

PURPOSE: Heart failure with preserved ejection fraction (HFpEF) is a heterogeneous syndrome based on central (cardiac) and/or peripheral (skeletal muscle) limitations to oxygen uptake. Patients with a central limitation may have a limited ability to increase pulmonary perfusion (cardiac output, Qc) relative to those with a peripheral limitation. This central limitation may contribute to ventilation-perfusion (V/Q) mismatch, manifesting as an increase in alveolar dead space (VD_{alv}) and worsened ventilatory efficiency (relation between ventilation [V_E] and carbon dioxide elimination [V̇CO₂]) during exercise. To test this hypothesis, we compared Qc, VD_{alv} and V_E/V̇CO₂ during exercise between centrally and peripherally limited HFpEF patients.

METHODS: 38 subjects were categorized based on their Qc/oxygen uptake (VO₂) slope and stroke volume (SV) reserve during a graded cycling test. Those with a Qc/VO₂ <5 or a Qc/VO₂ 5-6 and a SV reserve <50% were classified as having primarily a central limitation (n=14, 70.8±5.7y, 5 women). Those with a Qc/VO₂ >6 or a Qc/VO₂ 5-6 and a SV reserve >50% were classified as having primarily a peripheral limitation (n=24, 70.0±6.9y, 18 women). Subjects performed a 6min constant-load cycling test (20W). Arterial blood gases, gas exchange, and Qc (direct Fick) were measured. VD_{alv} (Enghoff modification of the Bohr equation) and V_E/V̇CO₂ (relation between the rest-to-20W change in V_E and V̇CO₂) were calculated.

RESULTS: Qc tended to be lower (p=0.06) in centrally (7.61±1.97 L/min) compared with peripherally (8.79±2.26 L/min) limited patients, whereas VD_{alv} (central: 0.310±0.07; peripheral: 0.262±0.08 L/br, p=0.01) and V_E/V̇CO₂ (central: 38.2±3.4; peripheral: 35.8±4.0, p=0.03) were greater in centrally compared with peripherally limited patients during exercise. There was a strong correlation between VD_{alv} and V_E/V̇CO₂ (r=0.61, p<0.01).

CONCLUSIONS: Our findings suggest that V/Q mismatch worsened during exercise to a greater extent in HFpEF patients with a central limitation compared with those with a peripheral limitation. Since the increase in Qc was lower in patients with a central limitation, it could be that these patients developed a greater relative distribution of high V/Q lung units, possibly due to an impaired ability to augment pulmonary perfusion.

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Patients With Myalgic Encephalomyelitis Have Blunted Exercise Ventilatory Responses In The Post-Exertional State

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Patients with Myalgic Encephalomyelitis (ME) have diminished exercise performance, work output, and lower oxygen consumption in the post-exertional state.

PURPOSE: To test whether reductions in ventilatory responses contribute to impaired exercise performance.

METHODS: Maximal exercise tests were performed on sequential days using a cycle ergometer. Ventilatory responses in 15 ME patients were compared with 18 control subjects. Values for minute ventilation (VE), respiratory rate (RR), breathing reserve (BR), and minute ventilation/carbon dioxide production (VE/V̇CO₂) were collected. Independent-samples t-tests compared ME and control groups at rest. Mixed ANOVA with repeated measures compared each dependent variable between test 1 and test 2, between ME and control groups, and between values collected in the resting state to those collected during maximal exercise.

RESULTS: Subject age was 39.3 ± 9.6 yr, height was 166.1 cm, and weight was 68.8 kg. ME subjects were 6.6 yr older (p = 0.05); there were no differences in height or weight (p > 0.20). Across the total sample at rest during test 1, VE was 11.5 ± 4.6, RR was 16.0 ± 6.0, BR was 90.6 ± 3.5, and VE/CO₂ was 31.1 ± 4.9. Between control and ME groups, RR exhibited a trending difference (p = 0.06); no other differences were observed (p > 0.25). When measuring peak values (control vs. ME), several differences emerged on test 2. During test 1, VE was similar (78.2 ± 5.3 vs 69.0 ± 6.0; p = 0.27) but differences were detected during test 2 (87.6 ± 6.1 vs. 63.9 ± 6.7; p = 0.01). BR values were also similar during test 1 (38.2 ± 3.8 vs. 38.7 ± 4.0; p = 0.92) and differed during test 2 (31.7 ± 3.4 vs 43.7 ± 3.6; p = 0.02). RR was similar during test 1 (38.5 ± 2.4 vs. 40.4 ± 2.7; p = 0.60) and exhibited a trending difference during test 2 (44.3 ± 2.4 vs. 37.2 ± 2.6; p = 0.06). VE/V̇CO₂ was similar during test 1 (29.9 ± 1.0 vs. 32.2 ± 1.1; p = 0.14) and the difference observed during test 2 was a weak trend (32.1 ± 0.89 vs 29.6 ± 0.97; p = 0.08).

CONCLUSION: Patients with ME display normal ventilatory response to exercise during initial testing but have post-exertional blunting of ventilatory responses in subsequent tests. Because multiple body systems must be activated to produce a robust exercise response, small dysfunction across several systems may contribute to post-exertional malaise in ME patients.

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Exercise Is Medicine® On Campus: A National Analysis And Community Impact

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Exercise is Medicine® on Campus (EIM-OC) calls upon colleges and universities to promote and increase physical activity. The distribution of EIM-OC programs across the U.S. and community impact have yet to be described in detail.

PURPOSE: To perform a national analysis of the recognized EIM-OC programs in the U.S. and their community impact.

METHODS: Recognized EIM-OC programs were analyzed with respect to recognition level (gold, silver, bronze), school population, presence of a medical school on campus, ACSM region, and state. County level population density (i.e., metro or non-metro county), physical inactivity prevalence, and presence of EIM-OC program were recorded. Data were obtained from the EIM-OC, U.S. Department of Agriculture, and Robert Wood Johnson Foundation websites. The number of EIM-OC programs in each ACSM region was normalized to number of states in that region.

RESULTS: Of the 131 recognized programs, there were 59 gold, 53 silver, and 19 bronze. School populations for gold (23,338), silver (15,688), and bronze (10,779) programs differed (P<0.01). The frequency of medical schools present at gold (40%), silver (20%), and bronze (17%) level programs differed (p<0.05). The Midwest and Southeast chapters had the highest frequency of total and gold EIM-OC programs. Thirty-five states had at least one EIM-OC program, with 26 states having at least one gold program. Ninety-two percent of EIM-OC programs and 90% of gold programs were in metro counties (i.e., ≥50,000 people). Compared to those counties with an EIM-OC program, physical inactivity prevalence was higher in counties without an EIM-OC program (26±4 vs 30±6 %, P<0.01).

CONCLUSIONS: Universities earning EIM-OC gold level status were mostly large flagship and/or research focused institutions with 40% also having a medical school. Midwest and Southeast ACSM regions ranked at the top for total and gold level EIM-OC programs. Two-thirds of states had an EIM-OC program with most gold programs in the eastern half of the country. Promotion of physical activity at smaller universities in non-metro counties is needed because physical activity levels