



Development of an exercise adherence program for breast cancer survivors with cancer-related fatigue—an intervention mapping approach

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Abstract

Purpose Cancer-related fatigue (CRF) is the most common and distressing symptom in breast cancer survivors (BCS), with severe impact on quality of life. CRF can be reduced through exercise, but conversely, is also a barrier to exercising. The aim of this article was to apply the intervention mapping protocol (IMP) to develop an exercise adherence intervention for BCS with CRF.

Method The program was developed using the IMP, which consists of six steps. Based on the data from focus group interviews and literature review, we produced a logic model of change.

Results Two performance objectives (survivors adopt and maintain exercise and survivors cope with fatigue) and 17 change objectives were generated. Also, we designed theory-based methods of change, and strategies for practical application. A structured program plan that includes intervention content and methods, ranges, and program data was proposed. Finally, an implementation and evaluation plan was developed.

Conclusion The IMP provided a useful framework to systematically plan an exercise adherence program. This study resulted in a theory and practice-based exercise adherence program, based on behavioral change theories, and practice-based knowledge that fits the needs of BCS with CRF.

Keywords Breast cancer survivor · Cancer-related fatigue · Intervention mapping protocol · Exercise adherence · Social capital

Abbreviations

CRF cancer-related fatigue
BCS breast cancer survivors

IMP Intervention Mapping Protocol
TPB Theory of Planned Behavior

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Introduction

Fatigue is one of the most common symptoms of cancer and its treatment, and persists for several years after cancer treatment [1]. Engaging in physical activities is a safe and effective method of relieving cancer-related fatigue (CRF) and improving the overall quality of life of breast cancer survivors (BCS) [2]. Paradoxically, however, fatigue makes regular exercise difficult, and is a major factor in motor impairment that makes cancer survivors feel socially isolated [3].

Adhering to prescribed exercise can be a new challenge for cancer survivors [4]. Cancer survivors are encouraged to keep exercising even after participation in exercise interventions may have been completed, in order to maintain the intervention's physical and psychological benefits [5]. Exercise adherence after an intervention has been reported as not only being affected by the length of the intervention, but also by general,

medical, behavioral, and psychosocial factors, as well as motivational factors, such as the components of planned behavior theory [6, 7]. According to a systematic literature review of exercise adherence by cancer survivors, factors such as perceived behavioral control, self-efficacy, attitude, and intention, contribute to exercise adherence by cancer survivors [5]. As such, the literature supports the need for developing a systematic exercise intervention program that comprehensively considers these factors.

Strategies that maximize exercise behavior, psychosocial factors, and motivation, are important for exercise adherence by cancer survivors [8]. Social capital refers to the resources that individuals and groups can use through membership within a social network, and has been noted as an important factor and strategy for promoting exercise commitment and adherence in cancer patients [9]. A previous study reported that social capital increases the quality of life of patients and helps maintain a healthy lifestyle, for instance by promoting physical activity [10, 11]. Interventions that combine behavioral therapy and exercise guidance have been noted to produce strong interventional effects in a meta-analysis [12]. Thus, this study aimed to develop an exercise adherence for cancer survivors using a strategy to activate social capital in addition to promoting a behavioral approach and exercise guidance.

An invention mapping protocol (IMP) is a framework to undertake a theory-based and ecological approach for effective decision-making during the stages of planning an intervention, as well its execution and evaluation [13]. IMP is a systematic method that helps in making decisions regarding knowledge concerning behavioral factors, specific goals, and methods of intervention, and applies theories to bring about changes in physical activities [14]. A meta-analysis of CRF interventions in cancer survivors supported the effectiveness of theory-based interventions and noted the need for multi-dimensional and individualized interventions for different cancer types [15]. As such, we considered the IMP for the present study, i.e., development of an exercise adherence program.

IMP consists of six stages which guide program development: (1) Logic model of the problem, (2) program outcomes and objectives (logic model of change), (3) program design, (4) program production, (5) program implementation plan, and (6) evaluation plan [13].

The aim of this article is to describe how IMP was used to develop an exercise adherence intervention for BCS with CRF.

Methods

Step 1: logic model of the problem

In the first stage, health problems and behavioral and environmental factors are investigated prior to program planning. In line with the IMP, an advisory group for program development

was formed, and a needs assessment was performed to construe a logic model of the problem. The advisory group consisted of two oncology nursing professors, one sports oncology expert, two clinical medicine professors, and an expert in network sociology. The research director individually met the members of the advisory group, or held a seminar, once per month on average, in the beginning stage of the research.

As a method of needs assessment, a literature review and focus group interviews were conducted. The literature review aimed to identify individual and interpersonal factors related to exercise adherence in BCS. Using breast cancer, fatigue, and exercise as main keywords, several databases (e.g., RISS, Korea Med, PubMed, and CINAHL) were searched. From the 400 pieces of literature identified, a list of personal factors and interpersonal factors were compiled and considered for the program. For the focus group interviews, 17 BCS were convenience sampled to investigate the exercise experiences of BCS with moderate or greater fatigue. Using a semi-structured interview protocol, interviews took 1–2 h in each group, and recorded interviews were transcribed and analyzed [16].

Step 2: program outcomes and objectives: logic model of change

In the second stage, the matrix of change objectives was determined by specifying what is needed to bring about the behavioral and environmental changes needed to improve health problems. Expected achievements were described, and performance objectives were specified, which in turn, specified change objectives in association with behavioral or environmental factors. Matrices that summarize these objectives were created to produce a logic model of change. Based on the data and analysis gathered in step 1, the best program suitable for BCS was chosen and adapted from other related programs, while considering the Korean context. In this study, two performance objectives were proposed, i.e., survivors' adoption and maintenance of exercise, and their coping with fatigue. In connection with the individual and interpersonal factors, change objectives were generated and aligned accordingly with each factor, to construct a change objective matrix.

Step 3: program design

In the third stage, the program was conceptualized and designed. Theory-based methods of change and practical application of such methods were selected. As appropriate theoretical methods must be selected for each behavioral determinant, findings from prior literature were checked. For a method of promoting behavioral changes to be effective, the factors that determine the behavior were targeted, and these determinants were discussed to check if subject to change, as well as their appropriateness for the target population, culture, and context [17]. With these considerations in mind, theoretical

and practical methods of application to achieve change objectives were identified.

Step 4: program production

In the fourth stage, the results of the previous stages 1–3 were integrated to develop the actual program. The program structure was formed; preparation was done for the planning of program materials, and data were created according to a message or protocol. Change objectives and applications were determined according to whether they are based on the subjects' needs, program practicability, and resource constraints [18].

Step 5: program implementation plan

In the fifth stage, an execution plan that would allow adoption, implementation, and adherence to the program was made. Potential implementers of the program were identified, and outcomes and performance of program use were described. During this stage, it was important to plan meetings during which the advisory group discussed program execution and implementation in association with program adherence [18].

Step 6: evaluation plan

In the sixth stage, the results of intervention mapping in the previous stages were evaluated. The process and effect regarding the evaluation question were recorded, and the development of a measurement tool for evaluation purposes was planned [13].

Results

Step 1: logic model of the problem

The literature review on factors that affect exercise adherence by cancer survivors found that individual factors included attitude/motivation, knowledge/cognition, and skills [5, 6]. Various theoretical approaches were needed to promote behavioral changes in cancer patients, and effective applications of the theory of planned behavior (TPB) were reported [11, 19]. TPB constructs were also identified by Bartholomew Eldredge and colleagues [13] and were adopted as providing a good framework on which to base interventions designed to promote exercise adherence in BCS. The interpersonal factors included bonding and bridging of social resources [20]. Exercise was found to effectively relieve cancer fatigue [2], and performing and adhering to exercises were found to positively affect the quality of life of cancer survivors [21].

Since strategies that can optimize exercise behaviors, psychosocial functions, and enhancing motivation were reported to be important for exercise maintenance by cancer survivors [8], social capital theory [22] was applied for this study.

From the four focus group interviews [16], the 17 BCS were within 5 years of diagnosis, their age ranged from 20 to 69 years, and all had finished surgery and chemotherapy. At clinical stages 1–3, they had moderate or higher fatigue scores (four points or higher on a numerical rating scale of 10). These participants reported difficulty in performing and adhering to exercises, as well as coping with fatigue. Barriers to exercise included treatment-related side effects, ambiguous information, and psychosocial and interpersonal barriers such as body image and relationship issues, and feeling limited and timid in participating in standard programs. The perceived facilitative factors for overcoming fatigue through exercise included anxiety about recurrence, feeling relief/exhilaration, and interacting with other BCS. Practical guidelines regarding CRF, physical and emotional caring, and consistent motivation for exercise maintenance were important issues noted.

Based on the results of the needs assessment, the program goal for BCS experiencing CRF was set as exercise adherence, and the determinants of this goal (behavioral outcomes) included exercise adoption, adherence, and coping with fatigue. The contributing factors were constructed as individual factors such as attitude/motivation, knowledge/cognition, and skills and interpersonal factors, which included bonding and bridging of social capital.

Step 2: program outcomes and objectives: logic model of change

The objective of the program was set to having the survivors adopt and maintain exercise as a way of coping with and managing fatigue. The performance objectives were specified as having the survivors adopt and maintain exercise and cope with fatigue. The objectives were converted to change objectives in connection with the personal factors and interpersonal factors, and presented as a matrix (Table 1).

An example of change objectives connected to a behavioral factor, which is one of the individual factors related to coping with fatigue, would be “Express positive feelings toward coping with fatigue.” An example of change objectives connected to a motivational factor would be “State increased motivation to cope with fatigue via exercise.”

Step 3: program design

The program application that was theory-based, as well as including practical strategies to achieve change objectives is shown in Table 2. This study utilized the TPB as an evidence-based physical activity framework to achieve the goals set in step 2. Other theories were also reviewed (content, methods, timeframe, etc.) for broader understanding of the various factors, and related efficacious strategies and health promotion applications were identified to support an evidence-based exercise program for BCS. For example, for attitude/motivation

Table 1 Intervention mapping protocol matrix for breast cancer survivors’ exercise adherence

| Program goal: breast cancer survivor’s exercise adherence | | Program objective: survivors will adopt and maintain exercise as a way of coping with fatigue (behavior outcome) | | | |
|---|--|--|---|--|---|
| Performance objectives | | Interpersonal factors | | | |
| Individual factors | | Bonding | | | |
| Attitude /motivation | | Skills | | | |
| Knowledge/cognition | | Bridging | | | |
| PO1. Survivors adopt and maintain exercise | AM.1.a Express positive feelings toward exercising regularly. | KC.1.a Understand and explain why exercise is important and what the exercise guidelines are. | S.1.a. Demonstrate and apply exercise correctly. | B.1.a. Communicate with peers about barriers to and experience of exercise. | BR.a Participate in peer outreach exercise event. |
| | AM.1.b State increased motivation to exercise regularly. | KC.1.b Compare benefits of various types of exercise. | S.1.b Regularly exercise. | B.1.b Enhancing trust within group. | BR.b Demonstrate willingness to network with others. |
| PO2. Survivors cope with fatigue | AM.2.a Express positive feelings toward coping with fatigue. | KC.2.a Recognize experience with fatigue. | S.2.a. Demonstrate and apply ways to cope with fatigue. | B.2.a. Communicate with peers about barriers to coping with fatigue, especially in terms of physical activity | |
| | AM.2.b State increased motivation to cope with fatigue via exercise | KC.2.b Understand and explain various strategies of coping with fatigue. | S.2.b. Demonstrate exercising as a way to cope with fatigue. | | |

PO, performance objectives; AM, attitude or motivation; KC, knowledge or cognition; S, skills; B, bonding; BR, bridging

factors, goal setting, self-monitoring of behaviors, planning coping responses, and motivational interviewing were derived from the theory of self-regulation. Feedback, reinforcement, and verbal persuasion were derived from social cognitive theory; belief selection from the TPB; and reflective work was derived from post-traumatic growth. These further led to identification of practical and strategic methods of program implementation.

Step 4: program production

In the fourth stage, a structured program plan that includes intervention content and methods, ranges, and program data was proposed (Table 3).

Through the multidisciplinary advisory board and research team seminars, methods and ranges of exercise appropriate for BCS were determined, and exercise-related information provided to the participants was put together to organize the program materials. The network sociology expert also provided consultation regarding strategies to activate social resources.

The intervention program to relieve CRF in BCS was determined to include exercise lessons as well as group work using strategies to activate social resources. A 12-week exercise adherence program integrating aerobic and muscle strengthening exercises and social resource activation strategies was designed. During the 12-week program, the introductory phase will consist of six sessions designated for intensively learning and performing exercises while reinforcing bonding capital in small groups. The adaptive phase will involve two sessions of home-based exercise with maintaining focus of bonding capital within the small groups of participants, and preparing for the formation of bridging capital. In the exercise training, an exercise expert will demonstrate exercises specifically developed for BCS at three levels of intensity (i.e., low, medium, and high intensity), and provide instructions. In addition, an exercise guideline, written information related to exercise, fatigue, and cancer, and an exercise journal will be provided. Group work in the introductory phase will mainly involve setting a goal for each exercise, learning to use the exercise journal, sharing experiences, consistently motivating oneself, and expressive activities for self-reflection. In the adaptation phase, the participants will check their individual exercise goals, participate in lectures and activities for improving leadership skills, and consistently motivating oneself, and expressive activities for self-reflection.

The program was determined to be operated in small groups of 3–6 participants, and the eight sessions are each expected to take 2 h. The entire program will take 3 months to complete.

In regard to the program delivery medium, the research team will directly interact with the participants to provide group work and exercise lessons. For effective group work, a workbook containing the topic of each session, and a host guideline will need to

Table 2 Theoretical methods, strategies, and practical application

| Factors | Change objective | Theory | Methods from theory* | Strategies and practical application |
|---------------------------|------------------|--|--|--|
| Attitude/motivation | AM.1–2 | Theory of self-regulation | Goal setting | Setting short and long term goals |
| | | Social cognitive theory | Self-monitoring of behaviors | Keeping a record of exercise |
| | | | Planning coping response | Making an exercise schedule |
| Knowledge/cognition | KC.1–2 | Theory of planned behavior | Motivational interviewing | Supporting and offering choices |
| | | Post traumatic growth | Feedback | Reward for good behavior |
| | | – | Reinforcement | Providing reinforcement and praise |
| Skills | S.1–2 | Theory of planned behavior | Verbal persuasion | Sending SNS messages |
| | | Health belief model | Belief selection | Using messages about positive belief |
| | | Social cognitive theory | Reflective work | Reflecting and taking charge |
| Social capital (bonding) | B.1–2 | – | Information | Educational material (workbook) |
| | | Social capital theory | Modeling | Role play about experience of fatigue |
| | | Social cognitive theory | Consciousness raising | Teaching, feedback and reminding |
| Social capital (bridging) | BR.1 | Theory of social networks and social support | Guided practice | The trainer's practice and guide |
| | | – | Enactive mastery experiences | Sharing their mastery experience |
| | | Social capital theory | Modeling | Exercise video |
| Social capital (bridging) | BR.1 | Theory of social networks and social support | Feedback | Feedback: home-based exercise |
| | | – | Participatory problem solving | Making an action/implementing plan |
| | | Social cognitive theory | Modeling | Sharing action plans |
| Social capital (bridging) | BR.1 | Theory of social networks and social support | Enhancing network linkages | Using social network services |
| | | – | Peer education | |
| | | Social cognitive theory | Mobilizing social support | Mentor-mentee activity |
| Social capital (bridging) | BR.1 | Theory of social networks and social support | Mobilizing social networks | Home activity: talk to friend about exercise |
| | | – | Developing new social network linkages | Use of peer outreach exercise event |
| | | Social cognitive theory | | |

AM, attitude or motivation; KC, knowledge or cognition; S, skills; B, bonding; BR, bridging

*The theory-based methods can be found in Bartholomew Eldredge et al. (2016)

be prepared. To encourage home exercise, participants will receive workout videos and be instructed to record their progress in their exercise journals. Their progress will be checked during each lesson, and the participants will receive feedback about their exercise postures and frequency. The group network will be reinforced through the use of social media, and motivational text messages will be sent on a regular basis.

Step 5: program implementation plan

To recruit participants in this program, i.e., BCS who experience CRF, patients visiting Y Cancer Center will be invited through convenience and snowball sampling. The study will be designed as a randomized controlled trial—the participants will be divided into an experimental group and a control group using a pretest-posttest design. The experimental group will participate in the program, while the control group will be provided with only exercise-related materials and one exercise lesson at the time of evaluation. The participants' physical, physiological, and psychological markers will be repeatedly measured over five time-points during evaluation.

The implementers of the program will consist of nursing professors as the main implementers, along with graduate students in the specialties of nursing and exercise. The implementers have participated in the program since its developmental stage, and are thus sufficiently trained and attuned to the program goal, i.e., helping BCS who experience fatigue after

completing cancer therapy to adhere to exercise. For quality control of the intervention services, the research director will hold a regular meeting once every week with the implementers and researchers and will directly participate in the program to instruct and supervise.

Step 6: evaluation plan

Evaluations were determined to be conducted over five time-points: before participation, at 12 weeks immediately after completion of the intervention, and at 1, 6, and 12 months after the intervention. They will consist of quantitative and qualitative evaluations of short- and long-term outcomes. For the quantitative evaluation, data will be collected through measurement of physical, physiological, and psychosocial markers, and statistical analyses will be performed using the SPSS Statistics 21.0 and STATA 13.0 programs. Descriptive statistics will be used for the participants' general characteristics and other variables. Pearson's correlation coefficients will be used to analyze the relationships between variables and the relationship between perceived and physiological fatigue. For analysis of the growth trajectory of individual similarities and differences that are observed over time, a quantile analysis using a latent growth model using ANOVA and fatigue scores will be performed. Changes within the participant groups will be analyzed according to the number of times the participants performed exercise and the number of times they participated in the intervention. In the qualitative

Table 3 The exercise adherence program for breast cancer survivors

| Session | Contents | Methods, practical application, activities | Tools/materials |
|---------|------------|---|---|
| 1 | Exercise | - Guided practice: exercise (low intensity) - Impact of exercise on cancer outcomes - Exercise guideline for cancer survivors | Exercise expert Workbook |
| | Group work | - Ice breaking and opening up | Workbook |
| 2 | Exercise | - Guided practice: exercise (low intensity) - Benefits of various types of exercise - Making individual exercise goal | Exercise expert Workbook |
| | Group work | - Sharing activities and feedback: my journey, my story - Communicate with peers about barriers to exercise | Workbook |
| 3 | Exercise | - Guided practice: exercise (moderate intensity) Line dance - Exercise and fatigue | Exercise expert Workbook |
| | Group work | - Role play about experience of fatigue | Workbook |
| 4 | Exercise | - Guided practice: exercise (moderate intensity) - Physical activity in life style | Exercise expert Workbook |
| | Group work | - Reflecting and taking charge: thanks letter and virtue-building - Communicate: barriers to coping with fatigue via exercise | Workbook |
| 5 | Exercise | - Guided practice: exercise (high intensity) line dance - Advantages of group exercise | Exercise expert Workbook |
| | Group work | - Sharing activities and feedback: mastery exercise experience | Workbook |
| 6 | Exercise | - Guided practice: exercise (high intensity) - Self-monitoring and home exercise goal | Exercise expert Workbook |
| | Group work | - Bridging strategy of individual and group - Individual and group mentoring activity - Identifying a mentee | Workbook |
| 7 | Exercise | - Guided practice: exercise - Feedback: home-based exercise - Question and answer time about exercise | Exercise expert Video file Exercise diary |
| | Group work | - Mapping my Bless Journey: Looking beyond cancer | Workbook |
| 8 | Exercise | - Guided practice: exercise - Feedback: home-based exercise - Question and answer time about exercise | Exercise expert Video file Exercise diary |
| | Group work | - Sharing action plans - Letter to self - Preparing for peer outreach exercise event | Workbook |

evaluation, the participants' experience with exercise and use of social resources, as well as reasons for not participating or withdrawal will be investigated via focus group interviews and individual interviews. The interviews may be conducted through phone calls or face-to-face. Thematic analysis will be done for the qualitative data.

Discussion

This study employed the systematic stages of IMP to develop a theory-based support program for helping BCS who experience CRF to adhere to exercise. This study has four strengths.

First, this study conducted a comprehensive needs assessments by combining a literature review in the early stages of IMP and conducting focus group interviews with BCS who experience CRF. Our findings echo the literature [3] that although BCS are aware of the importance of exercise, multiple barriers to exercise adherence exist, and these were identified and reflected in the outcomes. Thus, individual and interpersonal factors related to the performance outcomes of exercise adherence and coping with fatigue.

Second, a comprehensive theory-based approach was used in program development. In addition to exercise techniques, attitude/motivation and knowledge/cognition were determined and emphasized for exercise adherence. These factors

were reflected in step 2 of the IMP [13]. A previous study has reported that TPB intention, attitude, and perceived behavioral control affect exercise adherence by cancer survivors [5]. The present study used not only the TPB, for which effectiveness in a health promotion program has been verified, but several strategies based on other theories as well, such as social cognitive theory, health belief model, and theories of social networks and social support [20]. When using these theoretical strategies as practical strategies, decisions must be carefully made based on evidence regarding theoretical parameters [23], and these multiple strategies are expected to comprehensively allow participants to achieve their change objectives.

Third, IMP was followed as a method for developing an intervention related to changes in physical activities [14], particularly with cancer survivors. Previous studies using IMP include using interactive technology to reinforce the physical activities and medication adherence of patients with heart failure [24], developing a self-regulated exercise maintenance program for female elderly patients with osteoporosis [25], and developing a family-involved intervention aimed at increasing physical activity among preschool children [26]. These studies motivated participants to manage their disease in a self-directed manner, ultimately helping them maintain physical activities. Support from family, acquaintances, and exercise partners is also important for exercise adherence by cancer survivors, and this study identified individual and interpersonal factors for BCS through the IMP process. The IMP also uses an ecological approach, considering environmental as well as individual factors, and previous studies emphasizing such contextual influences included developing a program for improving peer support for diabetic patients [27] and a program aiming to help BCS return to work [28]. This study actively considered physical and social environments through phasing out to home-based activities and noting contextual factors.

Lastly, a multidisciplinary partnership was formed to construct program data. Methods of exercise appropriate for BCS were specified, and strategies for activating social resources were identified. Since the researchers who participated in this process will also participate as the implementers, they will be able to conduct the intervention in a trained manner. In addition, physical, physiological, and psychosocial markers will be measured to evaluate the participants' level of fatigue and exercise adherence until 1 year after the end of the intervention, thereby evaluating the short- and long-term effects of the program.

This study had a number of limitations. In order to follow the IMP methodologically, the program development took over a year. Moreover, since the program was not a tailored intervention, overall change objectives and detailed exercise goals were set, rather than setting program objectives appropriate for each individual. However, individual exercise

objectives were set in group work, and individual feedback was given during the exercise lessons to overcome this limitation.

In summary, the IMP provided a useful framework to systematically plan an exercise adherence program for BCS. This study resulted in a theory- and practice-based exercise adherence program, based on behavioral change theories and practice-based knowledge that fit the needs of BCS experiencing fatigue.

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Compliance with ethical standards

Ethics approval and consent to participate An institutional review board exemption was obtained from Severance Hospital, Korea (IRB 4–2017–0164).

Competing interests The authors declare that they have no competing interests.

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