PHYSICAL ACTIVITY, EXERCISE AND CANCER

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Welcome to a new journal in exercise and cancer

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Dear Editor:

Traditionally, patients with cancer were told to rest as much as possible and to avoid physical activity — not to mention strenuous exercise, which was not even a question. Yet an exponentially growing number of studies since the end of the last century have shown beneficial effects of not only regular, moderate physical activity but also supervised (sometimes even intense) exercise in the cancer continuum. Notably, for attenuating treatment-related toxicities and side effects. Thus, the paradigm has now shifted to the concept of "*exercise is medicine*", with leading world experts advocating that "*all people living with and beyond cancer can be as active as is possible for them*" (Schmitz et al., 2019).

The initial scientific work on exercise intervention during cancer treatment was published in 1989 by Winningham and co-workers. These authors showed the benefits of aerobic exercise training performed during chemotherapy on the body composition of women with breast cancer (Winningham et al., 1989). The same group also documented benefits on these patients' functional capacity (MacVicar et al., 1989), as well as on their self-reports of nausea (MacVicar et al., 1988). Some years later, before the start of the new

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century, Dimeo *et al*. published the first randomized controlled trial showing that exercise can attenuate chemotherapy-related toxicities (Dimeo et al., 1997). This pioneering effort was followed by an exponentially growing number of trials corroborating and expanding the aforementioned results in numerous types of malignancies. As a result, several prestigious organizations have now launched exercise recommendations for patients living with and beyond cancer. Notably, according to an expert international panel from the American College of Sports Medicine, "*there is sufficient evidence to support the efficacy of specific doses of exercise training to address cancer-related health outcomes*" including fatigue, physical function, anxiety, depressive symptoms, as well as health-related quality of life (Campbell et al., 2019).

Regular physical activity is also associated with lower cancer incidence (Ahmadi et al., 2022; Matthews et al., 2020), recurrence (Morishita et al., 2020), and mortality (Morishita et al., 2020; Arem et al., 2015). Importantly, this protective association is largely independent of major confounders (such as body mass index or smoking status) (Moore et al., 2016) and is potentially dose-response dependent, with a benefit threshold for mortality at approximately 3-5 times the minimum World Health Organization-determined dose and no excess risk at 10+ times the minimum dose (Arem et al., 2015). In fact, the first proof-of-concept biological evidence for a protective association between physical exercise (even at very high doses) and cancer was reported as early as in 1944 by Rush and Kline in albino mice with fibrosarcoma (Rusch et al., 1944). These visionary scientists showed that forced exercise applied for 2 or 16 hours/day delayed tumour growth rate by ~34% and ~25%, respectively, compared to controls (Rusch et al., 1944). Since then, a growing number of studies has attempted to identify the mechanisms underlying the potential antitumorigenic effects of exercise or physical activity.

The stimulation of immune function is a strong candidate to explain the potential anticancer effects of both *acute* and *regular* exercise (Rusch et al., 1944). Notably, the muscle modulates immune function through the release of 'myokines', such as interleukin (IL)6 and mainly IL7 and IL15. These signalling moieties can stimulate lymphocyte mobilization to tumours (IL6) or improve the proliferation and homeostasis of a major immune effector against tumours, $CD8^+$ T lymphocytes (IL7 and IL15) (Rusch et al., 1944). Furthermore, during each acute exercise session (*e.g.*, cycle-ergometer exercise at moderate-high intensities for up to 1 hour) and the subsequent post-exercise window (a few hours) adrenaline-stimulated immune effectors with a strong cytotoxic effect against nascent tumours [natural killer (NK) cells and the aforementioned $CD8^+$ T lymphocytes] are released in high amounts (*i.e.*, two or threefold higher compared to baseline) to the bloodstream(Rusch et al., 1944). These exercise-primed immune subsets are potentially able to infiltrate ('heat') tumours, at least after the accumulation of repeated acute bouts of exercise — that is, with *regular* exercise (Rusch et al., 1944).

According to scientific evidence, *physical exercise is beneficial for people with cancer*. As such, we believe that launching a new scientific journal solely focused on this field is always good news. Especially to attempt answering the numerous questions that remain open. These include, among numerous other unsolved issues: adequate identification and reporting of potential adverse effects of exercise interventions (as it is done in pharma trials); how to implement exercise interventions in *oldest old* patients (*i.e.*, those aged 80 years and above, who unfortunately represent the 'great forgotten' population segment in the medical literature); or how to close the gap between preclinical evidence (where exercise delays tumour growth in many animal models, including in the context of aggressive cancers) and the real clinical world (where exercise is unlikely to delay the growth of very aggressive malignancies). Furthermore, the biological mechanisms behind the potential exercise effects in the fascinating tumour microenvironment — a heterogeneous and continuously evolving universe of tumour and nontumor cells, including both

immunosuppressive and anticancer effectors — are awaiting to be studied in depth, including at the granular (single-cell) level. The task ahead is enormous.

Keywords: Physical exercise, Physical activity, Exercise, Cancer, Cancer prevention, Cancer treatments, Cancer survivors, Psychology, Sport medicine.

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We´ll roWIN

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Dear Editor:

Who are we?

Before starting this contribution, I would like to thank prof. Pérez-Turpin, whom I followed during my student days, and who many years later I met at a conference (blessed conferences that allow us to "*put a face*" to the quotations, models, and such exceptional works that are out there). That said, it is an honour for me that many years later we have met and you have trusted me to make my small contribution to this new challenge that is beginning: the edition of the magazine.

Physical Activity, Exercise and Cancer to whom I wish many years of life.

Furthermore, I am happy about the possibility that it gives me of not having to write a "*scientific*" article but rather being able to stop and think about the person or people… About the philosophy behind our work.

I remember my years at the Faculty in which we had to decide if Physical Education was Education and if it was Science, art or other disciplines…. Memories…

Life is a succession of events that mark the roadmap that we had predetermined. At that time, the person writing these words did not know that he was going to become a university professor, much less work with people with cancer... based on the phobia I have of hospitals…

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As I said, each one has a predetermined life plan, but which tends to be altered by different daily (and almost insignificant) events that make us take different alternatives until one day you find yourself in a place that you would never have dreamed of (or Yeah). The author of these lyrics became a "*university professor*" because of scoliosis. What a story!

So in my younger years, "*I grew more than necessary*"…"*little muscle for so much bone*." Clinical judgment: Spinal deviation: scoliosis. Treatment: Swimming!!! And since then I entered a pool never to come out again. As the motto of Barcelona 92 said ***"in life as in sport desire to improve"***. So I started swimming and swimming, swimming and swimming, (while I trained in Sports Sciences and Swimming) and ended up winning, on my own merits, an associate's place at the University. As modern coaches say, "*you never know when your life can change and if this change can be for the better or not. It is up to you to transform it and make it positive*."

Where are we going?

As I said before, life is a succession of events, and in this society in which we have had to live, cancer is the global pandemic and sooner or later, cancer appears in your life either because it comes to visit us or because it is in our loved ones.

Once it reaches us, we have to resign ourselves and accept it, but it should also make us think that with our training as Graduates or Graduates in CCAFD we can offer our "*grain of sand*".

In my case, breast cancer hit an aunt and seeing how it changed her life made me think about how I could with my training (initial, at that time) improve this family member's condition.

Logically we are not doctors nor do we pretend to be, but I believe that from Sports Sciences we can do many things to improve physical condition but above all the quality of life (understood within this, mental health) given the possibility that sport offers and the physical activity of offering people moments of social relationship, of getting closer to a discipline, perhaps different to a different environment, to people whom, at the beginning of the activity, they did not know anyone but who, after a few weeks, they do feel identified.

This is the starting point of the research project that has occupied the last few years of my professional career, and almost of my life, because in the end, the projects are vocational and what begins as "*just work*" ends up being part of oneself.

We have called the research project "*Vence-remos*" in clear reference to overcoming the consequences of breast cancer in people who have gone through it. This is important, inasmuch as we have a series of women to whom life has, on the one hand, given them a new opportunity, or has turned them inside out like a sock: Cancer has stopped their approach to life, their troubles. everyday thoughts, their way of being in the world, their work, their family, their relationship with others…

At the time of diagnosis, *"After the "beep", when you come to, everything automatically changes or at least your perception of everything, and everything goes to the background, because in the end, the first thing they have to do is heal themselves. The surgery is not especially complex (in some cases it is aggressive) but the path that begins after surgery is a large desert of chemotherapy sessions, radiotherapy sessions, of millions of tests to be able to know if they can continue with the treatment or You have to wait another week and they undermine the body, not only the physical part but also the psychological part of the person because you*

also have to go through it alone and, in many cases, also draw strength from weakness to support your loved ones. (incomprehensible, but truer than you think).”

Finally, the moment comes when the oncologist gives him the go-ahead and tells him that “*for now*” it seems that we can close the chapter and that life goes on… but in fact it is no longer the continuation of what we left “*on standby*.” a few months ago. You have to live and rethink that life and that is where our project, vence-remos, appears, a project that aims to “*live again*”, to enjoy what you have now!, not what you had before or what you will have tomorrow. We are no longer the same person who entered the operating room or the one who started the treatment, our body, our face and our spirit have changed, now we are a different person, with a different look, with a different scale of values, now what you want is to enjoy life and celebrate life.

What are Vence-remos keys?

Currently Vence-remos has several women's groups in different parts of Andalusia and Galicia. Although we know that the flame has caught on and there are already groups of women who, through rowing, improve their physical condition, their perception of life and their health in other locations in Spain.

Vence-remos is a research project/physical activity program based on rowing adapted for women who have overcome breast cancer. Vence-remos is a social project in which women socialize with other people who have gone through precisely the “*same path*” that they have gone through, which is a project that mainly affects the quality of life. And for this it is important that these people who "*have been alone*" for so long, socialize with other people with the same pathology. In fact, it is the first thing we do, we propose activities and moments that allow socialization, that they know each other by name, that they know “*the way of arrival*.”

There are people who come with conservation surgery, others who come with a total mastectomy, others with a radical mastectomy or even a double mastectomy. We have women who were diagnosed many years ago when much more aggressive surgeries were performed with grafts to the pectoral muscles from other muscles. Almost all of them have had part of the lymphatic chain removed from the arm of the affected breast. The majority have undergone various subsequent interventions. A large part have gone through a series of chemotherapy radiotherapy sessions, each one with different drugs, a duration, and a different periodicity. Here is a small example of what underlies breast cancer: A thousand different forms, a thousand different variants, and a thousand different people, each with their “*unique*” pathology and their personalized treatment.

Our first objective is for them to socialize and normalize their “*illness*”. The vast majority of women who start the project have never seen “*a paddle*” in their lives. They have never been on a boat. And the first thing that surfaces is the fear of falling into the water. Look, what these women have lived with…! Maybe the fear you have now is the fear of falling into the water or the fear of not knowing how to row... That's wonderful...!

Previously, we have talked about the quality of life, the perception of health, the psychological part of a physical activity like rowing, a global sport because it brings a series of benefits, now we will see it. We have also talked about socialization. Now we would like to point to the place where this activity takes place. Rowing normally takes place in large sheets of water, usually calm waters or with little current. That is, a quiet “*environment*” that allows us to view a natural landscape, even within the city itself (in the case of some cities that have rowing clubs) rowing allows us to be in contact with nature, The possibility of being in the sun, with a pleasant temperature, listening to the noise of water, feeling the wind on your body, the feeling of freedom is something that few sports can match.

"*You will never row alone*"

Little by little, through "*all being in the same boat*" the "*support group*" is formed, everyone is made to support each other, so that they go from being unknown to being "*the soul of that boat*." which needs them all, and requires all of them, affirming a commitment between all of them, "*to row, you need the entire crew*." In this way, they are all important, they are all necessary and they all row... in one way or another, someone cannot row, they do not have that much strength, it is not possible for them to row... so the solution is sought: from being a helmsman, to row only part, or row with less intensity, or not row at all... and the other rowers offer a ride to improve the spirit and strengthen the self-esteem of the partner.

The philosophy that underlies Vence-remos is a philosophy in which everyone contributes something, whether by rowing, or at the helm, by talking, by supporting, or by whatever. That is the essence of the project: "*You will never row alone*".

In fact, the project is based on team boats, nothing individual, they are team boats, Vence-remos proposes a rowing adapted for women who have suffered breast cancer with which we have to adapt the physical appearance. To do this, we have chosen very, very, very stable boats because we are talking about people between the ages of 30 and 77, who are totally unaware or totally unaware of the discipline of rowing, a team sport with maximum rapport. Did you know that the coordination within a rowing crew is so great that they even breathe at the same time?

Competition, yes or no?

Related to the first commandment: "*you will never row alone*" and what it entails: we are always together, we always participate, we always support each other, we are always there... so there are no teams, we are a family.

Vence-remos's approach is totally opposed to competition. We do not think that competition is bad, far from it, well-understood competition makes us improve ourselves, makes us grow…

But why compete and what do you have to prove when you have already won everything. These people have won a life, yes, a life... they already have all the medals! They have won a fight against cancer, they have won against a very harsh treatment…. So, why compete if we can enjoy them all?

Vence-remos is made up of support groups, closeness, unity, there is no room for competitiveness, when something is organized, meetings are held to enjoy the boats, the environment, the parties of another club, not to win. An African proverb states that "*if you want to get there quickly, walk alone. If you want to go far, go accompanied*." This is another aspect of our philosophy, we want to create a school in other rowing clubs, in other cities,... in which support is given to women who have suffered breast cancer.

And, why rowing and not any other physical activity?

Indeed it could be any other activity. Scientific literature is more than loaded with evidence about the convenience of different possibilities of physical activity, sports, etc.

Why have we considered rowing? Our research is based on what was started in early 2000 by Dr. McKenzie, a Canadian sports doctor, who, when no one "*prescribed*" physical activity (at that time, physical activity was

contraindicated for women with breast cancer).) convinced a series of women to start paddling in a Canadian canoe.

These women led the way, inviting them to participate in a world dragon boat championship (a discipline similar to Canadian canoe paleo), but with a subtle difference: canoeing is not competitive, and dragon boating is.

Be that as it may, the impact of McKenzie's study and the participation in the World Championship of a boat with women who had suffered breast cancer was the spark that lit the fuse in many places around the world. Not in vain, breast cancer is the disease most diagnosed in the world.

Here is a "*small detail*": dragon boating is an exclusively competitive modality, that is, almost all of the people who practice it do so to compete. And competition, for this type of people, is not especially indicated... We imagine that McKenzie, when he encouraged those women in Canadian canoeing, what he intended was a more playful concept. Over the years, this Canadian canoe paleo has been transformed into dragon boat paleo and this discipline in itself has a competitive vocation.

On the other hand, if we look a little at the biomechanics of the Canadian canoe or the dragon boat, we see that it is a fairly asymmetrical exercise. In fact, canonists have always done compensation work precisely because of the asymmetrical movement. Furthermore, we found that there are different positions that, if not harmful, are contraindicated for women who have had breast surgery.

Our knowledge of canoeing (dragon boat) and rowing makes us opt for the latter since rowing is a much more global exercise with a much more defined kinetic chain in which one hundred percent of the body's muscles are used and in which we can isolate certain movements so that they are not harmful. In fact, we consider that rowing could be much better for women with this pathology. This is the starting hypothesis of the Vence-remos project, which, as we have mentioned, aims to improve physical condition and quality of life through the adapted practice of rowing in these women's lives.

Rowing is an exercise in which all the muscles of the body move, and thanks to a second-degree lever, we manage to overcome the resistance offered by the water. The mobile bench row not only moves the arms and back but also uses the lower body to a large extent. Furthermore, having such a defined motor pattern allows us to isolate the movement of the upper body and adapt the exercises that can be done to each person. And logically, after any physical activity program that is carried out with a certain rigor with a certain periodicity, we will achieve results without having to vary much in other aspects such as diet or hours of sleep. In our case, the improvements in physical condition we have demonstrated thanks to the Vence-remos program are: improvements in strength in both the upper body and the lower body. Strengthening flexibility in both the upper and lower body and with an exercise program of 2 sessions of 1:30 hours for 12 weeks we have achieved cardiac adaptations in these women. These cardiac improvements materialize in lowering the pulse at rest, and the basal pulse, and we have managed to have significant differences in both systolic and diastolic pressure, which is very encouraging in women whose circulatory systems have been quite massacred due to chemotherapy treatments. . In short, to the improvements reviewed above, we add the fact that they have a much stronger, much healthier, much more powerful heart and reducing blood pressure means that our expectations with this project are met.

Keywords: Physical exercise, Physical activity, Exercise, Cancer, Cancer prevention, Cancer treatments, Cancer survivors, Psychology, Sport medicine.

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PHYSICAL ACTIVITY, EXERCISE AND CANCER

ORIGINAL ARTICLE

Cancer exercise app design: Tailored exercise for people living with and beyond cancer

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ABSTRACT

Background: Exercise is important for the health of people living with and beyond cancer. Yet most cancer survivors do not receive advice or referral to exercise oncology rehabilitation programs. A smartphone delivered exercise oncology app could minimize many of the barriers to exercise that these individuals face. Objective: To develop an exercise oncology application that provides a tailored exercise program (based on exercise history, current physical function, etc.) and adapts to user's fatigue levels to minimize many of the barriers faced by clinicians, patients and people in underserved areas. Methods: The algorithms in the app were developed based on previous research. The individualized exercise prescription is based on the user's daily level of fatigue, and if the user is on treatment, type and duration of treatment, and current fitness level. Results: Developed an easy to navigate, read and use app with reminders to exercise and positive feedback for reaching one's goals. Conclusion: Cancer Exercise is a unique app that provides a tailored exercise oncology program for cancer survivors. Additional research is needed to see how the app may benefit people living in rural and underserved communities.

Keywords: Physical activity, Exercise oncology, mHealth, Mobile app, Individualized, Customized, Physical activity, Exercise and cancer survivors.

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INTRODUCTION

Exercise is critical for people living with and beyond cancer. Yet, for the 1.9 million Americans diagnosed annually with cancer, referral to an exercise oncology program seldom occurs (Gallicchio et al., 2022). Referral to exercise oncology programs is poor (9% by nurses and 23% by oncologists) and is associated with barriers related to: lack of awareness of programs, uncertainty regarding the suitability and safety of exercise, need for education to make appropriate referrals and the belief that referrals to exercise are not within scope of practice (Fong et al., 2018; Hardcastle et al., 2018; Nadler et al., 2017; Nyrop et al., 2016; Smaradottir et al., 2017; Webb et al., 2016). Cancer-related fatigue is the most common and distressing side effect of cancer and its treatment during and following treatment and there is a strong evidence base that supports the beneficial effects of exercise to reduce cancer-related fatigue (Campbell et al., 2019; Zhang et al., 2023). People living with and beyond cancer face varying frequency, intensity and distress from fatigue and other side effects from cancer and its treatment. Their side effects cause different levels of disability that often require care from specially trained therapists or exercise trainers who can develop personalized exercise oncology rehabilitation and recovery programs. People living in rural and underserved communities have limited access to these highly trained professionals and face the burdens and barriers of cost, transportation, travel and time away from work and home (Field et al., 2018; Maganty et al., 2023). Patients who are immune compromised or recovering from treatment may not be safe or feel comfortable exercising in a community facility even if it is with a certified American College of Sports Medicine certified Cancer Exercise Trainer. As many as 31% of cancer survivors are completely inactive and only 23% met the national recommendations (Webb et al., 2016). For cancer survivors, a sedentary lifestyle is linked to a 12-13% increased risk of cancer mortality (Biswas et al., 2015; Lynch, 2010). Inactivity increases risks for comorbid conditions, such as, declines in functional ability, obesity, hypertension, cardiovascular disease, type II diabetes and other cancer (Patel et al., 2019). A smartphone delivered exercise oncology application that tailors an exercise program for each user based on the most common side effect, cancer-related fatigue, would minimize many of the barriers faced by clinicians, patients and people in underserved areas.

We are aware of only three mobile health studies specifically related to exercise for cancer have been conducted – a survey and 2 clinical trials. In a survey of 279 breast cancer survivors' preference were noted for remotely delivered: exercise counseling (84.6%), exercise intervention (79.5%) and 68% reported they would prefer using an app (Phillips et al., 2017). Survey respondents reported that components of a mobile health intervention that would be important were an activity tracker (89.5%), personalized feedback 81.2% and feedback on how exercise influenced mood, fatigue etc. (73.6%). Less important features of an app were: social networking (31.2%), group competition 33.9%, and seeing others' progress 35.1%. The Restwise trial randomly assigned 60 heterogeneous cancer survivors to a 12-week exercise program or Restwise + exercise (Schwartz et al., 2015). Restwise is an online program developed for elite athletes to promote recovery. It requires users to complete daily objective physiologic and subjective psychologic measures and delivers an individualized exercise intensity recommendation. At posttest, the Restwise + exercise group demonstrated significant improvements in the 6-minute walk, 1-repetition maximum leg press and chest press ($p < .0001$). The Restwise + exercise group demonstrated an 18.5% greater increase in the 6-minute walk, 35.2% greater strength gain in the leg press and a 45% greater strength gain in the chest press than the exercise group. Another randomized controlled study, FatigueU/Cope, enrolled 279 heterogeneous cancer patients actively receiving cancer treatment (Wilkie et al., 2022). Patients received a table-based exercise program that was tailored to the patient's fatigue level (Schwartz Cancer Fatigue Scale scores >15 higher dose of exercise or scores <14 lower dose of exercise). The determination of exercise dose was based on previous research (Schwartz, 1999, 2000; Schwartz et al., 2001; Schwartz et al., 2002). While the exercise intervention was only 4-weeks in duration, mean fatigue decreased significantly for the FatigueU/Cope group

compared to usual care (p = .02). This study indicates the efficacy of a low cost, unsupervised exercise intervention to reduce fatigue and the potential for a well-designed individually tailored mobile health solution to reduce fatigue and potentially improve functional outcomes.

Objective

The goal was to develop an exercise oncology application that could provide a tailored exercise program for each user. The following describes the design of the Cancer Exercise app. Cancer Exercise is an individually tailored exercise program delivered through an application for people living with and beyond cancer and their support person(s). The app meets the preferences identified by cancer survivors while integrating a well-tested intervention that follows the American College of Sports Medicine (ACSM) Exercise Guidelines for Cancer Survivors (Campbell et al., 2019; Phillips et al., 2017; Schwartz, 1999, 2000; Schwartz et al., 2015; Schwartz et al., 2001; Schwartz et al., 2002; Schwartz & Winters-Stone, 2009).

METHODS

Cancer exercise app decision tree structure

Cancer Exercise was developed from many years of exercise oncology intervention research. The protocols that were tested and revised over many years of research were refined into an algorithm that adapts to an individual's cancer treatment schedule and level of fatigue. The exercise dose determination begins when the user begins the onboarding process and it asks if a person exercises, how much they currently exercise and if they are ready to start an exercise program. The decision tree is then divided again by whether they are on treatment, and if yes, the type (chemotherapy, immunotherapy, radiation therapy, etc.) and duration of treatment. If the user is a support person, the app skips the treatment step and goes directly to the exercise section. The next decision is determined by results on a 6-minute walk and 30-second sit-to-stand test. The 6-minutes is timed by the app and distance walked is measured and recorded by the app. The user needs to count and record the number of sit-to-stands completed and record the number. This combination of information is used to produce an individualized exercise program that will have the user engage in 3 days of aerobic, 2 days of resistance and flexibility exercises. At 3-week intervals, the program asks the user if the workout is too hard, too easy or just right and at 6-week intervals the 6-minute walk and sit-to-stand tests are re-administered so the user can see their progress and current status. The program does not focus on weight change but there is a place to record weight, blood pressure and waist circumference with the fitness test data.

Algorithms

The algorithms in Cancer Exercise were developed using data amassed in the Authors's 20+ years of exercise oncology intervention studies. The exercise algorithms are tailored based on previous exercise status, type and timing of treatment and daily fatigue level and were tested and refined in studies with diverse populations of cancer survivors (Bea et al., 2022; Bea et al., 2023; de Heer et al., 2019; Schwartz et al., 2015)

Prior to each exercise session the user is asked to rate their fatigue. The fatigue algorithm adjusts daily based on fatigue that is rated on a visual analogue scale (Figure 1) and is calibrated to decrease the exercise dose based on the level of fatigue. If fatigue is rated 9-10 exercise is reduced to simple stretching or completely cancelled and a rest day is declared. When the dose of exercise is attenuated the intensity (based on rating of perceived exertion) and volume of aerobic exercise are decreased and the weight or resistance and number of repetitions of resistance exercises are decreased.

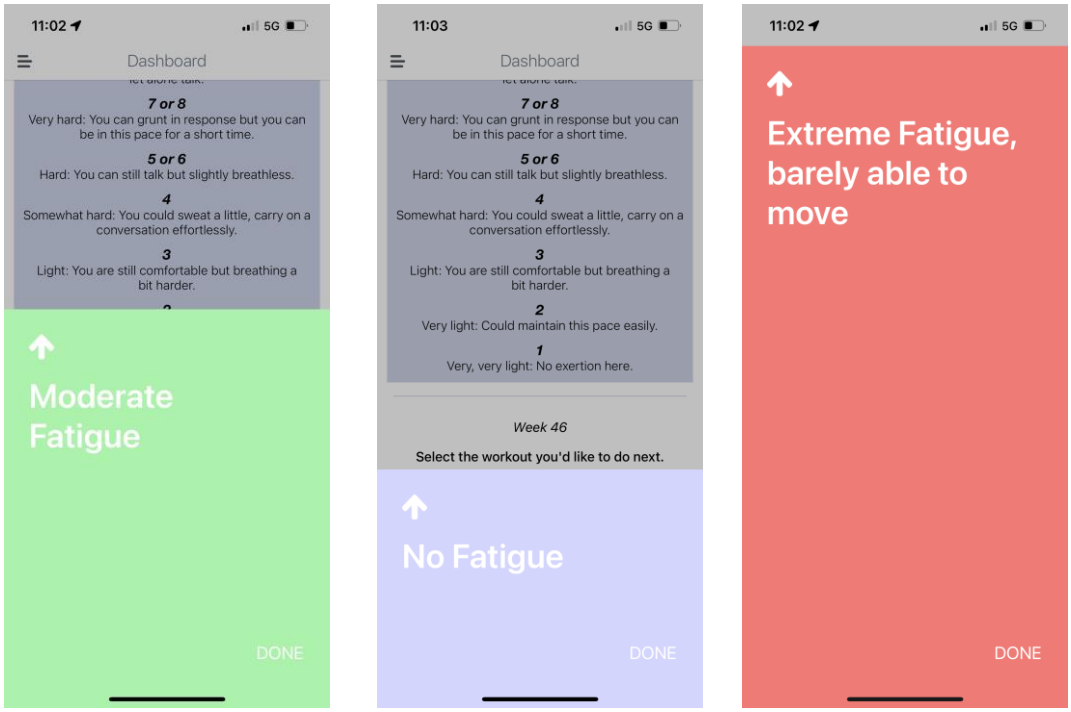

Figure 1. Example screenshots of ratings of fatigue.

On treatment days/weeks the dose of exercise is also attenuated depending on type of treatment (e.g. radition therapy, chemotherapy, immunotherapy). For example, for people living with cancer receiving radiation therapy, exercise may not be attenuated depending on the protocol because side effects accumulate slowly. In contrast, many chemotherapies and immunotherapies cause acute side effects, consequently the exercise dose is decreased, for several days after treatment. Currently, there are no specific exercise attenuations for blood and bone marrow transplant due to lack of data with this treatment. However, the app will provide an exercise program based on receiving chemotherapy and the individual's level of fatigue.

The exercise prescriptions provided, even when attenuated for treatment, adhere to the ACSM Exercise Guidelines for Cancer Survivors (Campbell et al., 2019) and provide a minimum of 90 minutes of aerobic exercise and 2 days of resistance exercise per week for most users. If a user is too fatigued or debilitated to exercise this much at the start of the program, the exercise dose gradually and systematically increases to meet the ACSM Exercise Guidelines for Cancer Survivors. As the user gets fitter and stronger, the exercise dose progressively increases over time so the user will meet the USPHS Physical Activity Guidelines for Adults (Piercy et al., 2018).

APP FEATURES

App features include reminders to exercise, re-enforcing encouragement for meeting daily exercise goals, and notifications to bring users back if they miss a few exercise days or weeks. The "*Resource Section*" provides detailed information about exercise, the ACSM Exercise Guidelines, "*Benefits of Exercise*", and "*How to Exercise Safely*". There is a dedicated section on "*Special Considerations*" for exercising with lymphedema, during chemotherapy, with bone metastasis, etc. The "*Resources Section*" also includes a library of all the workout exercises with illustrations and explanations, a stretch library and breathing exercises. The social cognitive theory forms the basis of the framework, and as such, the app has reminders

that re-enforce engagement and self-monitoring to allow users to track their progress. There are also encouraging comments for successfully completing exercises and weekly sessions. These approaches help people integrate physical activity into their lifestyle and personal identity (Duncan et al., 2010).

USE OF THE APP

During the user onboarding process information is entered on age, weight, type and stage of cancer, type(s) of treatment and dates of ongoing treatment, if applicable. At this point in the onboarding process, there is an option for the user to select that the user is a support person (e.g., partner, spouse, friend, etc.) and not a cancer survivor. Exercise history questions then ask the user how many days in the past week the user engaged in both aerobic and resistance. The next slide frame asks if the user feels they can exercise on their own with a custom program that shows them how to exercise (Figure 2. Caption A). If they answer "*Yes*" they get a "*Congratulations*" screen and continue to receive instructions on rating their fatigue and perceived exertion, what their weekly plan will look like and how it will change. Then the user begins the baseline testing (6-minute walk and 30-second sit-to-stand) which is recorded in the Results section. The initial fatigue measure is used to generate the exercise program. Figure 2. Caption B illustrates an aerobic exercise prescription for a user on chemotherapy with moderately severe fatigue (rating #7). The Warm-up begins at a low intensity and then s/he will begin a set of 4 aerobic intervals (walking, cycling or jogging or other aerobic activity of choice) for 30 seconds (or other appropriate time) and an RPE of 4-6 of equivalent recovery time at an RPE of 2-3, followed by a low intensity cool down. The intensity is set in RPE, and in this case the total exercise dose is reduced because the user is on chemotherapy and rated her fatigue 7 on a 10-point scale. Users can select the exercise type they prefer from the weekly exercise assignment of 3 days of aerobic exercise and 2 days of resistance exercise. The program will let the user do both aerobic and resistance exercise in one day but does not allow the user to progress to do more exercise without a rest day in between.

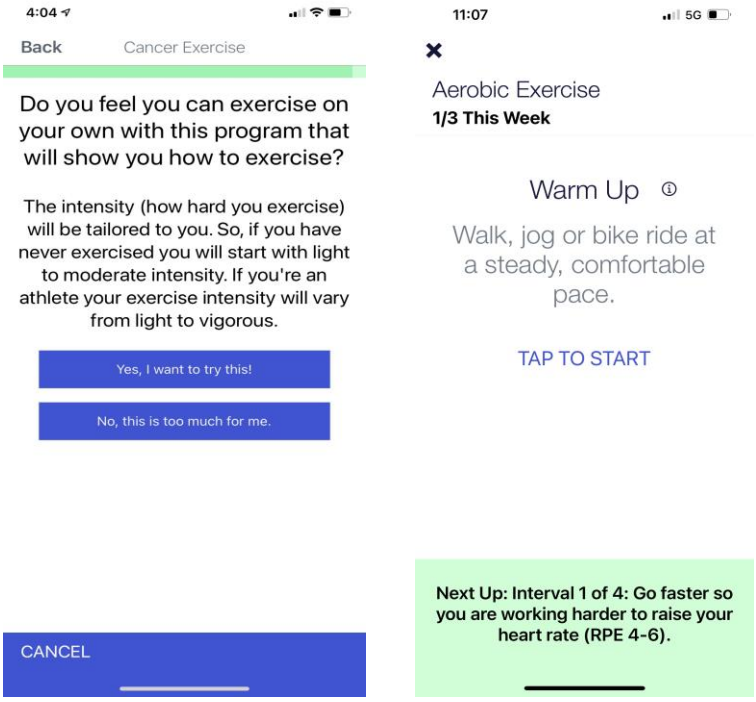

Figure 2. Example screenshots of Cancer Exercise app. (A) Are you ready to exercise with a program that shows you how? (B) Example: aerobic exercise warm-up with instruction for the next part of the exercise.

Design of the cancer exercise app

Knowing that many people living with and beyond cancer are over older, the app was designed for simplicity, readability, ease of navigation and use. To aid in usability, each exercise screen has an information button which takes the user to the library with a picture of the exercise and explanation of how to perform it. During aerobic exercises the screen color gradually changes as the time to completion of each exercise nears. Cancer Exercise is available for iOS and Android devices and can be used on a tablet or smartphone. The design and functionality were revised based on initial testing by cancer survivors. The app has been in the general domain since 2021for iOS devices and was published for android devices in 2023. It has been revised based on users' comments and suggestions to – provide more feedback after each session and the 6-week testing, add a place to record weight and blood pressure. The suggestions regarding feedback were integrated into the first version and subsequent updates were used to add a place for users to record their weight and blood pressure in the Progress tab.

Research use

There are opportunities for researchers to use the app too. For research, each participant user will be given a unique identification number that is tied to the specific study they are participating in. Data is stored securely and can be download for analysis. Researchers can download user data via a HIPAA compliant server, which allows for more extensive, formal app testing.

CONCLUSION

Cancer Exercise is a uniquely tailored mobile application for people living with and beyond cancer and their caregivers. It provides individualized exercise prescriptions based on whether the individual is currently receiving treatment, the type and timing of treatment and their level of fatigue when they begin the day's exercise. The caregiver can also use the application. The algorithms within the application are highly individualized and were derived from years of testing in randomized trials. Future research will focus on the effect of the Cancer Exercise app to benefit the lives of people living with and beyond cancer to maintain and regain their strength for life. The Cancer Exercise app received awards from Ava Digital Awards (Gold medals for apps in medicine and information). It was also nominated Best Mobile App 2020.

ABBREVIATIONS

ACSM, American College of Sports Medicine; RPE, Rating of Perceived Exertion.

AUTHOR CONTRIBUTIONS

A. L. Schwartz: app development and leader. W. Helling: programmer. S. Griffin: project manager. S. Mike's: graphic design. B. Weber overall direction of app development.

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DISCLOSURE STATEMENT

ALS is the developer of the app and President of Coleman Health LLC. BW is president of Inspiring Apps. SG, WH, SM and BW receive a salary from Inspiring Apps.

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PHYSICAL ACTIVITY, EXERCISE AND CANCER

ORIGINAL ARTICLE

Protocol of the oncological physical exercise unit of the province of Alicante

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ABSTRACT

The Oncological Physical Exercise Unit (UEFO) of the province of Alicante, was created by the Spanish Association Against Cancer and Kinetic Performance (EBT of the University of Alicante) with the aim of promoting healthcare, educational and research activities focused on the benefits of physical exercise in oncological disease and its impact on the quality of life of patients, and together with the better tolerance of oncological treatments. The Unit is made up of members of the GICAFD research group of the University of Alicante and professionals with professional experience in different areas of health and physical exercise.
Keywords: Physical activity, Exercise oncology, Healthcare, Quality of life, Oncological treatments, Educational activities.

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INTRODUCTION

The Oncological Physical Exercise Unit (UEFO) of the province of Alicante, was created by the Spanish Association Against Cancer and Kinetic Performance (EBT of the University of Alicante) with the aim of promoting healthcare, educational and research activities focused on on the benefits of physical exercise in oncological disease and its impact on the quality of life of patients, and together with the better tolerance of oncological treatments. The Unit is made up of members of the GICAFD research group of the University of Alicante and professionals with professional experience in different areas of health and physical exercise.

There is scientific evidence that shows that physical exercise is essential for patients to recover the functionality and energy they had before the treatments (in the references). Furthermore, for two decades there has been a call for clinical trials evaluating physical exercise in patients with cancer, which can be beneficial and safe in most types of cancer (see Spence et al., 2010 and Tiernan, 2004 for reviews). However, many patients do not know very well what they should do or where they can go. For this reason, in the Spanish Association against Cancer (AECC) of the province of Alicante, and Kinetic Performance (EBT of the University of Alicante) we have created the first Oncological Physical Exercise Unit in the province of Alicante, in order to provide support to patients.

EVALUATION CRITERIA PRIMARY ENDPOINTS

To evaluate the effect on the functional capacity and quality of life of cancer patients through a supervised physical exercise program for 12 weeks.

Secondary endpoints:

- Increase in VO_{2max} as a beneficial effect on cardiovascular capacity.
- Changes in maximum and elastic-reactive force as indicators of muscular performance.
- Changes in body composition: lean mass and fat mass.
- State of well-being/quality of life.
- Effect of the application of the training program through the correlation of the variables of anamnesis data and clinical history.

STUDY-PROGRAM DESIGN, PARTICIPANTS AND PROCEDURES

The study-program will be an uncontrolled trial that will use a pre-post design, with evaluations at the beginning and after the intervention (12 weeks). The study will be carried out between January 2024 and March 2024 at the Oncological Physical Exercise Unit of the Spanish Cancer Association in Alicante, Spain. This process will be repeated in the remaining quarters of 2024.

This Oncological Physical Exercise Unit has a healthcare service, and is integrated as one more care in the fight against cancer financed by the Spanish Association against Cancer of Alicante, providing free clinical physical exercise services for approximately 60 people with cancer each year.

Sample size

We will need to enroll 60 patients (15 patients each quarter of the year 2024) to detect a clinically important change in VO_{2max} from baseline to post-intervention of 3.39 (±6.7) ml/kg/minutes at 80% power , assuming 15% dropout and a combrach alpha of .05. The estimated change is 3.39 (±6.7) based on a meta-analysis

of the effects of exercise on CRF in breast cancer patients and survivors. Along with an improvement in body composition and strength.

Eligible patients with cancer from any hospital in the province of Alicante will be informed about the study by their oncologist during control visits.

Potentially, eligible participants will be referred to the Spanish Cancer Association in Alicante, Spain, where a health worker will be responsible for triaging patients into different support services, including physical exercise. Patients will be eligible for the study-program by presenting these criteria:

1. The subject is able and willing to follow the procedures of the described protocol.
2. Participants must be 18 years old or older.
3. Participants will have been diagnosed with any locally or regionally advanced primary cancer.
4. Have received adjuvant chemotherapy or adjuvant radiation therapy after chemotherapy.
5. Subjects are able to walk 500m without rest.
6. They do not present any serious physical impairment, nor effects related to cancer treatments such as weakness, fatigue, changes in body composition and/or pain.
7. They do not have any physical or psychological disability,
8. The American Thoracic Society Criteria for performing a cardiopulmonary exercise test (CPET) will be met. The final determination of eligibility will occur at the time of the initial aptitude test.

EXERCISE PROGRAM

The exercise program will be designed and carried out by a Graduate in Sports Sciences with a specific qualification, in accordance with what is indicated in the Exercise guidelines for cancer survivors: consensus statement from an international multidisciplinary roundtable (Cambell et al., 2019) The exercise program will be individualized based on initial fitness testing, including cardiopulmonary fitness, muscle strength, and body composition. Participants will be asked to complete a supervised, progressive, twice-weekly, 12-week program with multi-component exercises. Each exercise session will consist of a warm-up at 50% of maximum oxygen consumption (VO_{2max}) for 5 minutes, followed by 40 to 50 minutes of the main exercise phase and then a 5-minute cool down and stretching for 5 minutes.

Cardiovascular exercise can be done on an elliptical, stationary bike, treadmill, or rowing machine. Intensity will be monitored by a PolarH10 heart rate monitoring device (Polar Electro, 2021) and will gradually be increased during the 12-week program as established in the exercise protocols.

Strength exercises will be performed with multipurpose load-bearing material, and may also be performed with machines that include chest press, leg press and multifunctional machines. The intensity of the resistance will be gradually increased during the 12-week program and will include a new maximum strength test in the sixth week of the program. Apart from the supervised sessions twice a week, from the fifth week, 1 individualized session will be held to encourage training at home.

Nutritional guidelines will be recommended for each patient based on an assessment of body composition at the beginning of the program.

Although the exercise program will be individualized, the study-program will mainly develop exercises based on group objectives. For patients with low or normal muscle mass, the program will focus on building muscle mass. For patients with normal muscle mass and high fat mass, the program will focus on fat loss. The

program design will be the same for both groups. In terms of structure; However, different starting points will be used in exercise intensity for aerobic endurance.

Different starting points of exercise intensity will be prescribed in its aerobic resistance component, to align them with the patient's personalized goal. For those patients focused on gaining muscle mass, the resistance intensity progression will be every 3 weeks. It will begin with 2 sets of 12 repetitions at 70% RM and progressing to 3 sets of 10 repetitions at 75% RM (week 3), 4 sets of 8 repetitions at 80% RM (week 6) and 4 sets of 8 repetitions at 85% RM (week 9). Regarding the cardiovascular exercise program, the intensity will progress every 4 weeks. It will start from 45% to 65% MHR (weeks 1-4), from 65% to 85% MHR (weeks 5-8) and from 85 to 100% MHR (weeks 9-12). For those patients focused on fat loss, resistance intensity progression will be every 3 weeks starting with 2 sets of 12 repetitions at 65% RM and progressing to 3 sets of 10 repetitions at 70% RM (week 3), 4 sets of 8 repetitions at 75% RM (week 6) and 4 sets of 8 repetitions at 80% RM (week 9). Regarding the cardiovascular exercise program, the intensity will progress every 4 weeks from 60% to 70% MHR (weeks 1-4), from 70% to 85% MHR (weeks 5-8), and from 85% to 100% MHR (weeks 9-12).

VALUATION UNIT

Health-related physical fitness assessments will be completed at baseline and post-intervention, and all patients will be informed of the results. Baseline testing will be performed during adjuvant therapy, while post-intervention testing will be completed during or after adjuvant therapy.

ANAMNESIS

The first test will collect the patient's characteristics, demographic and behavioral variables, which will be evaluated through self-report. Medical variables will be extracted from medical data. Patient characteristics will be evaluated to predict the influence of exercise. This exercise will be related to the response to the treatment modality (chemotherapy versus radiotherapy), and the type of cancer (breast versus other). In addition to the comparison in the objective of the exercise program (fat loss versus muscle gain), in reference to BMI (≤25 vs. 25+), and age (<50 vs. 50+).

ASSESSMENT OF BODY COMPOSITION

The second test will determine body composition. It is a measure of energy, nutritional, functional and health balance that is widely used in clinical research and field studies (Hooshmand et al., 2021; Jung et al., 2020; Fernández-Lao et al., 2013) The evaluation instrument will be the Inbody 770 (Microcaya, 2016 S.L), a device with multi frequency direct segmental bioelectrical impedance, which takes 60 seconds to obtain measurements of weight, body mass index, lean body mass, skeletal muscle mass, fat mass, body fat, muscle and skeletal index, and waist-hip ratio. To standardize body composition measurements, patients will be asked to follow some nutritional recommendations. Furthermore, body composition measurements have been observed to correlate with parameters of cardiorespiratory function such as VO_{2max} in cancer (Hooshmand et al., 2021; Bortolozo et al., 2021).

ASSESSMENT OF THE WELFARE STATE

It has been widely determined in the scientific literature that physical exercise, prescribed appropriately (Cambell et al., 2019), can increase the feeling of well-being and improve the feeling of fatigue in different

types of cancer (Desbiens et al., 2017; Gopalakrishna et al., 2017; Lewis et al., 2007). In the third test, quality of life will be measured using the Functional Assessment of Fatigue by Cancer Therapy scale (FACT-F)26, which includes the FACT-General scale (Cella et al., 1998; Cella et al., 1993). (FACT-G) is a Fatigue subscale. FACT-F consists of 40 items including 27 items for the FACT-G scale and 13 items for the fatigue subscale (FACT-F). The FACT-G includes the 4 subscales of physical well-being, functional well-being, emotional well-being, and social well-being. Higher scores on the FACT-F, FACT-G, and fatigue subscale indicate better Quality of Life/less fatigue. The minimum important difference for the FACT-F, FACT-G and fatigue subscales are 7, 4 and 3 points, respectively.

ASSESSMENT OF QUALITY OF LIFE

In the fourth test, the health status will be measured using the Life-5 Questionnaire test (EQ-5 (Ramos-Goñi et al., 2018, Herdman et al., 2011). EQ-5 is an instrument that assesses generic quality of life developed in Europe and widely used in cancer patients. The EQ-5 consists of 1 question for each of the 5 dimensions including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Higher scores on the EQ-5 indicate better health and quality of life outcomes. The minimum important difference in EQ-5 is 4 points. The EQ-5 questionnaire has recently been used in the evaluation of quality of life through physical exercise in cancer patients in Spain (Gil Herrero et al., 2022a; Gil Herrero et al., 2022b).

ASSESSMENT OF MUSCLE PERFORMANCE

The fifth test is about Maximum Strength, which is the ability to exert maximum force against external resistance and requires a maximum voluntary contraction. Patients will be evaluated using the TKK dynamometer, performing an isometric grip of 6 seconds duration, in three repetitions and with a rest of 30 seconds between measurements. Likewise, leg strength will be collected through a CMJ jump, in three attempts and with 30 seconds of recovery. Additionally, maximum strength can be collected through chest and leg press exercises using a maximum of 3 to 5 repetitions (RM), following the ACSM protocol and the Mayhew formula to predict 1RM. Muscle performance is compromised in cachexia and pre-cachectic states in cancer (Dalise et al., 2020). Due to a possible anti-inflammatory effect, physical exercise can be used as a preventive treatment (Gould et al., 2013; de Lima et al., 2008; Petersen and Pedersen, 2005). Studies have also been carried out in elderly patients to prevent loss of muscle performance, with positive preliminary results (Rosero et al., 2020; Arrieta et al., 2019).

ASSESSMENT OF CARDIORESPIRATORY CAPACITY

The sixth test will measure the ability of the circulatory and respiratory systems to supply oxygen to the mitochondria of skeletal muscle in energy production during physical activity. To do this, a submaximal treadmill test will be used to estimate maximum oxygen consumption (VO_{2max}), the volume of oxygen will be recorded using a gas analyzer meter (Metalyzer Sport, CORTEX Biophysik GmbH, Leipzig, Germany) and will be used to predict maximum oxygen consumption in milliliters per kilogram per minute, relating to VO_2 and heart rate. The parameters will have a sampling rate of 15 seconds. The protocol will be carried out in accordance with ATS CPET criteria. In patients with lung cancer, a spirometry test will be completed to evaluate lung function.

Patients will begin with a 2-minute warm-up (3.5 km/hour) and a gradual increase in speed of 0.1 km/hour every 15 seconds and an increase in incline of 0.5% every 30 seconds. The Bruce protocol will be used for patients who will not be able to walk at 4 km/hour. Perceived effort will be measured using the Borg scale

every minute in both protocols. The determination of submaximal VO_2 is a parameter widely used in interventions to evaluate the improvement of cardiorespiratory capacity in various types of cancer (Maginador et al., 2020; Spence et al., 2013).

AUTHOR CONTRIBUTIONS

All authors have contributed equally to all sections of this article.

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No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTE FROM THE AUTHORS

This protocol is a replica of one of the protocols used in the Exercise Oncology Unit of the Spanish Cancer Association, in Madrid, Spain. The Exercise Oncology Unit is a cancer-specific community-based facility funded by the Spanish Cancer Association in 2018.

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Is it ethical today not to prescribe physical exercise in the gynaecology oncology consultation?

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Dear Editor:

If you have been diagnosed with cancer you can and should exercise. If you treat cancer patients you can and should prescribe exercise.

Exercise is medicine and a therapeutic tool. The scientific evidence is proving the reason with more and more force, as if based on *papers* it wanted to knock on the door of health professionals, reminding them of the importance of their involvement in the quality of life of their patient at each visit (Patel, et al., 2019; Campbell, et al., 2019; Pollán, et al., 2020; Rock, et al., 2022).

As a doctor, specialist in gynaecology and obstetrics and subspecialist in gynaecological oncology by the ESGO (European Society of Gynaecological Oncology) I see daily the urgent unmet need that exists in patients with gynaecological cancer to include exercise as soon as possible in their treatment routines. and self-care. I see the gap between the science that remains in the *papers* and the frenetic daily reality of health professionals. But I also see in projects like this journal and in new multidisciplinary teams, a light.

A light that will guide patients through new professionals to find a better quality of life. Patients only need a good exercise program where they can see the benefits in their own body, which, accustomed to fatigue and marked with scars, will feel how exercise transforms them with new hopes, it's filled with vitality and lets the exerkines, hormones, mitochondria, etc. do their work biochemically...(Chow, et al., 2022).

The hardest path is found with health professionals, whose voice has so much weight for patients. Although it should be as easy as encouraging to continue to do the best they do: studying and transferring that knowledge, it seems that the message does not reach. Studies based on real-world data do not show us this (Hardcastle, et al., 2018). Despite the overwhelming scientific evidence and the promising studies that are at

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its mercy, it seems that it still does not compensate with the dedication of time, resources and desire that needs to be invested to be able to look at the patient in a comprehensive manner, as a woman with a biopsychosocial profile independent of their cancer and with a timeline pending to be lived and accompanied by us.

Gynaecological cancers are all the cancers of women, and includes cancer of the uterus, ovary, fallopian tube and peritoneum, cervix, vulva and vagina. Leaving aside for a few minutes breast cancer, which tends to cloud any news related to it due to its numbers, gynaecological cancers represent 14.4% of new cancer cases diagnosed in women around the world.

Uterine cancer (mostly endometrial cancer) is the most common gynaecological cancer in developed countries and one of the few cancers that continues to increase, in incidence and mortality, and especially in women over 65 years of age. This is a worrying fact since as the world's population ages, a higher burden of this cancer is expected.

Exercise in endometrial cancer is crucial in different aspects, starting with prevention. So much so, that in Spain up to more than 45% of uterine cancer in 2012 was attributable to excess body mass index (BMI) and up to 1.2% of cancers in Spain and up to 20% in the US could have been avoided if BMI figures had been maintained since 1982 (Sung, et al., 2021).

And although these figures should speak for themselves to take government measures, the BMI on the contrary does not stop rising, and above all and more dangerously in the average life of adulthood of women. Matching in the moment of peri or post-menopause of most of women, where exercise is undoubtedly the most powerful and complete weapon to avoid complications from both situations.

The quality of life due to endometrial cancer and during menopause is diminished, and it has been shown that it worsens in patients with obesity (Shisler, et al., 2018; Coronado, et al., 2021).

Therefore, the prescription of physical exercise and increased physical activity in women to avoid weight gain (BMI) and thereby reduce a proven risk factor for endometrial cancer is indisputable.

In the majority of women under 40 years of age with early-stage endometrial cancer who wish to preserve their fertility, exercise is also the protagonist. The gold standard treatment is a combination of exercise, nutrition and hormonal treatment without having to give up motherhood.

I believe that at this point you are understanding the impact that the dissemination of these findings can have for the 49.5% of the world's population with their specific and unique cancers. And even without talking about the role of exercise as a tool for improving stress, anxiety, emotional management, self-esteem, at a social level and adherence to chemotherapy treatment, among others… We are talking about exercise as a therapeutic tool and as an unresolved need; exercise as medicine.

The majority of gynaecological cancers will require surgical treatment, and the implementation of exercise and its benefits in relation to this aspect are demonstrated and brought to clinical practice through international guidelines (Wijk, et al., 2019). The maximum expression is observed in ovarian cancer, the silent killer, the number one gynaecological cancer in mortality without the possibility of early detection and usually diagnosed in advanced stages. We are currently in a sweet spot for this tumour with the best survival rates ever seen thanks to the technical possibility of performing major surgeries with less morbidity and

mortality and maintenance drugs that allow us to control the disease and increase the number of long-term survivors.

When the scale comes into play, you must start weighing. Placing the aggressiveness of surgeries with multiple comorbidities, long hospital stays, the adverse effects of continuous treatments on one side and to compensate we have the exercise as a fundamental protagonist that will make the difference in this search for balance. The patient's functional reserve achieved and maintained primarily by exercise will tell us whether she will be able to withstand this surgery and its complications or adhere to a more or less aggressive treatment. Exercise allows us to prepare the patient as if it were the most important competition of her life and improve multiple parameters with a single intervention that none polypill could do.

It has been proven that we reduce many post-surgical complications, hospital stays and allow us to be more aggressive at the surgical level; but we also create the magic of habit and necessity where we will take advantage of this window of opportunity to create healthy life models that will remain forever. With the exercise as an ally, adherence rates to systemic treatment and long-term quality of life improve, offering not only general or disease-free survival but also life in years and not just years in life.

The intention of this call to action is to give your patients the opportunity to improve not only their survival or complete surgery rates but also the greatest treasure with which they get up and go to bed every day, the empowerment, autonomy and independence that offers a high quality of life related to health (HQoL).

The call is based on training to inform, stop and reorder priorities and dedicate time to recommend and/or refer to the necessary professionals who will help us overcome the true challenge of the 21st century of achieving quality of life in cancer patients, leaving the 20th century challenge of survival behind. A truly committed mentality as a health professional is one that practises medicine that not only offers the health of today but is congruent with the health of tomorrow.

To conclude, I leave a reflection shared by many professionals where the current question is: with all this evidence, and despite even the lack of specific guides, and millions of excuses that we can use to avoid having to leave our zone of comfort I ask you: is it ethical today not to prescribe physical exercise in our medical appointments?

Keywords: Physical exercise, Physical activity, Exercise, Cancer, Cancer prevention, Cancer treatments, Cancer survivors, Psychology, Sport medicine.

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