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Exploring the perceived benefits of a motivational exercise program (FIT-CANCER) in colorectal cancer patients during chemotherapy treatment: A qualitative study from self-determination theory

María Romero-Elías^a, David González-Cutre^{b,*}, Ana Ruiz-Casado^c, Roberto Ferriz^d, Natalia Navarro-Espejo^e, Vicente J. Beltrán-Carrillo^b

^a Instituto de Investigación Sanitaria Puerta de Hierro – Segovia de Arana, Hospital Universitario Puerta de Hierro-Majadahonda, Madrid, Spain

^b Department of Sport Sciences, Sports Research Centre, Miguel Hernandez University of Elche, Spain

^c Department of Medical Oncology, Hospital Universitario Puerta de Hierro-Majadahonda, Instituto de Investigación Sanitaria Puerta de Hierro – Segovia de Arana, Madrid, Spain

^d Department of Didactics of Physical, Artistic and Music Education, University of Valencia, Spain

^e Department of Mental Health, Hospital Universitario del Vinalopó, Elche, Spain

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ABSTRACT

Introduction: Physical activity (PA) is considered an important factor to enhance the survival rate and overall quality of life in colorectal cancer (CRC) patients. However, a small percentage of patients comply with PA recommendations and most of them decrease their PA levels during chemotherapy. Theoretical frameworks could be useful for guiding exercise programs focused on the promotion of patients' adherence to PA. Nevertheless, few studies have applied self-determination theory (SDT), one of the most prominent motivational theories, to understand exercise motivation in interventions with CRC patients. The aim of this study was to explore the benefits of an SDT-based 6-month exercise program (FIT-CANCER) regarding satisfaction of basic psychological needs and different psychological and behavioural consequences in CRC patients (stage II-III) during adjuvant chemotherapy. **Methods:** Qualitative data from 16 patients (nine men and seven women; $M_{age} = 64.00$, $SD = 11.58$), six relatives ($M_{age} = 55.00$, $SD = 15.09$) and five healthcare professionals ($M_{age} = 40.40$, $SD = 9.66$) were obtained through semi-structured interviews and field notes ($N = 27$). **Results:** Participants perceived that the motivational exercise program satisfied CRC patients' needs for autonomy, competence, relatedness and novelty, giving rise to positive psychological consequences during chemotherapy treatment, such as enjoyment of exercise, optimism, vitality, sociability and keeping some good memories. The program allowed patients to feel that they were actively doing something important to overcome their cancer, an aspect that could foster their psychological well-being. Participants perceived that patients increased their exercise participation during chemotherapy treatment, even during the COVID-19 pandemic, with an online adaptation of the exercise program, and integrated exercise into their lifestyle. Participants also highlighted the importance of patients belonging to a group undergoing a similar situation and the instructor's knowledge, specialization and empathy. **Conclusion:** Motivational exercise programs could help improve CRC patients' psychosocial and behavioural outcomes during chemotherapy treatment.

1. Introduction

Colorectal cancer (CRC) is the third most prevalent cancer and the fourth most common cause of cancer-related death worldwide [1]. After diagnosis, patients with localized CRC usually require surgery followed

by chemotherapy. Recently, there has been an improvement in surgical techniques, radiotherapy, and systemic therapies, which increases the survival rate of patients [2]. However, such exhaustive toxic regimens are followed by short- and long-term complications. Fatigue, peripheral neuropathy, allergic or hypersensitivity reactions and diarrhoea are

Abbreviations: BPN, basic psychological needs; CRC, Colorectal cancer; PA, Physical activity; RPE, rate of perceived exertion; SDT, self-determination theory.

* Corresponding author.

E-mail address: dgonzalez-cutre@umh.es (D. González-Cutre).

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some of the most common side effects, which have an important negative impact on patients' quality of life [3]. According to recent guidelines [4], meeting physical activity (PA) recommendations involves many benefits both during and after oncological treatment, improving several cancer-related health outcomes. PA has been established as an important factor to enhance the survival rate and overall quality of life (e.g., anxiety, depressive symptoms, fatigue, physical functioning) in CRC patients [5]. However, a small percentage of patients comply with PA recommendations [6–10], and most of them decrease their PA levels during chemotherapy [11]. Given these circumstances, the development of educational physical exercise programs to promote motivation towards PA becomes a unique area of study in this population. The application of theoretical frameworks for guiding these exercise programs has been recommended to better understand the cognitive and motivational processes that are present during the interventions [11].

In this regard, self-determination theory (SDT) [12] is a broad theory of personality and motivation highly applied to analyse factors related to the adoption of healthy lifestyles in many populations, including PA promotion [13,14]. SDT establishes the existence of three basic psychological needs (BPN; autonomy, competence, and relatedness) that humans need to satisfy for their psychological growth, well-being, integrity, and optimal functioning [15]. Particularly, SDT describes the process through which social agents (e.g., relatives, oncologist, instructor, etc.) can satisfy or thwart these needs [12,16]. Autonomy satisfaction could be promoted in an exercise program if patients feel that they are doing interesting activities, they can participate in the process, and their opinion is taken into account. Competence satisfaction would be developed if patients can carry out the different exercises of the program and achieve their personal goals. Relatedness satisfaction would be fostered if there are good relationships with the rest of the participants in the exercise program and with the instructor. Additionally, González-Cutre et al. [17] proposed the need for novelty as another candidate BPN, as it seems to meet the criteria to be considered within the current theory [18,19]. The need for novelty was defined as the need to experience something not previously experienced or that differs from the experiences that comprise a person's everyday routine. Overall, interventions that satisfied these BPN in the health domain had positive effects on autonomous motivation, physical and psychological health, and health behaviours [13,20].

However, few studies have applied SDT to understand exercise motivation in cancer patients [21–26]. In general, these correlational studies showed that autonomy support, satisfaction of BPN, and autonomous motivation were positively related to exercise participation and physical and mental health. Nevertheless, only two of these studies [22,24] were carried out with CRC patients. In these studies [22,24], exercise behaviour was predicted by patients' competence and relatedness satisfaction. According to these results, if CRC patients feel that they have the capacity to carry out PA and they perceive the social support from people around them to be physically active, it is more probable that they are committed with this behaviour. These studies provide interesting information to delineate motivational processes involved in CRC patients' PA participation, but exercise interventions are needed to study the benefits of applying motivational strategies/techniques focused on these SDT variables.

Two intervention studies including SDT-based exercise programs have recently been carried out with CRC patients during the course of chemotherapy [27,28]. In one study [27], the authors developed the Physical Training and Cancer (Phys-Can) intervention with breast, prostate, and CRC patients. This six-month program included two training sessions per week, combining supervised resistance training performed in group in a public gym and home-based cardiovascular endurance training. They used a mixed-methods design, including a qualitative analysis of patients' interviews showing that the application of behaviour change techniques during this program promoted patients' BPN satisfaction and intrinsic motivation. The most relevant motivational techniques identified by patients were social support from

instructors, structured and scheduled sessions, self-monitoring with resistance training log, and feedback based on heart rate monitor and fitness tests. Nevertheless, the psychological and behavioural outcomes derived from BPN satisfaction and motivational improvements were not analysed. Moreover, the effect of self-regulatory behaviour change techniques (goal-setting, self-monitoring, action planning, review of behavioural goals and problem solving) on exercise adherence was not clear because no effect was found during the exercise intervention [29], but it was found at the 12-month follow-up [30]. Although they compared intervention groups with and without self-regulatory behaviour change techniques, both groups were provided with evidence-based support such as supervision, instructions on how to exercise, graded tasks, self-registration of exercise, feedback on exercise behaviour and social support from instructors and peers.

Another study [28] developed the supPoRtive Exercise Programmes for Accelerating REcovery after major ABdominal Cancer surgery trial (PREPARE-ABC). Patients belonging to the hospital-supervised arm attended to three aerobic interval exercise sessions per week on a cycle ergometer during 3–4 weeks prior to surgery, and they also carried out two home-based resistance exercise sessions per week with resistance bands. After surgery, they carried out one supervised aerobic exercise session per month at the hospital during 10 months. This study also used a mixed-methods design with a qualitative part that included observations and interviews to health professionals and patients. Participants highlighted motivational strategies such as counselling, communication skills, flexible and individualised support according to patients' prior motivation and exercise levels, and understanding patient capacity. However, this study did not either analyse how these motivational strategies helped to improve patients' quality of life, well-being and PA participation.

The present study was developed considering the following gaps in the literature: 1) There are few intervention studies implementing SDT-based exercise programs in CRC patients during chemotherapy treatment; 2) These studies did not analyse the complete motivational sequence of SDT, trying to show how motivational strategies could help to promote patients' positive psychological and behavioural outcomes through their BPN satisfaction; 3) Previous qualitative research did not include the patients' family' point of view in this analysis.

Therefore, this qualitative study aimed to explore the motivational strategies and perceived benefits of an exercise program grounded on SDT (FIT-CANCER) on BPN satisfaction and different adaptive psychological and behavioural consequences in CRC patients under chemotherapy. FIT-CANCER is a 6-month exercise program developed after colorectal surgery, consisting of three 60-minute sessions per week of resistance and endurance training, with the objective of enhancing patients' overall quality of life and health status. This program included motivational strategies to ensure support to patients' needs for autonomy, competence, relatedness and novelty regarding exercise participation. This research considered the perspective of patients (recipients of the treatment and exercise program), relatives (outside observers), and healthcare professionals (providers) in order to provide a holistic understanding of the phenomenon under study.

2. Methods

2.1. Participants

This study is part of a broader research project that used a quasi-experimental design with a pseudo-random assignment. The research project was registered at ClinicalTrials.gov (registration number NCT04506840), entitled "Development of an educational and motivational program to promote adherence to physical activity and its positive effects in colorectal cancer patients (FIT-CANCER)" (PID2019–107287RA-I00), and funded by the State Research Agency-Spanish Ministry of Science and Innovation (MCIN/AEI/10.13039/501100011033).

This project had an experimental group of patients who participated in the exercise program during chemotherapy and a control group that followed the usual care recommendations from the oncologist. Patients from the experimental group participated in the present study and were recruited between January 2020 and January 2021 from an oncology unit located in a public hospital in the centre of Spain. Patients had to meet the following inclusion criteria: having been diagnosed with CRC (stage II-III), treated by curative surgery for colon or rectal cancer followed by chemotherapy for three or six months, aged more than 18 years, ECOG 0–2 (being functional enough to satisfy personal necessities autonomously), and having signed the written consent. Exclusion criteria were metastatic or incurable CRC and limiting physical/psychiatric symptoms detected by the oncology medical team. When a patient assigned to the experimental group was diagnosed with CRC and met the inclusion criteria, the oncologist informed about the exercise program and offered him/her the possibility of enrolling.

Some patients' relatives also participated in this study. We selected the relatives who were the main caregivers and used to accompany the patients to the hospital. Finally, the whole oncology team at the hospital was also offered to participate.

2.2. Procedure and data collection

Firstly, MR (PhD student and exercise specialist in charge of carrying out the exercise sessions with CRC patients) established an appointment with each medical team member (oncologists and nurses) to inform them about the research purposes. Then, each oncologist informed patients who met the inclusion criteria about the exercise program. Once the patients agreed to participate and signed written consent, the oncologist contacted MR to send the patients' data (name, surname, and telephone number). Then, MR called the patients to make an appointment with them. In the first appointment, MR explained the FIT-CANCER exercise program characteristics and gave a brochure of PA recommendations to the patients. This first appointment was held between the blood analysis and their oncologist's appointment and lasted approximately one hour. Relatives were also invited to participate in the study. MR explained the purpose of the relatives' participation and, if they agreed to be part of the study, they also signed the written consent and could participate in some exercise sessions with the patients and in the qualitative interviews at the end of the exercise program.

Two different techniques were used to gather qualitative information. First, MR took chronologically organized field notes of observed conversations or situations which might be of interest for the study aims. This information was written in MR's research diary from the beginning to the end of the exercise program. Second, MR carried out an in-depth semi-structured interview with each participant at the end of the exercise program. The questions of the semi-structured interviews are provided in the supplementary material. The interviews lasted between 90 and 120 min, were conducted by the same researcher for consistency, and were audio-recorded. Interviews were carried out at the hospital, in the patient's home or any quiet place preferred by patients. Both participants and the interviewer wore masks, following the regulations derived from the COVID-19 pandemic. Relatives and healthcare professionals were also invited to be interviewed after the patients' interview. The viewpoints of patients, relatives and healthcare professionals were included to provide a holistic view of the patients' subjective experiences, attitudes, perceptions, and beliefs during the exercise program.

As the study was focused on personal and private information or contained evaluations of other people, the participants' anonymity was protected through the use of numbers. This research was approved by the Ethics Committee both of the hospital and the second author's university. All participants were informed about the research procedures and provided their written consent. The Critical Appraisal Skills Programme [31] checklist for qualitative studies was used to assess the quality of this research. The study fulfilled the ten items included in the

appraisal tool.

2.3. Physical exercise program: FIT-CANCER

Initially, the exercise program took place in a fitness centre located close to the hospital from 20th January until 12th March 2020. However, due to the COVID-19 pandemic, exercise sessions were carried out solely online using the Meet app from 13th March 2020 until June 2021. Phone calls were made by MR to help those patients who experienced difficulties with technologies. The intervention was an individually tailored and supervised exercise program including progressive aerobic endurance, resistance, and balance exercises. The program consisted of three sessions (60 min) per week, began at the start of patients' treatment and lasted six months. With respect to recruitment, participants were enrolled as they were diagnosed, accepted to participate and began treatment, until complete the total of participants. Although the program was developed during one year and a half (time needed to achieve the required sample size), each patient only participated in it during six months.

Sessions consisted of a warm-up, the main part (combining resistance and endurance training) and a cool-down. The intensity of the main part increased progressively across the six months of the exercise program. Borg's scale [32] was used to instruct the patients about the intensity of the endurance exercise and to map their rate of perceived exertion (RPE). Sessions were designed including motivational strategies based on SDT with the purpose of satisfying the needs for autonomy, competence, relatedness and novelty. The instructor (MR) was a sport science professional, who was trained in strategies based on SDT. Table 1 includes the motivational strategies that were implemented in the exercise program. Patients showed a high exercise program attendance rate ($M = 94\%$, $SD = 0.04$).

2.4. Data analysis

MR collected all the research data and led the analysis. Semi-structured interviews and field notes were transcribed and analysed with the support of NVivo to organize and classify data efficiently [33]. The data were analysed following a thematic analysis [34]. First, MR carefully read all the transcriptions to become familiar with the data. Second, MR continued with an inductive phase of initial coding to select text fragments related to the effects of the exercise program on patients. Third, in the phase of searching for themes, DG, AR, RF, NN, and VB—who played the role of 'critical friends' [35]—helped MR to enhance the quality of reflections and the coherence and plausibility of the data analysis. After an initial map of codes presented by MR, the group decided to do a thematic analysis from a deductive approach based on SDT, because the concepts of this theory were useful to provide meaning to the majority of data selected in the initial coding. Therefore, the perceived physical effects related to the physiological impact of exercise were separated for further analysis, while this article was focused on the psychological and behavioural self-reported effects derived from the motivational, educative, and social aspects of the exercise program. After reviewing and refining the themes, the data were classified in the system of themes and subthemes described in Table 2, which determined the structure of results shown in the next section. As part of the analysis, MR wrote the first draft of the article and the critical friends helped to improve its write-up until reaching a final version. Although MR was the exercise instructor and the interviewer, a limitation that could reduce impartiality, she always kept in mind that the results of the study should be supported by the participants' experiences and ideas, and never by her possible potential interests. The other members of the research team also followed this principle of reflexivity due to an ethical commitment with rigor and trustworthiness.

Table 1

Motivational strategies based on self-determination theory and implemented during the exercise program (FIT-CANCER).

Basic psychological need	Motivational strategies
Autonomy	<ul style="list-style-type: none"> - To provide a choice of activities, range of work, ways to perform certain tasks, materials, music, training systems, and special requirements. - To explain the objectives of each exercise/session. - To provide strategies for autonomous physical activity participation: how to warm up, volume, frequency, and recommended intensity, use of heart-rate monitor, muscle work exercises, dumbbells, rubber bands, etc. - To involve patients cognitively through questions about the training program to verify that they acquired knowledge (e. g., about the usefulness of certain activities) and could become autonomous exercisers. - To publicize physical activities that were promoted through public institutions (e.g., popular non-profit races, such as races against cancer that offered non-competitive participation) or city associations (e.g., excursionist associations that carried out hiking outings in the natural environment).
Competence	<ul style="list-style-type: none"> - To inform patients about the exercise barriers that they might encounter and offer solutions to overcome these barriers. - To offer an individualized and progressive program that all patients could carry out. - To set short-term goals and monthly tests so that patients could evaluate their progress. - To ask patients their opinion about the sessions and the program in order to readjust it to their level. - To reinforce progress through positive feedback, focusing on effort and personal improvement. - To give abundant prescriptive feedback to correct movements. - To provide an optimal activities duration so that patients could perform them effectively.
Relatedness	<ul style="list-style-type: none"> - To perform physical activities that included cooperative games and socialization. - To encourage conversation between participants/patients. - To treat patients kindly, encourage them, smile, and support them. - To maintain permanent communication through a social network (WhatsApp group) and phone calls. - To generate a caring climate: The instructor was interested in the patients' lives and problems. - To share opinions at the end of each session. - To chat with patients to promote the expression of emotions and affective support.
Novelty	<ul style="list-style-type: none"> - To provide an exercise program that represented a novelty in patients' lives, given their low previous participation in physical activities and the lack of similar programs adapted to this population. - To carry out varied and novel tasks, providing new achievable challenges for patients, which can surprise and amuse them (e.g., yoga, hiking, dance, aerobics, exercises with dumbbells). - To provide new knowledge about physical activity. - To use various and new materials to improve physical condition: free weight, TRX, Fitball, BOSU (when the exercise program was face-to-face). - To use mobile applications that allow patients to quantify the physical activity carried out innovatively for them (e.g., to create individual and group challenges through the use of the pedometer). - To perform physical activity in new beautiful natural spaces (the frequency of this strategy was modified due to the COVID19 restrictions).

3. Results

Initially, 25 patients were recruited through the oncology unit but nine patients decided not to participate due to schedule incompatibility, distance from the centre (when the exercise program was face-to-face), not wanting to belong to a cancer patients' group, and other unknown

Table 2

Structure of Themes and Subthemes about the Perceived Benefits of the Self-determination Theory-based Exercise Program (FIT-CANCER) on Colorectal Cancer Patients

Themes	Subthemes
Motivational strategies and satisfaction of colorectal cancer patients' basic psychological needs	
AUTONOMY	<ul style="list-style-type: none"> Allowing to choose some aspects of the sessions Explaining the exercises' objectives Providing resources to promote internal locus of control
COMPETENCE	<ul style="list-style-type: none"> Adapting exercises to the participants' circumstances Specialized instructor who could promote safety and competence perception
RELATEDNESS	<ul style="list-style-type: none"> Belonging to a group of people in the same situation The instructor of the exercise program as an emphatic and empowering caregiver
NOVELTY	<ul style="list-style-type: none"> The exercise program as a novel initiative Use of technologies Novelty of physical exercises
Positive consequences	
PSYCHOLOGICAL	
	<ul style="list-style-type: none"> Enjoyment and satisfaction with the exercise program Better mood and optimism Improvement of vitality and well-being Increased sociability Keeping some good memories of chemotherapy time
BEHAVIOURAL	
	<ul style="list-style-type: none"> Increased physical activity levels during chemotherapy treatment High engagement with the exercise program Increased knowledge about physical exercise to become an autonomous exerciser Integration of exercise into their lifestyle

reasons. Finally, a total of 16 CRC patients participated in the study (nine men and seven women: $M_{age} = 64.00$, $SD = 11.58$). Patients' characteristics are shown in Table 3. The sample also included six relatives ($M_{age} = 55.00$, $SD = 15.09$) that accept to participate in the interviews: one man (patient's husband) and five women (three patients' wives and two daughters). The whole oncology team at the hospital ($M_{age} = 40.40$, $SD = 9.66$) also participated in the study, including three oncologists (two women and one man) and two nurses (both were women).

According to the different participants, the motivational exercise program developed during chemotherapy treatment improved self-reported BPN satisfaction in CRC patients and gave rise to get better psychological and behavioural consequences mentioned by these patients (Table 2), as described in detail in the following sections.

3.1. Motivational strategies and satisfaction of CRC patients' BPN

3.1.1. Autonomy satisfaction

Allowing to choose some aspects of the sessions. Patients reported that they were allowed to make some decisions regarding the sort of exercises they had to do, which fostered their autonomy satisfaction:

I loved the option to choose. It was not all scheduled, not an imposition, which was more comfortable or easier... If anything had been imposed, we would have rejected it (Patient 8).

Explaining the exercises' objectives. Patients mentioned additional motivation and autonomy satisfaction thanks to the explanation of the exercises'/sessions' purpose. In this way, they could understand

Table 3
Patients' characteristics.

ID	Sex	Age	Diagnosis	Stage of disease	Chemo	Stoma
1	Man	58	Colon	pT4N0M0 (II)	XELOX (3mo)	No
2	Woman	80	Colon	pT4N1M0 (III)	Capecitabine (6mo)	No
3	Man	69	Colon	pT4N1cM0 (III)	XELOX (6mo)	No
4	Man	70	Colon	pT4N0M0 (II)	FOLFOX (6mo)	No
5	Woman	60	Colon	pT3N0M0 (II)	Capecitabine (6mo)	No
6	Man	76	Colon	pT2N1aM0 (III)	XELOX (3mo)	No
7	Woman	56	Colon	pT4N1aM0 (III)	TOMOX (6mo)	No
8	Man	41	Colon	pT4N1bM0 (III)	FOLFOX (6mo)	No
9	Man	77	Colon	pT2N1cM0 (III)	Capecitabine (6mo)	No
10	Woman	73	Rectum	pT1N1aM0 (III)	Capecitabine (6mo)	No
11	Man	56	Colon	pT4N1bM0 (III)	FOLFOX (6mo)	No
12	Woman	59	Colon	pT4N0M0 (II)	Capecitabine (6mo)	No
13	Woman	71	Colon	pT4N1cM0 (III)	Capecitabine (6mo)	Yes
14	Man	45	Colon	pT4N2bM0 (III)	FOLFOX (6mo)	Yes
15	Man	75	Rectum	pT3N1cM0 (III)	Capecitabine (4mo)	Yes
16	Woman	58	Colon	pT4N2bM0 (III)	FOLFOX (6mo)	No

the importance of exercise and decide to do it autonomously:

The explanations that you have been giving us at all times... "We do this exercise because it is for a certain type of muscle, it is good for balance, coordination...", produces more motivation. We may have doubts but if you reason and explain something to us, we can understand its appropriateness and the need to exercise (Patient 8).

Providing resources to promote internal locus of control. Patients said that the exercise program helped them to feel that they were actively doing something to improve their health status. The patients' perception was in line with the opinion of the oncology team:

I feel that I have done something to help myself... and that is very rewarding to me. I feel better as a person, which helps me in my everyday life... it gives me a purpose, too. Not only the doctors are providing the solution (chemotherapy) ... because treatment is given to me, but this (exercise program) is something that I have done for myself (Patient 7).

I believe that patients are a little happier, more active, self-sufficient, independent; I believe that the exercise program allowed them to feel more involved in their disease and its treatment (Oncologist 3).

3.1.2. Competence satisfaction

Adapting exercises to the patients' circumstances. During the exercise program, patients could do the exercises with the available material at home, adapting the strength exercises with dumbbells or bottles of water, as well as adapting the exercises to their comorbidities, which improved their competence satisfaction during the sessions, and they reported lower fear of feeling clumsy or excluded:

I have seen him (the patient) doing the online training at home and I think the exercises were adequate for my father. You were able to adapt them to my father's situation (his injuries). If he did not have weights, you have given him the option to use other things like bricks of milk, tin cans, etc.

And I think he felt very good. He has never been worried because... when he could not do something, you have given him a solution, and that helped him not to feel excluded (Relative 3, daughter).

Specialized instructor who could promote safety and competence perception. The patients highlighted the instructor's knowledge, not only about exercise, but also about cancer and chemotherapy. The instructor's competence allowed the patients to feel safe and perceive that they were doing the exercise properly:

The instructor gave me a lot of peace of mind because she knew what she was doing. We can exercise anywhere but we don't know whether we might harm or benefit ourselves... so having someone qualified in cancer issues helps us a lot. The person who led the sessions is specialized, not only in exercise but also in the disease and the treatment that we are undergoing... (Patient 7).

3.1.3. Relatedness satisfaction

Belonging to a group of people in the same situation. The patients' relatedness and feeling of belonging were fostered through their social interactions in different contexts. For instance, both at the beginning and at the end of the exercise sessions, patients had the opportunity to discuss their circumstances and share doubts with other patients and the instructor. Several times, the patients and the instructor also met to go for a walk or do a picnic on weekends. Moreover, the patients sometimes coincided with their exercise mates in the hospital when they went to receive the chemotherapy treatment.

Patients reported that being part of a group of patients with a similar diagnosis helped them share thoughts and feelings related to the chemotherapy process and palliate their isolation emotions. This fact strengthened the relationships among patients:

A doctor helps you, but he/she is not experiencing the same as you. My exercise mates are not also relatives who are suffering for me. These people are strangers, but at the same time, we have something in common. I have feelings that are not very pleasant, but they have the same feelings and I do not feel weird, unique and alone. Sometimes I receive a lot of love and support from people around me, but nobody feels the same... Nobody anywhere has given me what you have given me with your program. If I had not known these people, the recovery process would have been very negative... I stopped doing my previous PA because I could not do it... and also because I did not want people to be thinking "poor woman, she must be suffering a lot!" (Patient 7).

The previous finding was also supported by the comments of some relatives:

The fact that he (the patient) has participated in a program in which he is with people in the same situation, he can share his problems and feelings, having your support every day... this is very suitable. For example, to receive photos when the treatment of another patient was over... to see him recovered encouraged my father a lot because he thought that he would soon be in the same situation (Relative 3, daughter).

Additionally, one of the oncologists pointed out the importance of relatedness during the treatment because many patients tend to isolate themselves. The exercise program fostered what is coined as "social hygiene", encouraging patients to maintain the habit of socializing as part of their health care:

I think that humans are really sociable, and it is well demonstrated that social interactions are very positive at all levels of life and during cancer treatment as well. This program guarantees the social interaction that patients may try to avoid due to fear when they receive a diagnosis like this (Oncologist 1).

The instructor of the exercise program as an emphatic and empowering caregiver. The patients thought that the instructor of the exercise program was a qualified professional, who took care of them

with an empathic, empowering, and optimistic attitude:

It is very difficult to find a person like you (the instructor). It was very good because you have not only given us physical exercise classes... you have been everything for us, at least for me. The way you are, because you pay attention to all of us, you are loving, you do not leave anyone aside, you ask all of us how we feel. If someone doesn't answer you, you call and ask about him/her... I can't ask more from you (Patient 5).

3.1.4. Novelty satisfaction

The exercise program as a novel initiative. Many participants reported that the FIT-CANCER program was something new and positive because it was the first exercise program developed at the hospital during chemotherapy, and because exercise sessions were different from the PA those patients had done previously, which was normally walking:

Well, I have learned everything because I had not done anything before. Everything I learned was new, like a baby discovering the world (Patient 2).

I think this program is something new because there are no exercise programs in the oncology department. You are setting it up because PA is great for anyone but even more for CRC patients (Nurse 1).

Use of technologies. The online version of the exercise program was an opportunity for patients to learn about the use of technologies, something which enhanced their self-realization and happiness:

At the beginning, when you told us that the program was face-to-face, it was very difficult for us because we live far away. But the pandemic has been very good for him (the patient). He has learned to use digital devices and he knew nothing about that before! One day he said, "give me my tablet; I want to exercise", and now he has a WhatsApp group... I see he is happier, cheerful (Relative 3, daughter).

I (the instructor) have gone to the home of some patients to teach them how to use the computer app to carry out the sessions. Some patients who had no previous knowledge of computers decided to participate, buying a computer, and learning to use it (Research diary).

Novelty of physical exercises. The patients realised that the exercises were different throughout the sessions of the exercise program, and they highlighted this novelty as a positive aspect:

It is something new and positive, of course. I really liked that you changed the exercises a lot, I did not think that so many movements could be done with the body... I really liked that you changed exercises every day (Patient 5).

When I learnt the exercises, you changed them. That was good because then, the sessions were not monotonous (Patient 13).

3.2. Positive consequences

BPN satisfaction during the exercise program led to perceive positive psychological and behavioural consequences, which are described in the following sections.

3.2.1. Psychological consequences

Enjoyment and satisfaction with the exercise program. Some patients reported enthusiastically their satisfaction for having participated in the exercise program:

I accepted to participate because my husband insisted. We even argued about that... but now I feel that it is the best thing that has happened to me this year (Patient 5).

I thought it (the exercise program) would have some benefits, but not at this level. I have really enjoyed it, I really tell you... and I feel sad because it is over, it has been fantastic (Patient 8).

Relatives also reported information about the patients' satisfaction with their exercise participation. For instance, the daughter of Patient 3 made the following comment:

I have observed he was really happy during the program as I had not seen him for a long time. His moment of exercise was a unique moment for him. He told me "You have your job, and I have my exercise". So, if he hadn't had it, I don't know what would have happened, because motivating a person who is always saying "it hurts me, it hurts me" is hard (he has chronic knee pain) ... I wouldn't have known what to do. During the program, I have seen that my father did not lose motivation to carry on (Relative 3, daughter).

Better mood and optimism. Several patients reported that the exercise program improved their mood and optimism and reduced their depressive symptoms:

Sometimes you can get depressed because you feel so bad and everything becomes more difficult for you... but if you clear yourself mentally, even due to physical exercise, it helps you to see things differently. At the end of the sessions, I felt much more lively... I felt good physically and mentally, and that kept me going" (Patient 7).

Specifically, a patient who had cancer previously and who suffered depressive symptoms highlighted that, during the exercise sessions, she felt she was healing and would not have another relapse:

It is like I had never had cancer and I would never have it again. The exercise program gave me security, it made me feel safe. I thought that I was doing well and I was not going to have cancer anymore (Patient 5).

Improvement of vitality and well-being. Patients also declared that the exercise program was an important resource to increase their vitality and energy, and improve their feelings of mental well-being:

When I did exercise, I noticed that I was a different person. It was like I was floating, and I weigh 130 Kg (laughs). You have helped me, not only to improve my physical agility but also to enhance my internal vitality... I feel I have much more energy (Patient 8).

The most positive thing that the program has given me is the mental well-being that I feel now. I consider myself a pessimistic person, especially with illnesses, and this program has helped me. I was very afraid of diseases before having this disease, and I do not have the fear I had before. I have assimilated the cancer; I have even gone beyond it. I am mentally calm, and I think it has been the exercise program... I feel at peace with myself. One friend told me that she perceives me better now than before the illness. I have always enjoyed being with my grandchildren a lot, but now I throw myself onto the ground with them... my life has changed, fortunately for the better. For me, the program has been essential (Patient 13).

Increased sociability. One patient expressed that the exercise program helped him to be more sociable. This psychological consequence could be a result of the other psychological benefits related to the exercise program, previously reported. It is logical for a person who feels vitality, well-being and optimism to tend to socialize more:

I have started to go outside more often, much more, thanks to the exercise program... to socialize more... the exercise program banishes laziness, it has awakened and driven me to be more social (Patient 8).

Keeping some good memories of chemotherapy time. One oncologist highlighted the fact that the exercise program could have helped the patients to deal better with chemotherapy treatment and even keep some good memories of this difficult phase of their lives:

The exercise program could make them undergo the chemotherapy process better, to have a better memory of chemotherapy. I would dare to say that they will have good memories of a bad stage of their life (Oncologist 1).

3.2.2. Behavioural consequences

Increased PA levels during chemotherapy treatment. Some relatives and members of the oncology team declared that patients increased their PA levels during the chemotherapy due to the existence of the FIT-CANCER program, specifically during the COVID-19 lockdown:

I am very sure that, without the program, some patients would have gone out for a walk but would have gotten tired, they would not have made an effort and would have not exercised strength. The lockdown affected all of us for a time, with a brutal impact... I believe that cancer patients limited their PA because of fear or because relatives told them not to go out. Therefore, I really believe that this program has been a miracle for them. This program (with an online version during the lockdown) has benefited them a lot because they were forced to be at home, but they have done physical exercise (Oncologist 1).

Exercise (online sessions) was the only thing he did physically here... I'm convinced that if he hadn't entered this group, he would have spent all his time on the couch until he could go out (due to the pandemic restrictions) (Relative 1, wife).

I think there has been a benefit that we will never be able to measure, which is how lucky we have been to have this program during the pandemic... how horrible must have been for all these patients to face their treatment during a pandemic time... and how different it has been thanks to the fact that they had a window to a very personal, particular, and beautiful world of contact with you. Other people in treatment have not had it (Oncologist 1)

High engagement with the exercise program. In general, patients showed a remarkable commitment to the sessions. A clear example of this finding was the case of Patient 3, mentioned in the instructor's research diary: "Patient 3 connected to the online session. He said that he was going to leave the program due to his chronic knee pain (he was emotional and crying). Ten minutes later, he logged in again to the class to participate. He said that he was really engaged with the program, and he did not want to abandon the group". In this regard, his daughter made this comment in an interview:

Even when he was too tired to exercise, he did not stop attending the program, because he knew that he had to do it because it was good for him... he even asked the doctor to change the medical appointment if it coincided with the exercise session... Well, his responsibility has surprised me... I think he was very committed... I had not seen him so excited about anything for a long time (Relative 3, daughter).

Increased knowledge about physical exercise to become an autonomous exerciser. The FIT-CANCER program also enhanced patients' knowledge about exercise and health. As some relatives highlighted, patients learned how to exercise by themselves, something very important to maintain an active lifestyle after the program:

Yes, I think you have taught him exercises to carry out in his day-to-day life. Exercises that he did not know or do before and that maybe he can do when he is bored at home. One day, he told me "I am going to do the exercise that María showed me" (Relative 3, daughter).

Integration of exercise into their lifestyle. Several patients admitted that, after the exercise program, they maintained a more active and healthier lifestyle:

Now I am going to dedicate more time to myself. For me, this has been a push, to continue doing more exercise every day if I can. I count the steps and every day I do more, I want to continue doing it because I think it is beneficial, I take care of my diet more than before... for myself (Patient 3).

I went on vacation and started walking in the morning and in the afternoon, I started doing my exercises without anyone seeing me, stretching...

once I took a pick and did the exercises... I'm going to continue doing the same exercise, I have this idea in my head (Patient 4).

This is one of the most interesting facts because one of the main purposes of the intervention was to improve patients' PA levels. In this regard, one oncologist remarked:

Education, to integrate the importance of exercise, to be convinced that it is essential for their life... I am completely sure that the exercise program has influenced them in that sense. I believe that the educational aspect is the most important issue because what we have to achieve in the end is a change in their life, and I believe that these programs only make sense if you get to change the patient's lifestyle to be more active (Oncologist 1).

4. Discussion

The purpose of this study was to qualitatively explore the motivational strategies and perceived benefits of a supervised SDT-based exercise program (FIT-CANCER) on BPN satisfaction and different psychological and behavioural consequences in CRC patients during chemotherapy treatment. Few studies have developed exercise interventions with CRC patients undergoing chemotherapy aimed to improve their quality of life and well-being (e.g. [36]), and only two studies used the SDT framework to promote adherence to exercise programs in this population [27,28]. These studies included a qualitative analysis but they did not examine the complete motivational sequence of SDT, from instructors' motivational strategies to patients' positive psychological and behavioural outcomes, nor did they analyse the relatives' views.

According to SDT, the results of our study showed that motivational strategies like *allowing to choose some aspects of the sessions* and *explaining the exercises' objectives* led to improve CRC patients' autonomy need satisfaction [13,37]. Similar results were also found in a qualitative study that carried out an SDT-based PA program with other clinical populations such as morbid obesity patients [38]. Additionally, the exercise program *provided resources to promote the patients' internal locus of control*. This type of motivational programs could be a useful tool for CRC patients to feel that they actively participate to improve their health status and overcome their cancer, in contrast to their passive role while undergoing chemotherapy. This aspect could increase their sense of control and internal resources, reducing their stress levels and promoting their psychological well-being. The psychological benefit that patients experienced by thinking that their exercise behaviour was part of the solution of CRC is a noteworthy finding of our study.

Regarding competence need satisfaction, strategies such as *adapting exercises to the patients' circumstances* and *the presence of a specialized instructor who could promote safety and competence perception* were identified in the thematic analysis. In this population, it is especially relevant to individualise the sessions using simple monitoring tools [27, 28] and adjusting the exercise sessions to each patient according to their moment of treatment and the chemotherapy cycles accumulation. Therefore, it is necessary for these interventions to be carried out by exercise professionals specialized in this population, as previous studies suggested [39]. The quality of the exercise professionals, supported and valued by the entire oncology team, is crucial so that patients can trust their instructors, be sure of doing the appropriate and correct exercise, and feel safe and competent. This aspect is essential if we take into account that competence satisfaction was the BPN that best predicted PA in CRC patients after treatment [22,24] and in other (breast) cancer patients during chemotherapy [21].

Belonging to a group of people in the same situation represented an important strategy for relatedness satisfaction. Previous research with lung cancer patients showed that a group-based exercise intervention created opportunities for mutual understanding among patients, making illness and treatment easier to manage [40]. In this sense, the findings of our study highlighted the importance for patients to share experiences

and feelings with a social group that offered them support and understanding which could not be provided by their relatives or the oncology team. In addition, we found that the *instructor of the exercise program was perceived by our patients as an empathic and empowering caregiver* who supported their need for relatedness. As has been studied in oncology clinicians and staff [41], the exercise instructor can also be an agent who shows kindness, helps to diffuse negative emotions that are associated with cancer diagnosis and treatment, and may even help to improve patients' outcomes. In view of these results and considering the amount of time that exercise instructors can spend with patients in different contexts, the presence of these professionals in the oncology teams seems fundamental.

Finally, novelty satisfaction was fulfilled, as participants perceived the *program as a novel initiative*, together with *the use of technologies* and *the novelty of physical exercises throughout the sessions*. All these novelties reduced boredom and monotony and improved motivation during the sessions. Thus, novelty satisfaction could be an essential element to promote more adaptative outcomes in exercise interventions with clinical populations [20,38]. For example, exercise programs could include novel activities such as dance, aquatic exercise or trekking, because only a traditional intervention with machines for endurance and resistance training could be boring for patients.

Ours results showed the importance of creating an environment that fosters need satisfaction to motivate patients to exercise during oncological treatment [27] and to achieve more suitable perceived effects. These self-reported benefits were classified as psychological and behavioural. The following psychological consequences were identified: *Enjoyment and satisfaction with the exercise program, better mood and optimism, improvement of vitality and well-being, increased sociability, and keeping good memories of chemotherapy time*. In this regard, motivational strategies that promote BPN satisfaction during the exercise program could imply benefits from a contextual level (exercise) to a global level (patients' life) [42] improving patients' psychological health [12,13]. Patients experienced many psychological benefits, becoming aware of the fact that, in spite of CRC, they could do exercise of some intensity and, therefore, they could continue doing most of their daily life tasks. Exercise instructors, and the rest of the oncology team, should bear this idea in mind and spread it among patients to promote their feelings of psychological benefits. Moreover, the fact that patients could keep good memories of the period in which they underwent chemotherapy represents a result to be considered in the health context. The construction of positive narratives is part of the psychological work with patients [43]. Perhaps, participation in a group exercise program can help patients to cope better with the chemotherapy process, especially at a psychosocial level, and increase their commitment to this necessary treatment to overcome CRC. Future research, from quantitative and qualitative methods, should shed light on this topic.

Favourable behavioural consequences related to the exercise program participation were also found in this study: *perception of increased PA levels during chemotherapy treatment, engagement with the exercise program, knowledge about physical exercise to become an autonomous exerciser and the sense of integrating exercise into their lifestyle*. Despite all the difficulties and barriers associated with PA adherence in this population [39], our findings showed that educational and motivational exercise interventions based on SDT constructs could be effective to improve PA participation and, consequently, CRC patients' well-being during and after treatment. Patients' physical education, understanding of exercise benefits, and integration of PA habits are the remarkable results of our research.

Another noteworthy finding of our study was that the online version of the exercise program during the COVID-19 lockdown made it possible to continue with exercise participation and its corresponding benefits. This is especially relevant considering that, during the COVID-19 lockdown, there was a significant decrease of moderate and vigorous PA in Spanish people with health problems [44]. In this regard, we highlight that online exercise programs involve several benefits compared to

face-to-face programs (safety, avoiding long trips in big cities, etc.), although they also involve limitations (reduced possibilities of social relationships and exercises, less equipment available, etc.). Both options (online and face-to-face) and even a combination of them could be good alternatives depending on the patients' profile and needs.

This study presents some limitations. First, we have to admit that the COVID-19 pandemic and lockdown modified our initial design and we had to adapt it to the circumstances. However, the development of an online program allowed us to reach our objectives and even obtain unexpected positive results related to the utility of this exercise program for CRC patients during the coronavirus time. Second, the number of patients participating in the program was not very high and the intervention was only done in one hospital. However, we think that recruiting CRC patients, who were undergoing such a complicated phase of their lives during chemotherapy treatment, was a very difficult and worthwhile task. Moreover, we collected data from different groups of participants (patients, relatives, and healthcare professionals), both through semi-structured interviews and field notes, to increase the trustworthiness of this study. Third, the specificity of the type and stage of cancer does not allow us to establish conclusions concerning other cancer diagnoses and treatments. However, the information obtained is a significant contribution to our comprehension of the motivational strategies that improve CRC patients' BPN satisfaction through a physical exercise program during chemotherapy, helping to promote positive psychological and behavioural consequences in this population.

This issue is of special interest because previous research has found that CRC treatment entails several side effects that negatively impact on patients' functioning and frustrate their BPN in their life [45]. For example, fatigue or neurotoxicity make it difficult for patients to carry out daily life activities, promoting a feeling of autonomy and competence frustration. Moreover, patients are not able to perform the same social plans than before diagnosis, aspect which may negatively affect their need for relatedness, and they can fall into the routine of cancer care and not do novel leisure activities that are important for mental health, such as going to the cinema, theatre or museum, hiking on a new footpath or doing a trip. The results of the present study showed that a motivational exercise program could contribute to alleviate this BPN frustration and improve patients' quality of life.

5. Conclusions

The implementation of an SDT-based exercise program with CRC patients undergoing chemotherapy treatment helped them to perceive an improvement in the satisfaction of their BPN for autonomy, competence, relatedness and novelty when they exercised. Need satisfaction during the exercise program seemed to be associated with some perceived benefits such as patients' enjoyment, optimism, vitality, sociability, good memories of chemotherapy time, high engagement with the exercise program, increased PA levels during treatment, greater knowledge about exercise and integration of exercise into their lifestyle.

Future research should develop interventions combining quantitative (with fitness tests and psychological questionnaires) and qualitative methodology to study in more detail the effects of exercise programs carried out before, during and after chemotherapy treatment on CRC patients' psychological and behavioural outcomes. It would be interesting to compare interventions with and without motivational strategies to show if the benefits found in this study are due to the motivational intervention or only to the exercise itself, because previous research has not clarified this question [29,30]. Furthermore, future studies should analyse whether an online exercise program could be better for these patients than a face-to-face program or a combination of these two modalities.

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CRedit authorship contribution statement

María Romero-Elías: Writing – original draft, Project administration, Methodology, Formal analysis, Data curation. **David González-Cutre:** Conceptualization, Methodology, Investigation, Data curation, Writing – review & editing, Project administration, Funding acquisition. **Ana Ruiz-Casado:** Writing – review & editing, Supervision, Resources, Project administration, Data curation. **Roberto Ferriz:** Methodology, Writing – review & editing. **Natalia Navarro-Espejo:** Methodology, Writing – review & editing. **Vicente J. Beltrán-Carrillo:** Writing – review & editing, Methodology, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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