement of Physical Behaviour.* 2019 September 1;2:188–196.
51. Wilbert J, Lueke. Analyzing single-case data with R and scan. 2021. Available from: <https://jazznbass.github.io/scan-Book/>
52. Leach HJ, Crisafio ME, Howell MJ, Nicklawsky A, Marker RJ. A Group-Based, Videoconference-Delivered Physical Activity Program for Cancer Survivors. *Transl J Am Coll Sports Med.* 2023;8:e000221.
53. Galiano-Castillo N, Cantarero-Villanueva I, Fernández-Lao C, Ariza-García A, Díaz-Rodríguez L, Del-Moral-Ávila R, Arroyo-Morales M. Telehealth system: A randomized controlled trial evaluating the impact of an internet-based exercise intervention on quality of life, pain, muscle strength, and fatigue in breast cancer survivors. *Cancer.* 2016;122:3166–3174.

54. St-Amour S, Brunet E, Cailhol L, Baretta D, Chevance G, Bernard P. Effects of supervised physical exercise on emotions among adults with a diagnostic of borderline personality disorder: A series of mixed method single-case experimental trials combined with ecological momentary assessment. *Asian Journal of Sport and Exercise Psychology*. 2024;4,4;46-59
55. Liebmann EP, Preacher KJ, Richter KP, Cupertino AP, Catley D. Identifying pathways to quitting smoking via telemedicine-delivered care. *Health Psychology*. 2019 July;38:638–647.
56. Bernard P, Romain A-J, Caudroit J, Chevance G, Carayol M, Gourlan M, Needham Dancause K, Moullec G. Cognitive behavior therapy combined with exercise for adults with chronic diseases: Systematic review and meta-analysis. *Health Psychol*. 2018;37:433–450.
57. Myrhaug HT, Mbalilaki JA, Lie N-EK, Hansen T, Nordvik JE. The effects of multidisciplinary psychosocial interventions on adult cancer patients: a systematic review and meta-analysis. *Disability and Rehabilitation*. 2020 April 9;42:1062–1070.
58. Toomey E, Hardeman W, Hankonen N, Byrne M, McSharry J, Matvienko-Sikar K, Lorencatto F. Focusing on fidelity: narrative review and recommendations for improving intervention fidelity within trials of health behaviour change interventions. *Health Psychology and Behavioral Medicine*. 2020 January 1;8:132–151.
59. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. *Med Sci Sports Exerc*. 2005 November;37:S531-543.
60. Salisbury CE, Hyde MK, Cooper ET, Stennett RC, Gomersall SR, Skinner TL. Physical activity behaviour change in people living with and beyond cancer following an exercise intervention: a systematic review. *J Cancer Surviv*. 2023 June 1;17:569–594.
61. Sheeran P, Klein WMP, Rothman AJ. Health Behavior Change: Moving from Observation to Intervention. *Annual Review of Psychology*. 2017;68:573–600.

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1Figure 1. Characteristics of the intervention

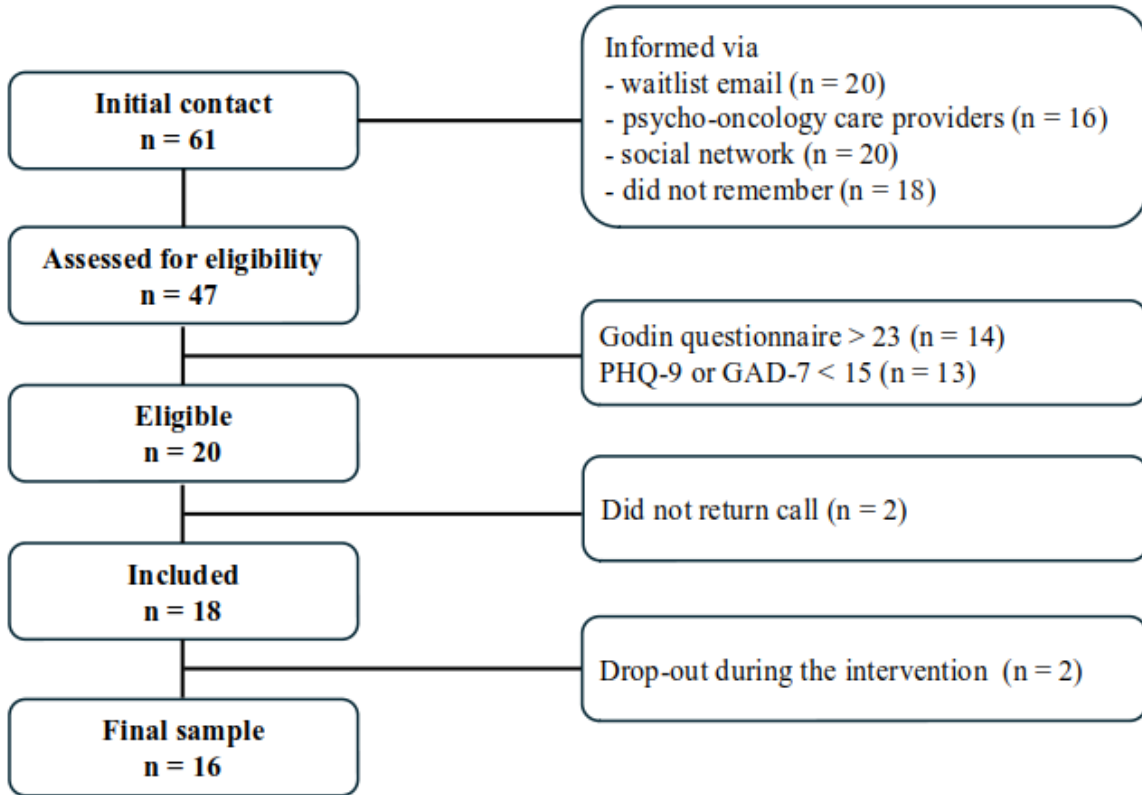
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1Figure 2. Flow-chart of included participants

2



1Table 1. Examples of short texts message

2

	<b>Name of BCT</b>	<b>Definition</b>
1.1	Goal setting (behaviour)	{participant name}, it's good to move a little each day IN YOUR OWN WAY , have you planned any physical activity in the next few days?
1.2	Problem solving	{participant name}, when you are tired, or sleeping poorly, moving can seem like a mountain . A Solution 1: dance to a good song 2: move in front of the TV.
1.3	Goal setting (result)	We all move for different reasons ... and what do you get out of it?
1.4	Action planning	It can be motivating to move at a low intensity every day of the week and do a SATURDAY-INTENSE . Have you planned to increase or decrease the pace once in your week?
2.3	Self-monitoring of behaviour	{participant name}! Every time you move, we suggest you write it down somewhere. Remember to record the physical activities you complete using the method you chose with {interventionist name} !!!
3.1	Social support (unspecified)	It's helpful to have support from those around you to get moving . Who could you talk to about what you do in our program?
5.1	Information about health consequences	It's sometimes difficult to move, but little by little you feel the benefits for your health
5.6	Information about emotional consequences	Women on breast cancer treatment experience a lot of fatigue, it will go away. Fatigue is REVERSIBLE thanks to adapted physical activity! Here's a video that talks about it: <a href="https://www.dailymotion.com/video/x2itz7n">https://www.dailymotion.com/video/x2itz7n</a>
7.1	Prompts / cues	For you, does scheduling your physical activity as a date help you to do it? If yes, you can add them when you have time. If not, you can use other reminders.
8.7	Graded tasks	{participant name}, The important thing is to do things at your own pace that's the point of the study!
10.3	Non-specific reward	I'm sure you've done an activity you're proud of since starting our program , feel free to share it with those around you, on the program group and/or to {interventionist name}
10.5	Social incentive	In the last few days, have you talked to anyone about what you're doing in the study ? If so, CONGRATULATIONS! If not... Maybe you can try sharing it today or tomorrow.

3

4

1

1Table 2. Presentation of behaviour change techniques used during supervised physical activity

2sessions

3

4

<b>BCT</b>	<b>Mode of delivery</b>	<b>W1</b>	<b>W2</b>	<b>W3</b>	<b>W4</b>	<b>W5</b>	<b>W6</b>	<b>W7</b>	<b>W8</b>	<b>W9</b>	<b>W10</b>	<b>W11</b>	<b>W12</b>	<b>Total</b>
Goal setting (behaviour)	FTF + TM					1	1	1	1	1	1	1	1	8
Goal setting (result)	TM					1	1					1		3
Action planning	FTF + TM	1		1		1							1	4
Discrepancy between current behaviour and goal	FTF + TM					1	1	1	1	1	1	1	1	8
Self-monitoring of behaviour	FTF							1					1	2
Social support (unspecified)	FTF + TM		1		1		1		1		1		1	6
Social support (practical)	FTF + TM	1	1	1	1	1	1	1	1	1	1	1	1	12
Social support (emotional)	FTF	1			1				1			1		4
Informations about health consequences	FTF	1	1	1										3
Information about emotional consequences	FTF + TM	1	1	1										3
Prompts/cues	FTF + TM				1					1				2
behavioural practice / rehearsal	FTF + TM	1	1	1	1	1	1	1	1	1	1	1	1	12
Pros and cons	FTF + TM	1		1		1	1							4
Non-specific reward	TM	1	1	1	1	1	1	1	1	1	1	1	1	12
Social reward	FTF	3	3	3	3	3	3	3	3	3	3	3	3	36
Social incentive	FTF + TM	1												4

5

6

7Note. W= Week; BCTs= behavioural change techniques, FTF= Face to face, TM= Text message

1Table 3 Study participant characteristics

id	Age	Marital status	Education	Workin g status	Incom es (k\$)	BMI	Cance r stage	Cance r surger y	Radio curren t	Chimi o curren t	Radio past	Chimi o past	Horm onoth erapy curren t	In treatm ent*	Smoki ng	SSS	GAD7	PHQ9
id1	44	Single	Coll	SL	40-60	23	I	Yes	No	No	Yes	Yes	Yes	Yes	No	5	13	17
id2	43						III	Yes	No	No	Yes	Yes		No		NA	15	17
id3	59	Married	Coll	FTW	>80	25	II	Yes	No	No	No	No		Yes	No	7	14	16
id4	29	Married	High S	SL	>80	48	IV	No	Yes	Yes	No	No		Yes	No	4	10	18
id5	38	Married	Univ	SL	20-40	30	II	Yes	No	No	No	Yes		Yes	No	5	12	15
id6	44	Married	Univ	SL	>80	27	I	Yes	No	No	Yes	No		Yes	No	6	12	15
id7	38	Married	Univ	SL	>80	61	III	Yes	No	No	Yes	Yes		No	No	7	14	18
id8	61	Single	Univ	PTW	40-60	14	I	Yes	No	No	Yes	Yes		Yes	No	5	13	21
id9	45	Single	Coll	FTW	60-80	55	III	Yes	No	No	Yes	Yes		No	Yes	6	12	18
id10	30	Married	Univ	SL	>80	37	III	Yes	No	Yes	Yes	Yes		Yes	No	8	15	19
id11	50	Other	Coll	SL	40-60	32	II	Yes	No	No	Yes	Yes		Yes	No	6	17	18
id12	37	Other	Coll	SL	40-60	28	III	Yes	No	No	Yes	Yes		No	No	6	10	15
id13	52	Married	Coll	PTW	20<	40	I	Yes	No	No	No	No		Yes	Yes	3	22	13
id14	47	Single	Univ	SL	40-60	14	DK	Yes	No	No	Yes	Yes		Yes	No	4	11	17
id15	29	Single	Colle	FTW	>80	21	II	Yes	No	No	Yes	Yes		No	No	7	9	16
id16	37	Divorced	Coll	SL	20<	28	II	Yes	No	No	No	Yes		No	No	3	11	19
id17	45	Divorced	Univ	SL	40-60	41	II	Yes	No	No	Yes	Yes		No	No	8	18	18
id18	60	Other	Coll	SL	20-40	74	II	Yes	No	No	Yes	Yes		No	No	4	11	21

2

3Note. DK = Don't know; \*= chemotherapy or radiotherapy; Univ= University; Coll= College; High S= High school; SL= Sick leave; FTW=

4Full-time work; PTW= Part-time work; BMI= Body Mass Index; SSS= Subjective social status; PHQ= Patient Health Questionnaire; GAD=

5General Anxiety Disorder.

1

1Table 4. Comparison of physical activity characteristics during phase A and A'

ID	LVPA				MVPA			
	Tau	CI lower	Z	<i>p</i>	Tau	CI lower	Z	<i>p</i>
2	0.53	0.19 - 0.75	2.37	<b>&lt;.05</b>	0.87	0.73 - 0.94	3.89	<b>&lt;.001</b>
4	0.53	0.15 - 0.77	2.15	<b>&lt;.05</b>	0.30	0.12 - 0.64	1.23	.22
17	1.00		.60	<b>&lt;.05</b>	1.00		2.60	<b>&lt;.05</b>
5	-0.19	-0.54 - 0.21	0.78	.43	0.07	-0.32 - 0.45	0.30	.77
7	-0.45	-0.78 - .05	1.42	.16	-0.75	-0.91 - -0.40	2.32	<b>&lt;.05</b>
8	-0.61	-0.81 - -0.29	2.55	<b>&lt;.05</b>	-0.88	-0.95 - -0.74	3.66	<b>&lt;.001</b>
11	0.06	-0.39 - 0.48	0.21	.83	0.06	-0.39 - 0.48	0.21	.83

2

3Note. LMVPA= Light to vigorous physical activity; MVPA= Moderate to vigorous physical activity; CI = Confidence intervals

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