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ORIGINAL ARTICLE

Older phase 2 cardiac rehabilitation patients engaged in gardening maintained physical function during the COVID-19 pandemic

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Abstract

This study aimed to clarify the effects of gardening on hemodynamic response, rating of perceived exertion (RPE) during exercise, and body weight in patients in whom phase 2 cardiac rehabilitation (CR) was interrupted due to the Coronavirus disease 2019 (COVID-19) pandemic. Among 76 outpatients participating in consecutive phase 2 CR in both periods from March to April and June to July 2020, which were before and after CR interruption, respectively, at Sanda City Hospital were enrolled. The inclusion criterion was outpatients whose CR was interrupted due to COVID-19. Patients under the age of 65 were excluded. We compared the data of hemodynamic response and RPE during exercise on the last day before interruption and the first day after interruption when aerobic exercise was performed at the same exercise intensity in the gardener group and the non-gardener group. Forty-one patients were enrolled in the final analysis. After CR interruption, the gardener group did not show any significant difference in all items, whereas the non-gardener group experienced significant increase in HR (Peak) ($p = 0.004$) and worsening of the Borg scale scores for both dyspnea and lower extremity fatigue ($p = 0.039$ and $p = 0.009$, respectively). Older phase 2 CR patients engaged in gardening did not show any deterioration in hemodynamic response or RPE during exercise, despite CR interruption and refraining from going outside. Gardening may be recommended as one of the activities that can maintain or improve physical function in older phase 2 CR patients during the COVID-19 pandemic.

Keywords COVID-19 · Cardiac rehabilitation · Gardening · Hemodynamic response · Rating of perceived exertion

Introduction

The Coronavirus disease 2019 (COVID-19) pandemic has interrupted much of the phase 2 cardiac rehabilitation (CR) around the world [1–4]. CR offers a wide range of important benefits for patients with heart disease, such as improving cardiopulmonary fitness, psychological factors, and quality of life and reducing morbidity and mortality [5, 6]. Therefore, interruption of phase 2 CR for these patients is a serious problem. In addition to interrupting phase 2 CR, the Japanese government's request to refrain from going outside is a concern that can lead to further decline in activity for older phase 2 CR patients. In fact, it has been reported that the physical activity of older adults has dropped significantly [7, 8]. Decreased physical activity and exercise due to the COVID-19 pandemic were observed in almost 50% of the older adults [9]. Older heart failure patients had lower physical activity even before the pandemic [10], and further loss of physical activity can have serious consequences.

Decreased physical activity is associated with decreased peak oxygen uptake, which is a determinant of prognosis, and the occurrence of cardiovascular events [11, 12]. In older phase 2 CR patients, there is concern that the risk of frailty increases due to decreased physical activity [13]. A report on patients with cardiovascular disease revealed a

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decline in their physical function [14]. However, the physical function of older patients who underwent outpatient rehabilitation during the pandemic, while taking sufficient safety measures did not deteriorate [15], but it is often difficult to improve the environment for infection prevention.

The above findings indicate an urgent need for cardiovascular patients to take measures to secure an adequate amount of activity during the COVID-19 pandemic by means other than health center-based activity. Although we reported that the risk of frailty increased in patients aged 75 years and older who interrupted their phase 2 CR during the COVID-19 pandemic [13], we noted that some patients had maintained their physical function. In particular, it appeared that those patients who had engaged in gardening were able to maintain their physical function. Gardening is an activity recommended by the Japanese government and World Health Organization even during the COVID-19 pandemic [16, 17]. In addition, the exercise intensity of gardening is moderate at 3.0–5.9 metabolic equivalents (METs) [18], which is almost the same level as the moderate-exercise intensity recommended in the CR guidelines of most independent regions and nations [19].

Therefore, in this study, we hypothesized that older phase 2 CR patients engaged in gardening could maintain physical function during the COVID-19 pandemic. The aim of this study was to clarify the effects of gardening on hemodynamic response, rating of perceived exertion (RPE) during exercise and body weight in patients in whom phase 2 CR was interrupted due to the COVID-19 pandemic.

Methods

Study design and patients

This was a retrospective, single-center, observational study. Seventy-six outpatients who participated in consecutive phase 2 CR in the two periods from March to April and June to July 2020, which were before and after the interruption, respectively, of CR at Sanda City Hospital were enrolled. The inclusion criterion was outpatients whose CR was interrupted due to COVID-19, and the exclusion criteria were patients with age < 65 years old, change in exercise intensity, and medications, or who experienced cardiovascular events during the period of interruption. We compared the data obtained on the last day before interruption of CR with that obtained on the first day after resumption of CR when aerobic exercise was performed at the same exercise intensity. Patients' characteristics and clinical parameters including age, sex, body mass index (BMI), gardening type, living alone, apartment, working, left ventricular ejection fraction, medical history, medications, CR interruption period, exercise intensity, and parameters of usual aerobic exercise in CR were obtained from the electronic medical records by two physical therapists. A nurse questioned each of the patients to determine if they had decreased their level of exercise during the interruption of CR.

The present study complied with the Declaration of Helsinki with respect to investigation in humans and was approved by the Ethics Committee of Sanda City Hospital (approval No 2021001). Written informed consent was obtained from each patient.

Gardening

Gardening was defined as (1) the garden is near the patient's residence; (2) mainly fruits and vegetables are cultivated; and (3) production is supplemental rather than a main source of family consumption and income, with partial reference to a previous report [20]. The patients were divided into two groups, the gardener group and non-gardener group.

CR exercise program

Aerobic exercise was performed based on the Guidelines for Rehabilitation in Patients with Cardiovascular Disease (JCS 2012) [21]. Exercise intensity is prescribed according to exercise at anaerobic threshold level, 40–60% of the peak $\dot{V}O_2$, 40–60% of maximum heart rate (HR), or a Borg scale score of 12–13 or resting HR + 30 bpm (resting HR + 20 bpm for patients receiving β-blockers). Some patients underwent high-intensity interval training at 85% peak HR. Aerobic exercise was performed on a cycle ergometer or uphill treadmill, and the exercise time was 20 min. All patients exercised while wearing a surgical or cloth face mask.

Hemodynamic assessment during CR

The variables chosen for monitoring were HR and systolic blood pressure (SBP) as indicators of hemodynamic response. We measured the resting (Rest) HR and peak (Peak) HR. For SBP, we measured the resting (Rest) SBP and the immediate post-exercise (Post) SBP. HR (Rest) was measured from lead II of a three-lead electrocardiogram recorded using the limb lead method during exercise. All SBPs were measured with the patient in the sitting position. These measurements were obtained by one physical therapist and two nurses.

Rating of perceived exertion assessment during CR

The RPEs for dyspnea and lower extremity fatigue were assessed using the Borg scale score [22] 10 min after the start of exercise and just before cooldown. The Borg scale score is suggested to be a valid tool for monitoring and prescribing exercise intensity independent of sex, age, exercise

modality, physical activity level and coronary artery disease status [23]. The same individuals assessed all patients to ensure minimal interindividual variability.

Statistical analysis

Continuous variables are expressed as medians and interquartile ranges, and categorical variables are expressed as numbers (percentages). Continuous variables were compared using the Mann–Whitney *U* test, and categorical data were compared using Fisher's exact test. The Wilcoxon rank sum test was used to compare findings pre- and post-CR interruption. A p value of < 0.05 was considered to indicate statistical significance. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics.

Results

Seventy-six outpatients participated in phase 2 CR during the two periods from March to April and June to July 2020. Of them, after excepting 14 patients who continued CR in individual 1:1 CR sessions, 62 patients with interruption of CR were enrolled. Patients with age < 65 years old ($n = 12$), change in exercise intensity ($n = 6$) or medications ($n = 2$) and patients admitted to hospital due to heart failure ($n = 1$) were then excluded. Thus, 41 patients were included in the final analysis (Fig. 1). Table 1 presents their clinical characteristics. The gardener group comprised 11 patients (26.8%). Ten patients gardened in their own garden, and one patient gardened in a community garden. There were no significant differences between the patients in the gardener group and the non-gardener group in age, sex, living alone, apartment, working, left ventricular ejection fraction, medical history, medications, CR interruption period, decreased exercise during CR interruption, and exercise intensity at CR. Body weight, BMI, hemodynamics, and RPE pre- and post-CR interruption can be compared in Table 2. Following post-CR interruption, the gardener group did not show any significant difference in any of these items, whereas the non-gardener group experienced a significant increase in HR (Peak) ($p = 0.004$) and worsening of the Borg scale scores for both dyspnea and lower extremity fatigue ($p = 0.039$ and $p = 0.009$, respectively).

Discussion

The deterioration of physical function in patients with cardiovascular disease due to the COVID-19 pandemic is a serious concern, and countermeasures are urgently needed. In this study, it was revealed that older phase 2 CR patients engaged in gardening did not experience deterioration of physical function due to the interruption of CR and the governmental request to refrain from going outside. In the non-gardener group, however, after CR interruption, their HR (Peak) increased and Borg scale scores for both dyspnea and lower extremity fatigue worsened when assessed at the same intensity of exercise as that performed before CR interruption. Increases in HR that occur with reduced training or complete cessation of training may reflexively arise to counteract the reduction in ventricular filling and maximal stroke volume that occurs when the volume of blood decreases [24, 25]. HR recorded at the same exercise intensity is used as an indicator of physical function [26], and an increase in HR observed in the non-gardener group may suggest a decline in their physical function.

The Borg scale score is useful as a marker of impending decline in mobility-intact older adults [27], and its decrease is a serious issue with regard to the prognosis of patients with cardiovascular disease. In the non-gardener group, the

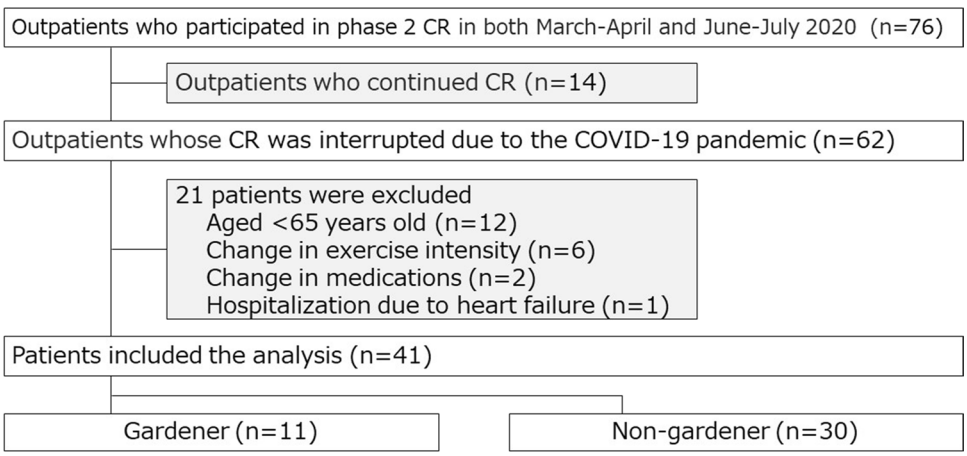

Fig. 1 Patient flow through the study. *CR* cardiac rehabilitation, *COVID-19* Coronavirus disease 2019

Table 1 Clinical characteristics

	Gardener group, $n=11$	Non-gardener group, $n=30$	p value
Age, yrs	73.0 (62.0–79.0)	75.0 (72.0–76.0)	0.976
Male, *n* (%)	9 (81.8)	25 (83.3)	1
Solitary life, *n* (%)	0 (0)	6 (20.0)	0.167
Apartment, *n* (%)	0 (0)	5 (16.7)	0.300
Working, *n* (%)	1 (9.1)	3 (10.0)	1
Gardening type			
Own gardening, *n* (%)	10 (90.9)	0 (0)	< 0.001
Community gardening, *n* (%)	1 (9.1)	0 (0)	0.268
LVEF, %	57.1 (47.5–62.2)	59.1 (46.2–67.9)	0.757
Medical history			
Ischemic heart disease, *n* (%)	7 (63.6)	24 (80.0)	0.413
Chronic heart failure, *n* (%)	4 (36.4)	13 (43.3)	0.736
Hypertension, *n* (%)	7 (63.6)	21 (70.0)	0.719
Diabetes mellitus, *n* (%)	7 (63.6)	16 (53.3)	0.726
Medications			
Beta blocker, *n* (%)	9 (81.8)	22 (73.3)	0.700
ACE-I/ARB, *n* (%)	6 (54.5)	18 (60.0)	1
CCB, *n* (%)	4 (36.4)	11 (36.7)	1
Diuretic, *n* (%)	5 (45.5)	12 (40.0)	1
Period of CR interruption, days	70.0 (63.0–101.5)	84.0 (64.0–90.8)	0.976
Decreased exercise during CR interruption, *n* (%)	8 (72.7)	21 (70.0)	1
Exercise intensity, watts[a]	50.0 (41.3–50.0)	52.5 (40.0–61.3)	0.604

Values shown are % (*n*), medians (interquartile ranges)

ACE-I angiotensin converting enzyme inhibitor, *ARB* angiotensin II receptor blocker, *CCB* calcium channel blocker, *CHF* congestive heart failure, *CR* cardiac rehabilitation, *LVEF* left ventricular ejection fraction

[a]Only cycle ergometer ($n=40$)

Table 2 Patients' body weight, hemodynamics and RPE pre- and post-CR interruption

	Gardener group, $n=11$			Non-gardener group, $n=30$		
	Pre interruption	Post interruption	p value	Pre interruption	Post interruption	p value
Body weight, kg	66.4 (58.3–69.3)	66.5 (57.8–68.9)	0.230	64.1 (57.8–68.4)	63.4 (56.3–67.9)	0.156
BMI, kg/m^2	24.5 (22.7–25.3)	24.2 (22.7–25.1)	0.183	23.2 (21.3–23.9)	22.9 (21.2–24.2)	0.193
Rest HR, bpm	67.0 (64.5–73.5)	69.0 (63.5–76.0)	1	63.5 (60.3–70.0)	64.5 (58.0–74.8)	0.324
Peak HR, bpm	107.0 (94.0–111.5)	108.0 (98.0–112.0)	0.476	100.5 (91.3–107.8)	104.0 (90.5–111.5)	0.004
Rest SBP, mmHg	124.0 (122.0–139.0)	124.5 (112.5–143.0)	0.790	124.0 (112.8–139.5)	131.0 (115.0–147.0)	0.699
Post-exercise SBP, mmHg	127.0 (124.5–147.5)	126.0 (115.0–142.0)	0.553	127.5 (108.5–139.0)	125.0 (119.3–136.8)	0.440
Peak Borg scale: dyspnea	12.0 (12.0–12.5)	12.5 (12.0–13.0)	0.096	12.0 (11.6–13.0)	12.8 (12.0–13.0)	0.039
Peak Borg scale: lower extremities	12.0 (12.0–12.5)	12.5 (12.0–13.0)	0.890	12.0 (12.0–13.0)	13.0 (12.0–13.0)	0.009

Values shown are medians (interquartile ranges)

BMI body mass index, *CR* cardiac rehabilitation, *HR* heart rate, *RPE* rating of perceived exertion, *SBP* systolic blood pressure

score was greater than the value reported as the minimally clinically important difference in lower extremity fatigue. The worsening of the Borg scale score for lower extremity fatigue reflects a combination of peripheral muscle weakness and metabolic alteration in the active skeletal muscles [28]. In older adults, because decreases in endurance performance and muscle mitochondrial enzyme activity due to deconditioning after aerobic training occur more quickly than they do in young people [29], older adults may be vulnerable to interrupting CR or refraining from going outside.

The decrease in physical function observed in the non-gardener group is thought to be due to decreased activity.

However, the percentages of those who answered that their physical activity decreased during the period of interruption of CR were 72.7% for the gardener group and 70.9% for non-gardener group, and there was no significant difference between the two groups. Nevertheless, it is surprising that only the gardener group was able to maintain their physical function. Zavorsky reported that reductions of one- to two-thirds in training frequency and/or duration do not significantly alter $\dot{V}O_2$ max or submaximal endurance time provided the intensity of each exercise session is maintained [25]. The exercise intensity of gardening is 3.0–5.9 METs, indicating that it is possible to achieve moderate exercise intensity [18]. It is presumed that the patients engaged in gardening were able to maintain their physical function despite the decrease in the amount of exercise, because they maintained their exercise intensity through gardening.

Gardening has been in the limelight in recent years, and especially in 2020, the number of papers on its health effects has increased significantly with the COVID-19 epidemic. Many papers, including reviews, have reported that gardening can not only maintain and increase a person's amount of physical activity but also maintain and improve physical function [30–34]. Gardening is effective not only for aerobic exercise, but it also improves muscle strength, flexibility, balance, physical function ability, and bone mineral density [30]. Multi-component exercises that include strength training, aerobic exercise, balance, and flexibility tasks are recommended for older adults [35]. In the era of the COVID-19 pandemic when home CR is required, gardening may be an effective measure for maintaining and improving the amount of activity and physical function of older phase 2 CR patients.

Study limitations

This study has several limitations. First, this was a single-center, retrospective study comprising a very small number of patients. Second, baseline physical function of the gardener and non-gardener groups could not be compared. Third, because the duration, intensity, and frequency of activity for each individual is unknown, this study does not show how much gardening activity is required to maintain physical function. Fourth, as gardening is an outdoor activity, it is necessary to consider that the amount of activity changes depending on the season. Finally, we need to consider on promoting physical activity [36, 37] and protection from future pandemics [38] in general in COVID-19 for older people.

Conclusion

Older phase 2 CR patients engaged in gardening did not show any deterioration in their hemodynamic response or RPE during exercise, despite CR interruption and refraining from going outside. Gardening may be recommended as one of the activities that can maintain or improve physical function in patients with cardiovascular disease during the COVID-19 pandemic.

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Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by AO, NH, YI, KK, NK and MW. The first draft of the manuscript was written by AO, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

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Declarations

Conflict of interest The authors have no conflict of interest to disclose.

References

1. Scherrenberg M, Wilhelm M, Hansen D, Völler H, Cornelissen V, Frederix I, Kemps H, Dendale P (2020) The future is now: a call for action for cardiac telerehabilitation in the COVID-19 pandemic from the secondary prevention and rehabilitation section of the European Association of Preventive Cardiology. Eur J Prev Cardiol. https://doi.org/10.1177/2047487320939671
2. Marzolini S, Ghisi GLM, Hébert AA, Ahden S, Oh P (2021) Cardiac rehabilitation in Canada during COVID-19. CJC Open 3:152–158
3. The Japanese Association of Cardiac Rehabilitation. [Survey on the current status of integrated rehabilitation for COVID-19 (2nd)]. In Japanese. https://www.jacr.jp/web/wp-content/uploads/2020/09/COCID19_2.pdf. Accessed 30 Mar 2021
4. Nicholls SJ, Nelson M, Astley C, Briffa T, Brown A, Clark R, Colquhoun D, Gallagher R, Hare DL, Inglis S, Jelinek M, O'Neil A, Tirimacco R, Vale M, Redfern J (2020) Optimising secondary prevention and cardiac rehabilitation for atherosclerotic cardiovascular disease during the COVID-19 pandemic: a position statement from the Cardiac Society of Australia and New Zealand (CSANZ). Heart Lung Circ 29:e99–e104
5. McMahon SR, Ades PA, Thompson PD (2017) The role of cardiac rehabilitation in patients with heart disease. Trends Cardiovasc Med 27:420–425
6. Anderson L, Thompson DR, Oldridge N, Zwisler AD, Rees K, Martin N, Taylor RS (2016) Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database Syst Rev 2016(1):CD001800

7. Yamada M, Kimura Y, Ishiyama D, Otobe Y, Suzuki M, Koyama S, Kikuchi T, Kusumi H, Arai H (2020) Effect of the COVID-19 epidemic on physical activity in community-dwelling older adults in Japan: a cross-sectional online survey. J Nutr Health Aging 24:948–950
8. Sasaki S, Sato A, Tanabe Y, Matsuoka S, Adachi A, Kayano T, Yamazaki H, Matsuno Y, Miyake A, Watanabe T (2021) Associations between socioeconomic status, social participation, and physical activity in older people during the COVID-19 pandemic: a cross-sectional study in a northern Japanese city. Int J Environ Res Public Health 18:1477
9. Ye F, Yale S, Zheng Y, Hu H, Zhou L, Fanning J, Yeboah J, Brubaker P, Bertoni AG (2021) Trends in physical activity among US adults with heart failure, 2007–2016. J Cardiopulm Rehabil Prev. https://doi.org/10.1097/HCR.0000000000000578
10. Visser M, Schaap LA, Wijnhoven HA (2020) Self-reported impact of the COVID-19 pandemic on nutrition and physical activity behaviour in Dutch older adults living independently. Nutrients 12:3708
11. Lau D, McAlister FA (2021) Implications of the COVID-19 pandemic for cardiovascular disease and risk-factor management. Can J Cardiol 37(5):722–732
12. Lavie CJ, Ozemek C, Carbone S, Katzmarzyk PT, Blair SN (2019) Sedentary behavior, exercise, and cardiovascular health. Circ Res 124:799–815
13. Ogura A, Izawa KP, Tawa H, Kureha F, Wada M, Harada N, Ikeda Y, Kimura K, Kondo N, Kanai M, Kubo I, Yoshikawa R, Matsuda M (2021) Impact of the COVID-19 pandemic on phase 2 cardiac rehabilitation patients in Japan. Heart Vessels. https://doi.org/10.1007/s00380-021-01783-5
14. Ishihara K, Izawa KP, Noto S, Shimizu I (2021) Physical and mental functions of cardiovascular disease patients decrease during the state of emergency initiated by the COVID-19 pandemic in Japan. Rev Recent Clin Trials. https://doi.org/10.2174/1574887116666210316110127
15. Izawa KP, Oyama M, Okamoto K (2020) Did the physical and psychological states of outpatients receiving rehabilitation at a geriatric health services facility decline during the state of emergency caused by the COVID-19 pandemic? Diseases 8:45
16. Ministry of Health, Labour and Welfare. [Response to novel coronavirus infections (for the elderly)]. In Japanese. https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/hukushi_kaigo/kaigo_koureisha/yobou/index_00013.html. Accessed 30 Mar 2021
17. World Health Organization, Europe. Stay physically active during self-quarantine. https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/publications-and-technical-guidance/noncommunicable-diseases/stay-physically-active-during-self-quarantine. Accessed 30 Mar 2021
18. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr, Tudor-Locke C, Greer JL, Vezina J, Whitt-Glover MC, Leon AS (2011) 2011 Compendium of physical activities: a second update of codes and MET values. Med Sci Sports Exerc 43:1575–1581
19. Price KJ, Gordon BA, Bird SR, Benson AC (2016) A review of guidelines for cardiac rehabilitation exercise programmes: is there an international consensus? Eur J Prev Cardiol 23:1715–1733
20. Galhena DH, Freed R, Maredia KM (2013) Home gardens: a promising approach to enhance household food security and well-being. Agric Food Secur 2:8
21. JCS Joint Working Group (2014) Guidelines for rehabilitation in patients with cardiovascular disease (JCS 2012). Circ J 78:2022–2093
22. Borg GA (1982) Psychophysical bases of perceived exertion. Med Sci Sports Exerc 14:377–381
23. Scherr J, Wolfarth B, Christle JW, Pressler A, Wagenpfeil S, Halle M (2013) Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. Eur J Appl Physiol 113:147–155
24. Neufer PD (1989) The effect of detraining and reduced training on the physiological adaptations to aerobic exercise training. Sports Med 8:302–320
25. Zavorsky GS (2000) Evidence and possible mechanisms of altered maximum heart rate with endurance training and tapering. Sports Med 29:13–26
26. Amorim H, Cadilha R, Parada F, Rocha A (2019) Progression of aerobic exercise intensity in a cardiac rehabilitation program. Rev Port Cardiol (Engl Ed) 38:281–286
27. Simonsick EM, Glynn NW, Jerome GJ, Shardell M, Schrack JA, Ferrucci L (2016) Fatigued, but not frail: perceived fatigability as a marker of impending decline in mobility-intact older adults. J Am Geriatr Soc 64:1287–1292
28. Stendardi L, Grazzini M, Gigliotti F, Lotti P, Scano G (2005) Dyspnea and leg effort during exercise. Respir Med 99:933–942
29. Fritzen AM, Andersen SP, Qadri KAN, Thøgersen FD, Krag T, Ørngreen MC, Vissing J, Jeppesen TD (2020) Effect of aerobic exercise training and deconditioning on oxidative capacity and muscle mitochondrial enzyme machinery in young and elderly individuals. J Clin Med 9:3113
30. Park SA, Lee KS (2011) Determining exercise intensities of gardening tasks as a physical activity using metabolic equivalents in older adults. HortScience 4:1706–1710
31. Soga M, Gaston KJ, Yamaura Y (2016) Gardening is beneficial for health: a meta-analysis. Prev Med Rep 5:92–99
32. Bail JR, Frugé AD, Cases MG, De Los Santos JF, Locher JL, Smith KP, Cantor AB, Cohen HJ, Demark-Wahnefried W (2018) A home-based mentored vegetable gardening intervention demonstrates feasibility and improvements in physical activity and performance among breast cancer survivors. Cancer 124:3427–3435
33. Thompson R (2018) Gardening for health: a regular dose of gardening. Clin Med 18:201–205
34. Machida D (2019) Relationship between community or home gardening and health of the elderly: a web-based cross-sectional survey in Japan. Int J Environ Res Public Health 16:1389
35. Jadczak AD, Makwana N, Luscombe-Marsh N, Visvanathan R, Schultz TJ (2018) Effectiveness of exercise interventions on physical function in community-dwelling frail older people: an umbrella review of systematic reviews. JBI Database Syst Rev Implement Rep 16:752–775
36. Jiménez-Pavón D, Carbonell-Baeza A, Lavie CJ (2020) Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: SPECIAL focus in older people. Prog Cardiovasc Dis 63(3):386–388
37. Ghram A, Briki W, Mansoor H, Al-Mohannadi AS, Lavie CJ, Chamari K (2020) Home-based exercise can be beneficial for counteracting sedentary behavior and physical inactivity during the COVID-19 pandemic in older adults. Postgrad Med. https://doi.org/10.1080/00325481.2020.1860394
38. Arena R, Lavie CJ, Network HL-PIVOT (2021) The global path forward - Healthy Living for Pandemic Event Protection (HL-PIVOT). Prog Cardiovasc Dis 64:96–101