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ORIGINAL ARTICLE

Digital home-based multidisciplinary cardiac rehabilitation: How to counteract physical inactivity during the COVID-19 pandemic

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KEYWORDS
COVID-19;
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Abstract
Introduction and Objectives: Center-based cardiac rehabilitation (CR) programs have been forced to close due to COVID-19. Alternative delivery models to maintain access to CR programs and to avoid physical inactivity should be considered. The aim of this study was to assess physical activity (PA) levels after completing a home-based digital CR program.
Methods: A total of 116 cardiovascular disease (CVD) patients (62.6±8.9 years, 95 male) who had been attending a face-to-face CR program were recruited and assessed (baseline and at three months) on the following parameters: PA, sedentary behavior, adherence, cardiovascular and non-cardiovascular symptoms, feelings toward the pandemic, dietary habits, risk factor control, safety and adverse events. The intervention consisted of a multidisciplinary digital CR program, including regular patient assessment, and exercise, educational and psychological group sessions.

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Results: Ninety-eight CVD patients successfully completed all the online assessments (15.5% drop-out rate). A favorable main effect of time was an increase in moderate to vigorous PA and a decrease in sedentary time at three months. Almost half of the participants completed at least one online exercise training session per week and attended at least one of the online educational sessions. No major adverse events were reported and only one minor event occurred.
Conclusion: During the pandemic, levels of moderate to vigorous PA improved after three months of home-based CR in CVD patients with previous experience in a face-to-face CR model. Diversified CR programs with a greater variety of content tailored to individual preferences are needed to meet the motivational and clinical requirements of CVD patients.

PALAVRAS-CHAVE
COVID-19;
Doença cardiovascular;
Prevenção secundária;
Reabilitação cardíaca domiciliária;
Telemedicina

Reabilitação cardiovascular em casa (REC-casa): como contrariar a inatividade física na era Covid-19?

Resumo
Introdução e objetivos: Os programas convencionais de reabilitação cardíaca (RC) foram forçados a encerrar devido à Covid-19. Modelos alternativos para que os doentes tenham acesso a um programa de RC evitando a inatividade física devem ser considerados. O objetivo deste estudo foi avaliar os níveis de atividade física (AF) de um programa digital de RC em casa.
Métodos: Foram recrutados e avaliados (inicialmente e aos três meses) 116 doentes cardiovasculares (CV) (62,6±8,9 anos, 95 homens) que frequentavam um programa presencial de RC, nos seguintes parâmetros: AF, comportamento sedentário, adesão, sintomas CV e não CV, sentimentos face à pandemia, hábitos alimentares, fatores de risco, segurança e eventos adversos. A intervenção consistiu num programa digital multidisciplinar de RC, inclusive acompanhamento regular, sessões de exercício, de ensino e de psicologia em grupo.
Resultados: Completaram com sucesso todas as avaliações *online* (15,5% *drop-out*) 98 pessoas com doença CV. Houve um efeito favorável no aumento da AF moderada a vigorosa e diminuição do tempo sedentário aos três meses. Quase metade da amostra fez, pelo menos, mais de uma sessão de exercício físico *online* por semana e assistiu a pelo menos uma das sessões educacionais *online*. Não se verificaram eventos *major* e registou-se apenas um *minor*.
Conclusão: Em tempo de pandemia, os níveis de AF moderada a vigorosa melhoraram após três meses em doentes CV que frequentavam previamente um modelo presencial de RC. São necessários mais programas de RC com maior variedade de conteúdos adaptados à preferência individual para dar resposta às necessidades motivacionais e clínicas dos doentes CV.

Introduction

After an acute event or with a chronic heart condition, patients need guidance and structured support to recover and improve their physical, psychological, social and vocational functioning. A comprehensive cardiac rehabilitation (CR) program is an effective and recommended secondary prevention strategy.[1]

To avoid the spread of the novel coronavirus disease 2019 (COVID-19), various governmental measures have been applied worldwide such as quarantine and various forms of lockdown, including the suspension of center-based CR programs.

An emerging major problem is the potential harmful effects of the suspension of center-based CR programs possibly leading to physical inactivity and deleterious lifestyle habits.[2] There are several negative effects of acute and prolonged cessation of physical activity, including increased risk of many severe and disabling disorders.[3] In view of the sudden closure of center-based CR programs because of the COVID-19 pandemic, alternative delivery models should be considered to avoid detraining and physical inactivity.[4,5]

Alternative models such as home-based CR are well established and have been studied as an effective method to improve survival, quality of life, functional status, cardiovascular risk profile and cost-effectiveness.[6]

One model of a home-based program is the distance delivery of a digital or virtual CR program using computer and communications technology to facilitate or optimize the quality and effectiveness of care. This includes telephone follow-ups and video-conferencing communication, e-mail,

text or other forms of messaging, smartphone applications, online platforms, and wearable devices.[7]

The primary aim of this study was to assess the amount of physical activity after a three-month home-based multidisciplinary digital CR program as an alternative to suspended center-based CR in patients with cardiovascular disease (CVD). Additionally, as a secondary aim, the study assessed adherence, dietary habits, subjective psychological impact, risk factor control, safety and adverse events in these patients during the three-month home-based intervention.

Methods

Study design

A prospective cohort study was conducted at the Cardiovascular Rehabilitation Center of the Cardiology Department of the North Lisbon University Hospital Center (CHULN), Faculty of Medicine of the University of Lisbon (FMUL) and Cardiovascular Rehabilitation Center of the University of Lisbon (CRECUL) a European Association of Preventive Cardiology-accredited Preventive Cardiology Center, in April 2020.

The primary aim was to assess the amount of physical activity after a three-month home-based multidisciplinary digital CR program. The secondary aim was the assessment of adherence to the program determined by the number of exercise training and educational sessions attended, dietary habits, subjective psychological impact, risk factor control, and occurrence of minor and major adverse events in general and during the exercise sessions.

The primary and secondary aims were assessed via an online questionnaire at baseline and at three months after starting the home-based CR program. The core components of the program are presented in Table 1. The study was carried out in accordance with the recommendations of the Declaration of Helsinki for human research.

Participants

Patients (men and women), independently of age, who had been participating at the CR center of the CHULN/FMUL/CRECUL were invited to participate in this study after the center-based CR program was forced to close due to COVID-19. Informed consent was obtained from all participants included in the study. Inclusion criteria were age over 18 years, with diagnosed CVD, clinically stable, and participation at the center-based CR program before COVID-19. Exclusion criteria were unstable cardiovascular or non-cardiovascular status, a medical condition that contraindicated exercise, or lack of access to the technology required to complete the online questionnaires.

Home-based cardiac rehabilitation program

Online assessment questionnaire

At baseline (three weeks after suspension of the center-based CR program due to pandemic lockdown in April 2020) and at three months after starting the home-based CR program, patients completed an online questionnaire regarding cardiovascular and non-cardiovascular symptoms and signs, feelings towards the pandemic, pharmacological therapy, resting heart rate and blood pressure, blood glucose (if diabetic), body weight, height, physical activity, and diet.

The International Physical Activity Questionnaire-Short Form (IPAQ-SF), validated for the Portuguese language, was used to assess physical activity.[8] The IPAQ-SF records the last seven-day recall for four intensity levels of physical activity: vigorous-intensity activity, moderate-intensity activity, walking and sitting.

Diet was assessed by asking about changes in eating patterns (including vegetables, meat, fish, fruit, beverages, water, etc.) before COVID-19 and at three-month follow-up, based on questions from a national study on eating habits and physical activity during the pandemic (REACT-COVID).[9]

Online exercise training sessions

The online exercise training sessions included in the home-based CR program consisted of recorded videos and real-time online exercise training sessions.

A recorded video of an exercise session was provided weekly on an online platform. Six exercise training sessions were recorded by exercise physiologists and physiotherapists. Participants were recommended to do each session three times a week, for 60 min (10 min warm-up, 40 min circuit training and 10 min cool-down), performing eight different exercises (two upper limbs, two lower limbs, two core stability, two balance). Each exercise had three levels of progression (easy, moderate, difficult) with two or three sets of 10-15 repetitions, and all exercises were done with body weight and/or household objects (e.g. books, bottles of water, packs of rice, etc.). The aim, using the Borg Rating of Perceived Exertion scale (6-20), was to reach moderate intensity, i.e. a score of 11-14.

The participants performed the exercise program in their own home, without simultaneous professional supervision. However, a pictorial exercise training guidebook was available to all participants, including instructions regarding safety, clothing and warm-up, and a detailed illustrated description of each home-based exercise session. Also, for questions or difficulties regarding the exercises, an e-mail address and telephone number were provided.

Once a month, real-time CR exercise sessions lasting 60 min were provided via computer, tablet or smartphone with internet access, at a specific time slot that allowed healthcare professionals to follow 6-8 patients per class at home, ensuring adherence and supporting them throughout the session.

A personal health diary was provided for documenting vital signs, adherence to the exercise training program (including online sessions, walking, cycling or other forms of physical activity), and adverse events. Serious adverse events were defined as symptoms that posed a threat to the participant's health and that led to study suspension for immediate medical treatment or consultation with a physician. Minor adverse events were categorized as meaningful events of moderate or minor clinical severity.

Table 1 Core components of the home-based cardiac rehabilitation program.

Components	Description	Tools
Patient assessment, risk assessment and identification of risk factors	Clinical history including screening for risk factors, cardiovascular and non-cardiovascular symptoms and signs; feelings toward the pandemic; pharmacological therapy; resting heart rate and blood pressure; blood glucose (if diabetic); body weight; height; physical activity; diet and quality of life	Online questionnaire Regular patient assessment and support
Physical activity counseling	Recommendation on gradual increase in daily life activities, minimum 2.5 hours/week of moderate aerobic activity, multiple bouts, each >10 min, 4-5 days/week; and recommendations to break sedentary time	Online educational sessions Illustrated booklets Phone calls
Exercise training	Submaximal endurance training with gradual increase (3 different levels of progression) and resistance training, 2-3 times per week	Online exercise training sessions (real-time exercise sessions and recorded videos)
Nutritional counseling	Assessment of eating habits and alcohol consumption; education of patient and family concerning dietary goals and healthy food choices	Online educational sessions and webinars
Weight control management	Weight, height and BMI measurements every 2 weeks	Online questionnaire
Blood pressure management	Blood pressure measurement at rest every 2 weeks	Online questionnaire
Diabetes management	Diabetes self-management education and support programs	Online questionnaire
Smoking cessation	Education and encouragement to smokers not to smoke through behavioral advice	Online educational sessions
Psychosocial management	Screening for depression and anxiety	Online educational sessions Psychological group sessions
Education	Education on each component of CR and its purpose, and on self-monitoring and self-management	Online educational sessions

BMI: body mass index; CR: cardiac rehabilitation.

Online educational sessions

A structured online educational program was provided for patients and family members/caregivers including educational videos and webinars.

One recorded video of an educational session per week was uploaded to the platform, followed by a healthy cooking recipe and nutritional tips aimed at improving cardiovascular health. The educational sessions, lasting 10-15 min, were delivered by the corresponding health professional from the CR team. These sessions aimed to educate and inform patients and their family members or caregivers on behavioral and lifestyle changes. The educational sessions covered the following topics: COVID-19 and CVD; coronary artery disease and cardiovascular risk factors; heart failure; hypertension; dyslipidemia; smoking cessation; diabetes; medical therapy and adherence; healthy food and the Mediterranean diet; exercise and physical activity; sedentary behavior; and sexual dysfunction and CVD.

One real-time webinar on nutritional myths lasting 90 min was developed as a replacement for the regular face-to-face workshop provided at the center-based CR program that took place every three months.

Self-monitoring of blood pressure, heart rate and blood glucose (if diabetic) was promoted, as was smoking cessation.

Psychological group sessions

The psychological group sessions included online support group sessions and relaxation sessions.

Monthly 60-min online face-to-face group support sessions, called 'heart talks', were provided, moderated by a psychiatrist, a cardiologist, and other members of the CR team.

The online relaxation sessions, lasting 45 min, were run by the psychologist of the CR team. These sessions were recorded and placed on the online platform to allow participants to re-watch and repeat them.

Regular patient clinical assessment and support

An online short-form follow-up questionnaire was completed in every two weeks. Patients who did not respond received a telephone call from the CR nurses emphasizing the need to complete it.

Table 2 Baseline characteristics of the study population.

	All patients (n=116)	Completed (n=98)	Did not complete (n=18)	p
Female/male, n	21/95	16/82	5/13	0.246
Age, years	62.6±8.9	63.0±8.5	60.17±11.2	0.154
BMI, kg/m²	27.5±3.3	27.7±3.2	26.4±3.9	0.448
MVPA, min/week	239±209	230±198	286±264	0.148
Diagnosis, %				
CAD	88.8	88.8	88.9	0.989
Heart failure	13.8	14.3	11.1	0.720
Valve disease	5.2	4.1	11.1	0.216
PAD	3.4	3.1	5.6	0.594
Implantable device	12.1	13.3	5.6	0.356
LVEF (%)	52.8±10.7	52.9±10.8	52.5±10.0	0.710
Risk factors, %				
Family history of CVD	41.7	41.8	41.2	0.959
Hypertension	58.6	60.2	52.9	0.574
Type 2 diabetes	18.1	17.9	22.2	0.572
Dyslipidemia	37.9	37.8	38.9	0.789
Ex-smoker	51.7	55.4	35.3	0.089
Smoker	12.9	14.3	5.9	0.310
Overweight (BMI >25 kg/m²)	74.7	78.3	50.0	0.055
Medications, %				
Beta-blockers	79.3	79.6	66.7	0.560
Statins	80.2	79.6	81.3	0.978
Diuretics	28.4	31.6	13.3	0.135
ACE inhibitors	51.7	52.0	43.8	0.462
Antiplatelets	38.8	38.8	44.4	0.433
Aspirin	78.4	75.5	83.3	0.127

ACE: angiotensin-converting enzyme; BMI: body mass index; CAD: coronary artery disease; CVD: cardiovascular disease; LVEF: left ventricular ejection fraction; MVPA: moderate to vigorous physical activity; PAD: peripheral arterial disease.
Data are mean ± SD.

Physician appointments (teleconsultations) were scheduled according to the signs and symptoms presented in the follow-up questionnaire or if patients requested one (by e-mail or telephone) to avoid non-urgent hospital visits and hence unnecessary exposure to COVID-19.

Minor and major adverse events such as hospitalizations for cardiac or other reasons, cardiac death, or death from non-cardiac causes were collected.

Statistical analysis

Descriptive statistics including means, standard deviation and percentages were calculated for all main and secondary outcome variables. Chi-square tests were performed to assess differences in categorical variables between the different time points. Normality was tested using Q-Q plots.

A paired Student's t test was performed to compare changes in BMI and parameters of physical activity and sedentary behavior from baseline to three-month follow-up. The Wilcoxon signed-rank test was used if a normal distribution could not be assumed.

A subanalysis was performed of differences in age, gender and adherence between groups. Changes over time within each group and any interactions were assessed by two-way repeated measures analysis of variance.

Statistical significance was set at an alpha level of 0.05. Data analysis was performed using IBM SPSS Statistics version 25.0 (IBM SPSS Inc., Chicago, IL).

Results

Baseline descriptive characteristics of all patients who completed or did not complete the study are presented in Table 2.

Nearly 90% of the participants who completed the home-based CR program had coronary artery disease, followed in number by heart failure (n=14), valvular heart disease (n=4) and peripheral artery disease (n=3). Regarding risk factors, overweight was the most common (78.3%), followed by hypertension (60.2%), family history of CVD (41.8%), dyslipidemia (37.8%), type 2 diabetes (17.9%), and smoking (14.3%). Within the obesity risk factor, 58% were classified as overweight and 20.3% as obese. Sixty percent of patients met the WHO recommendations for physical activity and 30% attained more than 300 min per week of moderate to vigorous physical activity.

Medication dosages taken by most patients (90%) did not change during the study. Among the 98 patients who completed the three-month home-based CR program, 83.7% were male and 16.3% were female.

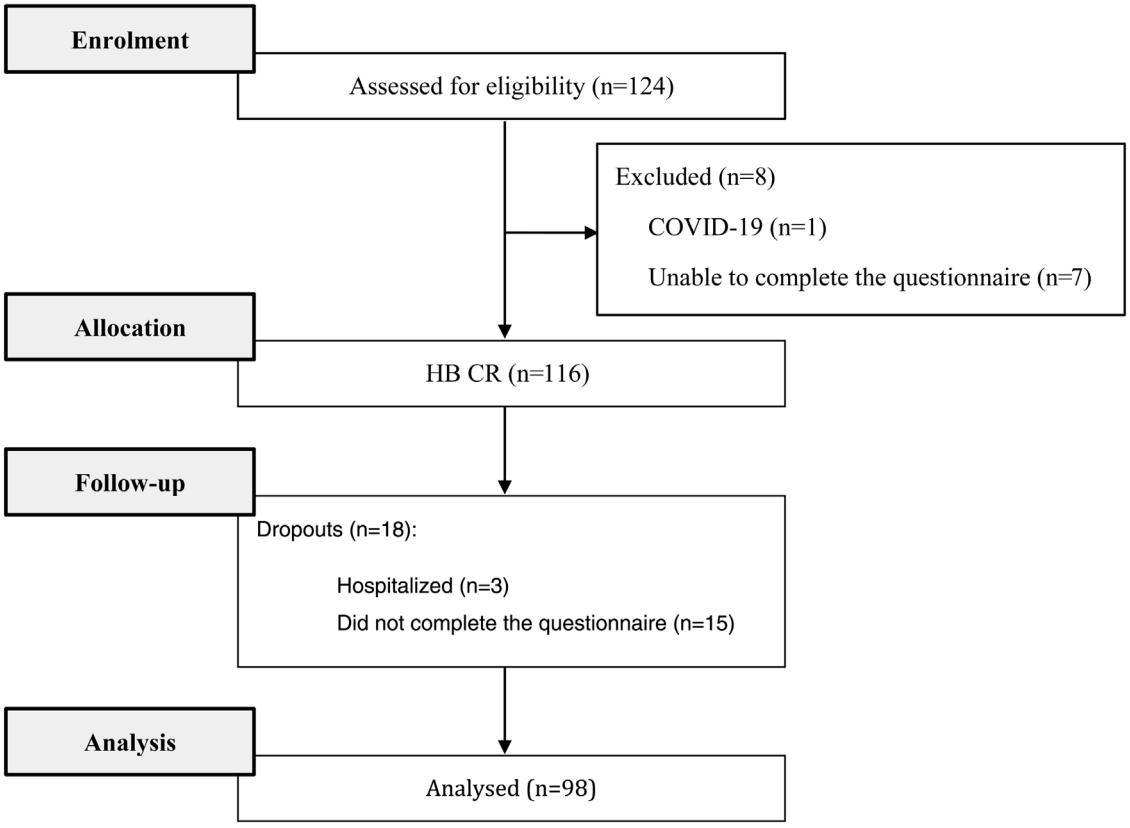

Figure 1 Study flow chart. CR: cardiac rehabilitation; HB: home-based.

The dropout rate was 15.5% (Figure 1). Three male participants dropped out in week 1, 2 and 4, due to hospitalization for knee surgery, pacemaker implantation and in-stent restenosis, respectively. Fifteen patients (five female and 10 male) did not complete the three-month online questionnaire. Only one adverse event (a sprained ankle) was reported during the exercise training sessions. None of the descriptive characteristics, including age, gender, BMI, physical activity, risk factors and medication, were significantly different between patients who did or did not complete the study (Table 2).

Data on all patients who completed the home-based CR program assessments on body composition, physical activity and sedentary time are summarized in Table 3.

Physical activity and sedentary time

A favorable main effect of time was evident after three months for moderate to vigorous physical activity ($p<0.001$) (Table 3). At three-month follow-up, almost 70% of the patients met the WHO recommendations for physical activity and 41% of the sample population attained more than 300 min per week of moderate to vigorous physical activity.

When fulfilling the questionnaire, participants were asked to choose which type of physical activity they did most (they could choose more than one). Walking was the most frequent type of exercise at baseline (56.1%) and at three months (72.4%), followed by cycling at baseline (13.3%) and at three months (16.3%), jogging at baseline (8.2%) and at three months (10.2%), and other physical activities at baseline (21.4%) and at three months (22.4%).

A main effect of time was observed in sedentary time on weekdays and weekends after three months ($p<0.001$ on both weekdays and weekends). Eighty percent of the participants spent their sedentary time watching TV (80.4% at baseline and 71.3% at three months); the second most frequent sedentary activity was using computers, tablets or mobile phones (68% at baseline and 63.2% at three months), followed by teleworking (35.7% at baseline and 31.6% at three-month follow-up).

Similar results were seen for gender (female vs. male), age (<60 years vs. >60 years) and attendance of the online sessions (attended vs. did not attend).

Adherence to the program

Nearly half (46.9%) of the participants did at least one online exercise training session per week. Among those who did training sessions, 58% did two or three times per week, 27% once per week and 15% more than four times per week. The main reasons for participants doing less than one session per week were as follows: lack of motivation to train alone (37.8%); preference for a different mode of exercise training such as walking or jogging (26.2%); other reasons (19%); unable to open or follow the online videos (11%); reluctance to perform the online exercise training sessions without supervision (4.1%); and limited space at home to perform the exercise training session (4%).

Table 3 Body composition, physical activity and sedentary time at baseline and after three months in the home-based cardiac rehabilitation program.

	Baseline (n=98)	3 months (n=98)	p
Body composition			
BMI, kg/m^2	27.76 ± 3.26	27.78 ± 3.42	0.824
Physical activity, min/week			
Moderate	189 ± 158	301 ± 321	0.001
Vigorous	48 ± 86	107 ± 157	0.001
Moderate to vigorous	230 ± 198	393 ± 378	0.001
Sedentary time, hours/day			
Weekdays	6.47 ± 3.26	5.17 ± 3.18	0.001
Weekends	6.49 ± 3.44	4.60 ± 2.43	0.001

BMI: body mass index.

Regarding the educational sessions, 49% of the participants attended at least one of the 13 online educational sessions, and the most attended webinar was on nutrition (22.4%). Only 6.1% of the participants made one of the healthy cooking recipes.

More than half of the participants (58.2%) stated that the CR home-based program helped them to keep a healthier lifestyle throughout the quarantine.

Cardiovascular and non-cardiovascular symptoms and signs

At baseline, 18.4% of the participants reported cardiovascular symptoms such as tiredness (6.2%), chest pain (6.1%), aching legs (3.1%) and/or dizziness (3.1%), and cardiovascular signs such as low blood pressure (2.1%). Regarding non-cardiovascular symptoms, 20.4% of the patients reported weight gain (6.1%), cough (3.1%), diarrhea (3.1%), weakness (3.1%), stomach pain (2%), unintentional weight loss (2%), fever (1%) and/or depression (1%).

At three months, 19.4% of the participants reported cardiovascular symptoms including tiredness (12.2%), chest pain (8.2%), shortness of breath (8.2%), aching legs (6.1%) and/or dizziness (5.1%). The only cardiovascular sign reported was low blood pressure (5.1%). Regarding non-cardiovascular symptoms, 21.4% reported weight gain (6.1%), weakness (3.1%), diarrhea (2.0%) and/or headache (2.0%).

All patients (n=28) with cardiovascular or non-cardiovascular symptoms were assessed by a physician in teleconsultations. Twenty-one patients had a consultation with the CR cardiologist, five with the CR psychologist and two with the CR nutritionist.

Regarding feelings toward the pandemic, at baseline 46.9% did not feel any mood changes, 19.4% felt anxious, 12.2% felt sad, 11.2% felt stressed and 10.2% had other feelings. The main reasons that more than half of the participants had these feelings were directly related to COVID-19 and the need to adapt to lockdown and/or teleworking. After three months, fewer patients felt sad (8.2%, p=0.007), and maintained anxiety (16.3%, p=0.077) and stress levels (5.1%, p=0.456).

Hemodynamic and glycemic control

Eighty-one patients (82.7%) had a blood pressure monitor at home to measure and record blood pressure and heart rate. When asked if they monitored their blood pressure and heart rate at least once per week, the answer was in the affirmative in 71 patients at baseline and in 83 patients after three months. After three months, systolic blood pressure decreased (117±14 vs. 114±12 mmHg, p=0.007) and diastolic blood pressure did not change significantly (71±9 vs. 70±9 mmHg, p=0.096). In our sample, 21 patients had type 2 diabetes and 16 (76%) measured their blood glucose at least once per day at baseline and 19 after three months.

Body composition

There were no changes in BMI from baseline to three months (Table 3).

After subanalysis of differences between gender (female vs. male), age (<60 years vs. >60 years) and attendance of the online sessions (attended vs. did not attend), the results were similar.

Diet

After the three-month follow-up, some improvements were found. Patients increased their consumption of fish (14.0% vs. 23.3%, p=0.005) and water (20.9% vs. 47.7%, p=0.004) and decreased alcohol consumption (23.3% vs. 12.8%, p=0.003). Regarding salty snacks, a slight, but significant, increase was observed from 7% to 8% (p=0.006). No changes were found in the consumption of red meat, fruit, vegetables, sweets, fast foods, takeaways or beverages. More than half of the participants (54.1%) reported eating an average of three or four meals per day.

Discussion

The primary aim of this study was to assess levels of physical activity after completion of a three-month home-based multidisciplinary digital CR program in the COVID-19 era. Our main finding was that moderate to vigorous physical activity

increased after three months of the program in patients who had previously been attending a center-based CR program.

The recommendation for physical distancing during the first peak of the COVID-19 pandemic led to the suspension of our center-based CR program. We are aware that physical inactivity, even for short periods of 1-4 weeks, can lead to rapid deterioration of cardiovascular health and premature deaths among populations at higher cardiovascular risk.[5] Current guidelines recommend at least 150 min/week of moderate-intensity physical activity or 75 min/week of vigorous physical activity, or an equivalent combination thereof, to promote or maintain health benefits including improvements in functional capacity, body composition, blood lipids, and other risk factors.[10,11]

Despite the many benefits of increased physical activity for patients with CVD, it has been reported that around 60% of these patients do not reach recommended levels.[12,13] In contrast to our results, some studies have reported that most CR participants do not reach physical activity targets.[13–16] Previous participation in a center-based CR program, the digital support and tools provided, and the telephone coaching of our home-based CR program might explain the higher proportion (70%) of patients who followed the physical activity recommendations, despite the substantial between-subject variability observed.

There is no consistency among studies on the optimal amount of sedentary time. In a recent meta-analysis based on 19 prospective cohort studies, the optimal upper limit of sedentary time was around nine hours per day.[17] One meta-analysis reported less than 7.5 hours per day[17] and another suggested seven hours.[18] The mean sedentary time in our sample at baseline (6.47±3.26 hours) was significantly reduced after the three-month program (5.17±3.18 hours). Sedentary time at both baseline and three months were lower than the results achieved in the studies mentioned above.

As a quality indicator, it is desirable to have a minimum training attendance of 75%.[19] Reports of adherence vary widely in the literature, from 30% up to 110%.[20] The interpretation of adherence is limited by the large variation in the methodologies used and the definition of what constitutes exercise adherence. In the present study, we found adherence to the online exercise sessions (49%) to be in line with the literature. One of the main reasons for non-adherence was lack of motivation to train alone, since these participants had spent on average at least six months on a long-term community-based CR program and were used to exercise in group sessions. Additionally, Buys et al.[21] concluded that younger CVD patients are more interested in using technology to follow their home-based CR program than the older population. In our study the mean age was over 60 years, which may have influenced adherence to the online program. Potential advantages and disadvantages of home-based compared with community-based CR have been reported in the literature, such as group dynamics that provide positive social support for participants.[22] Group dynamics are an important component of community-based CR programs, but may be challenging to establish in a home-based setting.[22] It is also possible that such patients prefer to take care of their health independently without any online support.[23]

The aim of the home-based CR program in our study was, however, to promote overall physical activity, which was effectively achieved, in order to avoid deterioration of cardiovascular health,[5] whether or not patients participated in the online exercise sessions. As such, the most frequently chosen type of exercise was walking, which is highly accessible and easily regulated, promoting health and cardiorespiratory fitness.[24]

We assume that the continuous support and encouragement of the team through telephone calls, e-mails, teleconsultations, educational materials and online exercise sessions was probably the main incentive to improve physical activity during these months of social isolation. We believe that there are different ways to increase patients' motivation to improve their physical activity, which may need to be tailored to the individual patient. We consider that our home-based CR program was successful due to the engagement of the team members and their empathy and enthusiasm in their communications with patients.

In this regard, more studies are needed to assess different alternatives to center-based CR programs according to patient motivations, preferences and limitations, including virtual reality, online face-to-face exercise training classes, recorded exercise sessions, online clinical appointments, and online nutritional and psychological counseling.[4,7]

Besides physical activity, it is also important to assess the other effects of home-based CR programs on risk factor control and psychological and nutritional status. CR should cover all components to be considered as effective as possible in terms of different benefits.

No significant differences were seen in patients' BMI between baseline and three months of the home-based CR program, despite lockdown. The explanation is most probably related to the healthier nutritional habits reported (less sugary food, more fruit and vegetables, less meat, etc.) and to the increase in physical activity. More than 80% of participants had an automatic sphygmomanometer and were able to self-monitor their blood pressure and heart rate, and 76% of patients with diabetes self-monitored their blood glucose.

At the beginning of the home-based CR program more than half of the participants had negative feelings like anxiety, stress and sadness, which were directly related to the situation created by the COVID-19 pandemic and consequently with the need to adapt to lockdown and/or teleworking. However, after three months the proportion of participants experiencing these negative feelings fell from 53.1% to 42.9%.

Our home-based CR program was shown to be safe, with no major events during the exercise sessions throughout the program, and only one minor event (ankle sprain) during exercise training.

Previous studies have shown that women are underrepresented on CR programs, with just 30% (16.3% in our study) of those who are eligible to attend, compared with 52% of men.[25]

Limitations

This study had some limitations, including the fact that the participants were selected from a single CR center. We were unable to determine the comparative efficacy of the

home-based program because there was no control group with center-based CR due to the pandemic.

Most patients had coronary artery disease, as usual in center-based CR programs, which means the results cannot be extrapolated to other populations.

Our CR team at the CR Center of the CHULN/FMUL/CRECUL created an online home-based CR program in a short period of time. This home-based CR digital program had some technological and resource limitations resulting from the need to quickly build a user-friendly platform with all the CR content and that could be delivered to all participants.

In our study we assessed physical activity with self-reported measures, which are frequently used to assess physical activity in CR programs due to their practicality and cost-effectiveness.[26,27] However, there are some limitations to this approach compared to direct measures, which are more valid and reliable,[26] but due to the pandemic they could not be performed.

Conclusion

Cardiovascular patients, mostly with coronary artery disease, whose center-based CR program was suspended in the context of the COVID-19 pandemic and started a home-based CR program, showed significant improvement in moderate to vigorous physical activity after three months. The home-based CR program also proved to be a safe intervention.

Our results indicate the need for diverse programs, even at distance. Home-based CR programs may be a reasonable option for selected clinically stable patients who are eligible for CR, and who for various reasons cannot attend a center-based CR program.

Conflicts of interest

The author has no conflicts of interest to declare.

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