Telehealth applied to physical activity during cancer treatment: a feasibility, acceptability, and randomized pilot study

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Abstract

Purpose Previous studies have underlined the benefits of exercise during cancer therapy. However, patients are insufficiently active during treatment. Telehealth is used to encourage people to be active, reducing difficulties and offsetting the lack of infrastructure often reported. We aimed to identify the effects of recommendations and telehealth on the level of physical activity, fatigue, and quality of life.

Methods Sixty patients suffering from various cancers under treatment were randomized into two groups. Every Sunday, they had to complete online questionnaires: number of steps, MFI-20, and EORTC-QLQ-30. Group R (recommendations) was given encouragement to improve physical activity during 8 weeks, using a recommendation guide, and received a weekly SMS text message for exercise promotion. Group C, without recommendations, was the control group.

Results Two-way ANOVAs for repeated measures did not reveal effect on the number of steps walked over time; however, the results indicated a beneficial effect for group R related to self-reported fatigue ($F = 2.686$, $p = .01$) and quality of life ($F = 2.431$, $p = .02$).

Conclusion Surprisingly, the level of exercise in group R did not significantly increase, but self-reported fatigue and quality of life were improved. This study underlines that inexpensive sharing of time, human, and financial means, through a protocol of physical activity, improves patient health.

Keywords Exercise · Telemedicine · Quality of life · Fatigue · Physical activity

Introduction

Over the past decade, several previous studies have demonstrated the beneficial effect of physical activity during cancer therapy [1]. Regular moderate activity makes it possible to reduce the secondary effects of therapies, in particular fatigue, to improve patients' physical capacities and to enhance their quality of life [2–5]. However, several studies have also shown that patients' levels of physical activity were still insufficient and that the rate of participation in adapted physical activity programs set up in the medical sector remained low.

Lack of time, fatigue, and transport difficulties are factors that limit patient participation in a supervised program of adapted physical activity. Cancer care centers are often regional hospitals, managing patients who can come from several cities, sometimes hundreds kilometers far away from the health center. It becomes necessary to propose programs of remotely controlled physical activity so that all patients in care can benefit from it.

In the last 20 years, telemedicine/telehealth applications have been increasing due to the development of more advanced telemedical devices and of the new patient-centered health care policies [6]. Telemedecine applied to rehabilitation has been proposed as a way of increasing accessibility to the care and supportive care for populations with disabilities, focusing on potential time- and cost-savings [7]. The telerehabilitation is now considered as a branch of medicine. This new field has been investigated mainly in neurology and

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cardiac rehabilitations; nevertheless, the data related with pathologies such as cancer are still scarce. The results from several articles show that telerehabilitation is efficient and induces benefits in 71% of cases [8] and could therefore be considered as a common use in the care of the patient.

Regarding cancer care, many studies have evaluated benefits with exercise home-based program [5], even if the results were encouraging, few authors were interested in the impact of telecommunication or connected tools, applied to physical activity, for their patients [9]. In addition to remotely control physical activity, this virtual relationship between the physical activity teacher and the patient through the telemedicine tools makes it possible to establish or conserve a link and acts as a reminder to the patients.

It is thus necessary to observe the feasibility and effectiveness of a telerehabilitation program for patients suffering from different cancers. The main aim of our study is therefore to investigate the benefits of a distance-guided physical activity program, including a booklet of recommendations and regular text messages, on the level of physical activity, fatigue, and quality of life.

Method

Participants and procedure

The patients included in this controlled study were all undergoing chemotherapy or systemic treatment as out-patients at the Institut Paoli Calmettes—cancer care center (Marseille, France). The patients were recruited in the various waiting rooms of the hospital.

The criteria for inclusion were (1) being capable to practice-adapted physical activity, in particular walking, (2) being able to read and write French, (3) regular internet access, (4) currently undergoing treatment, and (5) being available for the 8 weeks of the study.

Incapacity to perform physical activity, lack of regularity in filling out the questionnaires (questionnaires completed less than three times in the 8 weeks), and a technical problem with the pedometer were criteria for exclusion.

The patients agreeing to take part in the study were randomly divided (1:1) into two groups: the "recommendations" group (R) and the "control" group (C). The patients in group R received advice on increasing their level of physical activity, with the aid of a recommendation guide and SMS text messages sent at the start of every week (D1) to encourage them to undertake a physical activity. The patients in group C received no particular instructions. Each patient, regardless of group, had to wear a pedometer every day for the 8 weeks (W1 to W8) during the study.

At the end of each week (D7), the patients had to fill out online questionnaires via Google Forms (on the Web) to provide information about the daily or weekly number of steps taken, their level of fatigue, and their quality of life. Completion of the questionnaire, at home, took an average of 15 min. The patients had to do this eight times (from W1 to W8) over the whole period.

It was planned to include 60 patients in the study, i.e., 30 in each group. The recruitment lasted 4 months, and approximatively 100 patients were invited to participate. Figure 1 presents the protocol in diagrammatic form.

Measurements

The patients' demographic data were supplied by the doctor at the time of inclusion (age, sex, characteristics of the pathology).

Level of physical activity was measured by a pedometer counting the steps. The patients reported the number of steps they walked throughout the week, either the number of steps taken each day or the total number per week. The count was reset to zero at the end of the week (D7).

Fatigue was assessed using the French version of the Multidimensional Fatigue Inventory (MFI-20) [10]. MFI is a self-reported measure validated for cancer patients [11]. MFI-20 consists of five dimensions: (i) *general fatigue* includes general statements concerning a person's functioning such as "I feel rested"; (ii) *physical fatigue* refers to the physical sensation related to the feeling of tiredness; (iii) *reduced activity* and (iv) *reduced motivation* cover reduction in activities and lack of motivation to start any activity; and (v) *mental fatigue* includes cognitive symptoms such as difficulties in concentrating. MFI-20 is composed of 20 items, scored on a 5-point Likert scale. The total score for each dimension ranges from 0 to 100 in each dimension.

Quality of life was measured using the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC-QLQ-C30) [12], composed of 30 questions, created especially for cancer patients. QLQ-30 consists of a main scale evaluating general quality of life, including five functional scales [physical (five items), role (two items), cognitive (two items), emotional (four items), and social function (two items)] and seven symptom scales specific for cancer [nausea (two items), pain (two items), dyspnea (one item), insomnia (one item), poor appetite (one item), constipation (one item), diarrhea (one item); and a scale for financial difficulties (one item)], often represented during cancer. Finally, this questionnaire was completed with a fatigue scale, comprising three items. All the scales were scored on a scale ranging from 0 to 100.

Tools

Three tools were used in the study. First, the pedometer was used by all participants. It counts the number of steps taken in

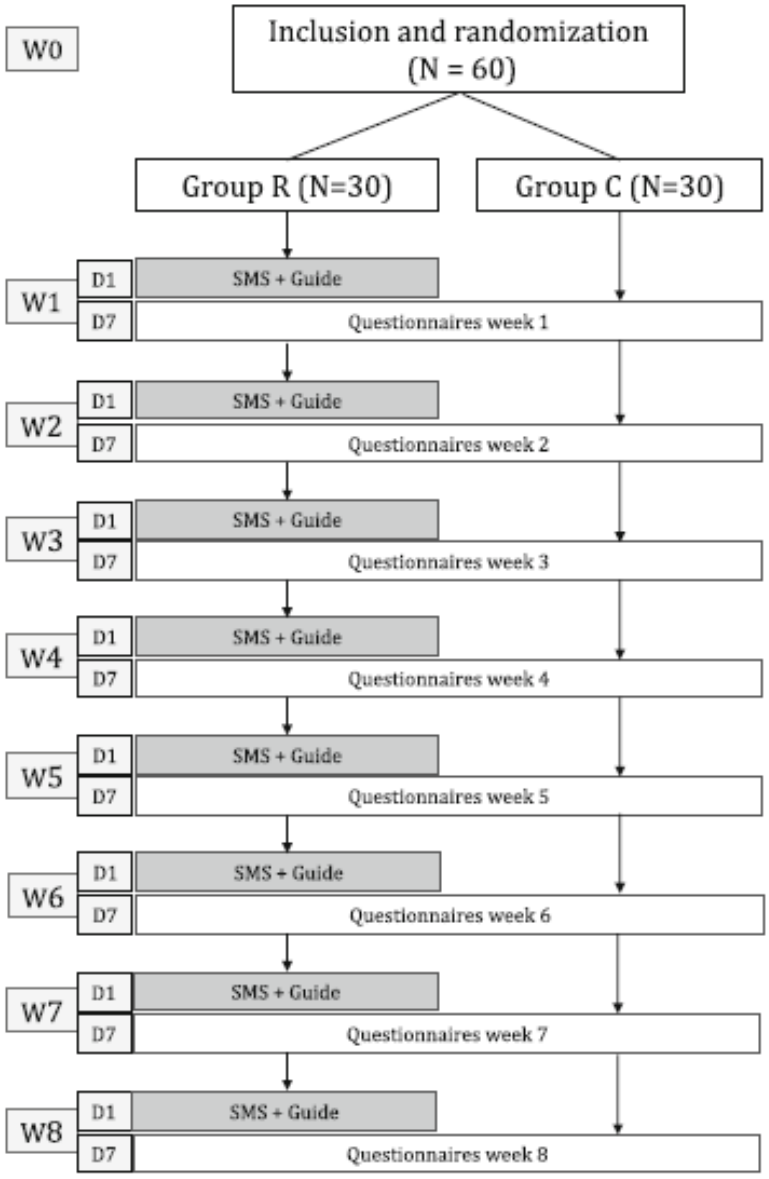

Figure 1 Design of the study: the control group "C" had to answer online questionnaires each week. In addition, the recommendations group "R" received a guide and a weekly SMS. Each group received pedometers

the course of a given time. The pedometer model ONWALK 100 was created by Geonaute® (France). If the pedometer failed to work properly, a new one was sent to the patient's postal address.

The second tool was the set of recommendations, presented as a paper booklet, only used by patients in the group R. This guide was written specifically for this study by an adapted physical activity teacher. It has eight sections for the 8 weeks of the study. Each week, several examples of exercises and numerous recommendations were given to the patients, in particular about walking. The aim of the guide was to encourage and steer the patients so that they maintained or increased their level of physical activity.

Finally, the patients in group R benefited from text messages sent at the beginning of each week (D1) to encourage them to undertake physical activity. These "motivating" messages were written by a teacher of adapted physical activity. Each of the eight messages underlined the need to read and refer the booklet of recommendations. For example, a typical message that could have been sent to the patients: "Undertaking physical activity is sometimes difficult: you're tired, you don't have time…. Often the hardest thing is to take the first steps; once that is done, physical activity is a pleasure. Set yourself a target for the week. Follow the guide you were given for more information. Have a good week!"

Statistics

All the statistical analyses were done using Statistica 6.0. In the first stage, descriptive statistics were produced (mean, standard deviation, frequency). We then carried out repeated two-way ANOVAs on the group factor (R and C) and the time factor (W0 to W8), complemented by post hoc Student-Newman-Keuls or Mann-Whitney-Wilcoxon tests, according to the normal distribution of the data. The significance threshold is set at $p < 0.05$. Data are given as mean ± standard deviation.

Ethics

The study was approved by the hospital's internal Ethics Committee. The human investigations were performed according to the principles outlined in the Declaration of Helsinki. Written informed consent form was obtained from all individuals included in the study.

Results

Among the 60 patients (19 men and 41 women) included in the study, 17 were excluded from the study before analysis of the results (Fig. 2). Finally, 43 patients were retained for the statistics (group $R = 21$; group $C = 22$).

The compliance related with the online survey was computed: based on the 480 questionnaires expected, only 310, i.e., 64.58%, were completed. However, although several patients did not fill out the questionnaire every week, it can be considered that 71% of the patients participated convincingly in the study.

The descriptive analysis showed that the majority of the patients were being treated in the oncology department ($N = 33$) and to a large extent suffered from breast cancer ($N = 21$). Half the patients treated in the hematology department ($N = 10$) suffered from Hodgkin's lymphoma ($N = 5$). In total, there were 31 women and 12 men, and the average age of the whole cohort was 49.70 years ± 13.71 (group $R = 47.84 \pm 11.49$; group $C = 51.46 \pm 15.26$). All the descriptive data on the patients, by group, are presented in Table 1.

At the beginning of the program, no statistical differences in age between the two groups were found ($t = -0.87$, $p > 0.05$). The number of men and women showed to be different between the groups (chi-squared = 6.89, $p < 0.05$).

ANOVAs with repeated measures on two factors—time (8 weeks) and groups (two groups)—were carried out for the weekly number of steps, the five dimensions of fatigue, and all the dimensions of quality of life.

The results illustrated no effect of time or group on the numbers of steps walked each week by the patients (Table 2).

Regarding the General Fatigue scale, the results showed a significant group × time effect ($F = 2.686$, $p < 0.05$). The Student-Newman-Keuls tests indicated that group R reported lower scores in the General Fatigue dimension than group C at W7 ($p < 0.01$) and W8 ($p < 0.05$) (Fig. 3a).

The ANOVAs on the four other dimensions of fatigue also indicated a group × time effect: physical fatigue ($F = 3.087$, $p < 0.05$), reduced activities ($F = 2.096$, $p < 0.05$), reduced

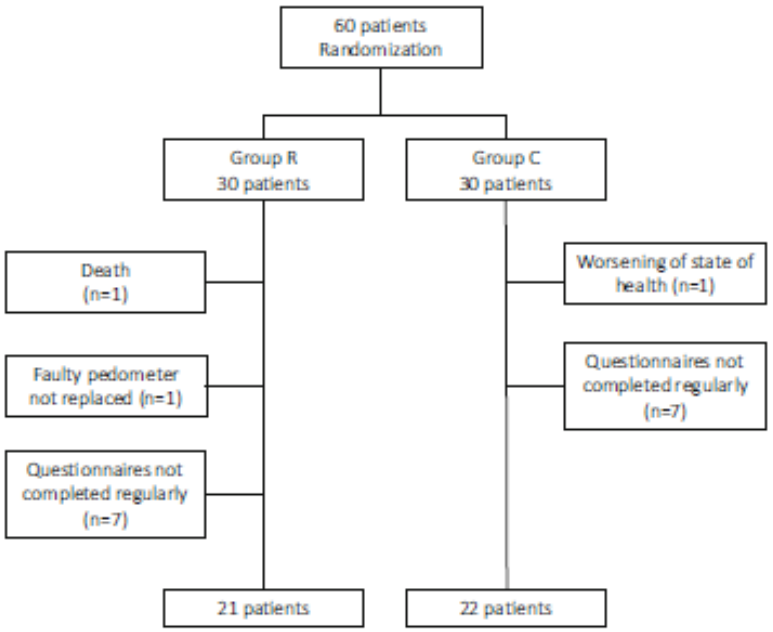

Fig. 2 CONSORT flow diagram of the study

Table 1 Characteristics of the patients

	Group R ($n=21$)	Group C ($n=22$)	Total
Participants ($n=43$)			
Males	$n=2$	$n=10$	$n=12$
Females	$n=19$	$n=12$	$n=31$
Age (years)	47.84 ± 11.49	51.46 ± 15.26	49.70 ± 13.71
Types of cancer (n=)			
Lung cancer	$n=1$	$n=1$	$n=2$
Pancreatic cancer	$n=0$	$n=1$	$n=1$
Breast cancer	$n=12$	$n=9$	$n=21$
Ovarian cancer	$n=3$	$n=1$	$n=4$
Digestive cancer	$n=0$	$n=4$	$n=4$
Tongue cancer	$n=0$	$n=1$	$n=1$
Leukemia	$n=2$	$n=1$	$n=3$
Non-Hodgkin's lymphoma	$n=0$	$n=1$	$n=1$
Hodgkin's lymphoma	$n=3$	$n=2$	$n=5$
Myeloma	$n=0$	$n=1$	$n=1$
Presence of metastasis (n=)	$n=8$	$n=5$	$n=13$

motivation ($F=2.057$, $p<0.05$), and mental fatigue ($F=2.285$, $p<0.05$). The Student-Newman-Keuls tests highlighted a difference at W7 and W8, when group R had significant lower scores than group C in these four dimensions (Table 3).

The ANOVA on the General Quality of Life dimension showed a group effect ($F=4.050$, $p=0.05$) and a group × time effect ($F=2.431$, $p<0.05$). The Student-Newman-Keuls tests demonstrated a significant decline in the Quality of Life scores between W1 and W7 for group C ($p<0.05$); they also showed a group effect at W7 ($p<0.05$) and W8 ($p<0.05$): group R had a higher score than group C for these two times of measurement (Fig. 3b).

The ANOVA showed a tendency for a group effect ($F=3.993$, $p=0.051$) and a significant group × time effect ($F=2.604$, $p<0.05$) on the role function. The Student-Newman-Keuls tests showed a significant decline in this score for group C between W1 and W7 ($p<0.01$); they also showed a higher role function score for group R than group C at W7 ($p<0.01$) and W8 ($p<0.01$) (Table 3).

The ANOVA showed a group × time effect on the physical capacity dimension ($F=2.296$; $p<0.05$); group R had higher scores than group C in W7 ($p<0.01$) (Table 3). A group × time effect was also found on the emotional capacity dimension ($F=2.985$; $p<0.01$); the Student-Newman-Keuls tests demonstrated that group R had significantly higher scores than group C from W5 to W8 ($p<0.05$) (Fig. 3c).

Data from the other scales composing the quality of life questionnaire (EORTC-QLQ-30) were processed, and no significant changes were observed throughout the study (data not shown).

Discussion

This study was designed to analyze the effect of a program of physical activity guided at a distance (text messages, booklet of recommendations, pedometer, and online questionnaires) on the level of physical activity, fatigue, and quality of life of patients undergoing treatment.

The ANOVAs on the two groups (R and C) and on the eight times of measurement showed that from the seventh week of the program, the general state of health of group R was significantly better than that of group C. Group R had a better general quality of life and reported lower fatigue than group C. The emotional state of group R was significantly better from fifth week of the program. On the other hand, contrary to our initial hypotheses, the weekly number of steps walked did not differ between the two groups and we observed no significant increase in the level of physical activity for the group receiving regular recommendations.

Table 2 Number of steps for group R and group C (mean ± SD)

	Group R	Group C
Week 1	9249.6 ± 5939	7323.4 ± 4545.7
Week 2	7382.3 ± 3798.4	8835.5 ± 8374.2
Week 3	7746.2 ± 4233.8	8209.8 ± 9574.9
Week 4	7016.7 ± 3895.4	9072.3 ± 6249.3
Week 5	7643.3 ± 3147.2	7933.3 ± 5183.7
Week 6	5861.1 ± 2539.7	6770.5 ± 4293.7
Week 7	6408.8 ± 2942.8	6440.2 ± 4881.2
Week 8	6782.6 ± 2805.2	6921.3 ± 4304.8

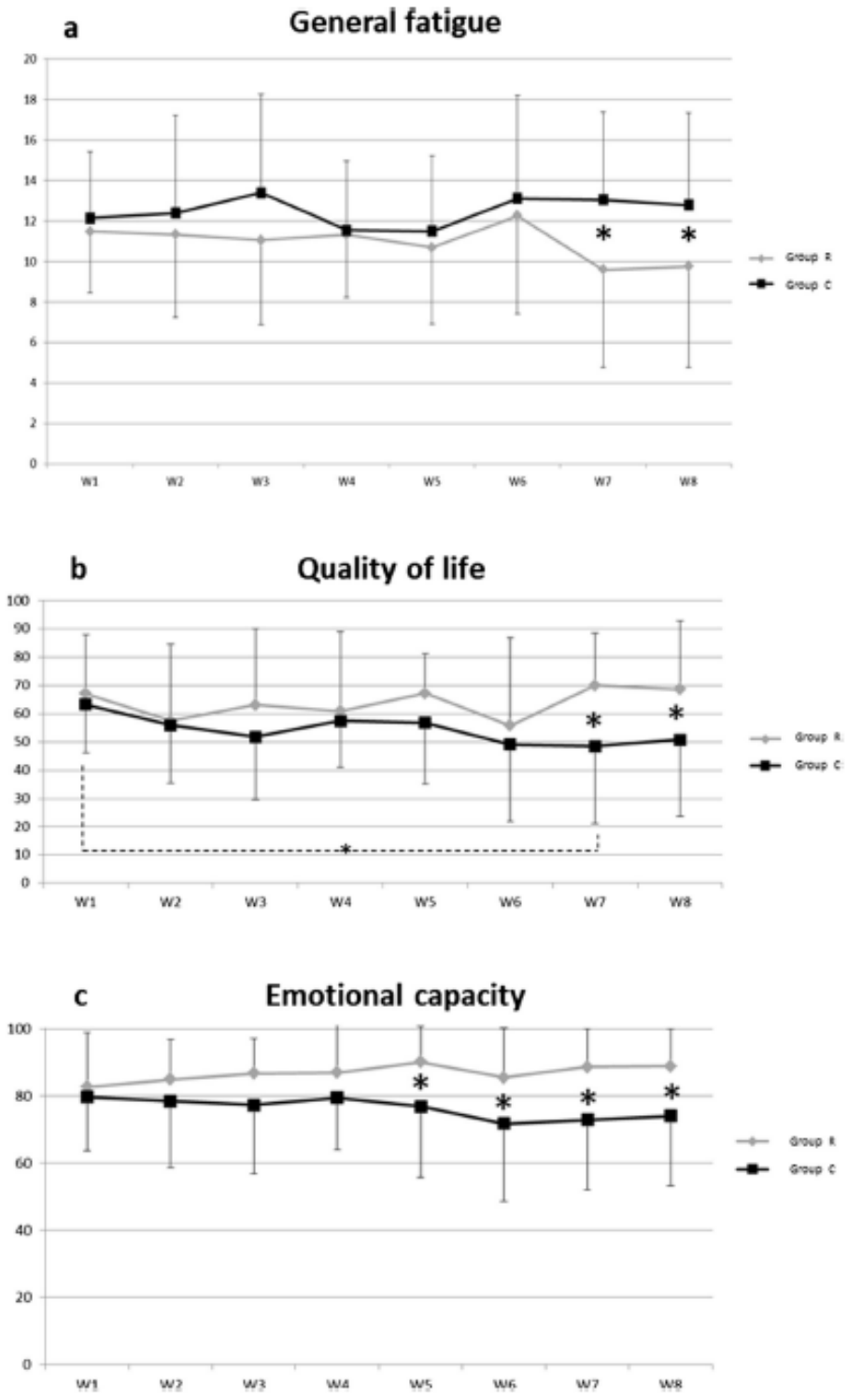

Fig. 3 **a** General Fatigue score from questionnaire MFI-20 for group R and group C, over the 8 weeks (*$p<0.05$). **b** Quality of life, from questionnaire QLQ-30 between group R and group C, over the 8 weeks (*$p<0.05$). **c** Emotional capacity from questionnaire QLQ-30 between group R and group C, over the 8 weeks (*$p<0.05$).

Our data are in accordance with the results of previous studies on physical activity during cancer treatment which have shown that the benefits of physical activity are particularly observable after 6 weeks of practice [5]. Most of the significant changes in our study are indeed obtained after 7 weeks of intervention.

Table 3 Scores of fatigue (MFI-20) and quality of life (QLQ-30) dimensions in group R and group C at W7 and W8

Variables	Week 7		Student - Newman-Keuls	Week 8		Student - Newman-Keuls
	Group R	Group C		Group R	Group C	
Physical fatigue (MFI-20)	9.27 ± 3.94	12.67 ± 4.93	$^{**}p<0.01$	9.76 ± 4.63	12.27 ± 4.63	$^{*}p<0.05$
Reduced activity (MFI-20)	8.60 ± 3.33	12.43 ± 4.84	$^{**}p<0.01$	8.24 ± 4.09	11.82 ± 4.16	$^{**}p<0.01$
Reduced motivation (MFI-20)	7.33 ± 3.75	11.05 ± 4.67	$^{**}p<0.01$	7.88 ± 3.74	10.73 ± 3.87	$^{*}p<0.05$
Mental fatigue (MFI-20)	6.73 ± 3.41	10.48 ± 4.28	$^{**}p<0.01$	6.94 ± 3.77	9.95 ± 4.19	$^{*}p<0.05$
Role function (QLQ-30)	83.33 ± 18.70	60.71 ± 28.85	$^{**}p<0.01$	82.35 ± 18.78	63.64 ± 23.11	$^{**}p<0.01$
Physical capacity (QLQ-30)	88.33 ± 13.45	75.48 ± 18.87	$^{**}p<0.01$	88.24 ± 13.57	83.64 ± 12.65	$p = 0.269$

$^{**}p<0.01$ * $p<0.05$

Several previous studies have stressed the effect of physical activity in reducing fatigue and in improving quality of life during cancer treatment [3–5, 13]. The hypotheses put forward on the underlying mechanisms suggest that maintenance of muscle mass helps patients to avoid or emerge from the vicious circle of physical deconditioning [14]. In our study, although the number of steps—and consequently the level of physical activity—is not significantly different between the two groups, we show that the general state of health (quality of life and fatigue) is improved. Our study thus shows that there appears to be an effect of the discourse on physical activity and an effect of the advice given to patients on fatigue and quality of life.

Several hypotheses could explain this phenomenon. First, it appears that the sense of personal efficacy (i.e., self-efficacy) [15] can have an effect on patients' fatigue and quality of life. Self-efficacy refers to individuals' beliefs as to their capacity to achieve particular performances [15]. Some studies have shown that self-efficacy, in particular in physical activity, seems to have an effect on the general quality of life in women with breast cancer [16]. According to Bandura [15], there are several sources of information that might modify self-efficacy for a given behavior. One of them is the verbal persuasion, which means that through suggestions, recommendations, and advice, people may be led towards the belief that they have the potential to perform the behavior successfully [17]. We may assume that the booklet of recommendations and the text messages sent regularly to group R help them to think that they are capable of performing regular physical activity, and so improve their self-efficacy, which in turn improves their perceived state of health even if they do not increase their level of physical activity. Other studies have examined Symptom Self-Management (SSM), a theory derived from Bandura's theory of self-efficacy [15]. SSM is a dynamic, autonomous process in which a patient suffering from a chronic disease such as cancer adopts behaviors that prevent, relieve, or diminish the symptoms (their frequency, intensity, duration, etc.) [18, 19]. Thus, according to Hoffman [18], an improved of self-efficacy impacts positively on the improvement of SSM and makes it possible to reduce the symptoms experienced.

It would also be interesting, in subsequent studies, to question the role of social support in telerehabilitation. Indeed, some authors have shown that social support could allow patients to have better coping strategies and thus have a better quality of life [20, 21]. It would be interesting to know if the teacher of physical activity, beyond the known benefits of physical activity, could not have an impact in the social support of the patient.

Our results are consistent with those presented in the meta-analysis by Van Dijck et al. [22], which shows that offering patients programs of physical activity to be performed autonomously (a guide or multimedia format) has beneficial effects on their quality of life through improved self-management. In this regard, it would be interesting in further studies to test patients' perceived level of physical activity in order to analyze whether the fact of considering that one engages in activity itself produces benefits.

Finally, no anomaly was observed due to the use of the pedometer or physical activity performed autonomously, and the patients' rate of compliance (71.6%) is convincing. Our results regarding compliance confirm those of a study on lung cancer patients [23]. Our study, which is economical in both financial and human terms, provides interesting results which could be a good alternative to the supervised physical activity programs offered in hospitals, or a strategy to extend the patients return from the hospital.

There are many limitations to this study. First, it is important to note that the number of patients is modest. Although this pilot study demonstrates that the feasibility of this type of protocol is good, a larger scale study should be conducted to confirm these original results. A more detailed analysis of the underlying mechanisms to demonstrated benefits (SSM, self-efficacy, etc.) could be proposed in order to deepen the hypotheses raised above. Then, the level of physical activity was focused on the analysis of the number of steps, not taking into account some other activities (biking, stretching, upper limb movements, etc.), although in the recommendations emphasis is on walking, some data on the level of physical activity may

not have been measurable. At last, it is important to nuance the results obtained, since we observe a difference between the two groups as regards the sex of the participants: there are more men in group R than in group C, which could have an influence on the level of self-reported fatigue and quality of life in each group.

In conclusion, the results of our study underline that patients receiving regular recommendations to raise their level of physical activity have a better quality of life and are less fatigued than patients who are not guided. However, the level of physical activity of all the patients did not change. Our study indicates that there could be a mediator between patients' physical activity and their state of health, which is not necessarily physical improvement but rather self-management in physical activity. The feasibility and adherence to this type of protocol was good and suggested that a remotely operated program could be a credible alternative to supervised programs. The use of inexpensive and engaging tools such as the pedometer and the recommendations booklet seems to be a way of coping with patients' fatigue and loss of quality of life without risk. These results also show that adapted physical activity specialists play an important part both in reducing fatigue and improving the quality of life and also in the patients' support.

Although the results of this study need to be confirmed in a larger study and a larger cohort of participants, we can wonder if the telerehabilitation, beyond the expected physical benefits, could be a way to achieve other objectives, more global and essential for the patient.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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