Colorectal cancer patients beyond their disease: Hindrances, motivation, and positive effects of exercise during chemotherapy treatment

TESIS DOCTORAL

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La presente tesis doctoral es un compendio de artículos publicados previamente. Las referencias completas que constituyen el cuerpo de la tesis son las siguientes:

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AGRADECIMIENTOS

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ABBREVIATION LIST

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Abbreviation	Meaning
AF	Actividad Física
BPN	Basic Psychological Needs
BPNT	Basic Psychological Needs Theory
CCR	Cáncer Colorrectal
CRC	Colorectal Cancer
HT	Hope Theory
M	Mean
NPB	Necesidades Psicológicas Básicas
PA	Physical Activity
SD	Standard Deviation
SDT	Self-Determination Theory
TAD	Teoría de la Autodeterminación
UMH	Miguel Hernandez University
WHO	World Health Organization

ABSTRACT/RESUMEN

ABSTRACT

The present doctoral thesis is framed within the research project entitled “Development of an educational and motivational program to promote adherence to physical activity (PA) and its positive effects in colorectal cancer (CRC) patients” with the reference PID2019-107287RA-I00. This dissertation is composed of a set of three main studies: 1) barriers to PA participation in CRC patients during chemotherapy treatment (descriptive study); 2) the concept of hope as a source of motivation regardless of the patients’ thwarted autonomy, competence, relatedness, and novelty during chemotherapy (descriptive study); and 3) positive psychological and behavioral effects of a motivational and educational PA program (FIT-CANCER) based on self-determination theory (SDT) (experimental study). Data obtained for the three articles were collected using qualitative techniques, and all patients were diagnosed with localized CRC (stages II-III) undergoing adjuvant chemotherapy. The current dissertation begins with a systematic review of the factors that promote and hinder PA participation in CRC patients during chemotherapy. This study was published but not included officially along with the rest of the articles due to compliance with the regulations established by the Miguel Hernández University (UMH). However, this study was essential to begin the aforementioned project, allowing us to comprehend prior scientific publications and to design the following research. **Study 1** qualitatively explores barriers to PA participation in CRC patients in the middle of adjuvant chemotherapy. Semi-structured interviews were carried out with patients, relatives, and healthcare professionals. Two main themes were identified after data analysis: a) PA barriers related to ostomy and chemotherapy, and b) PA barriers related to the lack of perceived support. Regarding the first theme, we found difficulties associated with ostomy, limitations of the intravenous chemotherapy device (Port-a-Cath), fatigue, associated reduction of physical fitness, focusing on cancer, and

restructuring of priorities. Regarding the latter theme, participants referred to the overprotection exerted by relatives, health professionals' lack of knowledge and time available to prescribe PA, as well as the lack of PA services in health centers. **Study 2** qualitatively explores the experiences of basic psychological needs (BPN), motivation to go on living, and psychological well-being in CRC patients during chemotherapy treatment, through two series of semi-structured interviews. Three themes were identified: a) thwarted BPN, b) hope as a source of motivation, and c) sources of hope to foster well-being. Patients reported feeling frustrated autonomy, competence, relatedness, and novelty needs during the chemotherapy. However, they mentioned hopeful thoughts as relevant sources of motivation to live, which had a positive impact on their psychological well-being. The last theme included several subthemes: positive attitude, religious faith, positive medical feedback, knowing that chemotherapy was short-term, and being aware that other patients were in a worse condition. **Study 3** qualitatively explores the effects of an educational and motivational PA program (FIT-CANCER) in CRC patients during chemotherapy. This study shows the benefits of applying motivational strategies based on SDT to satisfy patients' BPN. Two main themes emerged: a) motivational strategies and BPN satisfaction, and b) positive psychological and behavioral consequences. The main subthemes found were: Patients' feeling safe due to the specialized instructor, the feeling of belonging to a group of people in the same situation, integration of PA in patients' lifestyle, greater engagement in chemotherapy as well as better management of the side effects, having a good recollection of the treatment period, and the improvement of vitality and well-being.

RESUMEN

La presente tesis doctoral se enmarca en un proyecto de investigación titulado "Desarrollo de una programa educativo y motivacional para promover la adherencia a la práctica de actividad física (AF) y sus efectos positivos en pacientes de cáncer colorrectal (CCR)", con referencia PID2019-107287RA-I00. Esta tesis doctoral se compone de tres artículos, 1) barreras hacia la práctica de AF en pacientes de CCR durante la quimioterapia adyuvante (estudio descriptivo), 2) el concepto de esperanza como una fuente de motivación a pesar de la frustración de las necesidades de autonomía, competencia, relación y novedad en pacientes de CCR durante la quimioterapia (estudio descriptivo), y 3) efectos psicológicos y comportamentales positivos de un programa educativo y motivacional de AF (FIT-CANCER) basado en la teoría de la autodeterminación (TAD) (estudio experimental). Los datos de todos los estudios fueron obtenidos mediante el uso de técnicas cualitativas y todos los pacientes fueron diagnosticados de CCR localizado (estadios II-III) en tratamiento adyuvante de quimioterapia. La presente tesis doctoral comienza con una revisión sistemática sobre los factores que promueven y dificultan la práctica de AF en pacientes de CCR durante la quimioterapia. Este estudio fue publicado no se incluye oficialmente junto con el resto de los artículos para garantizar el cumplimiento de la normativa de la Universidad Miguel Hernández (UMH). Sin embargo, esta investigación fue esencial para comenzar el proyecto de investigación, permitiéndonos comprender la evidencia científica existente para diseñar el resto de los estudios. El **estudio 1** explora cualitativamente las barreras hacia la práctica de AF en pacientes de CCR a mitad del tratamiento adyuvante. Se realizaron entrevistas semiestructuradas a los pacientes, familiares y personal sanitario. Se identificaron dos temas principales después del análisis de datos, a) barreras hacia la AF relacionadas con la ostomía y la quimioterapia y, b) barreras hacia la AF relacionadas

con la falta de apoyo percibido. En cuanto al primer tema, encontramos las dificultades asociadas a la ostomía, las limitaciones del dispositivo de quimioterapia intravenosa (Port-a-Cath), la fatiga, la reducción de la condición física asociada y la focalización en el cáncer y la reestructuración de prioridades. Respecto al último tema, los participantes se refirieron a la sobreprotección ejercida por los familiares, la falta de conocimiento y tiempo disponible de los profesionales sanitarios para prescribir AF, así como la falta de servicios de AF en los centros de salud. El **estudio 2** explora cualitativamente las necesidades psicológicas básicas (NPB), la motivación para seguir viviendo y el bienestar psicológico en pacientes con CCR durante el tratamiento de quimioterapia, mediante la realización de dos series de entrevistas semiestructuradas. Tres temas principales fueron identificados después del análisis de los datos, a) frustración de las NPB, b) la esperanza como fuente de motivación y c) fuentes de esperanza para promover el bienestar. Este último tema incluye varios subtemas: actitud positiva, fe religiosa, feedback positivo del médico, saber que la quimioterapia tiene una duración corta, y ser consciente de que hay pacientes que están en peores situaciones. Los pacientes expresaron sentimientos de frustración de las necesidades de autonomía, competencia, relación y novedad durante la quimioterapia. Sin embargo, los pensamientos esperanzadores fueron una fuente de motivación para vivir, lo que tuvo un impacto positivo en su bienestar psicológico. El estudio 3 explora cualitativamente los efectos de un programa educativo y motivacional de AF (FIT-CANCER) en pacientes de CCR durante la quimioterapia. Este estudio mostró los beneficios de aplicar estrategias motivacionales basadas en la TAD para satisfacer las NPB de los pacientes. Emergieron dos temas principales, a) estrategias motivacionales y satisfacción de las NPB y, b) consecuencias psicológicas y comportamentales. Algunos de los subtemas encontrados fueron el sentimiento de seguridad por la especialización de la entrenadora, el sentimiento de pertenecer a un grupo de personas en la misma situación, integrar la AF en su estilo de vida, un mayor compromiso con el tratamiento y mejor manejo de los efectos secundarios, así como tener un mejor recuerdo del periodo de tratamiento, y mejorar la vitalidad y el bienestar.

INTRODUCTION

INTRODUCTION

According to the American Cancer Society (2020), cancer is a disease characterized by the unchecked split of abnormal cells and is the second major cause of death worldwide, affecting around 15 million of the global population in 2018 (GLOBOCAN, 2018). When this type of growth occurs in the colon or rectum, it is called colorectal cancer (CRC). The colon and rectum (colorectum), conjointly with the anus, compose the large intestine, forming the terminal part of the gastrointestinal system. The large intestine is sometimes called the large bowel, which is why CRC is sometimes referred to as bowel cancer. The main function of the large intestine is to absorb water and electrolytes from food matter and eliminate feces. CRC is the third most common cancer worldwide and the incidence rates are expected to increase 60% by 2030. In Spain, according to the latest estimates, around 43.600 new cases of CRC would be diagnosed in 2021 (Arnold et al., 2017). The diagnosis of CRC can be classified according to the TNM system. The letter “T” refers to tumor size, “N” refers to whether the tumor has spread to the lymph nodes, and “M” refers to whether the tumor has spread to other body parts. The results are combined to determine the stage of each person's cancer. There are five stages:

> Stage 0: is called cancer in situ. Cancer cells are found only in the mucosa, or inner lining of the colon or rectum. The usual treatment is a polypectomy, or removal of a polyp during a colonoscopy. No further surgery is needed unless the polyp cannot be completely removed.
>
> Stage I: The cancer has grown through the mucosa and invaded the muscle layer of the colon or rectum. It has not spread to nearby tissues or lymph nodes. In general, the only treatment necessary is the surgical removal of the tumor and lymph nodes. This stage does not require chemotherapy.

Stage II: The cancer has grown through the wall of the colon or rectum but has not spread to nearby tissues or lymph nodes. Surgery is usually the first treatment. Adjuvant chemotherapy is prescribed after surgery to destroy any remaining cancer cells.

Stage III: The cancer has grown through the intestinal wall or into surrounding organs and one or more lymph nodes but it has not spread to other parts of the body. The treatment usually includes surgical removal of the tumor followed by adjuvant chemotherapy.

Stage IV: The cancer has spread to one or more parts of the body. It is called metastatic cancer. CRC can spread to distant organs, such as the liver, lungs, the peritoneum (the tissue that lines the abdomen), or the ovaries in women. The treatment plan may include a combination of surgery, radiation therapy, immunotherapy, and chemotherapy to slow down the spread of the disease and often temporarily shrink a cancerous tumor.

Surgery can entail a high risk of complications. Approximately one-third of patients present surgical treatment-related issues, including wound complications, chest infections, anastomotic leakage, and hemorrhaging (Brown et al., 2014). Additional common adverse effects related to adjuvant treatments include pain, fatigue, weakness, cardiotoxicity, bowel dysfunction, diarrhea, anorectal dysfunction, sexual dysfunction, anxiety, depression, reduced physical fitness and function, and reduced quality of life (DeCosse & Cennerazzo, 1997; Birgisson et al., 2007). Difficulties in social and role functioning, particularly the ability to participate in social group activities and to cope with work tasks and employment have also been reported by CRC patients (Deimling et al., 2007). Moreover, more than 30% of the patients will experience disease recurrence, threatening long-term survival (Noone et al., 2017).

This Ph.D. dissertation aims to collect information about the factors that motivate and hinder physical activity (PA) participation in CRC patients during chemotherapy and then, to develop an educational and motivational program (FIT-CANCER), applying motivational strategies based on self-determination theory (SDT, Deci & Ryan, 2000). FIT-CANCER is intended to alleviate these PA barriers and to promote self-determined types of motivation and positive health-related consequences. The main reasons that justify the current research are: 1) the limited research of this cancer group and the psychological factors concerning exercise participation, 2) CRC prevalence and the high survival rate of localized CRC patients, 3) the consolidated benefits of PA for these patients undergoing chemotherapy, 4) the relation between CRC and modifiable risk factors and, 5) the low PA participation in this population.

Previous PA-related studies have mainly focused on breast and prostate cancer populations (Mikkelsen et al., 2020). Although exercise programs should involve different groups of cancer patients, comprehension of factors that are specifically observed in CRC patients is essential to be able to successfully design PA interventions adjusted to their needs and preferences (Midtgaard et al., 2015). On the other hand, there is a large gap in research on exercise in CRC patients during adjuvant chemotherapy, which is mostly carried out in the post-treatment period (Kilari et al., 2016). One of the reasons is the difficulty of recruiting older CRC patients, as most studies are conducted among younger cancer patients (Kilari et al., 2016; Kleplin et al., 2013). However, the number of young patients diagnosed with CRC is increasing (Loomans-Kropp et al., 2019). Therefore, we focused on CRC patients with radical resection for cancer stages II-III and scheduled for adjuvant chemotherapy. Despite major advances in cancer treatments and improvements in survival rates in recent years, such exhaustive toxic regimens lead to complications and long-term side effects. Usually, patients feel a symptom cluster (fatigue, neuropathy, impaired physical function, depression, anxiety, stoma, etc.), which impairs their quality of life (Tofthagent et al., 2013). However, PA engagement produces significant and positive improvements in patients' health (Basen-Engquist et al., 2014; Segal et al., 2017). PA may enhance the chemotherapy tolerability, prolong disease-free survival, and decrease the risk of recurrence and death (McTiernan et al., 2010; Vrieling & Kampman, 2010). However, a low percentage of CRC patients comply with the PA recommendations (Blanchard et al., 2008; Courneya et al., 2008; Maxwell-Smith et al., 2017; Schmitz et al., 2010; Smith et al., 2017), decreasing their PA participation rates during chemotherapy (Vallance & Courneya, 2012).

Nowadays, there are several international evidence-based exercise guidelines for patients living with and beyond cancer (Schmitz et al., 2021). Recently, the American College of Sports Medicine reported guidelines from a roundtable that involved 16 major medical or health-oriented organizations worldwide (Patel et al., 2019; Campbell et al., 2019). A total of 300 minutes per week of moderate activity or 150 minutes of vigorous activity, as an equivalent combination, is recommended, with a minimum of 10 minutes of continuous exercise. In addition, resistance exercise involving the main muscle groups should be performed twice a week (Bull et al., 2020). Practical considerations should be taken into account during chemotherapy due to the impact of side effects on PA participation (Campbell et al., 2019). There are different strategies to tailor exercise prescription for each side effect manifested. For instance, patients with a stoma can start the resistance training with low loads and progress slowly, as well as avoiding intra-abdominal pressure to prevent early herniations (Campbell et al., 2019). At the end of this document, detailed information will be provided for safe and effective exercise performance.

Following this information, we decided to begin this Ph.D. dissertation with a systematic review of the barriers and facilitators of PA participation in CRC patients. It was not included among the articles that comprise this doctoral thesis because the regulation of the Miguel Hernández University (UMH) does not allow the inclusion of studies that were published before the registration of the Ph.D. We identified four large categories among the systematic reviews' findings: 1) sociodemographic factors, 2) health factors (specific and nonspecific to the disease), 3) prior experience and preferences, and 4) motivational factors. Especially, comorbidity and side effects such as fatigue and nausea were related to less PA. Variables such as positive attitude, family support, patients' basic psychological needs (BPN) satisfaction, and self-determined motivation were shown to be facilitators of PA participation. Therefore, we decided to examine the factors associated with the lack of PA adherence in a specific sample of CRC patients (in the middle of the chemotherapy) at the University Hospital of Vinalopó (Elche, Spain), constituting **Study 1**. The most remarkable aspect was the sample, which included patients undergoing treatment and also relatives and healthcare professionals to obtain a more complete comprehension of the results. From this data collection arose the term "hope" inductively, constituting **Study 2**. This study was the first to combine two psychological theories simultaneously: SDT (Deci & Ryan, 2000) and Hope Theory (HT; Snyder, 1989) to interpret the sources of motivation in CRC patients during chemotherapy, which was one of the most novel findings of our research. It is essential to apply theoretical frameworks to understand the cognitive and motivational processes and develop educational interventions (Vallance & Courneya, 2012). Consequently, **Study 3** shows the positive psychological and behavioral consequences of the FIT-CANCER program for CRC patients undergoing chemotherapy at Puerta de Hierro-

Majadahonda University Hospital (Madrid, Spain), considering the above-mentioned theories.

SDT is currently one of the most applied motivational theories to study factors related to the adoption of healthy lifestyles as well as PA promotion (Ng et al., 2012; Ntoumanis et al., 2021). This theory postulates the satisfaction of BPN (autonomy, competence, and relatedness) for the individual's integral development and flourishing. BPN fulfillment allows one to develop more self-determined motivation and, consequently, leads to more positive consequences related to well-being. Recently, novelty was proposed as an additional need under this theoretical conception (González-Cutre, Romero Elías et al., 2020). Novelty is defined as the need for experiencing something new or that differs from the routine. SDT also defends that social agents are responsible for supporting patients to achieve BPN satisfaction. In the health context, many researchers have focused on examining the relationship between needs satisfaction and well-being outcomes (e.g., Kinnafick et al., 2016). However, few studies have focused on the relationship between the frustration of BPN and illness outcomes (depression, anxiety, side effects, etc.). In the cancer context, only one previous qualitative study investigated the psychological and behavioral outcomes associated with PA participation from an SDT perspective (Mazzoni et al., 2019) but there is no scientific evidence of BPN thwarting concerning negative results. On the other hand, Snyder et al. (1991) mentioned that the hope construct has long been postulated as an "overall perception that goals can be met." In the oncological context, hope is a state of mind that involves a positive viewpoint that one can accomplish a tangible outcome while maintaining a realistic comprehension of potential negative outcomes (Mattes & Sloane, 2015). Promoting hope was considered a vital protective factor for cancer patients (Lichwala, 2014). Furthermore, hope has been associated with positive well-being and clinical outcomes in breast cancer patients, but there is no evidence in CRC patients during chemotherapy.

This doctoral thesis is framed within a research project entitled “Development of an educational and motivational program to promote adherence to PA and its positive effects in CRC patients (FIT-CANCER)”. Although this inquiry entails additional measures and research goals, this document is focused on the psychological and social factors observed in CRC patients during chemotherapy, related to obstacles and motivation to perform PA as well as well-being and illness outcomes. Thus, this Ph.D. dissertation consists of three studies: 1) Barriers to PA participation in CRC patients during chemotherapy, 2) the hope concept as a motivational source despite BPN frustration from the SDT perspective, 3) satisfaction of BPN and positive psychological and behavioral consequences from FIT-CANCER participation. This experimental study continued despite the COVID-19 pandemic, switching from a presential to an online format. Finally, to our knowledge, the FIT-CANCER is the first trial that includes the recently approved three-month length of adjuvant chemotherapy (Iveson et al., 2018).

Study 1. This study is titled “Barriers to PA participation in CRC patients during chemotherapy treatment: A qualitative study” and was published in the journal *European Journal of Oncology Nursing* (Q1). This study aimed to explore the barriers that ten CRC patients (stage II and III) perceived to participate in PA when they were undergoing adjuvant chemotherapy. The views of ten relatives and ten health professionals were also included. Semi-structured interviews were conducted with each participant and audio recorded. Data were analyzed with an inductive thematic analysis (Braun & Clarke, 2006). We have tried to report specific results of the PA-related barriers in this population, in the middle of the treatment (three months from the start of the first cycle of chemotherapy). This moment was chosen in consensus with the medical team, as it may be the time that best reflects the patients' motives for (non)participation because, at the beginning of the treatment, they are still assimilating the disease and, at the end, they suffer a lot of toxicity from the treatment. However, further investigation is needed because barriers can differ according to the moment of the treatment (Fernandez et al., 2015).

Study 2. This study is titled "Beyond basic psychological needs: The hope construct during adjuvant treatment in CRC patients" and was published in the journal *Current Psychology* (Q1). This study does not provide information about PA. However, this research, which emerged inductively from Study 1, explored BPN experiences, the motivation to go on living, and the psychological well-being in CRC patients during adjuvant chemotherapy. Ten CRC patients, ten relatives, and ten healthcare professionals ($n = 30$) participated in this study. Based on the SDT framework, participants were asked about the state of competence, autonomy, relatedness, and novelty needs during the CRC patients' adjuvant treatment. Participants reported that the patients felt that their autonomy, competence, relatedness, and novelty were thwarted during this period. Furthermore, they mentioned the hope concept as an outstanding finding. To our knowledge, this is the first study that has attempted to explore the psychological experiences of CRC patients in treatment from a basic psychological needs theory (BPNT) perspective. It would be interesting for future research to explore the construct of hope as a hypothetical moderator between BPN and CRC patients' well-being during treatment. This idea was originally proposed by Richard Ryan in a conversation in the SDT conference (2019) in Egmond aan Zee on the North Sea coast of Holland. It really pleased me, and I appreciate this contribution. .

Study 3. This study is entitled "Positive effects of a motivational exercise program (FIT-CANCER) in CRC patients during chemotherapy treatment: A qualitative study from SDT". It is under review in *Psychology of Sport and Exercise* (Q1). This constitutes the first experimental study of the research project PID2019-107287RA-I00. The main purpose of this article was to qualitatively explore the effects of a six-month exercise program during adjuvant chemotherapy in CRC patients (Stages II and III), implementing motivational strategies based on SDT. A total of 16 patients were recruited. Additionally, we included relatives and healthcare professionals to provide a holistic understanding of the study purpose. Two different techniques were used to gather qualitative information. First, field notes about observed conversations or situations which might be of interest for the study aim. Then, in-depth semi-structured interviews were carried out with each participant at the end of their exercise program. The intervention was an individually tailored and supervised exercise program, including progressive aerobic endurance and resistance exercises. The weekly frequency was three sessions (60 minutes), from a time close to the start of the patients' treatment until six months later. Motivational strategies were used to satisfy patients' BPN and promote well-being outcomes.. To date, few studies have applied SDT to understand the motivation towards PA in cancer patients (Peddle et al., 2008; Petrella et al., 2021). Besides, no previous experimental studies had been carried out applying an exercise program based on the SDT perspective exclusively in a sample of CRC patients undergoing chemotherapy. The inclusion of conceptual frameworks to better define the path leading patients to acquire better health behaviors is needed.

Lastly, before continuing with the presentation of the literature review and the rest of the studies included in this dissertation, it should be mentioned that, according to the regulations of the Doctorate Program in Sport and Health of the UMH, to apply for the international Ph.D. mention, the abstract and the conclusions must be in English, in addition to the Spanish language. At the end of this dissertation, this manuscript also presents an additional section with acknowledgments from the patients collected during the FIT-CANCER, as well as a personal reflection. This also appears in Spanish to preserve the essence of the messages because they were provided in this language. This aspect entails the need to use inclusive and non-sexist language to refer to the group of men and women that are included in this study. We have focused exclusively on the inclusion of the male and female gender to simplify the writing and because the patients included in this thesis identified as cis women and cis men. On another hand, in the different sections of this dissertation, we used the first person plural (we) instead of the singular form (I). This is because we consider that the information presented herein was carried out with the rest of the research team. This work belongs to all the people who collaborated and who allowed the following research to be conducted.

Factors that promote or hinder PA participation in patients with CRC: A systematic review

A LITERATURE REVIEW

INTRODUCTION

Cancer is currently one of the major causes of mortality worldwide. In 2012, there were about 14 million new cases and 8.2 million cancer-related deaths (WHO, 2015). For example, cancer represents the second cause of death in the United States and is expected to exceed cardiovascular disease as the leading cause of death in the coming years (Siegel et al., 2015). It was estimated that 595690 Americans would die of cancer in 2016, which translates into about 1630 people per day (American Cancer Society, 2016). In Spain, the estimation 2015 was of 227076 cases, with an increase that occurs to a greater extent in the population ≥ 65 years (Spanish Society of Medical Oncology, 2014). Approximately 30% of cancer deaths are related to five behavioral risk factors: high body mass index, low intake of fruit and vegetables, smoking, alcohol consumption, and lack of PA (WHO, 2015).

Besides the human suffering involved in cancer, it has been estimated that this disease causes a high economic cost for health systems. For example, the total cost of cancer in 2008 in the United States was around $228 billion. This situation is a serious public health problem, such that research of the factors that can prevent or alleviate the disease is a priority for governments (American Cancer Society, 2010). Specifically, in the United States, CRC is the third cause of death by cancer in men and women, and the second cause when both sexes are combined. In Europe, CRC held the second position in incidence after breast cancer in 2012, and 49190 deaths from CRC were estimated in 2016 (Spanish Network of Cancer Registers, 2014). Five to ten-year survival rates for patients with CRC are 65% and 58%, respectively (Siegel et al., 2015). Due to CRC, patients live with physical and psychological sequelae that grow worse with treatment. Some of the symptoms are intestinal dysfunction, surgery pain, stoma, fatigue, muscle weakness, alteration of body image, anxiety, and depression (Downing et al., 2015; Zabora et al., 2001). To alleviate these sequelae, there is increasingly more scientific evidence of the physical and psychological benefits of PA, both during and after treatment for this disease (Garcia & Thomson, 2014). Specifically in CRC, it was found that regular exercise and improved physical condition are associated with many indicators of quality of life (Courneya et al., 1999a; Courneya et al., 2004; Courneya et al., 2000), with a lower probability of recurrence (Meyerhardt, Heseltine et al., 2006) and lower risk of death (Meyerhardt et al., 2008). In the study of Meyerhardt, Heseltine et al. (2006), it was found that patients who walked at least 6 hours per week at moderate intensity had a 47% higher chance of surviving the disease. Another study (Meyerhardt, Giovannucci et al., 2006) with 600 women diagnosed with CRC showed that those who increased their PA after diagnosis had a 52% lower chance of dying from the disease compared with those who were not exercising. However, those who decreased the amount of PA had a 32% higher chance of dying from the disease. Moreover, those who did the equivalent to walking 6 hours per week were more likely to have a longer life than those who did less or no PA.

In spite of the described benefits, only 35% of CRC survivors in the United States perform the recommended PA (Blanchard et al., 2008), and 17.1% in Canada (Courneya et al., 2008). In addition, various studies carried out in Canada (see Vallance & Courneya, 2012) show that, after diagnosis, PA decreases on average about 2 hours per week, and only 5-10% of the patients participate in PA during treatment, and 20-30% after treatment. After overcoming the disease, patients increase their PA participation but without reaching the initial levels. There is also a greater decrease of PA when combining various treatments such as surgery, chemotherapy, and radiotherapy, in comparison to receiving just one of them (Irwin et al., 2004). However, 80% of the patients feel capable of participating in PA, and 70% are interested in it so, in order to develop any intervention, it is essential to know the factors that promote or hinder PA participation in this collective (Vallance & Courneya, 2012).

Taking into account that there are already plenty of studies that have analyzed this problem in CRC patients, the aim of this study was to perform a systematic review to more clearly interpret all the factors related to these patients' participation in PA. There are several systematic reviews of the factors related to the PA participation in patients with cancer, all of them including different types of cancer (Park & Gaffey, 2007). Some authors have even systematically analyzed the effects of exercise in patients with CRC (Cramer et al., 2014; Kampshoff et al., 2014; Husebø et al., 2013). However, to date there is no systematic review of the factors associated with PA participation in patients with CRC, so this is the first one to be performed. This review is focused on CRC because it is the second most common type of cancer in Europe and the United States, and the most frequent in some countries like Spain (Spanish Society of Medical Oncology, 2014), presenting a moderate survival rate. Given its high incidence, but at the same time its positive prognosis, we think that it is interesting to focus on this type of cancer to more specifically deepen our knowledge of the factors related to the levels of PA. In addition, the variables contributing to predict PA in patients with CRC appear to vary as a function of the type of cancer, which indicates the need to analyze each one separately (Vallance & Courneya, 2012).

METHOD

Data sources and search terms

The electronic search was made by means of the WEB OF SCIENCE, SCOPUS and SPORTDISCUS databases up to February of 2016. The searches included diverse combinations of four sets of terms: 1) Terms related to cancer: CRC, cancer stage and treatment; (2) Terms about PA: PA, exercise and training; 3) Influential factors in PA participation: facilitators, barriers, sociodemographic and psychosocial factors, motivation and adherence; 4) Motivational theories: theory of planned behavior, SDT, self-efficacy theory, and socio-ecological model. The complete search strategies are not presented for the sake of brevity, but they can be requested from the authors.

Consultation of publications and construction of the catalogue

The selection of the studies focused on the factors associated with PA participation in patients with CRC (Figure 1). We conducted two levels of screening. First, we searched for combinations of all the keywords in all the databases, reaching 19213 identified registers. Another 18 additional registers were identified in the references lists of the articles, obtaining a total of 19231 recordings. We included all the references in the program "EndNote" to detect duplicates, finding a total of 15532, which were deleted.

Therefore, 3699 unique citations remained, from which we excluded 3649 after reading the abstracts because they did not analyze the relations between PA participation and CRC, so that finally, 50 articles remained, which were downloaded in full text. We then established the second screening system, which consisted of applying the following exclusion criteria: 1) including other different types of cancer without specifying the results separately for each one; (2) including other healthy behaviors without specifying the results referred to PA; 3) focusing on factors or strategies to promote PA in order to prevent CRC, but without using a sample of patients affected with this disease; 4) focusing only on the effects or benefits of PA in this population without covering the factors related to PA participation. We eliminated 27 registers for meeting these criteria, leaving a total of 23 final registers in the present study.

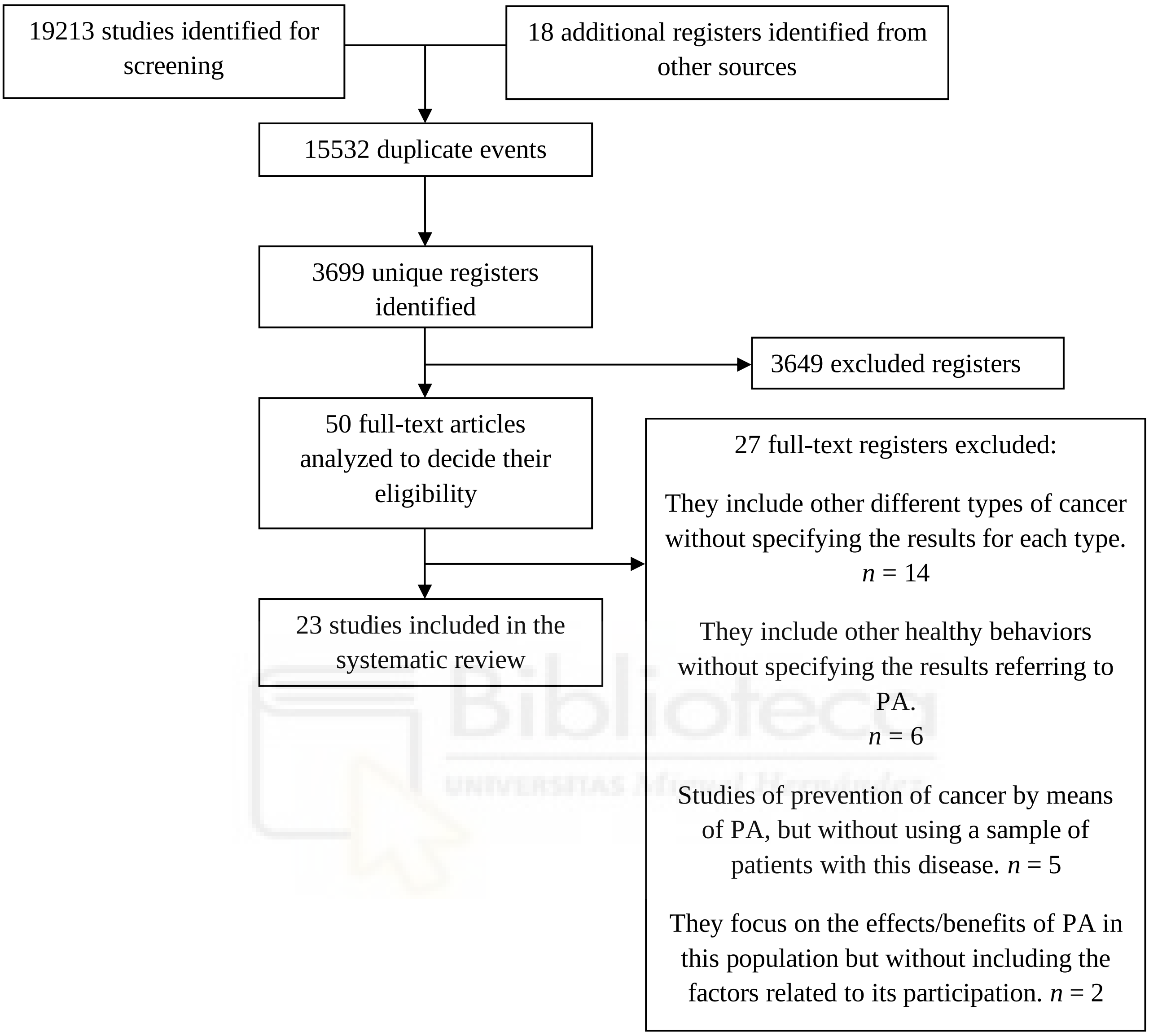

Figure 1. Flow Chart of the Selection Process of the Studies

Selection process and data extraction.

The necessary variables to analyze the results are grouped in Table 1. The following data are included: references; total number of patients, of men and women; age; cancer stage at the moment of the study; treatment; theoretical framework; design; measure of PA; and results related to the facilitators and barriers for PA participation. Cancer stage (see footnote of Table 1), type of treatment (surgery, radiotherapy, chemotherapy) and whether or not they were receiving treatment at the time of the study, or it had already concluded were included in this review. In addition, we indicate the design of the studies, dividing them into cross-sectional, longitudinal, experimental, and qualitative. We also aimed to identify whether the studies are supported by a theoretical framework, as this would guide interventions to promote PA with this collective in a more structured way, understanding how behavioral change occurs (Biddle et al., 2012). Lastly, we highlight the importance of analyzing how PA is measured, either by means of more subjective measures like questionnaires, or more objective measures like accelerometers. All these aspects are important when analyzing the factors that influence PA participation in this population.

Table 1. Studies that Analyze the Factors Related to PA Participation in Patients with CRC

REFERENCES	**NUMBER OF PATIENTS**	**AGE (years)**	**CANCER STAGE**	**TREATMENT**	**THEORETICAL FRAMEWORK**	**DESIGN**	**MEASURE OF PA**	**RESULTS**
Buffart et al. (2012)	1371 Total 56% males 44% females	≥ 65 = 69% *M* = 69.5, *SD* = 9.7	I = 28% II = 39% III = 28% IV = 5%	S = 67.54% RT = 0.07% CT = 1.02% S + RT = 22.90% S + CT = 24.58% S + RT + CT = 6.41%	Not used	Cross-sectional	European Prospective Investigation into Cancer (EPIC) Physical Activity Questionnaire	Being younger, male, employed, not smoking, lower body mass index, being only in chemotherapy treatment and not having comorbidities → ↑MVPA
Chambers et al. (2009)	978 Total 55.8% males 44.2% females	20-49 = 7.6% 50-59 = 20.3% 60-69 = 35% ≥ 70 = 37.2%	I = 28.7% II = 30.6% III = 25.8% IV = 0.7%	Not specified	Not used	Longitudinal 5, 12, 24 and 36 months post diagnosis	Active Australia Survey	↑Somatization → ↓PA ↑Negative assessment of the impact of cancer → ↓PA ↑Fatigue → ↓PA ↑Smoking → ↓PA ↑Obesity → ↓PA
Chung et al. (2013)	422 Total 63% males 37% females	*M* = 59.69, *SD* = 10.87	I = 95 II = 102 III = 103 IV = 16	Unfinished = 31.27 % Finished = 68.72 %	Not used	Cross-sectional	Exercise & Quality of Life Questionnaire	In treatment: Without changes in LPA, MPA and TPA.↓VPA End of treatment: Without changes in MVPA vs. pre-treatment. ↑LPA and TPA
Courneya et al. (1999b)	66 Total 57.57% males 42.42% females	*M* = 60.8, *SD* = 11.5	I = 6% II = 29% III = 26% IV = 5%	Did not receive AT = 27.3% RT = 7.6% CT = 46.9% RT + CT = 18%	Theory of planned behavior	Cross-sectional	Godin Leisure Time Exercise Questionnaire (GLEQ)	Intention and pre-diagnosis PA → PA post operation
Courneya et al. (2004)	102 Total 58.1% males 41.9% females	*M* = 60.3, *SD* = 10.4	III–IV = 80.6%	S = 100% RT = 20.4% CT = 64.5% Only S = 34.4% S + CT = 46.2% S + RT + CT = 19.4% All patients were operated in the past 3 months	Theory of planned behavior	Experimental	Godin Leisure Time Exercise Questionnaire (GLEQ)	Experimental group: Higher levels of PA, behavioral control, lower work status, and less adjuvant treatment → ↑PA Control group: higher levels of PA and more intention → ↑PA
Courneya et al. (2005)	69 Total 56.5% males 43.5% females	< 60 = 39.1% > 60 = 60.9%	Not specified	Alone S = 39.1% S + CT = 42% S + RT + CT = 18.8% All patients were operated in the past 3 months	Not used	Experimental	Godin Leisure Time Exercise Questionnaire (GLEQ)	Barriers: Lack of time, adjuvant treatment, side effects and fatigue

D'Andrea et al. (2014)	2378 Total	18-65	Not specified	Not specified	Not used	Cross-sectional	USA National Health Interview Survey	Hispanics and non-Hispanic blacks (vs. Whites) and current smokers → ↓PA Higher educational level, fewer chronic conditions, current drinkers → ↑PA
Dennis et al. (2013)	444 Total 55% males 45% females	36-91 (*M* = 69) ≥ 60 = 80%	Not specified	Pre-treatment = 12.16% In treatment = 13.96% Completed 6 months ago = 15.09% Completed more than 6 months ago = 40.1% Cancer-free group = 18.69%	Not used	Cross-sectional	Lifestyle survey for people with colorectal cancer	Preferences: Group-based PA programs Barriers: Stoma and treatment-related fatigue VPA (from - to +): Pre-treatment, in treatment, post-treatment, < 6 months and > of 6 months post-treatment and cancer-free group
Fisher et al. (2016)	478 Total 59% males 41% females	31-97 (*M* = 68)	Not specified	Finished = 73% Not finished = 16% Unknown = 5%	Not used	Cross-sectional	Godin Leisure Time Exercise Questionnaire (GLEQ)	Barriers: Fatigue, ageing, and comorbidities ↑Barriers → ↓PA Benefits: improvement of physical condition, improvement of health and maintenance/weight loss
Hawkes et al. (2015)	410 Total 54% males 46% females	*M* = 66.3, *SD* = 10.1	Insufficient PA I = 90.2% II = 85.1% III = 89.1% Sufficient PA I = 9.8% II = 14.9% III = 10.9%	S = 96% AT = 24%	Ecological model of health behavior	Experimental	Godin Leisure Time Exercise Questionnaire (GLEQ)	Being retired, having private health insurance, having healthy body weight, pre-diagnosis physical activity, having a habit, high level of self-efficacy, watching less TV, high quality of physical life, feeling well-being and being a part of the intervention group → ↑PA post 12 months
Husson et al. (2015)	1643 Total 56.11% males 43.88% females	< 65 = 28.97% 65-75 = 39.07% > 75 = 31.96%	I = 30.66% II = 36.33% III = 29.66% IV = 3%	Only S = 46.33% S + RT = 24.33% S + CT = 20.66% S + RT + CT = 8.66% Only CT = 1.33%	Not used	Longitudinal	European Prospective Investigation Into Cancer (EPIC) PA Questionnaire	↓Knowledge about health → ↓PA
Kang et al. (2014)	427 Total 63% males 37% females	< 60 = 52.9% ≥ 60 = 47.1%	I = 95 II = 102 III = 106 IV = 18	Unfinished = 30.9% Finished = 67%	Not used	Cross-sectional	Question about participation or not in PA and whether or not recommendations of the ACSM are met	Barriers (from + to -): 1st Fatigue 2nd Low physical condition 3rd Low health status 4th Lack of time and information ↑Treatment → ↓PA
Lynch et al. (2016)	185 Total 55.14% males 44.86% females	18-80 (*M* = 64.2, *SD* = 10.3)	I = 22% II = 28% III = 41%	Only S = 57.84% S + AT = 42.16% Adjuvant therapy finished	Not used	Cross-sectional	Accelerometer	Males, more comorbidities, higher BMI and time slot 8 am-3 pm → ↑Sedentary behavior Women, low educational level and lower BMI → ↑LPA More family income, being employed, lower BMI, younger, and time slot 6 pm-8 pm → ↑MVPA

Lynch et al. (2007)	1966 Total 60% males 40% females	20-49 = 8.5% 50-59 = 19.43% 60-69 = 33.31% 70-80 = 38.25%	Not specified	Not specified	Not used	Longitudinal	Active Australia Survey	High educational level, no smoking, no fatigue → ↑PA in males Only surgery, healthy BMI, living outside the capital, no smoking, no fatigue → ↑PA in women
Lynch et al. (2010)	Time 1 538 Total 63% males 37% females Time 2 403 Total 61.5% males 38.5% females	Time 1 20-49 = 8.9% 50-59 = 19.7% 60-69 = 31.1% ≥ 70 = 40.3% Time 2 20-49 = 8.9% 50-59 = 19.4% 60-69 = 29.0% ≥ 70 = 42.7%	Time 1 I = 25.5% II = 35% III = 30.6% IV = 8.9% Time 2 I = 26% II = 38% III = 29.4% IV = 7.1%	Time 1 S = 56.9% S + AT = 43.1% Time 2 S = 58% S + AT = 41.4% All the patients were operated in the past 3 months	Ecological model of health behavior	Longitudinal 5 and 12 months post-diagnosis	Not measured	Barriers 5 and 12 months (from + to -): 1st Cancer-specific barriers 2nd Barriers from personal attributes 3rd Barriers from social environment 4th Barriers from physical environment
McGowan, Speed-Andrews, Blanchard et al. (2013).	600 Total 58.33% males 41.67% females	< 65 = 39% ≥ 65 = 61%	44% Early stage diagnosis	RT = 24% 10% still receive treatment	Not used	Cross-sectional	Godin Leisure Time Exercise Questionnaire (GLEQ)	Older, lower educational level, lower yearly income, more time elapsed since diagnosis, fewer relapses, stoma, in treatment and active vs. sedentary → ↓ interest in PA
McGowan, Speed-Andrews, Rhodes et al. (2013)	600 Total 58.3% males 41.7% females	< 65 = 39% ≥ 65 = 61% *M* = 67.3	I = 12.6% II = 11.5% III = 21.5% IV = 11.33% Unknown = 43%	RT = 24.3% CT = 55.5% Not specified when they received treatment	Not used	Cross-sectional	Questions about type, frequency, and duration of PA in the past month	Males, married, social or regular drinkers, good health and ≥ 5 years since the diagnosis → ↑PA
Morielli et al. (2016)	18 Total 66.7% males 33.3% females	34-73 (*M* = 57.5)	72% IIIB	All received neoadjuvant therapy	Theory of planned behavior	Experimental	Godin Leisure Time Exercise Questionnaire (GLEQ)	Benefits: cardiovascular endurance, quality of life, self-esteem, better physical functioning Damage: Fatigue, diarrhea, and skin irritation Barriers: Side effects of neoadjuvant therapy and lack of motivation
Peddle et al. (2008)	413 Total 54% males 46% females	20-80 (*M* = 60, *SD* = 7.5)	48% did not know cancer stage. Nothing more specified	CT = 53%. At least 1 year ago S = 96%. Not specified when they were operated	Self-determination theory	Cross-sectional	Godin Leisure Time Exercise Questionnaire (GLEQ)	↑Educational level, identified and introjected regulation → ↑PA
Speed-Andrews et al. (2014)	600 Total 58.3% males 41.7% females	31-92 (*M* = 67.3)	44.2% Early stage diagnosis	RT = 24% CT = 55% Adjuvant therapy completed	Theory of planned behavior	Cross-sectional	Question about level of physical activity	Barriers: physical condition and health status, musculoskeletal issues and treatment Facilitators: having time, doing it with others, proximity to the facilities
Speed-Andrews et al. (2012)	600 Total 58.33% males 41.67% females	31-92 (*M* = 67.3) < 65 = 39% ≥ 65 = 61%	I = 12.66% II = 11.5% III = 21.5% IV = 11.33% Unknown = 43%	RT = 24.3% CT = 55.5% Adjuvant therapy completed	Theory of planned behavior	Cross-sectional	Godin Leisure Time Exercise Questionnaire (GLEQ)	Being younger, unmarried, higher educational and economic level, employed, not smokers, social drinkers, no radiation therapy, disease free, better health and fewer comorbidities → ↑PA

Spence et al. (2011)	10 Total 70% males 30% females	42-74 (*M* = 57.8)	II = 40% III = 60%	Chemotherapy completed 4 weeks ago	Not used	Experimental Qualitative	Questions about the level of physical activity: nothing, sporadic (< 3 sessions per week) or regular (≥ 3 sessions per week)	Benefits: Self-esteem, healthy habits, positivity, intention to perform PA, learning about the importance of PA, physical condition, recovering levels of energy prior to treatment and decreasing fatigue. Preferences: Need for trainer supervision. Start PA 2-4 weeks post-treatment, but can also be done during treatment, decreasing the intensity. Post-program PA: introduce strength training and everyone intends to continue.
van Putten et al. (2016)	5375 Total Time 1 = 45.6% of the total Time 2 = 29.32% of the total Time 3 = 25.58% of the total 54.6% males 45.5% females	< 55 = 7.6% 55-74 = 60% ≥ 75 = 32.4% *M* = 69.6, *SD* = 9.5	I = 31.8% II = 38.6% III = 29.5%	Only S = 49.6% S + RT= 23.1% CT= 20.3% S + RT + CT = 7%	Not used	Longitudinal	European Prospective Investigation into Cancer (EPIC) Physical Activity Questionnaire	Fatigue, dyspnea, side effects of chemotherapy, urination problems, loss of appetite, weight loss, pain, not so young, without partner, obesity, anxiety, depression, worse quality of life and physical functioning → ↓MVPA ↑PA males vs. women

Note. ↑ = increase; ↓ = decrease; → = relation; AT = adjuvant therapy; S = surgery; RT = radiotherapy; CT = chemotherapy; PA= physical activity; LPA= light physical activity; MPA = moderate physical activity; VPA = vigorous physical activity; MVPA = moderate and vigorous physical activity; TPA = total physical activity.

Stage I: the tumor affects the wall of the colon or rectum without going through the muscular layer. Lymph ganglia not affected. Stage II: the tumor has infiltrated all the layers of the wall of the colon or rectum. It can invade the surrounding organs. Lymph nodes not observably affected. Stage III: the cancer has invaded the neighboring organs and affects the lymph nodes. Stage IV: the cancer has spread to distant organs of the colon or rectum, such as liver, lung or bones.

Data analysis

The information gathered in this review was analyzed by means of a conventional content analysis (Hsieh & Shannon, 2005). First, all of the items selected for the review were carefully read to gain a deep comprehension of all the information. Second, we selected the specific results of each article that represented the most important ideas or concepts for the aim of this review by establishing the factors related to PA participation and encoding the information in a text file. Each code was composed of the concrete result of each article and an identification label of its contents and the corresponding bibliographic reference. Lastly, using inductive reasoning, all the codes were classified in a system of categories and subcategories that provided meaning and order to the data and was useful for drafting the results of this study (see Table 2). The data were grouped into four large health categories: 1) Sociodemographic factors; 2) Health factors; 3) Prior experience and preferences; and 4) Motivational factors.

Table 2. Categories and Subcategories of the Data Analysis

CATEGORIES	SUBCATEGORIES
Sociodemographic factors	Age, gender, marital status, race, educational level, employment, and economic status.
Health factors	Nonspecific: Obesity, anxiety, depression, quality of life, and healthy habits. Specific: Adjuvant treatment, side effects, benefits of PA during the disease, time of diagnosis, and recurrence.

Prior experience and preferences	Experience of PA, group activity, type of PA, information and advice about PA, schedules, facilities, moment of performing the program during the treatment, and supervision of training.
Motivational factors	Self-efficacy, intention, attitude, expectations and beliefs, personal attributes, social and physical environment, BPN, and types of motivation.

RESULTS

The results of the 23 studies reviewed reveal that participation in PA in CRC patients is associated with different factors that we will try to reflect in this section, taking into account the categories described in the Method section to facilitate the follow-up of the results.

Sociodemographic factors

According to the sociodemographic factors, gender and age influence PA participation in patients with CRC. Thus, being younger and male are associated with meeting the recommendations of moderate and vigorous PA by reference institutions such as the American Cancer Society and the American College of Sports Medicine (Buffart et al., 2012; McGowan, Speed-Andrews, Rhodes et al., 2013; Speed-Andrews et al., 2012), and with higher levels of PA (Speed-Andrews et al., 2014). However, being older and female are related to less PA participation (Downing et al., 2015; Husson et al., 2015). In addition, women perceive themselves as being less fit, having more fatigue and poorer health status, and they show little PA interest and experience, which is associated with less exercise (Kang et al., 2014). On another hand, van Putten et al. (2016) found that the intensity of PA in CRC patients was relatively stable during and after treatment but men performed more moderate-vigorous PA than women. In this sense, another study revealed that women performed more light PA and men spent more time sitting (Lynch et al., 2016).

Examining age differences, the study of Chung et al. (2013) showed that patients under 60 years increased their levels of total PA during treatment with regard to the prediagnosis values, whereas those over 60 decreased both their total and moderate levels of PA during treatment. After finishing treatment, only the youngest patients increased their levels of total and vigorous PA. In the study of Kang et al. (2014), patients over 60 perceived more drawbacks to performing PA due to lack of physical fitness, whereas patients under 60 indicated a lack of time. In this sense, Fisher et al. (2016) showed that patients over 65 and with more than one comorbidity performed less PA and, to a greater extent, perceived ageing and comorbidities as barriers to PA participation. Another study indicated that younger patients preferred doing PA with their family and friends, receiving information by internet, and they were more interested in participating in a post-treatment program of PA (McGowan, Speed-Andrews, Blanchard et al., 2013).

Regarding the influence of marital status and personal relationships, the studies show contradictory results. On the one hand, Speed-Andrews et al. (2012) found greater levels of PA in patients who were not married or were single. In contrast, van Putten et al. (2016) showed that having a couple relationship is associated with doing more moderate-vigorous PA over time. Husson et al. (2015) observed that patients with fewer personal relationships complied with the recommendations of PA to a lesser extent.

However, there is only one study that has analyzed differences in PA participation in patients with CRC as a function of race, finding that Hispanics and non-Hispanic Blacks were less likely to comply with the recommendations of light to moderate PA than were Whites. This reveals the influence of cultural factors in the PA participation in this collective (D'Andrea et al., 2014).

Some studies (Peddle et al., 2008; Speed-Andrews et al., 2012, 2014) found that the higher the educational level, the higher the levels of PA shown by CRC patients. Having higher studies was related to greater participation in light PA and more compliance with the recommendations of moderate and vigorous PA by the institutions of reference (Buffart et al., 2012). On another hand, patients with a lower educational level were less interested in PA, less likely to want to do it at a health center, less interested in receiving information via email or in starting a post-treatment program of PA tailored to their characteristics (McGowan, Speed-Andrews, Blanchard et al., 2013).

With regard to the factors related to the work situation, Speed-Andrews et al. (2012) found higher levels of PA in employed patients who had a higher economic status. Likewise, other studies (Husson et al., 2015; Lynch et al., 2016; Peddle et al., 2008) found that being employed, having less occupational experience, and higher economic status, respectively, were related to complying with the recommendations of moderate and vigorous PA by the institutions of reference. In addition, a lower annual income has been associated with showing less interest in starting a PA program for patients with CRC (McGowan, Speed-Andrews, Blanchard et al., 2013). However, Kang et al. (2014) revealed that working full time entailed more drawbacks to adhere to PA, whereas other authors (Hawkes et al., 2015) found that being retired and having private health insurance were associated with doing sufficient PA twelve months after diagnosis.

Health factors

First, we will refer to the health factors non-specific to the disease. Obese patients performed less total PA, whereas normo-weight patients performed sufficient PA twelve months after diagnosis (Hawkes et al., 2015). With regard to intensity, it has been found that having a lower body mass index is related to performing more moderate and vigorous PA (Buffart et al., 2012), whereas the study of Lynch et al. (2016) revealed that men who have a higher body mass index performed more light PA and they spent more time sitting. In the same direction, normo-weight patients performed more moderate-vigorous PA over time with respect to obese patients (van Putten et al., 2016). Taking into account the results of Speed-Andrews et al. (2012), being obese reduces the likelihood of increasing levels of PA after treatment. On another hand, overweight or obese patients perceived surgical complications as obstacles to perform PA more than those who had a body mass index within the range of normality (Hawkes et al., 2015).

Regarding health and psychological well-being factors, it was found that the manifestation of physical symptoms of psychological stress (somatization) was related to lower levels of PA 12, 24, and 36 months after diagnosis (Chambers et al., 2009). In this same study, it was found that high levels of anxiety were related to a lower probability of increasing the levels of PA after diagnosis. In this sense, Hawkes et al. (2015) found higher levels of anxiety and lower perceived quality of life in patients who performed less PA. With regard to the intensity of the activity, van Putten et al. (2016) revealed that patients with less anxiety and depression, and better quality of life and physical functioning performed more moderate and vigorous PA over time.

With regard to health-related habits, various studies found that non-smokers and moderate social drinkers (versus those who drink more regularly) complied to a greater extent with the recommendations of PA (D’Andrea et al., 2014; Hussson et al., 2015; McGowan, Speed-Andrews, Rhodes et al., 2013; Speed-Andrews et al., 2012).

On another hand, some specific health factors are related to CRC and can promote or hinder PA participation in this population. Relapse-free patients who were not treated with radiation therapy had less comorbidities and, therefore, better health status, and performed more PA (Chambers et al., 2009; Lynch et al., 2016; Speed-Adrews et al., 2012). However, those who had a greater number of comorbidities, besides exercising less, perceived ageing and the comorbidities as a barrier to performing PA. Thus, Kang et al. (2014) found that participants who were receiving neoadjuvant (before surgery) or adjuvant (after surgery) radiotherapy and/or chemotherapy were more likely to fear exercising due to the adverse side effects of the treatment, the surgical pain, and their poorer health than those who had completed the treatment. In contrast, Buffart et al. (2012) noted that patients without comorbidities who were receiving chemotherapy (compared to those who were not receiving treatment) performed more moderate and vigorous PA, which, in this case, could be due to the fact that the former patients were the healthiest, the youngest, and with fewer comorbidities.

Chung et al. (2013) discovered that patients receiving adjuvant treatment did not change their amount of total or mild and moderate intensity PA compared to the pre-diagnosis levels. However, the amount of vigorous PA decreased, and fewer patients followed the recommendations of PA after diagnosis. Even so, the patients who had finished the treatment increased their levels of mild activity and their amount of total PA with regard to the pre-diagnosis levels but there was no significant change in the amount of moderate and vigorous PA compared with the pre-diagnosis levels.

The study of Courneya et al. (2005) showed that patients who received adjuvant treatment perceived more difficulties to perform exercise related to side effects such as fatigue and nausea compared to patients who had only undergone surgery. Likewise, Kang et al. (2014) found that patients who had not yet completed the treatment perceived more obstacles to participate in PA, such as the lack of time and information, poor health status, a tendency to be inactive, and surgical pain during exercise, in comparison to those who were not in treatment. In line with these results, Courneya et al. (2004) noted that patients who, in addition to having surgery, were treated with adjuvant therapy, participated less in PA.

Morielli et al. (2016), in a study with patients undergoing neoadjuvant treatment, found that exercise during chemo-radiotherapy produced improvements in cardiovascular endurance, quality of life, and self-esteem. In addition, after completing the neoadjuvant therapy, the most common perceived benefits of exercise were a better physical functioning and, again, better cardiovascular endurance and quality of life. These perceived benefits could promote participation in PA in patients with CRC. However, the most common perceived negative effects of exercise during chemo-radiotherapy, which can represent a barrier to participate in PA, were fatigue, diarrhea, and skin irritation. After completing chemo-radiotherapy, the most common perceived negative effects of exercise were fatigue and the hand-foot syndrome (redness, sensitivity, and possible peeling of the palms and soles which can develop numbness or tingling). The side effects of treatment were the most common difficulty to exercise during chemo-radiotherapy, whereas the lack of motivation was the most common difficulty after treatment.

Regarding the benefits of PA for this population's health, other studies found that patients who performed more PA showed less fatigue and improved chemotherapy-related side effects such as urination problems, loss of appetite, weight loss, pain, and dyspnea (van Putten et al., 2016); they reported to feel healthier, more physically fit, with fewer musculoskeletal problems (Kang et al., 2014); and they also felt they aged less and had fewer comorbidities (Fisher et al., 2016). The perception of this type of benefits could promote patients' stable acquisition of the habit of exercising. In addition, in a qualitative study, Spence et al. (2011) found that, through exercise, patients' mental health improved, and their self-esteem, positivity, self-confidence, intention to perform PA, domestic tasks, and go back to work all increased. Patients also perceived that their healthy life habits improved and they learned the importance of PA, as well as of stretching and modulating the intensity of exercise, something about which they had no prior knowledge. Lastly, the patients felt that they recovered the levels of energy and physical fitness they had before the treatment. In another study, patients who performed more PA after diagnosis had better physical quality of life, better recovery after the disease and, therefore, better cancer-specific quality of life, and greater well-being (Hawkes et al., 2015). The study of Fisher et al. (2016) also analyzed the perception of the benefits of participating in PA: firstly, improved physical fitness, followed by improved health, maintenance and loss of weight, and lastly, psychological benefits. However, few believed that PA was useful to prevent CRC.

On another hand, the study of McGowan, Speed-Andrews, Blanchard et al. (2013) analyzed patients' interest in starting a post-treatment program of PA, reporting less interest in patients who had received the diagnosis a longer time ago, who did not experience cancer recurrence, who had a stoma, and who already participated in PA (compared with sedentary patients). In contrast, patients who experienced a cancer recurrence were more interested in the program of PA. Lastly, patients who were already disease-free were more interested and felt more capable of participating than those who were still sick.

Lastly, differentiating by gender, the health variables related to doing enough post-diagnosis PA in men were: not having fatigue and not smoking, whereas in women they were: having undergone only surgery (without chemotherapy), not having fatigue, having a healthy body mass index, and not smoking (Lynch et al., 2007).

Prior experience and preferences

Some authors indicate that having more experience of PA before diagnosis is related to greater participation in PA. Specifically, patients who already performed PA on a regular basis complied with the recommendations of the institutions twelve months after diagnosis (Courneya et al., 2004; Hawkes et al., 2015). In this sense, some studies (Fisher et al., 2016; Hawkes et al., 2015) observed that lack of time was the most frequent barrier in patients who did not perform PA before diagnosis in comparison with those who already exercised.

With regard to preferences, it was found that many patients felt the need for group-based PA programs (Dennis et al., 2013), although we note that patients with a stoma showed less preference for group participation in a fitness center (McGowan, Speed-Andrews, Blanchard et al., 2013). On another hand, a study carried out in Canada found that walking was the favorite PA both in summer and in winter (McGowan, Speed-Andrews, Blanchard et al., 2013), whereas another study of Canadian CRC patients found a greater preference for golf and, secondly, for bowling (McGowan, Speed-Andrews, Rhodes et al., 2013).

In addition, according to the study of McGowan, Speed-Andrews, Blanchard et al. (2013), patients who performed less PA showed less interest in doing group activities in a fitness center and in receiving information via email. Most of the patients were interested in receiving information about PA after diagnosis; they felt capable of participating in a PA program to increase their levels of activity, they preferred receiving information from a fitness expert in a health center, from brochures and printed material and receiving face-to-face personal advice, or from a video. As an example of interventions that have shown the efficacy of personal advice to increase participation in PA in this type of patients, we highlight the study of Hawkes et al. (2015), who carried out a 6-month intervention consisting of 11 telephone calls made by nurses, psychologists, or other health professionals. They also included a participant's handbook, motivational postcard prompts, and the use of the pedometer to stimulate and control the level of PA. The phone sessions addressed the experience with cancer, cancer symptoms, and strategies to improve health-related behaviors, in line with the recommendations and the individual goals established. The patients who formed part of this intervention group performed sufficient PA twelve months after diagnosis, increasing their levels compared to the pre-intervention levels.

Other authors identified that having time, participating with others, and having access to facilities were the most common facilitators of PA (Speed-Andrews et al., 2014). Likewise, Dennis et al. (2013) found that the patients considered their family and friends' support important, as well as receiving information about healthy habits from books or magazines.

Regarding time schedule preferences for PA in CRC patients, a study in Australia and Canada, measuring the levels of activity with accelerometers, has recently been carried out (Lynch et al., 2016). The results showed that the patients were less sedentary from eight in the morning until three in the afternoon and more sedentary from six in the afternoon. The percentage of time performing moderate-vigorous PA was lower between ten o'clock in the morning and three in the afternoon and higher from four to ten in the afternoon.

Lastly, Spence et al. (2011) carried out a study in Australia, analyzing patients' preferences after chemotherapy by means of semi-structured interviews. The patients preferred to choose the type of exercise and a gym with air conditioning to regulate body temperature and be able to make more effort without suffering from the heat. They also preferred to start the PA program between 2 and 4 weeks after completing chemotherapy because they thought they needed time to recover from it. However, some preferred to start later but to maintain contact with the hospital during this time of recovery after chemotherapy, so as not to lose their motivation and commitment to the program. On another hand, half of the patients claimed that they could have started the program during the adjuvant treatment but decreasing the intensity. In contrast, the other half said that this would be very difficult due to the fatigue caused by the treatment and the physical and emotional energy required to overcome these symptoms. However, almost everyone believed that if they had performed exercise during treatment, they would have felt better when the treatment was finished.

In this study, the patients also positively valued the supervised individualized training, adapted to their characteristics, being able to choose the schedule, place, type of session, etc. In fact, they expressed difficulty to continue the PA program without the trainer's support and follow-up. They all considered the trainer's supervision necessary to achieve greater motivation and increase their levels of self-confidence. Concerning group PA, they thought that it would be more economical, they would have more social support, and would share experiences. However, most preferred to carry out the PA program individually and, if it was done in a group, they preferred their classmates to be cancer survivors or people whose life had recently been at risk. Lastly, after the program, all the participants intended to continue doing PA and proposed to include strength training and to maintain the level of aerobic exercise. They pointed out that it would be difficult to continue the frequency and the intensity of the workouts without the supervision of the trainer.

Motivational factors

Next, we present the factors associated with the motivational theories that explain human behavior, trying to understand which variables are related to the PA participation in this population. On the one hand, some studies have found higher levels of perceived self-efficacy in patients who perform more PA (Hawkes et al., 2015). On the other hand, based on the theory of planned behavior, Courneya et al. (1999b) found that the intention to exercise and exercise pre-diagnosis were related to post-surgery exercise. Moreover, the attitude towards exercise was the only variable that correlated significantly with the intention to exercise. From this same theory, Morielli et al. (2016), trying to understand the influence of prior expectations before the PA program, revealed that patients perceived exercise during chemotherapy as more pleasant and less difficult than anticipated.

Continuing with the theory of planned behavior, among the most frequent beliefs about the benefits of PA (behavioral beliefs), Speed-Andrews et al. (2014) found that patients believed that PA improved physical fitness, it could improve their wellbeing and energy levels, and they felt better after exercising. With regard to normative beliefs, the most common belief was that PA should be approved by the members of the family, the oncologists, and one's best friend. As regards control beliefs, the factors that made them feel less confident of being able to overcome barriers were medical or health problems, pain, and the fact of returning to treatment (Speed-Andrews et al., 2014). In this sense, Courneya et al. (2004) found that patients who perceived less behavioral control, that is, they felt less capable of carrying out activity, showed less adherence to PA.

Using the ecological model of health behavior as the conceptual reference framework, Lynch et al. (2010) found that disease-specific barriers (fatigue, not feeling well enough to be physically active, diarrhea, and incontinence) and personal attributes (fear of injury, lack of enjoyment and interest, and being sedentary) were the greatest barriers both at five and at twelve months after diagnosis, followed by social environment (lack of time, not having the support of family, friends, and doctor) and physical environment (lack of access to facilities, the center perceived as unsafe and unattractive). All of these barriers were negatively related to participation in PA, except for the disease-specific barriers. Contrary to expectations, participants who showed a higher level of PA twelve months after diagnosis also had a greater number or intensity of disease-specific barriers. Perhaps the symptoms and side effects of the disease and treatment had decreased in general in this population, but they were more evident among those who submitted their body to a greater physical burden by exercising.

Lastly, Peddle et al. (2008) analyzed the factors that influenced PA participation in these patients from SDT. The results showed that perceived autonomy support in close people was positively linked to satisfaction of the needs for autonomy, competence, and relatedness, and with identified regulation (a kind of motivation characterized by valuing the benefits of an activity). Relatedness positively predicted identified regulation and introjected regulation (a kind of motivation characterized by a feeling of guilt), autonomy positively predicted introjected regulation, and perceived competence positively predicted identified regulation. Both identified regulation and introjected regulation positively predicted PA.

DISCUSSION AND CONCLUSIONS

The aim of this study was to provide a global view of the factors that facilitate or hinder the PA participation in patients with CRC by means of a systematic review of the literature. This is the first systematic review that specifically analyzes these factors in CRC. From all the information collected in this review, we reached various conclusions that will allow us to establish recommendations for the promotion of PA in this population.

First, among the sociodemographic factors, the following favor participation in PA in patients with CRC: being male, white, younger, higher educational level and higher economic status, having a job that does not involve a very extensive work schedule, having less occupational experience, or being retired. However, some contradictory results emerge when analyzing the influence of marital status and personal relationships on PA. Speed-Andrews et al. (2012) found that being single is related to doing more PA, whereas van Putten et al. (2016) found that having a couple relationship favors the participation in moderate and vigorous PA. It is true that conjugal obligations can cause people to have less time to do PA, but the partner's support to carry out PA during the disease seems essential (Mackenzie, 2015).

With regard to health factors non-specific to the disease, we can conclude that obese patients perform less total PA, while patients with lower body mass index perform more moderate and vigorous PA. In addition, patients who are overweight or obese perceive surgical complications as barriers to exercise to a greater extent. Among the factors associated with psychological well-being, patients with more stress, anxiety, and depression perform less PA whereas those who have better quality of life and physical functioning participate more.

Regarding disease-specific health factors, patients who are not receiving adjuvant treatment, have fewer comorbidities, and perceive better quality of life perform more PA. During treatment, patients perceive more barriers to exercise related to the side effects, such as fatigue, diarrhea, or skin irritation (Morielli et al., 2016). Although in general, receiving adjuvant treatment hinders PA participation, one study (Buffart et al., 2012) found that chemotherapy was a predictor of moderate and vigorous PA. The authors of this study try to explain this result arguing that the patients who received chemotherapy were the healthiest, the youngest, and with fewer comorbidities, and perhaps they also received more advice about PA to alleviate the side effects of chemotherapy.

Considering the influence of prior experience and preferences on PA, we find that the patients who exercised the most were those who performed PA before diagnosis (McGowan, Speed-Andrews, Blanchard et al., 2013). Thus, lack of time was only a drawback for those patients who did not exercise before diagnosis. Moreover, most of the patients felt capable of doing PA, they preferred to receive information about PA after diagnosis through the personal advice of a fitness expert and preferred to participate in group-based PA programs. Nevertheless, it should be highlighted that patients with a stoma showed less preference for group participation in a fitness center.

Having access to facilities was also a relevant factor for PA participation (Speed Andrews et al., 2014), and walking was the favorite PA both in summer and in winter (McGowan, Speed-Andrews, Blanchard et al., 2013). This result could be due to the fact that walking is a simple and accessible activity, it does not imply any cost and does not require much knowledge about methods of physical training. However, some activities could be more recommendable to achieve greater levels of intensity that translate into greater benefits. As pointed out in the literature, PA decreases during and after treatment in spite of the fact that 150 minutes per week of moderate activity, or 75 minutes of vigorous activity, or an equivalent combination are recommended (Rock et al., 2012; Schmitz et al., 2010). In this regard, it is likely that patients do not know what other activities they can carry out, and specific programs for this type of patients are probably not provided in fitness centers.

Patients were less sedentary from eight in the morning until three in the afternoon and more sedentary from six in the afternoon, reaching higher levels of vigorous PA from four to ten in the afternoon (Lynch et al., 2016). Learning more about the variability of PA patterns at different moments of the day may be helpful to consider more appropriate strategies to promote PA. In the following section, we propose some recommendations from this evidence.

Lastly, we will discuss the motivational factors related to PA behavior in these patients. According to the theory of planned behavior, the attitude towards exercise was the only variable that was related to the intention to exercise, which in turn, was linked to performing more post-surgery PA (Courneya et al., 1999b). With regard to beliefs (Speed-Andrews et al., 2014), thinking that PA would improve one's physical condition, energy level, and well-being was associated with performing more PA. In addition, the patients thought that PA should be supported by relatives, friends, and doctors. Lastly, medical or health problems, pain, and relapse and return to treatment, were the most frequently reported control beliefs that hindered PA participation. Based on SDT, one study showed that autonomy support, satisfaction of the three basic psychological needs (autonomy, competence and relatedness), and identified and introjected regulations were important variables for PA participation in patients with CRC (Peddle et al., 2008).

The results of this review have allowed us to sort and classify all the existing information on this topic to date. When designing PA programs for CRC patients, sociodemographic features, health factors, prior experience and preferences, as well as certain motivational factors should all be valued. The different conclusions reached should be taken into account for the development of PA in this population, considering the important benefits that can be achieved.

RECOMMENDATIONS

Drawing from the results obtained in this review, we present the following recommendations to promote PA in patients with CRC:

1) The existence of a less active profile in these patients, together with the physical and psychological side effects caused both by the disease itself and by the treatment, reveals the need to create specific programs of PA targeting this population, which contemplate their personal features. Special attention should be paid to the promotion of PA among older patients, women, and patients with lower socioeconomic status and educational level, because these sectors of the population are less interested in doing PA.

2) The programs should incorporate motivational strategies to foster a positive climate during the sessions of PA, ensuring that the participants feel respected and valued. Social environments should not only be inclusive but also the structure of the exercise facilities should favor the inclusion of patients with CRC. For example, the incorporation of showers and changing rooms that comply with the privacy of patients with a stoma, who may suffer from a problem related to body image, would be desirable.

3) It would be interesting to inform the patients about the benefits of PA for their disease, conducting seminars in the health centers. These seminars could include testimonials from patients who have already overcome the disease and who carried out PA during its course. This could improve patients' attitude towards PA and their intention to exercise.

4) Professionals from the sport sciences should be incorporated into the multidisciplinary medical team so that they could advise patients, recommend the best PA for each individual, and design individualized training programs. The competence of the professionals in charge of the direction of PA programs is essential because CRC patients are in a delicate health situation and need to be assured that their exercise will be carried out in conditions of safety to obtain the most benefits and take as few risks as possible.

5) If future studies with accelerometers confirm that patients with colorectal participate less in PA in the morning, programs of active rest during working hours could be designed, and active commuting for everyday trips could be fostered. Likewise, it would be interesting to develop PA programs in the afternoon time slots which patients usually dedicate to leisure.

6) Group activities to promote social relations among patients who are engaged in exercise programs could be designed, and also adapting the training loads to each person and offering autonomy. Thus, more self-determined motivation would be achieved and, thereby, more involvement and adherence to PA. To achieve these goals, it would also be necessary to promote patients' perception of competence, so they will feel capable to participate in PA programs.

7) Family, friends, health professionals, and other patients/peers should collaborate in the promotion of an active and healthy lifestyle in people suffering from CRC. Social support can be essential for these patients to acquire habits of PA that can contribute to alleviating the symptoms of their disease and to substantially improving their quality of life.

LIMITATIONS OF THE LITERATURE AND FUTURE RESEARCH DIRECTIONS

In spite of the results found in this review, we also identified important gaps in the literature that we shall detail in the following paragraphs. First, it should be noted that, out of all the reviewed articles, only five used an experimental design. There is still a lack of knowledge about the type, frequency, duration, and intensity of PA that are necessary to optimize the physical and psychosocial benefits and reduce the risks in patients with CRC at different phases of treatment and as a function of the types of treatment. Increasing this knowledge is essential to improve the therapeutic effects of exercise and to promote PA participation in these patients. In addition, more studies are needed to implement and analyze the effect of strategies to motivate these patients to participate in PA.

It is also necessary to highlight that only one study collected information by means of qualitative techniques. There is a lack of qualitative studies that analyze in depth the reasons that lead patients with CRC to participate in PA, as well as the barriers they find. It would be interesting to combine experimental designs with qualitative techniques of data collection, attempting to confirm the psychosocial effects of specific group-based PA programs for this population, as well as to identify possible problems that may arise during the course of such programs. Thereby, we would obtain more vital and comprehensive knowledge to design and implement appropriate programs of PA for these patients.

Another of the limitations found in this review is that most of the studies do not use a theoretical framework of reference. Of the 23 articles that make up this systematic review, only five studies used the theory of planned behavior, two applied the ecological model of health behavior, and only one study is based on SDT to analyze the factors that influence adherence to PA in patients with CRC. However, as some authors indicate (Biddle et al., 2012), it is necessary to apply theoretical frameworks that guide the studies and allow us to understand the information accurately and in a structured way. Accordingly, it is striking that only one study applied SDT with CRC patients, taking into account that this theory has proven to be one of the most relevant to study behavior in health contexts (Ng et al., 2012).

Besides, most of the studies measure PA by means of questionnaires, except for one study that incorporated a more objective measure using accelerometry. New studies are necessary to analyze the levels of PA in patients with CRC objectively, in order to determine their relationships with different factors that may increase or decrease them. The increasingly advanced development of wearable devices for tracking PA could facilitate this task accordingly.

Lastly, out of the 23 reviewed articles, 11 studies analyzed the factors associated with the performance of PA during the complementary treatment to surgery, another nine were carried out after finishing the treatment or only a minority of patients was in treatment, and three studies did not specify the time of treatment. From our viewpoint, the differences between the factors that promote or hinder PA participation during and after the complementary treatment to surgery remain unclear. A greater analysis of these factors throughout the entire process of the cancer is necessary (Milne et al., 2008), even analyzing the barriers that may appear during a “chemotherapy week” compared to a week of rest from chemotherapy, to know more specifically how the side effects of the treatment affect the levels of PA. Basically, although knowledge of the factors that promote PA participation in patients with CRC has advanced, we must continue delving into this so that this population can benefit from the positive effects of PA, even more so when taking into account the high incidence and severity of the disease.

DOCTORAL THESIS STUDIES

STUDY 1

Barriers to physical activity participation in colorectal cancer patients during chemotherapy treatment: A qualitative study

STUDY 2

Beyond basic psychological needs: The hope construct during adjuvant treatment in colorectal cancer patients

STUDY 3

Positive effects of a motivational physical activity program (FIT-CANCER) in colorectal cancer patients during the adjuvant chemotherapy: A qualitative study from self-determination theory

STUDY 1

Barriers to physical activity participation in colorectal cancer patients during chemotherapy treatment: A qualitative study

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ABSTRACT

Purpose: To explore the barriers that CRC patients (stage II and III) perceive to participate in PA when involved in adjuvant chemotherapy. Views of relatives and physicians concerning this issue were also included.

Method: Qualitative data from ten patients, ten relatives, and ten health professionals were obtained through semi-structured interviews (n = 30).

Results: Two main themes were identified after data analysis: (a) barriers to PA related to ostomy and adjuvant chemotherapy and (b) barriers related to perceived lack of support for PA. In regard to the first theme, participants reported difficulties associated with the ostomy, limitations of the intravenous chemotherapy device, fatigue and reduced physical fitness, and focusing on cancer and restructuring priorities. Concerning the perceived lack of support for PA, participants referred to their families' overprotection, the health professionals' lack of knowledge and time to prescribe PA, and the lack of PA services in health centres.

Conclusions: Further information from health professionals about the recommendations of PA and its benefits during adjuvant chemotherapy could palliate these PA barriers. The offer of specific PA programmes for these patients is also recommended.

Keywords: exercise, qualitative, fatigue, Port-a-Cath, stoma, health professionals.

INTRODUCTION

CRC is the third most prevalent cancer and the fourth most common cause of cancer-related death worldwide (Bray et al., 2018). The treatment of CRC usually requires surgery followed by adjuvant chemotherapy. Chemotherapy implies several side effects that impact on patients’ health, such as fatigue, disrupted sleep, neuropathy, chronic pain, impaired physical function, impaired cognition, depression, anxiety, and decreased quality of life (Clifford et al., 2018; Fallon, 2013; Pachman et al., 2012; Vrieling & Kampman, 2010). There is growing evidence about the positive role of PA during and after treatment in CRC patients. Segal et al. (2017) showed that PA involves significant and positive changes for physical aspects of quality of life, such as physical functioning, energy levels, pain, and general health perceptions. Besides, active patients feel less stress, anxiety, negative emotions, and cognitive problems (Basen-Engquist et al., 2014). PA may also improve patients’ ability to complete the treatment, prolonging disease-free survival and reducing risk of recurrence and death (McTiernan et al., 2010; Vrieling & Kampman, 2010). In spite of the described benefits, only about 17-35% of CRC patients comply with PA recommendations (Blanchard et al., 2008; Courneya et al., 2008a; Courneya et al., 2008b; Maxwell-Smith et al., 2017; Schmitz et al., 2010; Smith et al., 2017). Studies focused on analysing the barriers to PA for CRC patients represent a necessary step for the promotion of PA in this population. A systematic review of this topic (Romero-Elías et al., 2017) highlighted some of these barriers. Female participants who were older and had a lower socioeconomic status were more inactive. Disease-specific barriers, such as fatigue, nausea, diarrhoea, or difficulties with the stoma pouch were also reported. Perceived lack of time and insufficient health knowledge were other barriers to PA. This systematic review (Romero-Elías et al., 2017) identified a clear lack of qualitative studies shedding light on the barriers to PA in CRC patients. As Lynch et al. (2010) suggested, the barriers included in the measures of quantitative studies are pre-established, and a qualitative methodology may be appropriate to identify additional barriers from the perspective of CRC patients.

To our knowledge, only two qualitative studies have focused on barriers to PA in patients who had completed active treatment for CRC in the previous 2 years (Hardcastle et al., 2017; Maxwell-Smith et al., 2017). However, no previous qualitative studies have been carried out with CRC patients who were still receiving chemotherapy treatment. Moreover, these two previous studies did not include the views of other social agents who could provide a more complete understanding of the topic under study. This qualitative study aims to explore the perceived disease-specific barriers to PA in CRC patients during adjuvant chemotherapy, including the perspectives of the patients, their relatives, and their health professionals.

METHODS

Design

A qualitative descriptive study design was adopted using semi-structured interviews. The Critical Appraisal Skills Programme (2018) checklist for qualitative studies was used to assess the quality of this research. The study adjusted favourably to the ten items included in the appraisal tool.

Participants

Participants were ten CRC patients, ten relatives, and ten health professionals (*n* = 30). Patients (50% female; 35-75 years, *M* = 58.80, *SD* = 12.47) were recruited through the oncology unit of a Spanish hospital (University Hospital of Vinalopó, Elche). Table 3 shows an overview of their clinical characterization, including medical diagnosis, specific stage of the disease, and type/duration of chemotherapy treatment. The following criteria had to be met for their inclusion in the study: aged more than 18 years; confirmed

CRC (stage II–III); treated by curative surgery for colon or rectal cancer followed by chemotherapy treatment; and to have finished half of the cycles of the adjuvant chemotherapy treatment. Exclusion criteria were: metastatic or incurable CRC, and limiting physical/psychiatric symptoms detected by the oncology medical team. Four of the 14 relatives screened at the beginning of the study declined participation, alleging personal reasons. Therefore, ten relatives (23-75 years, *M* = 50.90, *SD* = 17.14) were finally included in the sample; five men (patients' husbands) and five women (two wives, one sister, and two patients' daughters). Finally, the whole oncology team of the hospital participated in the study, including one psycho-oncologist (woman), four oncologists (two men and two women), and five nurses (two men and three women). Health professionals aged between 35 and 55 years (*M* = 40.80, *SD* = 7.70), and accumulated an average of 7.6 years of experience in oncology services.

This research was approved by the Ethical Research Boards of both the hospital and the Miguel Hernández University of Elche. All participants were informed about the research procedures and provided their written consent.

Table 3. Patients' Characteristics

ID	**SEX**	**AGE**	**DIAGNOSIS**	**STAGE OF DISEASE**	**CHEMO**
1	Woman	64	Adenocarcinoma rectum	pT3N0M0 (IIA)	CAPOX Started: 18/09/17 (5 weeks after surgery) Ended: 22/2/18 (5 months)
2	Woman	61	Adenocarcinoma sigma (colon)	pT3N0M0 (IIA)	CAPOX Started: 23/10/17 (4 weeks after surgery) Ended: 19/4/17 (6 months)
3	Man	75	Adenocarcinoma rectum	cT3aN2M0 (IIIB)	Capecitabine Started: 8/11/17 (7 weeks after surgery) Ended: 3/4/18 (5 months)
4	Man	65	Adenocarcinoma rectum	cT3aN2M0 (IIIB)	FOLFOX Started: 17/1/18 (5 weeks after surgery) Ended: 16/7/18 (6 months)

5	Woman	35	Adenocarcinoma rectum	cT4N0M0 (IIC)	Capecitabine Started: 8/2/18 (4 weeks after surgery) Ended: 30/5/18 (3 months)
6	Man	61	Adenocarcinoma sigma (colon)	pT4pN0M0 (IIC)	FOLFOX Started: 6/3/18 (6 weeks after surgery) Ended: 20/8/18 (6 months)
7	Woman	42	Adenocarcinoma sigma (colon)	pT4bN0M0 (IIC)	FOLFOX Started: 29/3/18 (4 weeks after surgery) Ended: 18/10/18 (6 months)
8	Man	64	Adenocarcinoma sigma (colon)	pT3N0M0 (IIA)	CAPOX Started: 21/5/18 (4 weeks after surgery) Modified to FOLFOX in cycle 5 Ended: 7/12/18 (6 months)
9	Man	70	Adenocarcinoma sigma (colon)	pT3N0M0 (IIA)	Capecitabine Started: 30/5/18 (4 weeks after surgery) Ended: 17/11/18 (6 months)
10	Woman	51	Adenocarcinoma sigma (colon)	pT3pN2aM0 (IIIB)	FOLFOX Started: 18/6/18 (6 weeks after surgery) Ended: 26/12/18 (6 months)

Procedure and data collection

Semi-structured interviews were conducted with each participant and audio-recorded by MR (a sport sciences doctoral student experienced in CRC and exercise). Questions for patients, relatives, and health professionals were developed by MR in consultation with VB, DG and AJ (initials of the other members of the research team), who had expertise in qualitative research and PA promotion. Then, MR established phone contact and carried out several meetings with the oncology unit to explain the purpose of the study. Once the oncologists agreed to participate, they informed the nurses and the psycho-oncologist about the possibility of also being interviewed to determine their perceptions of the barriers that patients might have to overcome during adjuvant chemotherapy. The nurses and the psycho-oncologist also agreed to participate. In addition, at each medical consultation, oncologists informed patients about the study and asked for their participation. If the patients accepted, MR contacted them by phone to arrange a time and location for the interview. All interviews were performed at the hospital, university, or participants' home, according to their preferences. In the case of patients, interviews were conducted halfway through the treatment, following medical recommendation. After the patients had been interviewed, they were asked if the relatives who shared the most time with them during treatment could also be interviewed. Subsequently, the same protocol as the one applied to patients and health professionals was also applied to those relatives who agreed to participate. Table 4 contains several examples of questions asked to the three groups.

Table 4. Examples of Interview Questions

PA Participation	
Patients	**Physicians and Relatives**
- Do you usually do any kind of sport or PA? Why? - How many days per week do you do moderate and vigorous PA? † - Do you feel able to do PA during the treatment? - At what point in the treatment do you feel more energised to participate? And at what time less energised? - Have you been informed of the benefits of PA in general? And during the illness and the treatment?	- Do you usually do any kind of sport or PA? Why? - How many days per week do you do moderate and vigorous PA? † - How much time do you spend walking and sitting? - Do you think that exercising is good for your health? Why? - Do you think that exercising is good for the health of patients with CRC? Why? What benefits can it bring? - Do you think that PA involves risks in patients with CRC? What risks? Why? How can those risks be reduced?
Factors influencing PA participation in CRC patients	
Patients	**Physicians and Relatives**
- What barriers have you perceived to do PA during treatment? - Have you had physical problems, low perception of ability, fear of hurting yourself, boredom, etc.? - How do you think your physical fitness is in general? - Do your relatives support you to do PA? - Do you consider that there are available spaces and facilities to do PA?	- Does X (the family member with cancer or the patient) habitually perform some type of sport or PA? Why? And before the illness? - What barriers do you think he/she finds to do exercise? - What aspects might facilitate his/her participation in PA? - Do you think it would be interesting to incorporate PA and sports professionals into the team of health professionals who care for these patients? What qualifications should these professionals have? - Do you think that exercise could be part of a complementary treatment for CRC patients?

Quality of life		
Patients	**Relatives**	**Physicians**
- What symptoms do you have daily (nausea, fatigue, pain, need to lie down, etc.)? How do they affect you? - Do you feel that the disease has affected your social relationships? - Do you think people in your social environment accept your illness? - Do you feel that your illness affects your mood? - Do you enjoy life? Can you work, enjoy leisure time, eat and sleep well? - Are you worried about any other issue? - Do you think that carrying the colostomy bag (if you carry it) affects your day-to-day life?	- How does the disease affect the patient's quality of life? - How does it affect his/her relationship with the family? - How does it affect you? - Do you think that exercise could somehow improve the patient's quality of life and his/her family relationships? - What do you worry about the most in this situation (the disease and its effects)? -What encourages you the most to fight and face the situation?	- How has the disease affected his/her quality of life? - How has it affected the relationship with the family? - How did the news of the disease affect him/her? - Do you think that exercise could improve the quality of life of the patient and the relationship with his/her family in some way? - What worries you the most about this disease? - What is the worst thing about CRC for patients? - What is the best and worst part of your work with CRC patients?

†: The concepts related to the different intensities of PA were explained; PA: PA; CRC: CRC.

Data analysis

Qualitative data from the interviews were transcribed verbatim and analysed using QSR Nvivo software (Bazeley & Jackson, 2013). The data were analysed with an inductive thematic analysis (Braun & Clarke, 2006). First, all transcriptions were read carefully to become familiar with the data. Second, any data extracts which represented interesting information related to the aim of the study was coded. This initial coding was inductive and descriptive. Third, inductive reasoning was also used to identify from the codes two main themes ("Barriers related to ostomy and adjuvant chemotherapy" and "Barriers related to perceived lack of support to PA participation") with their corresponding sub-themes. These themes and sub-themes determined the structure of the results shown in the next section.

Data analysis was led by MR, whereas VB, DG and AJ played the role of 'critical friends' (Smith & McGannon, 2018). According to these authors, the involvement of critical friends during the process of data analysis improves the quality of interpretations and favours a more defendable and plausible data analysis. In a series of three meetings, MR presented the data analysis using diagrams, outlined the codes included in the different themes, and responded to the questions and suggestions of the critical friends. The critical friends helped their colleague to refine the names and contents of the different themes, so as to achieve a more coherent thematic map at the end of data analysis. They also collaborated to improve the write-up of the analysis and the entire article.

RESULTS

The themes and sub-themes identified in the data analysis are presented in the following sections. Table 5 summarizes the main similarities and differences of participants' views about PA barriers during chemotherapy treatment.

Table 5. Summary on the Similarities and Differences of Participants' Views about PA Barriers During Chemotherapy Treatment

Barriers related to ostomy and adjuvant chemotherapy	**Differences**	**Similarities**
Difficulties associated with the ostomy	–	Patients, relatives, and health professionals considered that ostomy was a potent barrier to PA, especially at the beginning of the treatment.
Limitations of the intravenous chemotherapy device	Two nurses commented that patients, who had acquired an exercise routine, did not perceive the intravenous chemotherapy device as a main barrier to do PA.	Many patients thought that the chemotherapy device was a barrier to PA participation. They were uncomfortable with the cables and felt ashamed of a large device that could be seen by others through clothing. This idea was supported by relatives and health professionals.
Fatigue and reduced physical fitness	Some patients did not perceive fatigue as a barrier.	Many patients and relatives supported fatigue as the main barrier. Health professionals reported fatigue as the most prevalent side effect of CRC treatment, which was related to less PA.
Focusing on cancer and restructuring priorities	Relatives did not inform about this theme as a barrier to do PA during the treatment.	This barrier was mainly reported by younger patients with children. Oncologists were the main agents who highlighted this issue as a barrier to PA.
Barriers related to perceived lack of support for PA		
Families' overprotection	Patients did not report this issue as a barrier to do PA during the treatment.	Relatives acknowledged that they overprotected patients and influenced on their inactivity during the treatment. This fact was also perceived by health professionals.

Health professionals' lack of knowledge and time to prescribe PA	Nurses declared to have more time to inform about PA, but they demanded specific training before giving some PA recommendations or prescribing any type of PA.	Health professionals mentioned their lack of knowledge and time to prescribe PA. Oncologists recommended "exercise" but they recognized not having enough knowledge for a detailed prescription. Oncologists considered that they should have the possibility of referring their patients to other professionals in charge of PA aspects. Relatives and patients agreed with these ideas and considered essential the oncologist's initial recommendation for PA participation.
Lack of PA services in health centres	–	Patients, relatives, and health professionals informed about the lack of PA services in health centres. All of them reported that PA programmes should be mandatory for patients. Especially, the youngest relatives and patients suggested that PA should be offered at the hospital as part of CRC patients' treatment.

–: No differences were found between the participants' views.

Barriers related to ostomy and adjuvant chemotherapy

Difficulties associated with the ostomy

Most patients declared that colostomy represented a shock in the early stages after this surgical operation, and was a potent barrier to perform PA:

> *At the beginning, wearing the stoma is a horrible shock. It was a very negative thing, I was sitting around all day, and I didn't feel like walking or going anywhere (Patient 7).*

Health professionals agreed that, at the beginning, patients felt insecure and embarrassed, and needed some time to adapt to the handling of the pouch. This situation negatively affected the patients, who tended to isolate themselves and reduce their participation in social activities:

> *Some patients with a stoma find it difficult to get out on the street and participate in group activities, because the stoma makes sounds, gases pass out and they cannot control either the sound or the smell... maybe an environment where people understand these issues is better (Oncologist 1).*

Some patients also reported not doing PA because of their fear of getting a hernia. This concern was in line with oncologists' recommendations after ostomy:

> *I don't recommend doing PA if they have a stoma. Especially at the beginning, because they don't manage the stoma well and the pouch could break. I tell them to avoid vigorous PA, sudden movements, or resistance training in order not to suffer pain (Oncologist 1).*

Limitations of the intravenous chemotherapy device

Wearing the intravenous chemotherapy device was a barrier commonly reported by the patients. The device consists of a bottle connected to a subcutaneous Port-a-Cath for 48 hours. Patients felt uncomfortable because the bottle is very big and is easily noticeable under their clothes. Hence, patients tended to stay at home on those days, which implied a decrease of their PA participation:

> *When I didn't do anything… it was when they put the bottle on me for two days, because it makes a bulge in my body and I don't like it. When I'm receiving the treatment, I don't want to go anywhere. The bottle is like a knapsack, it's very big and can be easily seen (Patient 4).*

According to different health professionals, it was possible to walk and do some exercise while wearing the chemotherapy device. However, the social barriers associated with wearing the device were the main problem, especially for patients living in small towns where they could come across with neighbours and feel obliged to give unpleasant explanations:

> *Especially in small towns, my patients don’t want to be seen with the bottle. This is not so uncomfortable to walk and exercise, but I think it's more because of the neighbours. They tend to isolate themselves, they don’t feel like dealing with people, people ask them questions and they have to respond…In the city, I think they go more unnoticed… (Nurse 4).*

For many patients, the bottle was not the only impediment to do PA. They also expressed their concern about the subcutaneous Port-a-Cath and the possibility of receiving a blow while doing exercise:

> *I feel overwhelmed with the Port-a-Cath when I do Pilates. I can feel it, I feel weird about it…I have cables inside, and I was told not to receive any blow on it… (Patient 1).*

Fatigue and reduced physical fitness

According to many patients, fatigue was the main perceived hindrance to do PA during chemotherapy:

> *Fatigue is the main barrier to do PA, now I'm on chemotherapy and I feel tired. I used to walk four or five km a day…Now, really, the chemotherapy exhausts me… and I don’t have any spirit to do PA (Patient 3).*

Fatigue was also associated with the perception of reduced physical fitness. This situation led some participants to drop out of activities they did in group, such as walking, because they were worried about not being able to keep up with the pace of the group:

> *I don’t dare to go walking because I don’t know how I will respond. Partly, I think I can go with them, but they are used to a pace that I can’t follow now (Patient 4).*

> *One of the limitations was that he [Patient 4] couldn't keep up with his mates. He was physically able to go walking, but he didn't want to slow down the group or make them wait for him. Sometimes when people do PA in a group, they stop going if they cannot remain at the same level (Psycho-oncologist 1).*

Focusing on cancer and restructuring priorities

Some health professionals highlighted the fact that patients were focused on cancer and changed their priorities after diagnosis, especially during the first cycles of chemotherapy. This situation involved a reduction of their PA levels:

> *The first months of the treatment, patients are focused on their thoughts, the disease, their survival and overcoming fear. Obviously, in that situation, they aren't going to do the same PA as before having cancer. They have another perspective because their priorities have changed (Oncologist 3).*

However, only patients with young children talked about this barrier to PA. The cancer diagnosis represented a radical change which was difficult to accept and changed their priorities. During this unstable period, they decided to devote their efforts and vitality to attend to priority tasks:

> *I stopped PA because… your priorities change, and you have to save yourself and move on. Until you accept the disease, all your energy is dedicated to do what you have to do…in my case, my children and my husband. At the end of the day, you do what the body allows you to do (Patient 9).*

Barriers related to perceived lack of support for PA

Families' overprotection

The relatives themselves acknowledged that they tended to overprotect the patients due to their health problems. This fact, also perceived by the health professionals, led to a reduction of patients' PA participation, although the patients did not refer to this barrier clearly:

> *I overprotected him. I told him not to do certain things and he didn't get up. Maybe this was incorrect but, during the treatment, I was afraid when he carried bags because he had a huge scar. I didn't realise he was being overprotected (Relative 5).*

> *I think family members wouldn't let them do PA. One patient loved his motorbike. It was his hobby and now his wife doesn't let him do anything. He doesn't work… he isn't well…because he doesn't know what to do. Doing exercising would be very good for them (Nurse 4).*

Health professionals' lack of knowledge and time to prescribe PA

Health professionals acknowledged their lack of knowledge to prescribe PA, an aspect that represented a strong barrier for the promotion of PA in CRC patients:

> *What kind of exercises, how to do them, how often, in what way, by what means… because it's an unfamiliar area for us …we are unaccustomed to address it with patients. We have that conversation when a patient asks about exercise, but it's difficult to remind all patients about the importance of doing PA (Oncologist 4).*

> *I don't have the academic qualifications to decide which exercises the patients can or cannot do. There is no one better than the sport sciences professional to prescribe PA for patients (Nurse 4).*

Some relatives also believed that the oncologists did not have much knowledge about PA prescription, and that this fact caused the oncologists to avoid recommending or prescribing PA:

> *Doctors in general didn't say anything about doing exercise. I believe doctors don't have any knowledge of PA. Otherwise, they would have informed us (Relative 4).*

According to relatives and patients, this lack of PA recommendations or prescription was a fundamental barrier to the patients' PA participation:

> *He [the patient] would have done everything possible to recover his health…and I would have taken my father wherever they [the doctors] would have told me (Relative 3).*
>
> *If the doctor had told him [the patient] to do exercise every day, he would have done it more often… (Relative 4).*
>
> *The biggest barrier to training was not knowing that I could do it (Patient 10).*

Moreover, nurses declared that oncologists did not have enough time to give PA recommendations during consultations, but they spent more time talking with patients and could give some PA recommendations if they received an appropriate training:

> *Doctors only have 20 minutes for each patient [consultation time] but we [nurses] have almost 5 hours while delivering the chemotherapy. So… if we receive training, we could help the patients. It would be great if the hospital organised some workshops about PA for CRC patients (Nurse 1).*

Due to their lack of time and multiple responsibilities, oncologists thought that they should have the option of referring their patients to other health professionals in charge of running PA programmes:

> *The oncologist can't be in charge of so many things. It would be interesting for patients to do PA, but the oncologist is not the one who has to run the plan. Oncologists would have to refer their patients to a team in charge of carrying this out (Oncologist 3).*

Lack of PA services in health centres

Participants reported that the hospital did not provide PA services for CRC patients. This situation represented a barrier to PA for the patients, who did not know of appropriate places to do PA programmes adapted to their characteristics and needs:

> *I don't think that sport centres are prepared for cancer patients… and I'm not going to go centre by centre asking if they have activities adapted for me, because I don't want to explain my case to everyone (Patient 9).*

Nevertheless, many health professionals, and the youngest relatives and patients, suggested that PA should be included in the hospital as part of the CRC patient's treatment:

> *Patients would do PA if it was established as another therapy. They would surely do it, and successfully (Oncologist 3).*
>
> *I believe that PA should be compulsory, and the hospital should offer a PA programme for patients (Relative 3).*
>
> *I would like to access a PA programme for cancer patients where we could encourage each other (Patient 1).*

Finally, one nurse thought that the incorporation of sport sciences professionals in the team of health professionals is necessary to create and offer such PA services in health centres:

> *A professional in sport sciences with knowledge of cancer is the figure who should prescribe and run the PA programme (Nurse 4).*

DISCUSSION

As recommended by Kendall et al. (2009), this qualitative study followed a multi-perspective approach, which included the view of patients, relatives and health professionals, and was useful to provide a more complete understanding of the topic under study. Our findings revealed that ostomy and adjuvant chemotherapy entailed several barriers to PA which could be framed in both a physical and a psychosocial dimension. With regard to the physical barriers, and in line with previous research (Russell, 2017; Saunders, 2018), patients were worried about suffering a hernia or breaking the ostomy bag with vigorous PA and sudden movements. Patients also expressed their concern about receiving a blow while doing PA or getting injured while wearing the Port-a-Cath. As other studies have pointed out (Blaney et al., 2013; Lynch et al., 2010), the fatigue associated with chemotherapy was another physical barrier to their PA participation.

Nevertheless, ostomy and adjuvant chemotherapy also involved important psychosocial barriers to PA. Patients undergoing a treatment phase with a recent diagnosis were worried about their survival and felt afraid, insecure and uncertain. The stoma, the ostomy pouch, and the intravenous chemotherapy device also involved important body changes that were difficult to accept. Patients also reported that they could not control the sound or smell of their ostomy pouch or that the chemotherapy device made a strange bulge in their body easily seen by others. These aspects led patients to avoid social activities or situations in which they could feel obliged to give explanations about very private, unpleasant, or embarrassing issues. Similar findings were reported by Saunders and Brunet (2019), who highlighted that having a stoma can be a barrier to PA when cancer survivors isolate themselves to avoid social exposure. The fact that patients felt fatigue and reduced physical fitness also had social implications in the PA context which have not been underlined in previous research. For instance, in some cases, participants decided to stop walking with their mates because they were not able to keep up with their pace and did not want to be a burden to the group. Therefore, the psychosocial aspects associated with ostomy, chemotherapy, and fatigue were also strong barriers to PA in CRC patients.

The patients of this study were in a confused phase of their lives, in which they were focused on cancer and they had restructured their priorities. In these conditions, it seems logical that the focus and energy were aimed at recovery, survival, and priority tasks such as looking after children, instead of participating in PA. However, this probably occurred because PA was not conceptualized and considered as an official part of their treatment by the health system, health professionals, patients, and relatives. Otherwise, patients (and their families) would have understood that PA was one of the priority tasks they had to carry out in their fight against CRC. In fact, cancer patients tend to think about the reasons of their disease during treatment and are usually open to changes in their lifestyle which could improve their health (Henriksson et al., 2016). This important point is linked to the barriers related to the lack of support for PA identified in our study. In line with previous studies with CRC patients (Saunders, 2018) and patients with prostate cancer (Cormie et al., 2015), the fact that the patients and families did not receive precise recommendations for the patients to do exercise was a very strong barrier to do PA. This lack of information and knowledge, together with the logical concern about the patients' health, made relatives overprotect the patients and promote their inactivity. This last finding is consistent with the results reported by Henriksson et al. (2016).

According to our findings, the fact that health professionals did not give precise PA recommendations was related to their lack of knowledge about this topic. This situation seems to be quite common. In a survey completed by 323 CRC clinicians from the UK (Anderson et al., 2013), only 52% reported that they were familiar with guidance for lifestyle advice (diet and PA) for CRC patients, and 50% of responders said that they would value additional training in this area. In the case of the oncologists, another reason for not giving precise PA recommendations was that they had little time to interact with their patients during consultations. Moreover, oncologists felt swamped by so many responsibilities and demanded more professionals on their health teams to take charge of

PA aspects, so that they could refer their patients to these professionals. In a qualitative study with health professionals carried out by Koutoukidis et al. (2018), whereas some health professionals thought they should encourage CRC patients to lead a healthier lifestyle, others thought they were not the right person to provide lifestyle advice, given their limited knowledge on the topic and other priorities during their short consultations.

Finally, the lack of PA services in health centres represents a potent structural barrier to PA in CRC patients. This barrier is especially serious, taking into account that the services which can be offered by conventional sport and fitness centres are far from the special needs of CRC patients.

IMPLICATIONS FOR PRACTICE AND RESEARCH

This study has several implications for practice and research. Psychological intervention with patients would be necessary to empower them to face the fears, concerns, and insecurities associated with CRC, ostomy, and chemotherapy. Patients should also receive more technical training to improve their management of the ostomy pouch and the chemotherapy device to feel more confident.

It is necessary to provide patients and families with very clear information regarding what exercises patients can or cannot do at the different stages of CRC and its treatment. Oncologists could prescribe PA for CRC patients and give general PA recommendations, which could be extended by nurses, who have more time to interact with and talk to the patients. Then, specific training in PA recommendations for CRC patients would be desirable for these health professionals. However, to design and supervise the type, frequency, intensity and duration of exercise that is desirable for each patient is not an easy matter. Therefore, the incorporation of sport sciences professionals into the health teams led by oncologists would be essential to provide PA services in hospitals and health centres. In this way, oncologists could refer their patients to professionals in charge of designing, implementing, and evaluating the effects of PA programmes in CRC patients. Family members should also be educated on the benefits of PA (Segal et al., 2017) and the potential consequences of inactivity during and after treatment (e.g., reduced physical function, increased dependence on daily tasks, muscle and bone loss, and potential risk of falls). This knowledge could help family members to see PA as a complementary treatment, and would be especially interesting for those families who tend to overprotect CRC patients.

The PA services in hospitals and health centres could offer counselling for PA, personal training sessions, or group PA programmes in which patients could do exercise with other participants who are in a similar situation. Previous research on PA and cancer supports this argument. For instance, Haas and Kimmel (2011) informed about the benefits of performing group PA sessions to build camaraderie and support in these patients. The systematic review by Segal et al. (2017) also provides evidence on this matter, suggesting that exercising in a group and under supervision (by exercise professionals) can enhance patients' motivation and optimize their safety and options to do PA. However, light or moderate at-home exercises might also be a suitable option for patients who have received surgery and just started chemotherapy. In this way, fatigue, fear of sudden blows, potential pouch breakages associated with vigorous movements, and feelings of embarrassment related to the stoma, the ostomy pouch, and the intravenous chemotherapy device could be prevented.

Future studies, from a qualitative, longitudinal, and case study perspective could analyse the changes in the barriers to PA over the different phases, from CRC diagnosis until recovery or decease. Upcoming research should also gather data concerning older adults' perspectives on this topic. In the present study, only three of the ten participant patients were over 65 years old. Considering that CRC is the most common cancer among the elderly, and the increasing proportion of elder patients in the coming years, the view of this population should be considered. Finally, future research could analyse what kind of PA programmes would be better to palliate each one of the negative side effects of ostomy and chemotherapy (e.g., hernia after ostomy, fatigue, disrupted sleep, chronic pain, depression, or neuromuscular impairment due to neurotoxicity). The cost-effectiveness assessment of PA services and specific PA programmes would also be necessary.

STUDY 2

Beyond basic psychological needs: The hope construct during adjuvant treatment in colorectal cancer patients

Note: This study was published

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ABSTRACT

This study explored BPN experiences, motivation to continue living, and psychological well-being in CRC patients during halfway of their adjuvant chemotherapy treatment. Qualitative data from 30 participants (ten CRC patients, ten relatives and ten healthcare professionals) were collected by performing two sets of semi-structured interviews. Three categories were identified: (a) BPN frustration, (b) hope as a source of motivation, and (c) sources of hope. This last category included several subcategories: positive attitude, religious faith, positive medical feedback, knowing that they were going to receive a short-term chemotherapy, and being aware that other patients were in a worse condition. CRC patients felt their BPN were thwarted during adjuvant treatment. However, hopeful thoughts were reported as relevant sources of motivation to live, which positively impacted on patients' psychological well-being. Future research could explore the construct of hope as a hypothetical moderator between BPN and CRC patients' well-being during treatment.

Keywords: disease, qualitative, chemotherapy, motivation, well-being.

INTRODUCTION

SDT (Ryan & Deci, 2017) is a broad theory of personality and motivation composed of six mini-theories, joined to provide a comprehensive map of human behavior and functioning. The fourth mini-theory, the BPNT, highlights the role of three BPN (autonomy, competence, and relatedness) to support people's health and well-being outcomes. Moreover, BPNT outlines the manner in which social environments can satisfy or thwart these needs (Legault, 2017; Ryan & Deci, 2017). Autonomy satisfaction refers to the individuals' perception that they are the origin of their own actions and participate in self-directed decision-making without external pressures, whereas autonomy frustration involves feeling controlled through externally established elements or self-imposed compulsion (DeCharms, 1968; Deci & Ryan, 1985). Competence satisfaction refers to feelings of efficacy, that one's actions are useful to attain desired goals, whereas competence frustration involves perceptions of unsuccessful behaviors and low self-efficacy (Bartholomew et al., 2011). Relatedness satisfaction reflects feeling integrated and accepted by others maintaining close and intimate social relationships. Conversely, relatedness frustration involves the experience of social exclusion and solitude (Chen et al., 2015). Overall, satisfaction of these BPN leads to experiencing well-being outcomes (e.g., life satisfaction, vitality, meaning in life, positive affect) whereas BPN frustration leads to experiencing ill-being outcomes (e.g., depressive symptoms, anxiety, burnout, negative affect) (Ryan & Deci, 2017).

In health contexts, research based on SDT have mainly examined the relations between need satisfaction and well-being outcomes. As proposed in the SDT model of health behavior change (Ryan et al., 2008), satisfaction of BPN improves mental health (e.g., lower depression, anxiety, and higher quality of life) and the adherence to health-related behaviors (e.g., tobacco abstinence, PA, healthier diet, medication use). However, few studies have explored BPN frustration related to ill-being in clinical settings. In this line, for example, research has shown that BPN frustration was associated with lower quality of life in patients with HIV (Majeed et al., 2017), and that people with morbid obesity had their BPN thwarted, suffering impaired optimal functioning and well-being (Megías et al., 2018). Another study with patients presenting severe chronic fatigue showed that BPN frustration predicted higher symptoms of stress and the associated maladaptive pattern of fatigue and poor sleep (Campbell et al., 2017). Therefore, it seems interesting to determine the factors related to need frustration in people with diseases, with the aim of alleviating negative psychological symptoms and improving their quality of life.

Nevertheless, cancer patients have received little attention from a BPNT perspective. Some of the studies focused on PA (Milne et al., 2008) and healthcare domains in breast cancer patients (Hull et al., 2016), in order to understand the relationship between BPN satisfaction and positive well-being outcomes, rather than the negative consequences of suffering frustration of autonomy, competence, and relatedness. We should take into consideration that cancer treatment is associated with side effects such as fatigue, reduced quality of life, or psychosocial disorders, among others (Kroker et al., 2019; Shapiro & Recht, 2001), which could be linked to BPN frustration. With the aim of improving patients' wellness throughout cancer treatment, other theoretical frameworks have been applied to understand coping responses associated with better disease adjustment. For example, the hope theory (Snyder, 1989) has been commonly applied to cancer patients undergoing adjuvant treatment (Irving et al., 1998; Song et al., 2000; Vellone et al., 2006). Previous research showed that breast cancer patients with higher hopeful thinking (thoughts of the positive expectation of achieving one's goal, such as overcoming the disease) adapted better to the disease and had improved health status and quality of life (Irving et al., 1998; Taylor, 2000).

The main and novel aim of this study was to examine BPN experiences in CRC patients during adjuvant chemotherapy treatment, and their associations with their motivation to continue living and coping with CRC, and their perceived psychological well-being. The viewpoints of patients, relatives, and healthcare professionals were included to provide a holistic view of the subjective experiences, attitudes, perceptions, and beliefs that patients have at this stage of their lives. The present research was consequently grounded in a qualitative design to collect in-depth information about the participants, and it led to the emergence of novel insights concerning the important role of hope to maintain motivation to cope with CRC in spite of BPN frustration. In this sense, this study extends the current literature on SDT (Ryan & Deci, 2017), and hope theory (Snyder, 1989), and offers insights which could be used by health professionals to support CRC patients' motivation and well-being during chemotherapy.

METHODS

Participants

Ten CRC patients, ten relatives, and ten healthcare professionals ($n = 30$) participated in this study. Patients were purposefully recruited between December 2017 and September 2018 from an oncology unit located in a public Spanish Hospital [University Hospital of Vinalopó, Elche]. Patients were five woman and five men, aged between 35 and 75 years old ($M_{\text{age}} = 58.8$, $SD = 12.47$). They were diagnosed with colon ($n = 6$) or rectal ($n = 4$) adenocarcinoma, at Stages II and III, and were treated with adjuvant chemotherapy (Capecitabine, CAPOX, or FOLFOX) for 3 or 6 months, between 4 and 7 weeks after surgery. To be interviewed, included CRC patients had to be more than 18 years of age, be diagnosed with CRC at Stage II-III, be treated with chemotherapy preceded by curative surgery for colon or rectal cancer, and to be in the middle of chemotherapy treatment.

Relatives were those family members who cohabited with patients and were the main caregivers of each patient throughout the treatment. They included five husbands, two wives, one sister, and two patients' daughter (23-75 years, $M_{\text{age}} = 50.90$, $SD = 17.14$). Finally, healthcare professionals comprised the whole oncologist team that treated these CRC patients. The team consisted of one psycho-oncologist, four oncologists, and five nurses (four men and six women), aged between 35 and 55 years ($M_{\text{age}} = 40.80$, $SD = 7.70$). The psycho-oncologist had an initial meeting with the patients of 1 hour, and a meeting of 40 minutes per month until recovery. The oncologists attended the patients in consultations of 15-20 minutes every 2-3 weeks during treatment. The nurses were with the patients during an extraction for an initial blood analysis and approximately 1 hour during the 4-hour chemotherapy sessions (6-12 sessions along 3-6 months).

Procedure

Several meetings were held between the research group and the healthcare professionals of the oncologist team to explain the purpose of the study and to establish collaborative bridges between the two groups. Once the healthcare professionals had agreed to participate, the oncologists were responsible for recruiting patients during their usual medical consultations and encouraging them to participate in the present study. The patients who showed interest (100% of the patients) were subsequently contacted by phone by the first author of this study (MR), to set an individual meeting to conduct a semi-structured face-to-face interview. The participants' interviews were performed to identify and explore their BPN experiences (autonomy, competence, and relatedness), motivation to continue living, and well-being during adjuvant chemotherapy treatment. This data collection technique was chosen because it allows collecting open-ended data, and delving deeply into participants' thoughts, feelings, and beliefs which are sometimes associated with sensitive issues (DeJonckheere & Vaughn, 2019). According to the advice and recommendations given by the healthcare professionals, patients were interviewed when they had received half of the adjuvant chemotherapy cycles. This stage was considered as ‘ideal’ because at the beginning of the treatment, patients are in a difficult psychological stage due to their new condition, whereas at the end, they are more affected by the side effects of the chemotherapy (e.g., toxicity). MR also conducted semi-structured interviews with the healthcare professionals and the patients’ relatives, to know their opinions about the patients’ BPN experiences, motivation to continue living, and well-being during chemotherapy treatment. All the relatives who were requested also agreed to be interviewed. When analyzing this first set of interviews to patients, relatives, and healthcare professionals, the concept of ‘hope’ and its sources emerged inductively (see Data Analysis). Therefore, a second set of interviews was carried out, just with patients, to know in depth the subjective meaning of the hope construct for them, their’ sources of hope, and the influence of hope in their psychological health during the treatment. All participants were given the choice of being interviewed in whatever quiet place they preferred (e.g., research center at the university, patients or relatives’ home, hospital rooms). Questions for patients, relatives, and healthcare professionals were developed by MR in consultation with DG, VB and AJ (initials of the other members of the research team), who had expertise in qualitative research and health promotion. The final script of the questions was sent to the oncologist team, who supported its structure and content (see the script of questions in Table 6). This research was approved by the Ethical Research Boards both of University Hospital of Vinalopó and Miguel Hernández University of Elche. All participants were informed about the aim and procedures of the study before the interviews and provided written consent. We tried to avoid very technical psychological terms and, therefore, patients were told that the general objective of this study was to examine patients’ experiences, motivation to continue living and coping with CRC, and well-being during chemotherapy treatment. The participants’ anonymity and confidentiality were guaranteed using coded identification numbers.

Table 6. Script of Questions for the Semi-Structured Interviews

a) Questions about BPN experiences during adjuvant treatment

Patients, relatives, and healthcare professionals*

- Do you feel competent in your daily life activities?
- Do you feel autonomous (with freedom to decide and to perform daily activities by yourself)?
- Do you feel that your social relationships are improved or worsened? How does cancer affect your social life?
- In general, how do you feel during treatment?
- Despite the side effects of the treatment and the discomfort previously reported, what motivates you to continue living?

b) Questions about hope during adjuvant treatment

Patients

- What expectations do you have regarding the disease?
- What goal do you want to achieve?
- Do you think you have the means or solutions for your goal / to fight the disease?
- What means / solutions / do you use to reach the goal / fight the disease?
- Do you feel capable of finding a solution to combat the disease? Do you think you have the energy and motivation to achieve it? What does ‘hope’ mean to you?
- What things give you hope and what things take it away from you?
- What gives you strength and energy and what takes your strength and energy away?
- How do you think the evolution of hope has been throughout the treatment?
- Do you think that having hope makes you feel better, that is, that you feel more comfortable about the disease?

*Although questions are addressed to patients in the first section of the table, these were adapted to ask the same information to relatives and healthcare professionals.

Data analysis

All semi-structured interviews were audio-recorded and transcribed verbatim by the interviewer with a word processor. Transcriptions were analyzed using NVivo software, which was used to organize and store the data efficiently (Bazeley & Jackson, 2013). The qualitative data were analyzed following strategies of both ‘directed’ (deductive) and ‘conventional’ (inductive) content analysis (Hsieh & Shannon, 2005). As the study employed a BPNT perspective, the analysis started with a deductive phase to detect any type of information related to the purpose of the study. Concretely, all the transcriptions were read several times in detail to become familiar with the data. After that, the text fragments which represented key concepts about BPN experiences, motivation to continue living, and perceived psychological well-being of CRC patients were identified and coded. Then, beyond BPNT, in an inductive phase of the analysis, the research team identified several experiences, thoughts, and reflections reported by patients and relatives which had to do with the concept of 'hope' and 'hope sources', as a means to be motivated to cope with CRC in spite of BPN frustration. Therefore, a second set of interviews was performed to inductively explore the meaning of hopeful thinking for these patients and their sources of hope at that time. This round of interviews was also used to cross-examine and deepen issues related to the first set of interviews, to avoid gaps in the data.

Finally, all the information, which had previously been coded (deductively or inductively), was classified in three main categories; 'BPN frustration', 'hope as a source of motivation', and 'sources of hope'. This last category included several subcategories: 'positive attitude', 'religious faith', 'receiving positive feedback from physicians', 'knowing the short-term of chemotherapy treatment', and 'comparison with other patients in a worse condition'.

The process of data analysis, which was led by MR, was supervised by the other members of the research group (DG, VB and AJ), who played the role of 'critical friends' (Smith & McGannon, 2018). Concretely, in a series of three meetings, MR presented the data analysis using diagrams, described the codes included in the different categories, and responded to the questions and suggestions of the critical friends. The critical friends helped their colleague to refine the names and contents of the obtained codes and categories, in order to achieve a more coherent map of interrelated categories and subcategories. The final map of categories and subcategories sustained the headlines and structure of results presented in the following section. The critical friends also collaborated to improve the write-up of the analysis and the entire article. The inclusion of other researchers during the data analysis process improved the quality of interpretations and favoured a more rigorous data analysis (Smith & McGannon, 2018).

RESULTS

This section describes the BPN frustration experiences in CRC patients during the process of adjuvant chemotherapy treatment. Data concerning motivation to continue living related to the hope construct, and several hope sources which allowed patients to cope more adequately with the treatment, are also presented.

BPN frustration

According to many informants, overall, chemotherapy caused a change in the patients' daily lifestyle. This condition led patients to abandon several social plans, resulting in the frustration of their need for relatedness. Patients reported feeling less connectedness with their friends for not being able to participate in the same activities as them:

> 'During the treatment, I do not go out with friends because they usually go to some places where I can't go… they drink some beers until late into the night and I can't keep up with them... Only hello and goodbye, I have lost my group of friends …On Saturdays we used to go to see football together, on Tuesdays to the bar to play cards, and now I can't…' (01, patient).

This issue was also reported by the patient's wife, who said, 'He no longer goes with friends, I tell him to go to the park, where he has friends who are retired, but he no longer feels like going. He says that he is muddled…now he has completely distanced himself from his social life…from his friends' (09, relative). This situation also thwarted needs for autonomy and competence, as these negative effects of chemotherapy were not chosen and also patients did not feel able to maintain their social relationships.

The general negative effect of treatment on patients’ social life was related to several side effects that thwarted their BPN, such as fatigue, stoma (an artificial opening on the side of the abdomen for the evacuation of feces as a result of an operation), sexual problems, and neurotoxicity. In this vein, fatigue was reported by patients as a condition that negatively affected their well-being. They expressed notable feelings of ‘uselessness’ and ‘dependency’ in daily activities, which would reflect competence and autonomy frustration:

> ‘I spend all day at home because I can’t do anything, and I’m not in the mood. Even my sister has to shower and dress me… I feel very tired, even when she washes my hair… I have to sit down so that my sister can shower me. I don’t have any strength and I feel more dependent on everyone for everything… I feel useless because I can’t do anything. To get up, to go to the toilet, to sit down, they have to help me with everything... I can’t go up the stairs of my house, I have to stop… my sister comes up, crying when she sees my face… I don’t want to leave home because I can go down the stairs, but going up the stairs is impossible’ (05, patient).

Furthermore, fatigue led patients to stay at home and prevented them from participating in group activities, leading to relatedness frustration. For example, a patient said ‘I used to have more relationships, but now I don’t feel like it anymore… because the chemotherapy exhausts me, and I don’t feel like interacting’ (01, patient).

As reported by several healthcare professionals, the stoma pouch that some patients carried also affected relatedness negatively. Patients did not entirely enjoy social events because of stoma management:

> ‘Many patients with a stoma pouch feel ashamed to go out and they participate

> less in group activities because the stoma makes noise, and patients feel embarrassed, because gas comes out and they can’t control either the sound or the smell’ (04, nurse).

Accordingly, patients informed that stoma characteristics restricted them from performing some activities such as eating certain foods and bathing in the pool. This would also frustrate their need for autonomy, as the stoma restricted some activities and foods, compromising their active engagement in the decision-making process. Competence need was also frustrated, as it was very difficult to experience success in life with so many things that patients could not do:

> ‘Two days ago, I tried to eat mandarin oranges and the stoma pouch was swollen and I had to discard the stoma pouch every hour because of the gases it contains… the same happens with artichokes, broccoli, cauliflower… I have to replace the stoma pouch every hour and it limits being able to go anywhere’ (01, patient).
>
> ‘The stoma is awful, and it makes me feel ashamed when I go out on the street. Before leaving home, I think it over carefully. Also, when I go to my country house, I can’t take a bath in the swimming pool, then I leave because it is not comfortable to see people bathing when I can’t’ (04, patient).

Additionally, patients reported sexual problems due to chemotherapy side effects and surgery. Patients experienced pain, lack of desire, and inefficiency, which negatively affected their autonomy, competence, and relatedness. Patient 10 said, ‘I have stopped having sexual relations because I don’t feel like having them. I notice less lubrication, and the scar hurts me when I am penetrated, and I have stopped until I finish the treatment... also the libido decreases because you no longer have your period’.

Another collateral damage of chemotherapy was neurotoxicity, which was manifested with trembling when patients touched cold objects, and tingling feet. Patients expressed their awkwardness when they tried to pick up something with their fingers, experiencing both autonomy and competence need frustration related to kitchen tasks:

> ‘I start doing something and I can’t. I get a trembling in my fingers when I touch the fridge, things fall out of my hands, it is due to the treatment... I feel more dependent on everyone for everything and useless because I can’t do anything…’ (05, patient).
>
> ‘The most affected part are the hands…I can’t take things out of the fridge. Then my husband must do it. I feel more dependent. If he is not at home, I take things out of the fridge but wearing thick gloves. Even at lunchtime, I feel an uncomfortable coldness when I pick up the cutlery’ (07, patient).

Hope as a source of motivation

Most patients mentioned the construct of hope when they were asked about the origin of their motivation to continue living and coping with CRC. They reported that the hope of overcoming CRC, of recovering their previous lives, and continuing to enjoy their family motivated them throughout the chemotherapy treatment, despite their frustrated BPN:

> ‘For me, hope is to think that I have a lot to live for; now I think day to day… Cancer makes you realize that life is too short and that you have to enjoy it… For me, hope is to live a long time and for nothing bad to happen to you’ (09, patient).
>
> ‘The hope that I will overcome cancer. If you lose hope, you will no longer have energy to get out of bed. Hope of overcoming cancer motivates me every day’ (01, patient).
>
> ‘I have never lost hope. My hope is to recover my life, and to see my grandchildren grow up, so I fight every day. What gives me strength and energy is the idea of getting well and returning to my normal life. My life has been perfect, and I hope to recover my health and to have time to enjoy my

> life again, because I love my family very much. Nothing will take away my hope, I am convinced that this will be overcome' (06, patient).

The identification of overcoming CRC to recover normal life and continue enjoying the positive aspects of live (e.g., family love), as the goal of patients' hope, was also reflected by relative 03: 'My father is motivated to live and to see his grandchildren, to see them grow up and to enjoy them. My daughter was born when his illness began and that encouraged him a lot'.

Sources of hope

The following section provides participants' comments about some aspects that fostered and nurtured their hope of overcoming cancer (desired goal) and motivated them to cope better with the disease during adjuvant treatment.

Positive attitude

Patients reported that a positive attitude toward CRC motivated them and increased their hope of recovering in the future:

> 'I have always thought positively that I'm going to overcome cancer, and these thoughts motivate me to feel better every day' (03, patient).
>
> 'What I most try to do is to laugh and to have a positive attitude, in order to face the disease and feel hope of recovering. Attitude is very important for me' (02, patient).

This fact was also expressed by some relatives, 'He [patient] is very positive, and I think that it has helped him a lot to face the disease' (07, relative).

Religious faith

Faith in God was another issue that increased some patients' hope. Beliefs about the existence of a higher being, along with prayer, raised their hope of overcoming the disease.

> 'I don't go to Mass, but I have faith in the Virgin and in God. I believe in those who are beyond us and that they will help me… my wife has made a

> promise to Christ, and we pray although I do not like going to church. Believing in God, like everyone, gives me hope to overcome the disease' (04, patient).
>
> 'Religious faith has helped me a lot. I have taken the cord of Jesus Christ (a religious necklace) that I had in the brotherhood. As I could not go up to dress Him [the statue of Jesus Christ], I have taken that, and every day I thank him for being alive' (03, patient).

Receiving positive feedback from physicians

Many patients stated that physicians' positive comments about the amelioration of the disease were a source of hope. For instance, patient 04 said: 'The fact that doctors tell you that everything is fine gives you hope'. Also, patient 02 said: 'I think about getting ahead and I like the doctors to tell me that everything is going well; that gives me great joy'.

Additionally, physicians mentioned to patients that, with the evolution of medicine, carrying a stoma nowadays does not imply a worse prognosis. This message also promoted patients' hope: 'If the doctor tells me that there is a lot of life expectancy even if I wear this (the stoma pouch), that encourages me a lot, and I believe there is more hope. This is not like before, when, if you were operated, you were going to die soon' (04, patient).

Knowing the short-term of chemotherapy treatment

Being aware that they were going to receive a short-term chemotherapy treatment also heightened the beliefs about life expectancy and, therefore, patients' hope and motivation to continue living and coping with CRC: 'The worst is now, during the treatment, it's a terrible time but I know it's temporary and it will end... For me, the fact that it's a short time gives me the strength to fight every day... You know it's temporary and that it’s going to end and that motivates you’ (08, patient).

A relative supported this idea and stated that longer duration of treatment would make patients despair: ‘The fact that there is very little time until finishing the treatment gives him hope of overcoming cancer and encourages him to think that it’s something temporary that will end and a door will be closed forever …I think that if doctors told you that treatment lasts two years, it would be more overwhelming; six months is like it isn’t so serious’ (07, relative).

Comparison with other patients in a worse condition

Some patients found the hope of recovering through the perception that other patients were undergoing harder conditions: ‘Seeing other people who are worse off than me encourages me because I am better off and then I think I am going to recover’ (02, patient). This was also stated by some relatives: ‘Another thing that gives him hope is to see that there are other people worse off than him. I think that seeing people that are worse off makes him feel that he should be happier, because other people are going to die’ (09, relative).

DISCUSSION

To our knowledge, this is the first study that has attempted to explore the psychological experiences of CRC patients in treatment from a BPNT perspective. Theoretical frameworks are needed to delineate the constructs involved in the psychological processes associated with the (non)adherence to health behaviors, in order to develop effective intervention strategies (Biddle et al., 2012). However, there is a lack of studies about motivational processes that lead to maladaptive behaviors and diverse detrimental outcomes that affect general ill-being in people diagnosed with cancer. The purpose of our study was to explore the BPN experiences in CRC patients undergoing adjuvant chemotherapy treatment, and their relationship with their motivation to continue living and coping with CRC, and their perceived psychological well-being.

We found that patients' thwarted BPN was due to several factors associated with the treatment, such as the chemotherapy process itself, fatigue, wearing a stoma pouch, sexual problems, and neurotoxicity. As other authors mentioned (Clifford et al., 2018; Fallon, 2013; Vrieling & Kampman, 2010), cancer treatment implies several side effects that negatively impact on patients' functioning. Our study provides insights about autonomy, competence, and relatedness frustration in CRC patients as a consequence of these adverse effects. Receiving chemotherapy regularly led patients to feel autonomy frustration because they could not avoid its negatives impact and carry on with their normal life. They reported not being able to perform the same social plans, also feeling less connected to their environment, which thwarted their need for competence and relatedness. Moreover, we found that the fatigue and neurotoxicity associated with chemotherapy thwarted the need for autonomy, competence, and relatedness in many CRC patients.

In this regard, a study with morbid obese patients (Megías et al., 2018) found that personal limitations and health problems associated with the disease thwarted their BPN. Similar results were found in a study with breast cancer patients, who reported difficulties participating in social events and feelings of family dependence and inefficacy in activities such as taking a shower, climbing the stairs, or kitchen tasks (Curt et al., 2000).

Additionally, our research revealed that wearing a stoma pouch entailed living with clinical features (i.e., bowel changes, uncontrolled gases), which prevented patients from eating certain foods or participating in social activities. As other authors have pointed out (Vonk-Klaassen et al., 2016), this situation hindered their adequate interaction with the close environment, and negatively affected their quality of life. We also observed that sexual problems associated with the lack of lubrication and libido (produced by chemotherapy) and with pain due to the surgery scar thwarted BPN. These sexual problems have been described in the literature about CRC patients (Hendren et al., 2005; Vonk-Klaassen et al., 2016).

According to BPNT, BPN frustration leads to controlled motivation and maladaptive psychological outcomes, mainly depression and anxiety (Pitman et al., 2018). As previous research claimed (Ng et al., 2015; Tang et al., 2017), cancer patients who presented symptoms of depression and anxiety also perceived low global wellness and physical, role, cognitive, emotional, and social functioning over time. Despite our information about BPN frustration in CRC patients undergoing adjuvant treatment, most patients unexpectedly expressed feelings of positive motivation to continue living, attributing them to the concept of hope. Hope can be defined as a confident but uncertain expectation of attaining a good future, based on setting realistic and meaningful goals for the person (Dufault & Martocchio, 1985). Hope is a significant motivating and coping factor in the face of adversity (Sanatani et al., 2008). In clinical settings, hope was identified as an essential feature for enhancing coping mechanisms in patients diagnosed with severe illness such as cancer (Chi, 2007). Other authors have also observed that hope was linked to goal setting, positive personal attributes, future redefinition, meaning in life, peace, and energy (Owen, 1989).

Few constructs have been more frequently linked to health and well-being as hope (Scioli et al., 2016). Consequently, previous researchers have identified the positive effects associated with the hope construct in cancer patients, such as less anxiety, pain, and depression, and higher well-being, psychological adjustment, meaning in life, perceived health status, and healthier habits acquired (Benzein & Berg, 2005; Taylor, 2000; Vellone et al., 2006). Moreover, oncologists declared in a survey that hope is the single most important psychological factor impacting on mortality (Cousins, 1989).

Our study upholds the powerful role of hope as a source of motivation in CRC patients during adjuvant treatment. This finding is in accordance with previous qualitative research in palliative patients (Nierop-van Baalen et al., 2016), revealing that hope can give patients energy to fight the disease, continue living, recover their previous life, and see their grandchildren grow up. Therefore, the novelty of these results lies in discussing the role that hope plays from a SDT perspective, in order to enhance the integral psychological well-being throughout the cancer. From our point of view, hope could reinforce autonomy, competence, and relatedness when they are hard to satisfy because of the harmful consequences of cancer treatment. In this regard, one study tested the reciprocal longitudinal interactions between the components of the hope theory and BPN satisfaction in the work environment (Wandeler & Bundick, 2011). The authors concluded that trainees' hope development can benefit from perceived professional competence, which in turn also positively influences future perceived levels of competence. Further research on the hope construct within the SDT framework is required, to comprehend its moderating role between BPN, motivation, and CRC patients' well-being during adjuvant treatment. Hope may act as a moderator between BPN frustration and well-being, so that if hope is high, the negative impact of BPN frustration on motivation and different outcomes may be attenuated.

Additionally, this study also revealed several sources of hope that gave CRC patients the motivation to continue living and facing adjuvant treatment. We found that hope was fostered by a positive attitude, religious faith, positive medical feedback, a short-term chemotherapy treatment, and comparison with other patients in a worse condition. These results are in line with previous studies (Nierop-van Baalen et al., 2016; Sanatani et al., 2008) and a review about the role of hope in cancer settings (Chi, 2007), which pointed out that the most common strategies to increase hope were religion and prayer, living the present, relationships and talking with others, achieving control of their situation and symptoms, positive thinking, and uplifting memories.

This study presents some limitations. On the one hand, CRC patients were interviewed when they were undergoing chemotherapy, an aspect which hindered the collection of a larger number of patients. However, the information obtained provides a significant contribution to our comprehension of the factors that thwart BPN during adjuvant chemotherapy treatment and, very importantly, we inductively identified the role of hope as a key construct to take into account from a SDT perspective in this population. Moreover, the participants were interviewed two times and their relatives and healthcare professionals were also interviewed, aspects which reinforced the method of this qualitative study. On the other hand, the interviews were performed in the middle of the CRC patients' treatment, so the findings cannot be generalized to other cancer populations and stages on the cancer continuum. Nevertheless, this qualitative study offered in-depth and rich data about the subjective perspectives of the patients' experiences during a very delicate and important phase of their lives, which is underexplored due to the difficult access to participants with this profile. Future longitudinal studies could collect more detailed information about the changes in BPN frustration, as the treatment involves many physical and psychological changes over time. Additionally, quantitative studies are needed in order to explore the construct of hope as a hypothetical moderator between BPN and CRC patients' well-being during adjuvant treatment.

In summary, this study showed that CRC patients at Stages II and III have frustrated BPN during the treatment, although the hope to go on living motivates them throughout the process. Intervention programs aimed at improving patient's well-being should consider the factors that thwart their BPN and reinforce hope sources. In this regard, health professionals should promote patients' positive attitude and show a realistic/evidence-based, but caring and supportive, communication style. They should be very respectful of patients' religious faith and help patients (believers or non-believers) to face the disease and find psychological well-being during treatment. The establishment of clear and short-term health goals may also be desirable, so that patients do not feel overwhelmed and confused during CRC treatment. Finally, although comparisons with other concrete patients would be ethically problematic, it seems appropriate that patients with a good prognosis should be made aware of the fact that there are more complicated cases. This idea could help patients to analyze their problem with perspective, and promote their acceptance, gratitude, positive attitude, and hope.

STUDY 3

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

Note. This study is currently under review.

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ABSTRACT

Purpose*:* To explore the effects of a SDT-based 6-month exercise program (FIT-CANCER) on BPN satisfaction and different positive psychological and behavioural consequences in CRC patients (stage II-III) during adjuvant chemotherapy.

Method: Qualitative data from 16 patients (nine men and seven women; M_{age} = 64, *SD* = 11.58), six relatives (M_{age} = 55, *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: The exercise program satisfied CRC patients' needs for autonomy, competence, relatedness and novelty, giving rise to positive psychological and behavioural consequences during chemotherapy treatment. The program allowed patients to feel that they were actively doing something important to overcome their cancer, an aspect that fostered their psychological well-being. Patients also 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. Patients' perceived benefits were mainly due to the instructor's knowledge, specialization and empathy, and their belonging to a group of patients undergoing a similar situation.

Conclusion: Motivational exercise programs should be implemented with CRC patients during chemotherapy treatment.

Keywords: exercise, chemotherapy, CRC, motivation, quality of life.

INTRODUCTION

CRC is the third most prevalent cancer and the fourth most common cause of cancer-related death worldwide (Bray et al., 2018). After diagnosis, patients diagnosed 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 (GBD Colorectal Cancer Collaborators, 2017). However, such exhaustive toxic regimens are followed by short- and long-term complications. Fatigue, peripheral neuropathy, allergic or hypersensitivity reactions and diarrhoea are some of the most common side effects, which have an important negative impact on patients' quality of life (Tofthagen et al., 2013). According to recent guidelines (Bull et al., 2020), meeting 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 in CRC patients (Campbell et al., 2019). However, a small percentage of patients comply with PA recommendations (Blanchard et al., 2008; Courneya et al., 2008; Maxwell-Smith et al., 2017; Schmitz et al., 2010; Smith et al., 2017), and most of them decrease their PA levels during chemotherapy (Vallance & Courneya, 2012). Given these circumstances, the development of educational PA 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 (Vallance & Courneya, 2012).

In this regard, SDT (Ryan & Deci, 2017) 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 (Ntoumanis et al., 2021; Sheeran et al., 2020). The founders of SDT established the existence of three BPN (autonomy, competence and relatedness) that humans need to satisfy for their psychological growth, well-being, integrity and optimal functioning (Deci & Ryan, 2000). Particularly, SDT describes the process through which social agents (e.g., relatives, oncologist, instructor, etc.) can satisfy or thwart these needs (Hagger et al., 2020; Ryan & Deci, 2017). 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. (2016) proposed the need for novelty as another candidate BPN, as it seems to meet the criteria to be considered within the current theory (González-Cutre, Romero-Elías et al., 2020; Vansteenkiste et al., 2020). 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 (González-Cutre et al., 2019; Ntoumanis et al., 2021).

However, few studies have applied SDT to understand exercise motivation in cancer patients (Fin et al., 2021; Kim et al., 2021; Milne et al., 2008; Peddle et al., 2008; Petrella et al., 2021; Wilson et al., 2006). 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 (Kim et al., 2021; Peddle et al., 2008) were carried out with CRC patients.

Moreover, only one previous experimental study applying an SDT-based exercise program during chemotherapy was found (Mazzoni et al., 2019). Mazzoni et al. (2019) developed the Physical Training and Cancer (Phys-Can) intervention with breast, prostate and CRC patients. The qualitative analysis of patients' interviews showed that the application of behaviour change techniques during this program promoted patients' BPN satisfaction and intrinsic motivation. Nevertheless, the psychological and behavioural outcomes derived from BPN satisfaction and motivational improvements were not studied. Considering these gaps in the literature, this qualitative study aimed to explore the effects of a 6-month exercise program grounded on SDT (FIT-CANCER) on BPN satisfaction and different positive psychological and behavioural consequences in CRC patients under chemotherapy. As a remarkable novelty, the present study analyses the perspective of patients, relatives and healthcare professionals to provide a holistic understanding of the phenomenon under study.

METHODS

Participants

This study is part of a broader research project that used a quasi-experimental design with a pseudo-random assignment. The first patients diagnosed were assigned to the experimental group to foster relatedness during exercise (based on SDT principles) and, when this group was completed, we began to recruit patients for the control group. 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 Spanish Hospital [Puerta de Hierro-Majadahonda University Hospital, Madrid]. 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, and having signed the written consent. Exclusion criteria were metastatic or incurable CRC and limiting physical/psychiatric symptoms detected by the oncology medical team. Nine patients decided not to participate due to schedule incompatibility, distance from the centre (when the exercise program was face-to-face), for not wanting to belong to a cancer patients' group, and other unknown reasons. Finally, a total of 16 CRC patients participated in the study (nine men and seven women: M_{age} = 64, *SD* = 11.58). Patients' characteristics are shown in Table 7. The sample also included six relatives (M_{age} = 55, *SD* = 15.09): one man (patient's husband) and five women (three patients' wives and two daughters). The relatives were the main caregiver and the person who used to accompany the patients to the hospital. Finally, the whole oncology team at the hospital (M_{age} = 40.40, *SD* = 9.66) participated in the study, including three oncologists (two women and one man) and two nurses (both were women).

Table 7. 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

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 in this first appointment with the patient. 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 Table 8. The interviews lasted between 90 and 120 minutes, 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 Miguel Hernández University of Elche. All participants were informed about the research procedures and provided their written consent. The Critical Appraisal Skills Programme (2018) checklist for qualitative studies was used to assess the quality of this research. The study fulfilled the ten items included in the appraisal tool.

Table 8. Interview Questions

BPN Satisfaction

Autonomy

- Do you believe you were able to choose activities that matched your preferences?
- Do you think the program was adjusted to your interests and what you like?
- What aspects could you choose? Did you feel you would have liked to choose more things or be able to comment on how the program should have been?

Competence

- Could you perform the exercises successfully?
- Did you encounter any difficulties to carry out the exercise program?
- Do you think CRC patients can carry out a program of these characteristics during chemotherapy treatment?
- Did you ever feel incompetent?

Relatedness

- Do you think the exercise program helped you to feel related to the rest of the patients? Or did you miss more social relationships?
- What did exercising with other people in the same situation mean for you?
- How was your relationship with the rest of the group?
- How was the relationship with the exercise instructor?
- What did the exercise instructor mean in your life during the cancer process?
- Did you feel good about the group?

Novelty

- Do you think the exercise program was something new and positive for you?
- Did the exercise program ever seem boring and monotonous?
- What new things did you do in the exercise program? Did you discover/learn anything?

Psychological consequences

- How did you feel during the exercise program?
- What effect do you think the exercise program has had on your health and well-being?
- What were the most positive/negative aspects of the exercise program for your physical, psychological and social condition?
- Did the exercise program help you in your daily-life activities?
- Did the exercise program help you to cope with the disease with more optimism?
- Did you feel fear or worry during your participation in the exercise program?
  Do you think the exercise program could serve to better deal with those fears?

PA participation

- How was your commitment to the exercise program?
- What things facilitated and hindered your participation in the exercise program?
- What aspects of the program would you change? (e.g., number of sessions, type, intensity, place, aspects of the instructor...)
- What key aspects should be taken into account in exercise programs for cancer patients?
- Did you have any physical problems, perception of low physical condition, fear of hurting yourself, boredom, etc. that influenced your level of participation in the exercise program?
- Were there any social factors that influenced your level of participation in the exercise program (instructor, family support/no support, support/no support from healthcare professionals, etc.)?
- Was there any physical-environmental factor that influenced your level of participation in the program (distance to the fitness centre or adverse weather in face-to-face mode, internet connection problems in online mode, etc.)?
- Did the initial reasons for exercising in the FIT-CANCER program change throughout the program?
- Do you think you have the knowledge/resources needed to exercise autonomously after the FIT-CANCER program?
- Are you going to continue exercising after the program?

Note. Questions are addressed to patients but were adapted to ask the same questions to relatives and healthcare professionals.

PA 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 online using the Meet app. 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 minutes) per week, began at the start of patients' treatment and lasted 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 (Borg, 1982) was used to instruct the participants 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 9 includes the motivational strategies that were implemented in the exercise program.

Table 8. Motivational Strategies Based on SDT and Implemented During the Exercise Program (FIT-CANCER)

Basic psychological need	**Motivational strategies**
AUTONOMY	- 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 PA 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	- 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	- 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	- 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 PA. - 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 PA carried out innovatively for them (e.g., to create individual and group challenges through the use of the pedometer). - To perform PA in new beautiful natural spaces (the frequency of this strategy was modified due to the COVID-19 restrictions).

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 (Bazeley & Jackson, 2013). The data were analysed following a thematic analysis (Braun & Clarke, 2006). 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' (Smith & McGannon, 2018)— 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 informed by 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 another publication, while this article was focused on the psychological and behavioural 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 10 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.

Table 9. Structure of Themes and Subthemes about the Effects of the SDT-based Exercise Program (FIT-CANCER) on CRC Patients

Themes	Subthemes
Motivational strategies and satisfaction of CRC patients' basic psychological needs	
AUTONOMY	Allowing to choose some aspects of the sessions Explaining the exercises' objectives Providing resources to promote internal locus of control
COMPETENCE	Adapting exercises to the participants' circumstances Specialized instructor who could promote safety and competence perception
RELATEDNESS	Belonging to a group of people in the same situation The instructor of the exercise program as an emphatic and empowering caregiver
NOVELTY	The exercise program as a novel initiative Use of technologies Novelty of PAs
Positive consequences	
PSYCHOLOGICAL	Enjoyment and satisfaction with the exercise program Enhanced self-esteem Better mood and optimism Improvement of vitality and well-being Increased sociability Keeping some good memories of chemotherapy time
BEHAVIOURAL	Increased PA levels during chemotherapy treatment High engagement with the exercise program Increased knowledge about PA to become an autonomous exerciser Integration of exercise into their lifestyle

RESULTS

According to the different participants, the exercise program satisfied CRC patients' BPN and gave rise to positive psychological and behavioural consequences in these patients (Table 10), as described in detail in the following sections.

1. Motivational strategies and satisfaction of CRC patients' BPN

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 reported additional motivation and autonomy satisfaction thanks to the explanation of the exercises'/sessions' purpose. In this way, they could understand 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 reported 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).

Competence satisfaction

Adapting exercises to the participants' 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 reduced the 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:

> Having an instructor who knew what he was doing gave me a lot of peace of mind because 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).

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 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 PA 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).

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 that 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 before, he knew nothing about that! 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 PAs. 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).

2. Positive consequences

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

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).

Enhanced self-esteem. The exercise program helped patients realise that, in spite of cancer, they could still do exercise and other life activities. This aspect clearly reinforced their self-esteem:

> He says that he feels good after exercise, he feels that he can still do exercises.... when you are diagnosed with cancer, you think that you are not going to be able to do anything. He has confirmed that he can continue being active and that has been a great surprise for him… (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 PA, 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 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 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, optimism and higher self-esteem 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).

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 benefitted them a lot because they were forced to be at home, but they have done PA (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 high exercise program attendance rate (*M* = 94%, *SD* = 0.04) and 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 PA to become an autonomous exerciser. The FIT-CANCER program also increased 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 objectives 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).

DISCUSSION

The purpose of this study was to qualitatively explore the effects of a supervised motivational exercise program (FIT-CANCER) on BPN satisfaction and different psychological and behavioural consequences in CRC patients during chemotherapy treatment. Previous intervention trials have shown that participation in a home-based exercise program has improved physical functioning, quality of life and mood, and it has reduced fatigue among CRC survivors (Courneya et al., 2003, Pinto et al., 2013; Kim et al., 2019). However, only two studies have focused exclusively on CRC patients undergoing chemotherapy (Hatlevoll et al., 2021; Van Vulpen et al., 2016), and only one study used the SDT framework to carry out an exercise intervention in cancer patients (breast, prostate and CRC) (Mazzoni et al., 2019). Considering the specificity of each type of cancer (Vallance & Courneya, 2012), the present study was the first SDT-based exercise intervention carried out only with CRC patients during chemotherapy.

According to SDT, motivational strategies like *allowing to choose some aspects of the sessions* and *explaining the exercises' objectives* led to CRC patients' autonomy need satisfaction (Ntoumanis et al., 2021; Teixeira et al., 2020). 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 (González-Cutre, Megías et al., 2020). 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 benefits 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 participants' 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 individualize the sessions using simple monitoring tools and adjusting the exercise sessions to each patient according to their moment of treatment and the chemotherapy cycles accumulation. Therefore, it is very important for these interventions to be carried out by exercise professionals specialized in this population, as previous studies suggested (Romero-Elías et al., 2020). The quality of the exercise professionals, supported and valued by the entire oncology team, is very important 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 other (breast) cancer patients during chemotherapy (Fin et al., 2021).

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 (Missel et al., 2019). 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, 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 (Berry et al., 2017). 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 PAs 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 positive outcomes in exercise interventions with clinical populations (González-Cutre et al., 2019; González-Cutre, Megías et al., 2020).

Ours results showed the importance of creating an environment that fosters need satisfaction to motivate patients to exercise during oncological treatment (Mazzoni et al., 2019) and to achieve positive effects. These benefits were classified as psychological and behavioural. The following positive psychological consequences were identified: *Enjoyment and satisfaction with the exercise program, enhanced self-esteem, 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) (Vallerand, 2007), improving patients' psychological health (Ntoumanis et al., 2021; Ryan & Deci, 2017). 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 psychological benefits. Moreover, the fact that patients could keep good memories of the period in which they underwent chemotherapy represents a clinically relevant result. The construction of positive narratives is part of the psychological work with patients (Yang et al., 2020). Perhaps, patients' participation in a group-based exercise program could increase their psychological tolerance of chemotherapy and their commitment to this necessary treatment to overcome CRC. Future research, from quantitative and qualitative methods, should shed more light on this topic.

Positive behavioural consequences related to the exercise program participation were also found in this study: *increased PA levels during chemotherapy treatment, high engagement with the exercise program, increased knowledge about PA to become an autonomous exerciser* and *integration of exercise into their lifestyle.* Despite all the difficulties and barriers associated with PA adherence in this population (Romero-Elías et al., 2020), our findings showed that educational and motivational exercise interventions based on SDT constructs could be effective to improve PA participation and, consequently, CRC patients' quality of life 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 (López-Sánchez et al., 2021). Therefore, as Newton et al. (2020) pointed out, exercise programs for cancer patients should not be interrupted by the COVID-19 pandemic, but especially promoted and implemented at this time. 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 PA 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 patients reported frustration of their BPN in their life during the treatment (Romero-Elías et al., 2021).

STRENGTHS AND LIMITATIONS

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Throughout the doctoral thesis, we have gathered a set of strengths and weakness issues from the various studies described above, which are displayed below. Concerning strengths:

1) We used qualitative methods to achieve research aims. This methodology allows obtaining participants' subjective perceptions and different realities, as well as a greater understanding of the contextual dimensions. We applied two main qualitative techniques for data collection, individual *semi-structured interviews* and direct observation (collecting field notes in a research diary) . The use of more than one technique to collect information is called *Triangulation,* one of the most common criteria of rigor applied within the qualitative research paradigm (Johnson et al., 2020). Data analysis was also done simultaneously while the process of data collection continued (Glasser & Strauss, 1967), leading to two sets of semi-structured interviews, using an inductive and a deductive approach. Throughout the studies included in this thesis, in-depth information related to sensitive and intimate information during a disease process was obtained, a challenge for current research.

2) According to Kendall et al. (2009), linked interviews conducted with patients and individuals close to them can generate a richer understanding of patients' needs and experiences than a sole perspective, most frequently used in qualitative research. We presented information collected from relatives and healthcare professionals, which was one of the most remarkable novelties of our research, allowing us to obtain a holistic view related to patients' processes during chemotherapy. Furthermore, involving people close to the patients to promote healthy life habits such as PA participation can generate a "team perception", improving patient-perceived support.

3) Another noteworthy aspect is the participants' characteristics. We focused exclusively on CRC patients undergoing adjuvant chemotherapy. Knowledge of specific tumor groups, as well as treatment stages, should be deepened because cognitive processes that contribute to predicting the intention to exercise could vary depending on the type of cancer. This implies that each case needs to be analyzed separately, and specific intervention programs should be developed (Vallance & Courneya, 2012). In Studies 1 and 2, patients were interviewed in the middle of the treatment. In Study 3, all the patients began the PA program after surgery, close to the beginning of chemotherapy and all of them finished their participation six months after that point. We considered this aspect a major strength, allowing us to maintain sample homogeneity, despite the challenge of recruiting patients with a similar chemotherapy cycle. Also, because of the COVID-19 pandemic, patient recruitment was very difficult, and patients were less accessible. For instance, they were not allowed to spend more time in the hospital than necessary for appointments related to cancer treatment.

4) Another noteworthy aspect is the application of *theoretical frameworks*, which allowed us to create a context to comprehend, explain and, ultimately intervene (Michie et al., 2014; Rothman, 2004). We include two main frameworks: SDT (Ryan & Deci, 2017) and the hope theory (Snyder, 1989). The former is frequently applied to support positive changes in health behaviors (Ntoumanis et al., 2021). The support of hope may serve as a buffer against depression when an individual considers their life as lacking meaning (Feldman & Snyder, 2005). A large amount of research has indicated that greater hope promoted positive changes in breast cancer patients (Casellas-Grau et al., 2014; Farhadi et al., 2014; Hedtke, 2014; Ho et al., 2012; Rustøen et al., 2011; Thornton et al., 2014), and a reduction of major cancer symptoms in lung cancer patients (depression, pain, fatigue, and cough) (Berendes et al., 2010). However, the literature concerning CRC

patients and, specifically, exercise-based interventions, is scarce. To date, Studies 2 and 3 were the first ones to combine these two theories in this research topic. This may be useful to gain insight into issues that only one theory cannot explore.

5) A further noteworthy aspect is that all the studies that make up this Ph.D. dissertation follow a logical research order. Firstly, the *systematic review* allows establishing a starting point to understand prior published information related to the research topic and, subsequently, elaborating the successive studies. From there on, Study 1 uses a *descriptive* design focused on specific difficulties perceived by CRC patients to perform PA during the chemotherapy phase, also considering the relatives' and healthcare professionals' views. Study 2 is also *descriptive, using* an inductive approach, determining the meaning of hope as a relevant element to become motivated to go on living during that period. It also examines several ways to promote a feeling of hope and improve these patients' perception of well-being. Finally, Study 3, using an *experimental* design, proposes a motivational PA program (FIT-CANCER) based on SDT and adjusted to the information collected from the two previous studies.

6) All data research were collected, analyzed, and written by the same researcher (MR), which grants consistency and additional methodological rigor. The remainder of the research group has played the role of *"critical friends"* (Smith & McGannon, 2018), improving the quality of the interpretations and promoting a more rational and adequate data analysis. Throughout the doctorate process, we obtained a greater conceptual understanding of qualitative approaches, increasing our awareness of qualitative skills such as *good interaction skills* and *reflexibility capacity*, both favoring the *qualitative sensibility* acquired (Braun & Clarke, 2013). Furthermore, the research team is composed of a multidisciplinary team (healthcare professionals—oncologists, nurses, and a psycho-oncologist—specialists in designing framework-based interventions to promote health-

related behaviors, and qualitative methodology), which allowed us to achieve more realistic and feasible research objectives and better interpretation of the results.

7) We also highlight the length of the exercise intervention and the follow-up. Globally, the literature shows a notable variety of exercise intervention lengths in the cancer domain. A systematic review including several cancer groups (Grimmett et al., 2019), indicated that the length of interventions varied from a single contact (Nyrop et al., 2017) to ten months of regular interaction (Demark-Wahnefried et al., 2012). This heterogeneity makes it difficult to obtain solid conclusions. FIT-CANCER lasted six months for all CRC patients, a period that coincided with chemotherapy. However, one year elapsed from the recruitment of the first patient to the last one (January 2020 to January 2021). Although ideally restorative exercise should begin as soon as possible after diagnosis and should be extended over the end of adjuvant chemotherapy (Schwartz et al., 2017), we focused on the chemotherapy period because little research has been carried during this time frame. Additionally, we carried out a one-year follow-up after FIT-CANCER participation, to promote autonomous PA after the cancer treatment.

8) Lastly, the fact that the exercise specialist was trained in SDT is also highlighted, as previous research did not mention the instructor's training in psychological theories to promote exercise in the cancer field. This allowed us to design motivational strategies according to the patients' needs and make some modifications during the COVID-19 restrictions. The global pandemic switched the FIT-CANCER program from a presential to an online format. Nevertheless, the great variety of exercises and the strategies applied favored obtaining positive results. According to Newton et al. (2021), we maintained the *group structure,* following a set of practical recommendations for home-based exercise in people living with cancer during the confinement period. Also, a meta-analysis of SDT-guided intervention studies in the health context showed the need to carry out

interventions to support relatedness (Ntoumanis et al., 2021). In this regard, Kim et al. (2021) mentioned that PA in CRC patients was associated mainly with the need for competence and relatedness. We fostered relatedness through phone and group video calls, as well as through face-to-face meetings, both outside and inside of the hospital, with the appropriate security measures. One fact that shows patients' engagement with the PA program is the rate of attendance, reaching 94%, and no injuries or accidents occurred.

Despite these strengths, we should admit some limitations in the mentioned studies:

1) One limitation is that we focused on CRC patients undergoing chemotherapy. Consequently, a reduced sample of participants was collected, and findings cannot be generalized to other cancer groups and stages on the cancer continuum. However, qualitative methods are not intended to access many participants. Our research aims instead to obtain deep and extensive information about the subjective realities of a small number of participants (Sparkes & Smith, 2014). Furthermore, the principles of *generalization* in quantitative research are not applicable to justify the importance of qualitative research (Smith, 2018). In this regard, we do not consider sample size as a potential limitation. Moreover, the inclusion of social agents such as relatives and health professionals enriched the results of our studies and improved their rigor and trustworthiness.

2) Another possible limitation of this manuscript is that MR carried out the PA sessions and performed the semi-structured interviews with participants. That could have influenced the data collection procedure. However, the participants met the interviewer (MRbefore the interviews, which helped to promote a relaxed and pleasant atmosphere (Flick, 2006) and, by redirecting the open questions of the interviews, it was easier to delve into patients' experiences and circumstances. In this regard, the concept of *rapport*, defined as "getting along with each other, a harmony with, a conformity to, and affinity

for one another” (Seidman, 2013) and “conveying empathy and understanding without judgment” (Patton, 2015) justifies this issue. This implies a mutual desire for proximity between interviewer and interviewee (Prior, 2018). Furthermore, MR noted the importance of participants’ sincerity before beginning the semi-structured interviews. Complementarily, we kept a notebook throughout the intervention period called “research diary”. This document reflected the process and practice of recruitment and data collection, analytic insights that occurred during data collection, and the emotional aspects of the research (Braun & Clarke, 2013). Thus, we believe that by applying these qualitative strategies, we preserved the participants’ sincerety and the research rigor.

3) Throughout Studies 1 and 2, only three of the ten participant patients were over 65 years old. Older adults constitute an increasing cancer population although they are underrepresented in clinical trials (Gross et al., 2005; Scher et al., 2012). In fact, a systematic review found that, out of all the randomized controlled trials evaluated in a one-year period, only 3% were specifically designed for adults aged 65 years or older (Broekhuizen et al., 205). Additionally, older adults are often eliminated due to comorbidities, secondary cancers, and defective physical function and cognition (Forbes et al., 2020). Considering that CRC is the most common cancer among the older population, and its increasing proportion in the coming years, the viewpoint of this population should be considered. However, there is a notable increase of young patients diagnosed with CRC (American Cancer Society, 2020). In this regard, this year, nearly 18,000 people under the age of 50 will be diagnosed with CRC in the United States (American Cancer Society, 2020). This could limit the interpretation of the results as a function of patients’ age. It is therefore interesting to increase the amount of research related to this topic in different age groups.

4) The COVID-19 pandemic hindered the face-to-face modality, so an online format was implemented. We acknowledge that people living with cancer stopped participating in PA in public spaces during confinement (Newton et al., 2020). However, preserving an exercise regimen is important for general well-being, the mitigation of treatment toxicities, the amelioration of other chronic conditions, and the improvement of important clinical outcomes, etc. In this regard, pandemic restrictions implied that some previously designed FIT-CANCER-based motivational strategies were not applied. We reduced some face-to-face complementary activities, although they were reincorporated when COVID-19 restrictions ended. Nevertheless, we created new strategies to maintain group structure, as it is one of the primary reasons for patients to perform, adhere to, comply with, and, ultimately, succeed in their exercise program (Lund et al., 2019). Hence, although the PA program was modified due to the pandemic restrictions, we do not consider the format modification an important limitation, as continuity was more important.

5) Although we tried to maintain motivational strategies for the sessions across the FIT-CANCER program, the teaching-learning process generated some modifications in the intervention methodology related to the COVID-19 pandemic and participants' requirements. In this regard, we used "memo writing," which was a useful tool for refining and developing analytic ideas, such as re-reading past memos and writing additional ones on that topic. That helped the researcher to make conceptual leaps, from raw data to abstractions that explain research phenomena in the context in which they are examined (Birks et al., 2008). On another hand, a recent systematic review (Johnson et al., 2020) declared that "*researcher reflexivity" is* a criterion to guarantee the rigor of qualitative research. Essentially, it is a researcher's insight into their biases and rationale for decision-making as the study progresses. Accordingly, we do not consider these changes derived from the research development as a relevant research limitation.

6) Lastly, we obtained research data from two different contexts. Whereas Studies 1 and 2 were developed in the University Hospital of Vinalopó (Elche, Alicante), Study 3 was carried out in the Puerta de Hierro-Majadahonda University Hospital (Majadahonda, Madrid). Socioeconomic and educational conditions were different, as well as the medical team's behavior and awareness of exercise prescription. However, this matter allowed us to investigate two different conditions and gain different perspectives of knowledge. Regardless of these circumstances, we consider that we have extracted *high-quality qualitative information*, which is an essential requirement for good qualitative research (Wilkinson, 1988).

FUTURE DIRECTIONS

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According to the results of this doctoral thesis, the following future research directions are proposed.

1) Coinciding with the research project in which this dissertation is framed ("Development of an educational and motivational program to promote adherence to PA and its positive effects in CRC patients, PID2019-107287RA-I00), we are currently working on two additional studies, using a qualitative methodology: 1) Support perceived by CRC patients from healthcare professionals, relatives, and the exercise specialist throughout the FIT-CANCER program. Based on the SDT framework, we will inquire which aspects were perceived as supporting PA participation in CRC patients during chemotherapy, and 2) the effects of exercise on psychological, social, and physical domains in CRC patients during chemotherapy. This qualitative research aims to show the perceived benefits of participating in the FIT-CANCER program throughout the COVID-19 pandemic. As a result of that intervention, further studies will be generated, using a quantitative methodology: (1) how could the hope construct mediate between the needs for autonomy, competence, relatedness, and novelty and the patients' motivation, 2) determining which BPN satisfaction could predict more forms of autonomous motivation and positive consequences, 3) determining the effects of FIT-CANCER participation on the correlations between physical, psychosocial, and behavioral outcomes, both short, mid, and long term, 4) obtaining additional knowledge about the PA levels and the adherence of CRC patients during chemotherapy at the beginning, in the middle, at the end, and one year after their PA participation.

2) It would also be interesting to check the exercise performed and the exercise recommended for these cancer patients. The general PA guidelines advice is similar for

cancer patients and healthy adults, adding some practical considerations for comorbidities and other health-related issues, such as the type of cancer and treatment. However, future research should focus on revised and adjusted PA recommendations across several stages of cancer. Accordingly, previous research mentioned that types of tumors and stages could determine some PA intensities and frequencies (Jaeschke et al., 2020). Therefore, PA levels in cancer patients during chemotherapy may not be representative of other cancer patients and treatment schedules. Even when a cancer diagnosis is similar, individual differences concerning treatment tolerance (e.g., cycle number one vs. cycle number six) or treatment modality could modify patients' intention and the PA performed. Thus, it is necessary to explore PA levels throughout different points of the disease to create interventions in which the exercise prescription is individualized, and it is essential to assess the patients' physical condition.

3) Further research is required using objective tools to measure the amount and intensity of exercise in cancer patients. PA levels could be checked through accelerometry, which is the most objective, reliable, and effective tool (Limb et al., 2019). Checking the correct cut-points of an accelerometry measure in cancer patients could lead to the reformulation of evidence-based PA recommendations (Bammann et al., 2021). Recently, it has been found that PA measured with accelerometry is one of the best predictors of 5-year all-cause mortality in older adults. This finding reveals the importance of wearable technology to provide reproducible, unbiased, and prognostic biomarkers of health (Smirnova et al., 2020). To encourage patients' motivation for daily PA, devices such as watches and other applications can be effective tools to foster and assess PA participation in cancer patients.

4) Cancer patients' accomplishment of PA recommendations is a great challenge for health institutions and professionals. Nevertheless, previous works showed that

although breast cancer patients complied with PA guidelines, their physical condition was poor, and the authors pointed out the importance of increasing exercise intensity (Sanchis-Gomar et al., 2015). Therefore, medical consultations and exercise services should emphasize exercise-intensity prescription and teach patients to optimize their exercise performance. “Talk test” (Renzo et al., 2013) is a good way for patients to identify PA intensity. Previous research concluded that high intensity was effective to prevent side effects in breast cancer patients during chemotherapy. Further, a recent systematic review mentioned that high-intensity training improved the scores of global quality of life, physical functioning, role functioning, social functioning, cognitive functioning, fatigue, pain, dyspnea, and insomnia (Lavín-Perez et al., 2021). These conjoint findings increase the evidence supporting the incorporation of high-intensity exercise prescription as an essential component of PA in cancer patients.

5) Regarding our results, future cancer research should consider psychological aspects, specifically, motivational strategies and defining exercise methodologies for PA interventions. Behavioral change is lasting and more effective when patients are autonomously motivated. Previous meta-analyses mentioned that SDT is a viable framework to study outcomes of motivation for health-related behavioral changes in the clinical context (Ng et al., 2012; Ntoumanis et al., 2021). Moreover, framed within the hope theory, hopeful thoughts could be promoted to foster motivation and well-being when cancer patients feel their BPN are being frustrated. In this regard, it would be appropriate to design further SDT-framed research on the satisfaction of the needs of autonomy, competence, relatedness, and novelty during chemotherapy. However, it is also essential to study the effects of BPN frustration on illness outcomes in the cancer field (Chen et al., 2015) and the role of hope related to exercise motivation.

6) Future exercise-based interventions should be guided and supervised by

exercise specialists, and a group structure should be maintained to favor patients' motivation and to optimize their safety and exercise options (Segal et al., 2017). Exercise research has mostly focused on face-to-face formats, but our society now demands the application of new technologies, making the implementation of virtual PA programs inevitable. During the COVID-19 pandemic, Iglesias-Campos et al. (2021) showed that a web-based program is feasible in ovarian and breast cancer patients after chemotherapy completion. In our research, we included an initial individual session to teach patients how to manage online devices. We even visited some patients to install and explain the app functioning to them. Helping people to manage new technologies was one of the most important issues for FIT-CANCER adherence in older patients (extracted from memos). According to our results, future interventions should consider the combination of both presential and online modalities, depending on the patients' capacities and preferences. That could reduce the "distance to the center," one of the most common barriers in these patients. Besides, many patients do not feel safe and able to drive a car because of the side effects related to chemotherapy (fatigue, neurotoxicity, diarrhea, etc.). Some older patients do not have a driving license or need someone to drive/accompany them. To prevent reducing the feelings of *closeness* and *warmth* between the patients and the exercise instructors during online sessions, additional strategies should be implemented. In this sense, some activities carried out in FIT-CANCER were: hiking through the "Casa de campo [a large park]", a dance workshop taught by a professional dancer who was a cancer patient, joint walking in the 1st post-covid race organized by the "Spanish Cancer Association" (see pictures on annex section).

7) Additional experimental research including CRC patients with a stoma is needed. Although previous PA-related studies have shown improvements in the prevention of the parastomal hernia (Thompson, 2008), there is limited information about

exercise benefits to improve other well-being domains related to stoma conditions (Hubbard et al., 2019). According to our results, the stoma is a social and physical barrier to any PA participation, so additional research and awareness-raising workshops are required, including patients' nearby social agents. On October 16th, 2021, we carried out a workshop targeting patients, relatives, and healthcare professionals at the Puerta de Hierro-Majadahonda University Hospital (Madrid). It was composed of a multidisciplinary team addressing issues related to ostomy features and exercise. The support of health professionals is one of the factors that improve patients' PA levels and adherence (Saunders et al., 2019). Hubbard et al. (2020) suggested that medical consultations should send the message that "*exercise is reliable and safe in patients with a stoma.*" Specifically, professionals should avoid victimizing the patient with a stoma, as previous research suggested that exercise prescriptions have underestimated the physical capacity of patients with a stoma.

8) Future longitudinal studies could analyze the barriers to PA participation across the different phases of the disease. It would be interesting to continue delving into the impact of supervised and motivational PA programs to palliate the negative side effects of cancer treatment (e.g., hernia after ostomy, fatigue, disrupted sleep, chronic pain, depression, or neuromuscular impairment due to neurotoxicity). There is strong evidence supporting the efficacy of exercise in oncology programs to improve physical and psychosocial outcomes during active treatment in the short term and at six-month follow-ups. But there is not as much scientific evidence of the long-term effects on quality of life in CRC patients during chemotherapy. Adequately powered randomized control trials with longer follow-ups are required to assess the effect of PA interventions on CRC patients' disease-related physical and mental health (McGettigan et al., 2020). These trials have revealed that is uncertain whether PA interventions improve physical function.

Although our qualitative results indicate better mental health during chemotherapy, further research should be performed to support these results.

9) Additionally, prior research indicated that diagnosis time is one of the most “teachable moments” for the promotion of healthy behaviors to improve patients’ lifestyles (Lawson & Flocke, 2009). Accordingly, recent research suggests starting as soon as possible as of the cancer diagnosis, even before surgery, to prepare and enhance patients’ general and physical health and to achieve a better prognosis and recovery after surgery, a terminology defined as *“prehabilitation”* (Silver, 2015). This term consists of preparing patients for surgery with several support strategies: nutritional, psychological, and physical. Nevertheless, many patients continue to consider themselves as “patients with cancer” after the treatment, presenting long-term side effects related to negative emotions and physical sensations. Hence, future designs should focus on the most suitable moments to finish exercise interventions, and elaborate exercise programs lasting beyond the disease.

10) Exercise participation should not be only a persuasion for individual responsibility. It must also involve legislation and governments (Tulchinsky & Varavikova, 2000). In this regard, we suggest that exercise programs should be included as a regular, free, and assistential practice for cancer patients at all healthcare centers. Healthy lifestyles should be promoted from primary healthcare because Zhao et al. (2020) found that those who engaged in both aerobic and muscle-strengthening activities consistent with the PA recommendations presented a 40% reduction in the risk of all-cause mortality. However, the lack of information and time in consultations are prominent barriers to counseling patients about improving their health behaviors. Therefore, having an exercise service in hospitals is a pertinent need to promote exercise and other health behaviors. Authorities and health institutions should be aware of the importance of

exercise specialists being part of the healthcare professional teams.

CONCLUSIONS/CONCLUSIONES

CONCLUSIONS

The purpose of this doctoral thesis was to explore psycho-social and behavioral factors that affect CRC patients' participation in PA during chemotherapy. We included three studies, addressing in all of them patients', healthcare professionals' and relatives' views. 1) Barriers to participate in PA; 2) the role of hope in patients' motivation during chemotherapy, despite their reports of feeling that their needs for autonomy, competence, relatedness, and novelty were frustrated; 3) the effects of a six-month exercise program, applying motivational strategies based on SDT. In addition, a guide for promoting exercise in this population is in process, outlining the practical implications of exercise in CRC patients undergoing chemotherapy and of conducting this type of initiative from health centers. Below are the general conclusions of each of the studies carried out:

Study 1

The main purpose of this study was to inductively explore the factors that hindered PA participation of CRC patients (Stages II-III) during chemotherapy. Participants were interviewed in the middle of the chemotherapy period. The main conclusion was:

Conclusion I: We found several reasons for CRC patients' lower PA. They perceived barriers due to the cancer and the chemotherapy side effects, such as fatigue, ostomy, reduced physical fitness, Port-A-Cath device, their focus on cancer, and their restructuring priorities. Additionally, the lack of support for PA participation, such as their families' overprotection, the health professionals' lack of knowledge, limited time to prescribe PA, and the lack of exercise services in health centers. Support from healthcare professionals, spending more time, and transmitting knowledge about exercise and its benefits throughout treatment could reduce some of these barriers. In this sense, exercise programs should be implemented from hospitals, involving healthcare professionals and relatives to enhance cancer patients’ adherence to PA.

Study 2

The main aim of this study was to explore BPN status in CRC patients undergoing chemotherapy, their motivation to go on living, and their psychological well-being. The main conclusion of this research is presented below:

Conclusion II: The patients felt that their BPN were thwarted during chemotherapy. According to SDT, this could lead to lower levels of motivation and negative consequences related to ill-being. However, the construct of hope was a source of motivation for these patients during chemotherapy, and it positively impacted several domains of well-being. Some sources of hope promotion were found: positive attitude, religious faith, positive medical feedback, knowing that they were going to receive a short-term chemotherapy, and being aware that other patients were in a worse condition. Future exercise-based interventions should consider the theory of hope to promote motivation and well-being in cancer patients undergoing chemotherapy.

Study 3

This research aimed to explore the effects of a six-month exercise program (FIT-CANCER) on BPN satisfaction and several positive psychological and behavioral consequences in CRC patients (Stage II-III) undergoing chemotherapy.

Conclusion III: FIT-CANCER satisfied the needs for autonomy, competence, relatedness, and novelty in those patients because several motivational strategies were implemented. For instance, adapting the exercises to the participants’ circumstances, the specialization of the exercise instructor, belonging to a group of people in the same situation, the use of new technologies, providing resources to promote the internal locus of control, etc. BPN satisfaction led to positive psychological and behavioral consequences. Among other results, the patients increased their participation in PA during chemotherapy, even during the COVID-19 pandemic, with an online adaptation of the exercise program. Additional and longer exercise programs, using motivational strategies, should be implemented with cancer patients during chemotherapy.

Global conclusion

Throughout the research studies, we identified many barriers to CRC patients' participation in PA during chemotherapy. Our awareness of that information allowed us to design specific intervention strategies. Inductively, we found that the hope construct is a source of motivation when the patients felt that their BPN were frustrated due to the side effects of chemotherapy. In this regard, FIT-CANCER was developed to promote PA participation, reduce the barriers during the chemotherapy period, and provide positive results in patients' well-being. Although it is necessary to know which factors influence (non)participation in PA in specific groups of cancer patients, future exercise-based interventions should combine several types of cancer patients, in terms of diagnosis and treatments. They should also apply and combine theorical frameworks, including times longer than the duration of the chemotherapy and they should be supervised and guided by an exercise specialist. Government and public organizations should support these initiatives, permitting the development of exercise programs in hospitals. In addition, the presence of experts in sports sciences and exercise should be considered. Lastly, the presence of healthcare professionals and relatives is essential for promoting healthy lifestyles in cancer patients.

CONCLUSIONES

El propósito de esta tesis doctoral fue explorar los factores psico-sociales y comportamentales que afectan a la práctica de AF de los pacientes de CCR durante la quimioterapia. Se incluyeron tres estudios, considerando en todos ellos la visión de los pacientes, el personal sanitario y los familiares. 1) Barreras percibidas hacia la práctica de AF, 2) el rol que juega la esperanza sobre la motivación de los-as pacientes durante la quimioterapia, a pesar de que los-as pacientes informaron sobre la frustración de las necesidades de autonomía, competencia, relación y novedad, 3) efectos de un programa de seis meses de ejercicio físico, aplicando estrategias motivacionales basadas en la TAD. Además, se está elaborando una guía de promoción de AF en esta población, contando las implicaciones prácticas para entrenar a pacientes con CCR en tratamiento y para llevar a cabo este tipo de iniciativas desde los centros de salud. A continuación, se presentan las conclusiones generales extraídas de cada uno de los estudios realizados:

Estudio 1

El objetivo principal de este estudio fue explorar inductivamente aquellos factores que dificultaban la práctica de AF en pacientes de CCR (estadios II-III) durante la quimioterapia. Los-as participantes fueron entrevistados a mitad del tratamiento. La conclusión principal fue la siguiente:

Conclusión I: Se identificaron diferentes aspectos por los que los pacientes de CCR fueron menos activos físicamente. Ellos-as percibieron barreras respecto a la enfermedad del cáncer y los efectos secundarios del tratamiento, como la fatiga, la presencia de estoma, la reducción de la condición física, el dispositivo Por-A-Cath, centrarse en el cáncer y la reestructuración de prioridades. De acuerdo con la percepción de falta de apoyo, los participantes informaron de que existía una sobreprotección de las familias, falta de conocimiento y tiempo del personal sanitario para prescribir AF y falta de servicios de AF dentro de los centros de salud. Más información de los profesionales de la salud sobre las recomendaciones de ejercicio físico y sus beneficios durante la quimioterapia adyuvante podría paliar estas barreras. En este sentido, los programas de ejercicio físico deberían ser implementados desde los hospitales, involucrando al personal sanitario y familiares, para mejorar las posibilidades de adherencia a la AF de los pacientes con cáncer.

Estudio 2

El objetivo principal de este estudio fue explorar el estado de las NPB en pacientes de CCR en tratamiento de quimioterapia, la motivación para continuar viviendo y el bienestar psicológico. La principal conclusión de esta investigación se presenta a continuación:

Conclusión II: Los-as pacientes informaron sobre la frustración de sus NPB durante el tratamiento de quimioterapia. Según la TAD, esto podría estar relacionado con niveles más bajos de motivación y consecuencias negativas relacionadas con el malestar. Sin embargo, el concepto de *esperanza* fue una fuente de motivación para estos-as pacientes durante la quimioterapia, lo que tuvo un impacto positivo en varios dominios del bienestar. Se encontraron algunas fuentes para fomentar la esperanza: Actitud positiva, fe religiosa, retroalimentación positiva del-a médico-a, saber que iban a recibir una quimioterapia de corta duración y ser conscientes de que otros-as pacientes se encontraban en peor estado. Las futuras intervenciones basadas en el ejercicio deberían considerar los constructos de la teoría de la esperanza para promover la motivación y el bienestar en los pacientes con cáncer que se someten a quimioterapia.

Estudio 3

Este estudio tuvo como principal objetivo explorar los efectos de un programa de ejercicio físico (FIT-CANCER) en la satisfacción de las NPB y en diferentes consecuencias psicológicas y comportamentales positivas en pacientes de CCR (estadios II-III) sometidos a quimioterapia.

Conclusión III: FIT-CANCER satisfizo la necesidad de autonomía, competencia, relación y novedad en los-as pacientes, debido a que se implementaron varias estrategias motivacionales. Por ejemplo, la adaptación de los ejercicios a las circunstancias de los participantes, la especialización de la instructora en ejercicio, la pertenencia a un grupo de personas en la misma situación, el uso de nuevas tecnologías, la provisión de recursos para promover el locus de control interno, etc. La satisfacción de las NPB derivó en consecuencias positivas tanto psicológicas como conductuales. Entre otros resultados, los-as pacientes aumentaron su participación en ejercicio físico durante el tratamiento de quimioterapia, incluso durante la pandemia de COVID-19, con una adaptación online del programa de ejercicio. Se deben implementar programas de ejercicio motivacionales adicionales y más prolongados con los pacientes de cáncer durante la quimioterapia.

Conclusión global

A lo largo de los estudios de investigación mencionados se identificaron abundantes barreras para la participación en AF en pacientes con CCR durante el tratamiento de quimioterapia. Esta información nos permitió diseñar estrategias de intervención específicas. Además, de forma inductiva apareció el concepto de esperanza como una fuente de motivación, cuando los pacientes sentían sus NPB frustradas debido a los efectos secundarios de la quimioterapia. En este sentido, FIT-CANCER fue desarrollado para promover la AF, paliar las barreras durante el período de quimioterapia y generar resultados positivos en el bienestar de los pacientes. Aunque es necesario conocer los factores que influyen en la (no)participación en AF en grupos específicos de pacientes con cáncer, las futuras intervenciones basadas en el ejercicio físico deben combinar varios tipos de pacientes con cáncer en cuanto a diagnósticos y tratamientos. Además, éstas deberían aplicar y combinar marcos teóricos, incluir tiempos superiores a la duración de la quimioterapia y deberían estar supervisadas y guiadas por un-a especialista en ejercicio. El gobierno y las organizaciones públicas deberían apoyar estas iniciativas, permitiendo desarrollar programas de ejercicio en los hospitales. Además, se debería considerar la participación de personas expertas en Ciencias de la Actividad Física y del Deporte. Por último, la presencia de profesionales sanitarios y familiares es fundamental para promover estilos de vida saludables en los pacientes oncológicos.

PRACTICAL IMPLICATIONS AND RECOMMENDATIOS

PRACTICAL IMPLICATIONS AND RECOMMENDATIONS

For my supervisors and me, it is especially relevant to highlight the relation between the results of our research and its transfer to social practice. In this regard, we consider the following practical recommendations useful, to improve the available information about the promotion of PA in CRC patients during chemotherapy. In this section, we have considered two main sections; *how to develop this type of exercise intervention from hospitals,* and *practical considerations for cancer patients' exercise, extracted from the FIT-CANCER program*.

How to develop exercise programs from hospitals

Ethics Committee. The first step is to elaborate and present the research project to the hospital's ethics committee. Once the project is approved, the following aspects will be decisive for the implementation of the exercise program. We prepared four main documents: the research project, data collection notebook, informed consent, and a guide for patients with basic exercise-related constructs.

The existence of a multidisciplinary team. Having a multidisciplinary healthcare team was one of the main features that allowed us to carry out the FIT-CANCER program. They showed engagement and the desire to support the project development, which was essential for the recruitment of patients. Basically, oncologists should convey clear messages about exercise based on scientific evidence during medical consultations, as they are the main and most important trusted people for the patients. Healthcare professionals' and relatives' support is essential to improve patients' health behaviors. Besides, exercise should be provided with supplementary audiovisual information (brochures, videos, etc.) as healthcare provider-delivered exercise interventions may increase cancer survivors' PA behavior (Brunet et al., 2020). In this sense, all the information among healthcare professionals and exercise specialists should be coherent.

Unifying PA understanding in social agents near to the patients. We propose organizing several workshops for healthcare professionals, relatives, and cancer patients to increase their knowledge about the benefits of exercise during chemotherapy, which could reduce PA-related barriers and ideas about fear of hernias, injury, and pain that limit the patients' participation. Specifically, Price et al. (2020) mentioned that raising awareness of PA benefits related to the risk of cancer recurrence and health problems strengthed patients' self-efficacy and helped them to overcome barriers, promoting cancer survivors' attainment of moderate-to-vigorous-intensity PA. The most important message is the *safety* and *effectiveness* of exercise participation, improving patients' survival, independently of their previously performed exercise (Singh et al., 2020).

Communication between exercise specialists, oncologists, and patients. The protocol to access patients is paramount. Firstly, the oncologist informs patients about the PA program availability and delivers informed consent. At this point, it is very important for the oncologist to inform patients about the benefits of exercise during the oncologic process. Once the patients sign the written informed consent, the oncologist establishes their contact with the exercise specialist. Also, the oncologist should comment the relevant clinical aspects, as well as the patients' associated comorbidities with the exercise specialist. One of the most remarkable and novel findings of our research was the additional role of the exercise specialist as a "*referral person*" for patients and a useful intermediary between oncologist and patients. For example, solving several doubts of patients about the disease, resulting in patients' fewer phone calls and medical appointment requests. This reduced the health system saturation during the COVID-19 pandemic, and more information was obtained about tolerance and chemotherapy side effects. For instance, two participants of FIT-CANCER had strong side effects which affected the overall functioning of their systems (tachycardia, high weight loss, and intense vomiting). The patients communicated these issues to the exercise specialist, who informed the oncologist, who, in turn, modified the dosage of the chemotherapy treatment. Moreover, the exercise specialist accompanied patients to several facilities (analytic and oncologist consultation, pharmacy, computed tomography, and the room where they received intravenous chemotherapy), reducing their feelings of disorientation and nervousness caused by the lack of information about the medical appointment's location. Definitely, the exercise professional becomes an accompaniment and support person for cancer patients.

The personal and social skills of exercise specialists. Cancer patients face the disease differently and go through different emotional states. Exercise professionals should acquire several communication skills requested by cancer patients, such as *empathy*, *closeness*, *joy*, *warmth*, *mental flexibility*, and *demonstrating their exercise knowledge*. Understanding the patient's situation and helping them to increase their *self-confidence* and *security* during chemotherapy is essential. One patient said, "*It is very important that you (the exercise professional) do not victimize us, and you believe in our strength, empowering us because you never call us "poor;" on the contrary, you encourage us to give the best of ourselves* (extracted from the diary notes collected at the end of an exercise session).

Appointments structure and exercise information. It is important for patients to become familiar with the different schedules in the hospital. In this sense, the exercise specialist should always receive patients at the same location, so as not to make them feel more confused or uncertain. Throughout FIT-CANCER, we schedule appointments in the same oncology waiting area. During the first appointment, patients are concerned about several issues (being punctual to medical appointments, fear of chemotherapy effects, etc.). Thus, the first encounter with patients should focus on giving them information about exercise related to its benefits during the cancer treatment and provide them with supplementary written information. When patients pass the first cycle of the chemotherapy, they will have a more positive attitude toward the exercise plan or to receiving more specific information. At the second appointment, a motivational interview is conducted to determine their interests, preferences, and previous experiences related to exercise assessment, injuries, and exercise record. They are also informed about the procedure of the following exercise meetings. This section can be modified depending on the organization and management of each hospital. Although the research design can be established to evaluate patients at a specific time, this can be modified due to multiple issues (patients' feeling dazed, change of treatment appointments, consultation delay, not having enough time, etc).

Assessment of patient's physical condition. Both for scientific research and exercise counseling, it is important to make a global assessment of patients' physical condition. This information allows us to optimize the exercise prescription and to know their health status. Below are described some tests that have been used in the hospital during the patients' treatment:

- One Mille-Walking test (1606 meters) as fast as possible without running
- 6 minutes walking, test as fast as possible without running
- Handgrip test left and right with a dynamometer. Press for 5 seconds
- Sit and stand test: sit down and stand up for 30 seconds or 5 repetitions

- Body composition: body mass index, waist and hip circumference, weight, and height

Prescription of exercise. Delivery of written information and PA recommendations. As a function of the patient’s record (preferences, physical conditions assessment, comorbidities…), we must elaborate a home-based or supervised exercise plan. In any case, it should include four main components: resistance, endurance, flexibility, and balance training, and follow the “training principles” such as specificity, individualization, recovery, individual needs, overload, and reversibility. Additionally, we must define the FITT acronym: F (frequency), I (intensity), T (time), and T (type), according to the progressive overload principle. Some additional tips to transfer to patients are the energy level management during chemotherapy, how to start exercising after surgery, how to reconcile the new routine to include exercise (employed or unemployed), exercise contraindications, examples of resistance exercises to do with household material, and examples of PA monitoring tools such as the pedometer device.

Practical considerations for exercise participation in CRC patients during chemotherapy

Below are described some practical implications that could be useful to optimize exercise participation in CRC patients undergoing chemotherapy. These practical considerations were extracted from participants of the FIT-CANCER program and may be appropriate for future exercise interventions with cancer patients.

Mixing presential and online modalities. Many patients requested the online format when they did not feel able to leave home due to chemotherapy side effects. For example, some patients were advised not to drive for the first month after surgery, and some of them did not feel capable of driving autonomously. Also, patients suggested receiving audiovisual information related to exercise. Alternating face-to-face and online modalities could be a useful resource at this period, as the distance to the center is one of the most frequent barriers for these patients. This combination could enhance the patients' comfort and their PA levels throughout the chemotherapy.

Considerations to develop an online exercise program. CRC patients are usually older people with limited knowledge of new technologies. Online modalities require additional time to explain how to access the virtual platform and also to explain the exercises. Good supervision is required to preserve the patients' health and support them during exercise. The RPE scale is useful for patients to monitor their exercise intensity (from 1 to 10 points of effort) and it correlates with the VO2peak. This tool was effective and easy to learn for cancer patients participating in the FIT-CANCER. Household material is necessary and can vary depending on the objects available (bottles of water, 1-1.5kg of some food such as rice, legumes, etc). Resistance training was prescribed through the "character of the effort", which combines the number of repetitions and the weight. If patients could not increase the weight, exercise intensity was increased through additional speed, less recovery time, combined with more multi-joint exercises, and exercise complexity. To ensure the intensity prescribed throughout the exercise sessions, we ask patients for some verbal feedback. In this way, the "talk test" helped us to determine whether patients achieved *light, moderate,* or *vigorous* intensity.

The infuser management (Port-a Cath device). Patients with a reservoir could do exercise safely two weeks after surgery (scar healed). Sometimes, patients reported discomfort during exercise in the area where the device is located. Thus, we had to adapt the exercises, limiting movements as long as that discomfort or pain lasted (e.g., shoulder flexion and extension). Also, the bottle in which chemotherapy is applied can be placed in a fanny pack, which can facilitate exercise participation. Patients who practiced high-impact sports put a plug on top, which covered the port-a-Cath area, to enhance the feeling of safety (see photo in the annex section 2). Once there is no more discomfort, every type of exercise can be performed. Hence, the port-a-Cath is not incompatible with exercise performance, but such exercise must be adapted and supervised by exercise professionals. Thus, increasing patients' *confidence* and *safety* in the first weeks is a definite goal.

The presence of comorbidities. Many CRC patients present some comorbidities (diabetes, cardiac problems, obesity, hypertension, etc.) that can impact patients' health and limit PA practice. At this point, the "symptoms cluster" has a highlighted value in the cancer context, consisting of two or more symptoms that are related to each other and that occur together (Kim et al., 2005). Multifactorial aspects can determine the exercise prescription, producing day-to-day modifications. The exercise specialist must be knowledgeable about the patient's relevant clinical record for exercise prescription.

Peripheral neuropathy associated with *oxaliplatin* medication. This is a chemical compound that leads to *peripheral neuropathy*, a result of damage to the nerves located outside of the brain and spinal cord (peripheral nerves), which often causes weakness, numbness, and pain, usually in the hands and feet. It can also affect other areas and body functions including digestion, urination, and circulation. This affects the management of daily activities as well as PA participation. For example, patients cannot drink cold water to prevent an apparent "drowning." If these patients drink cold water, they feel like they were choking and will start to cough. However, we must calm them down and let them cough because a few seconds later, that feeling disappears. Patients should have this information to avoid that unpleasant and traumatic feeling. For cold sensations in the hands due to peripheral neuropathy, one solution is to wear gloves the first days after chemotherapy, because it may be difficult to grasp objects. In addition, pressing the handgrip (dynamometer) to assess strength may be limited. When the weather is hot, patients may feel uncomfortable exercising in closed shoes because they have cracks in their feet. They are recommended to use a cream with 5% or 10% urea and wear open shoes. To reduce the loss of sensation in the feet, shoes with a rubber sole/soft material (instead of hard material like leather) isolate the foot more and provide better mobility.

Solar protection. Chemotherapy makes patients more likely to suffer sunburn, so they are recommended to cover the skin with clothing (long sleeves, hat, etc.), use sunscreen, and avoid the hottest hours of the day. Finally, sports centers should have an adequate temperature because patients tend to feel colder during chemotherapy (higher sensitivity to cold). This dysregulation in temperature perception must be recognized by patients, ensuring adequate hydration before, during, and after exercise sessions.

Stoma. Patients with ostomies have additional barriers to PA participation. Sports centers should have a bathroom close to the training area and a “bag change kit” (bags, discs, and paper), as well as a mirror to facilitate the necessary bag refills. Wearing a just-changed/empty bag and avoiding foods that cause flatulence before exercise sessions are recommended. At the end of this document, some strategies to increase comprehensive comfort in patients with a stoma are included. We show photos with several stoma bag designs (see photo in the annex section 2). Support garments are widely used today, both for exercise and for daily activities. The main goal is to keep the bag attached to the body and enhance comfort. Even if the bag is full, patients feel that the disc is attached to the body and will not come loose. There is also a corset that keeps the bag close to the body, reducing its visibility. It also improves comfort during exercise sessions.

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ANNEXES

ANNEXES

1. Pictures of patients during extra physical activities proposed by FIT-CANCER team


726
727
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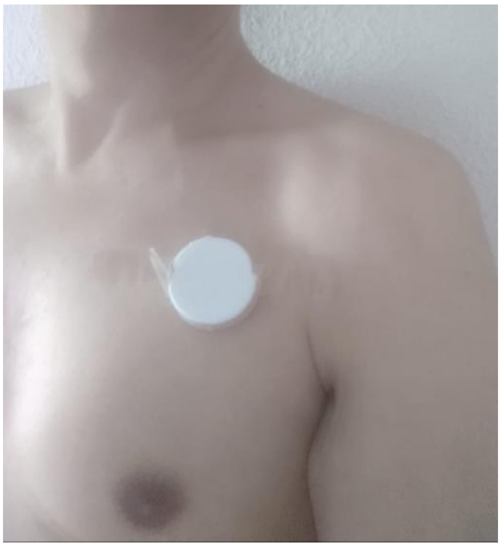
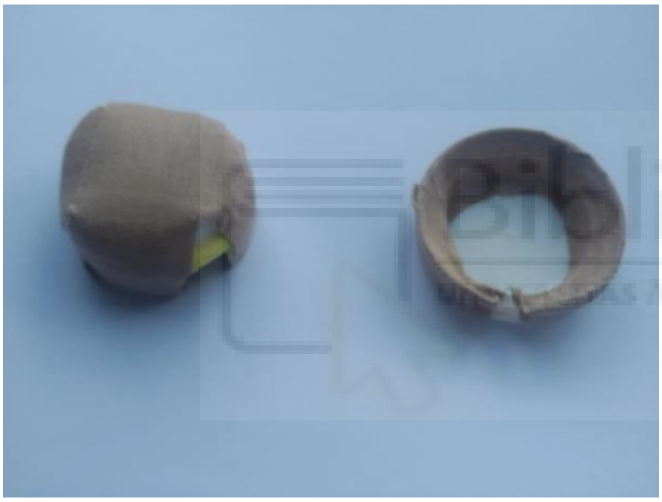
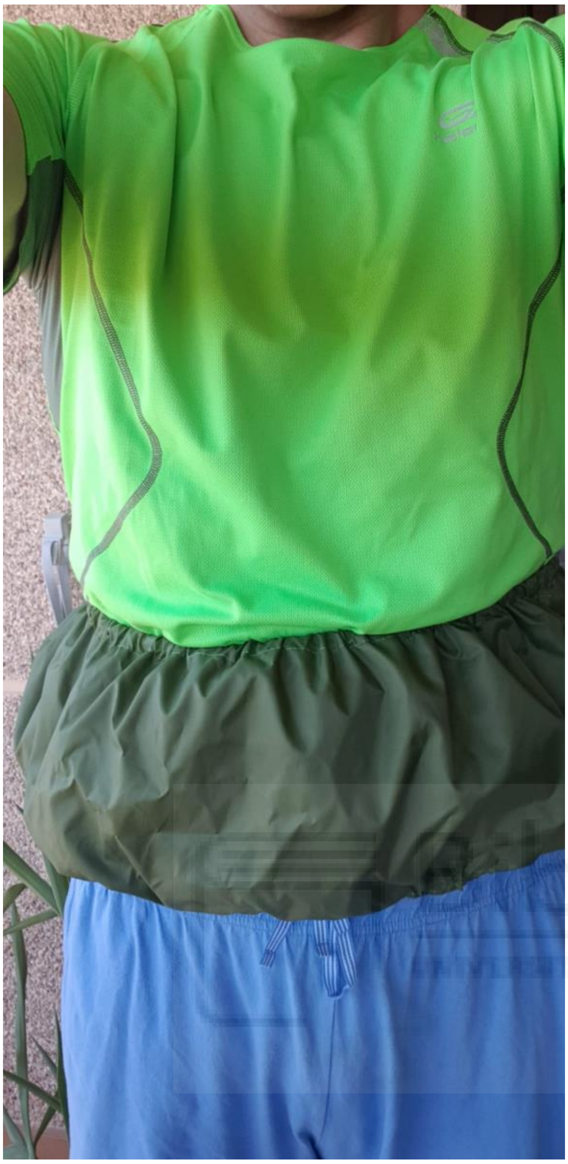
VIII Carrera contra el cáncer


UNIVERSITAS
umh
MIGUEL HERNÁNDEZ

2. Pictures of devices related to treatment







3. Pictures of patients during exercise sessions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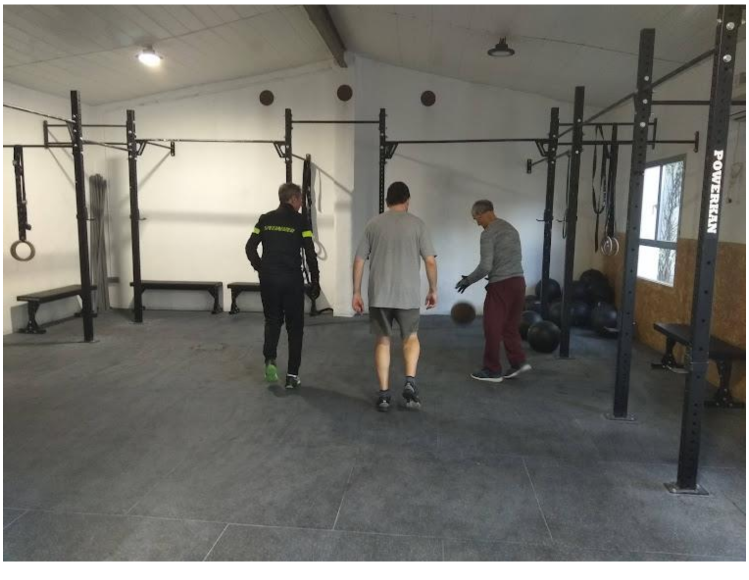

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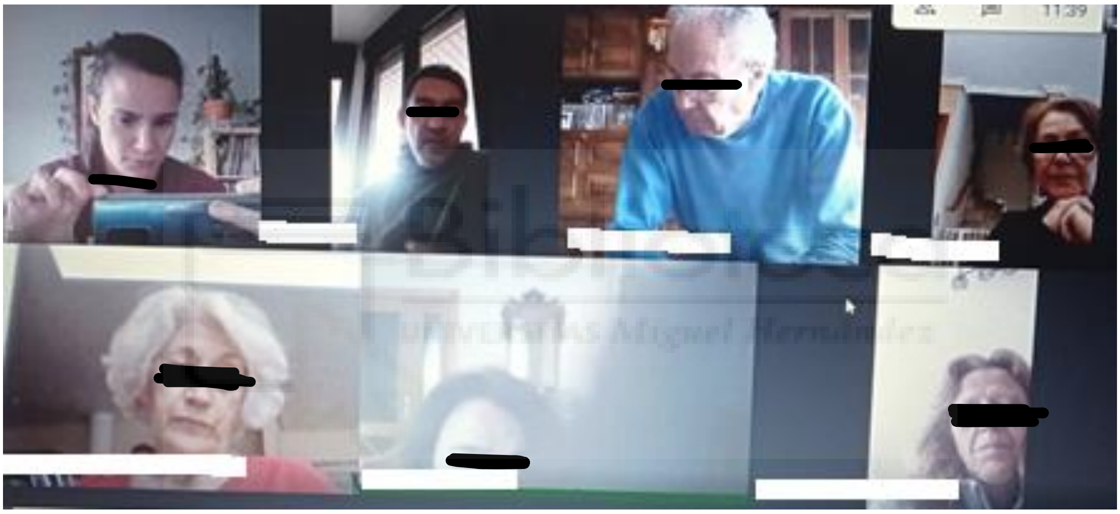
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Citas de agradecimientos de los pacientes y familiares

Thanking quotes from patients and relatives

“*Sí, el contacto con el médico, las enfermeras... para mí dentro de la enfermedad ha sido positivo, me siento con mucha más tranquilidad, a veces me costaba concentrarme solo de pensar que podía ponerme enferma por algo, ahora lo disfruto, yo siempre he disfrutado mucho con mis nietos pero ahora me tiro al suelo... ha cambiado mi vida afortunadamente a mejor. Para mí el programa ha sido fundamental... te tendría que dar las gracias no se cuántas veces, de haberte conocido y de haber conectado contigo tan bien porque eres un cielo de niña y de verdad que espero que cuando esto se termine no perder el contacto... al final te parece hasta parte de tu familia, sobre todo en este momento... Sin darme cuenta es como si te conociera de hace mucho tiempo*” (Paciente).

“*Me motiva tu forma de tratarnos, tu manera y tu cariño que nos das, porque sin darte cuenta nos das ese cariño, ese apoyo constante…estás constantemente pendiente de nosotros, para mí, no se los demás pero yo estoy encantada contigo y se lo digo a todos mis amigos, tengo una profesora de ejercicio que me la traía a mi casa, eres muy cercana, vives todos los problemas nuestros del día a día y eso es muy importante... De verdad que no es porque estés aquí delante, nos dices las cosas y nos corriges de una manera tan cercana, yo estoy super superencantada y no te lo digo para quedar bien, si de ti no me gustara algo te contestaría otra cosa y ya... tienes una cosa que eres muy humana y cuando estás con nosotros te pones en nuestra situación.... a quien le preguntes del grupo, yo creo que todos estamos encantados contigo, por eso, porque llegas a nosotros... nos tratas como si fuéramos tu familia, eres muy cercana, sinceramente te lo* *digo, no tengo nada negativo que decir, y te dije que me da pena que se me acabe esto.. me dan ganas hasta de llorar...”* (Paciente).

“Quiero que sepas que estás haciendo una labor maravillosa y que te lo agradecemos de corazón” (Mujer de paciente).

“De verdad gracias, porque me ha encantado, me has ayudado tanto… es que no te lo puedo explicar con palabras, ni te lo imaginas, y ese agradecimiento por eso estoy aquí el tiempo que tu necesites, de verdad …has hecho bastante más de lo que tú te piensas, aunque nosotros después del programa te olvidemos entre comillas y demás, lo que tú nos has ofrecido es nuestra salvación…tú no vienes aquí a hacer amistades, tú vienes a salvar vidas (metafóricamente), *porque, la diferencia de seguir un programa de estos a no seguirlo es la depresión y realmente uno no muere por el cáncer, muere por la depresión que tiene, tú has limitado eso, ya te digo, eternamente agradecido…*” (Paciente).

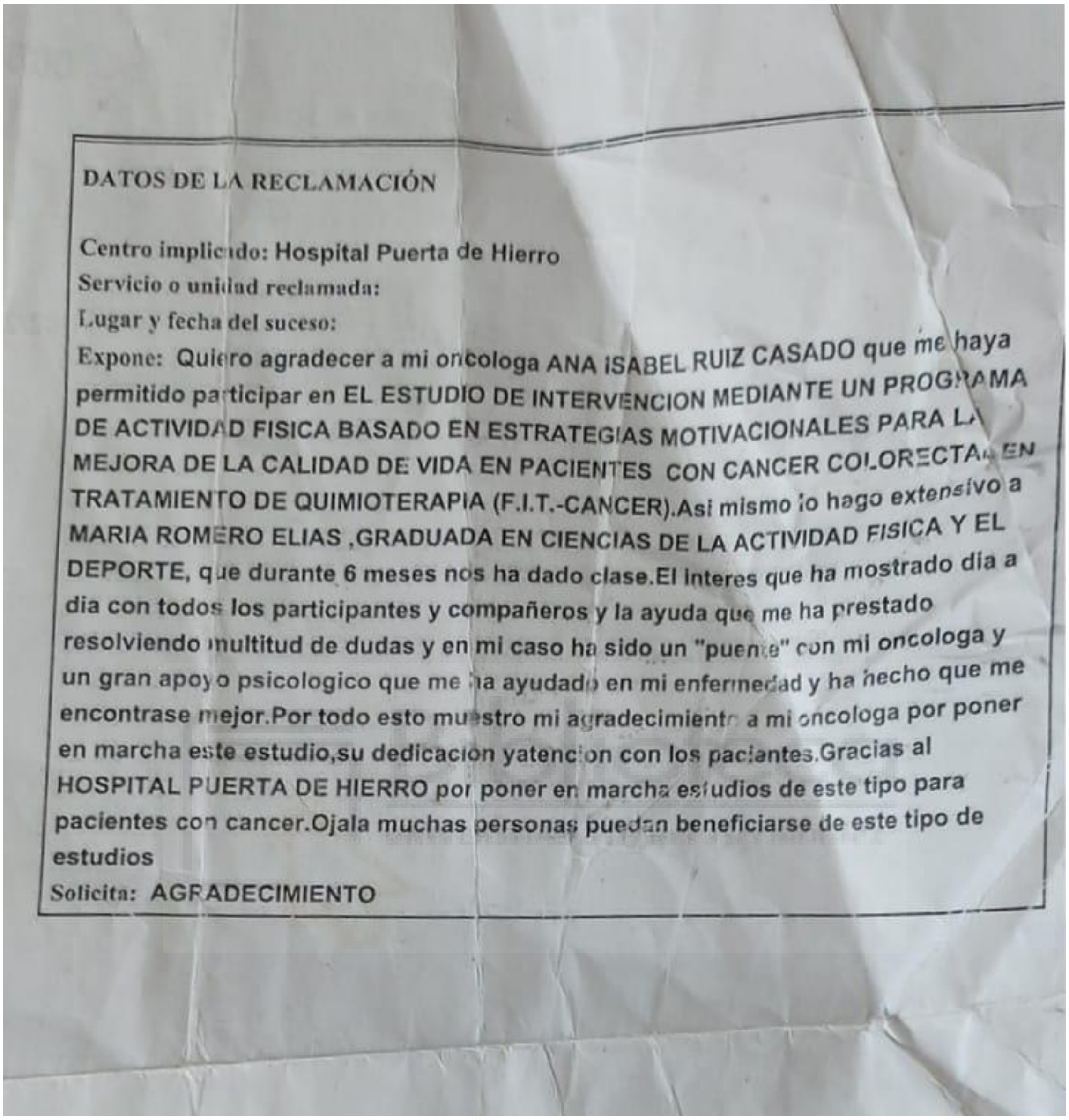
“Tengo que reconocer que esta sesión estoy durmiendo mejor y soportando mejor los efectos secundarios. Estoy segura de que es porque estoy en mejores condiciones físicas. Y eso es por tus clases” (Paciente).

“El entrenamiento me ayuda a respirar y pensar en positivo, me relajo y dejo atrás los pensamientos negativos, me ayuda a afrontar el tratamiento y me dijeron que nunca habían visto a nadie sonreír como yo antes de entrar en un quirófano. No te haces una idea de lo bueno que es el ejercicio para mí, cuando antes no quería saber nada cuando me lo propusieron” (Paciente).

“Gran idea y participar en algo tan fundamental como dar a conocer los grandes beneficios aportados a mis miedos por superar el cáncer y hábitos nuevos de vida y

valorar la aportación del PUERTA DE HIERRO con un servicio de oncología tan profesional y que nos ha quitado en lo que a mi concierne los miedos a sufrir y luchar contra el cáncer. La gimnasia ha sido fundamental y forma ya parte de mis hábitos. Mis agradecimientos a todos los compañeros-as de viajes y a la monitora que nos hace vencer el miedo al esfuerzo. Yo me encuentro como antes de la maza de tener que pasar por el quirófano pero sin ninguna secuela de lo sufrido. Como me indicó el oncólogo los síntomas desaparecen en tres meses y he aprendido a entender de legumbres y pescado azul y mucha agua y aunque lo llevo peor, lo combino con algún tinto de calidad. VIVA EL ÁNIMO DE IR PALANTE. Un abrazo" (email de paciente).

Carta de agradecimiento



DATOS DE LA RECLAMACIÓN

Centro implicado: Hospital Puerta de Hierro

Servicio o unidad reclamada:

Lugar y fecha del suceso:

Expone: Quiero agradecer a mi oncologa ANA ISABEL RUIZ CASADO que me haya permitido participar en EL ESTUDIO DE INTERVENCION MEDIANTE UN PROGRAMA DE ACTIVIDAD FISICA BASADO EN ESTRATEGIAS MOTIVACIONALES PARA LA MEJORA DE LA CALIDAD DE VIDA EN PACIENTES CON CANCER COLORECTAL EN TRATAMIENTO DE QUIMIOTERAPIA (F.I.T.-CANCER).Asi mismo lo hago extensivo a MARIA ROMERO ELIAS ,GRADUADA EN CIENCIAS DE LA ACTIVIDAD FISICA Y EL DEPORTE, que durante 6 meses nos ha dado clase.El interes que ha mostrado dia a dia con todos los participantes y compañeros y la ayuda que me ha prestado resolviendo multitud de dudas y en mi caso ha sido un "puente" con mi oncologa y un gran apoyo psicologico que me ha ayudado en mi enfermedad y ha hecho que me encontrase mejor.Por todo esto muestro mi agradecimiento a mi oncologa por poner en marcha este estudio,su dedicacion yatencion con los paciantes.Gracias al HOSPITAL PUERTA DE HIERRO por poner en marcha estudios de este tipo para pacientes con cancer.Ojala muchas personas puedan beneficiarse de este tipo de estudios

Solicita: AGRADECIMIENTO

Reflexión final

Esta tesis tiene como objetivo final contribuir al bienestar de las personas o mejorar en alguna medida sus condiciones de vida. El ejercicio físico me ha acompañado desde pequeña como parte fundamental de mi vida, como terapia y como sostén en muchas situaciones. Cada vez creo más en su poder y la ciencia avanza en ese camino, en evidenciar sus beneficios. Y nosotros-as somos los-as responsables de transmitirlo con conocimiento y con mucho cariño. Para mí, el conocimiento y su transferencia deberían ir de la mano con la sensibilidad y la empatía hacia las personas con las que trabajemos. Creo que hay que seguir trabajando en mejorar el conocimiento de las personas, educar en la promoción de estilos de vida, así como hacerles creer que son capaces. Sobre todo, darles confianza, dejar de victimizarles y empoderarles para que sientan que tienen las fuerzas y el apoyo suficiente como para llevar a cabo tanto las sesiones de ejercicio físico como las tareas del día a día.

Acompañar es mi palabra preferida desde que empecé a trabajar con pacientes oncológicos. Creo que esta palabra enmarca todo el trabajo que hacemos. Me he metido en sus casas, me he sentado al lado mientras se les inyectaba quimioterapia, me he acercado a sus miedos y me he ido con ellos a cenar además de entrenar. Sin embargo, después también he escuchado y he visto cómo el programa FIT-CANCER en un momento de pandemia mundial, les ha servido de gran apoyo y fuerza durante el tratamiento. Ahora entiendo de verdad y valoro la importancia del sentimiento de compañía, la importancia de cuidar a las personas, de cada gesto, de cada conversación, mensaje o sesión de entrenamiento. Durante un año de pandemia mundial, entre tantas restricciones y muchos cambios en mi vida, poder conocer y entrenar a cada uno de los pacientes ha llenado mi vida de conocimiento y de más felicidad. Me han contagiado sus ganas de vivir, aún más si cabe. Acompañarles en este momento de su vida, atender sus necesidades, escucharlos… ha sido un gran proceso para mi vida personal y profesional. Y es que es difícil sentir empatía cuando no calzamos los miedos ajenos, pero he tratado de ponerme en sus pieles, muy difícil, ¡¡¡pero con todo mi cariño hemos ayudado a incrementar su confianza, conocimiento y ganas para seguir!!!

Durante esta etapa formativa me he dado cuenta de que ver a pacientes y poder prescribir ejercicio físico para intentar mejorar un poco la vida de los pacientes, es una de mis grandes pasiones y fuente de motivación diaria. Algo que sin duda no habría conseguido sin los-las pacientes, soporte del personal del hospital, mis supervisores, mi familia y amigos-as. Y, por supuesto de mi esfuerzo y dedicación. Desde aquí me gustaría hacer un llamamiento (que quizá nunca nadie lea) a las universidades, ministerios, autoridades, profesionales de la salud, y toda aquella persona que esté leyendo este documento. Por favor, permitan que los-as profesionales de las Ciencias de la Actividad Física y del Deporte puedan trabajar en hospitales y centros de salud, por que trabajar en equipos multidisciplinares es la única forma de mejorar la salud de las personas. Somos capaces y tenemos herramientas y conocimientos para hacerlo. Animo a los futuros profesionales de las Ciencias de la Actividad Física y del Deporte a que se muevan por lo que realmente les motive y persigan sus sueños, siempre os encontraréis con personas que confíen en vuestro trabajo y os ayude a cumplir vuestras ilusiones profesionales. Agradezco a las personas que me rodean a confiar en mí y haberme apoyado a realizar este trabajo. Finalmente, creo que trabajar y vivir con personas que nos ayuden a ser mejores profesionales y personas, es fundamental. Por ello, animo a mis compañeros-as de profesión a que la rama de la salud sea una salida profesional que también nos compete.