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# Cardiorespiratory fitness assessment on active patients who kept attending their phase III exercise-based cardiac rehabilitation during the COVID-19 era

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**Background:** Cardiorespiratory fitness (CRF) is a powerful predictor of all-cause mortality among individuals with coronary artery disease (CAD). A structured community-based phase III cardiac rehabilitation (CR) is very important in lifelong maintenance of phase II CRF and health gains. During the COVID-19 pandemic, CR programs had to adapt, mainly using new technologies and remote follow-up. The CRF impact in patients (Ps) who kept going their phase III program, during this troubled era is still unknown.

**Purpose:** Assess the variation in CRF and prognostic parameters in Ps with CAD who maintain high adherence levels in their phase III CR before and during the COVID-19 pandemic.

**Methods:** A cohort of Ps enrolled in a community-based phase 3 CR program, with active participation at the end of 2019, was included in this retrospective study. The inclusion criteria for this study were high levels of attendance (>80%) to the CR program before and during COVID-19 and high levels of physical activity with more than 150 mins of moderate to vigorous physical activity (MVPA). All Ps were evaluated with transthoracic echocardiography (TTE) and a cardiorespiratory exercise test (CPET) in a cycloergometer in 2019 and between october and november of 2021. All Ps had used accelerometers to measure their physical activity levels and dual-energy absorptiometry (DEXA) scan to evaluate their body composition. Between 2020 and 2021, Ps had online (in lockdown periods) and face to face exercise training sessions, 3xtimes per week, 60 mins each exercise session.

A t-test paired two sample for means was used to compare CPET variables before the beginning of the first COVID lockdown (end of 2019) and after the removal of the majority of restrictions (end of 2021).

**Results:** A total of 30 Ps with high levels of adherence were included (99.6% male, $65 \pm 9$ years old). In this cohort, the majority had history of an ACS before the referral to the CR program (73.3%) and $55.6 \pm 10.4\%$ of left ventricular ejection fraction.

There was no significant difference in body mass index ($27.9 \pm 3.2$ kg/m2 vs $28.1 \pm 3.6$ kg/m2, p=0.493 but there was a significant increase in the percentage of body fat mass ($30.1 \pm 5.7\%$ vs $31.0 \pm 6.6\%$, p= 0.042). There was a maintenance on MVPA levels ($352 \pm 137$ minutes/week vs $313 \pm 194$ minutes/week, p = 0.106) during this period.

When comparing the 2 CPET results, Ps achieved higher exercise loads in the 2021 test ($175 \pm 51$W vs $185 \pm 52$W, p=0.005), higher VO2 peak ($25.3 \pm 6.9$ ml/kg/min vs $21.5 \pm 6.3$ ml/kg/min, p =0.001) and higher percentage of predicted VO2max ($78.8 \pm 16.8\%$ vs $95.27 \pm 20.8\%$, p = 0.001).

**Conclusion:** In spite of all the difficulties in maintaining a phase III CR program during the COVID-19 pandemic, we observed that in physically active CAD Ps, with the aid of new technologies and remote follow-up (during the lockdown periods) and face to face exercise sessions, it is still possible to have functional gains and improvements in CRF.

Table 1. Baseline characteristics and echocardiography data

## Baseline characteristics

| | |
|---|---|
| Sex (n), male (%) | 29 (96.7) |
| Age (years) | 64.9 ± 8.9 |
| Previous myocardial infarction | 22 (73.3%) |
| Beta-blocker | 27 (90.1%) |

## Echocardiography data

| | |
|---|---|
| Left ventricle ejection fraction (%) | 55.63 ± 10.1 |
| Left ventricle end-diastolic volume (ml) | 95.88 ± 36.5 |
| Left ventricle end-sistolic volume (ml) | 43.08 ± 28.7 |
| Left ventricle mass (g) | 171.17 ± 58.1 |
| Global longitudinal strain (%) | - 16.74 ± 3.3 |
| E/e' | 6.75 ± 1.8 |
| TAPSE (mm) | 20.28 ± 3.3 |
| Left atrium volume (ml/m2) | 26.50 ± 6.9 |

*Abbreviations: TAPSE, tricuspid annular plane systolic excursion*

Table 2. Body composition, physical activity and cardiorespiratory parameters of the patients.

| | 2019 Evaluation (n=30) | 2021 Evaluation (n=30) | p value |
|---|---|---|---|
| **Body Composition** | | | |
| Percentage of body fat mass (%) | 30.06 ± 5.7 | 31.04 ± 6.6 | 0.042 |
| BMI (kg/m$^2$) | 70.9 ± 7.9 | 69.9 ± 8.6 | 0.493 |
| **Physical Activity** | | | |
| MVPA (mins/week) | 351.50 ± 137. | 313.25 ± 194.1 | 0.106 |
| **Cardiorespiratory Parameters** | | | |
| Peak RER | 1.15 ± 0.05 | 1.19 ± 0.09 | 0.029 |
| Peak exercise load (W) | 175.0 ± 51.3 | 184.6 ± 51.3 | 0.005 |
| Peak VO2 (ml/kg/min) | 21.52 ± 6.3 | 25.32 ± 6.9 | 0.001 |
| Peak of predicted VO2 max (%) | 78.8 ± 16.8 | 95.27 ± 20.8 | 0.001 |
| Predicted maximum heart rate (%) | 79.56 ± 11.5 | 87.10 ± 12.9 | 0.001 |
| Predicted VO2 peak at 1º VT (%) | 53.87 ± 11.7 | 57.86 ± 14.1 | 0.163 |
| Predicted VO2 peak at 2º VT (%) | 71.36 ± 15.7 | 81.65 ± 19.2 | 0.003 |

*Abbreviations: BMI, body mass index; MVPA, moderate to vigorous physical activity; RER, respiratory exchange ratio; VT, ventilatory threshold.*