



**2021 – 2022 ACSM PRESIDENT’S CUP  
Abstracts**

Central States Chapter

**Comparative Accuracy of a Novel Approach to Automatic Temporal Event Detection During Drop Vertical Jump**

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Motion capture technology can add meaningful insight to the drop vertical jump (DVJ); however, these systems are quite expensive. **PURPOSE:** Therefore, the purpose of this study was to compare a low-cost depth-sensing camera (DSC) with body tracking software to the gold standard optical retroreflective motion capture system (OMC) in detecting the timing of initial ground contact (IGC) and maximum knee flexion (MKF) using a novel approach to automatic IGC detection without a force plate. This approach was also validated with force plate IGC detection. **METHODS:** This pilot study included 19 individuals (24.16±2.39 yrs, 174.66±9.42 cm, 72.79±10.13 kg). Participants were fitted with retroreflective markers and completed 5 DVJ repetitions from a 31 cm box onto 2 force plates (right foot, left foot) sampling at 1000 Hz. Each trial was simultaneously recorded using a 12-camera OMC sampling at 100 Hz, and a DSC sampling at 30 Hz placed 2.7 m from the capture space, and 1.0 m above the ground in the frontal plane. A custom MATLAB (version 2019b) algorithm detected the moment left and right ankle joint centers crossed below 180 mm (relative to ground) in the vertical plane for both devices. Right and left times were averaged to determine IGC. Maximum right and left knee flexion values within 1 second following IGC were averaged to determine MKF for both devices. Force plate IGC was defined as the moment vertical ground reaction force exceeded 10% of participant body mass. Because the DSC and OMC could not be synchronized, time difference between MKF and IGC was analyzed as a measure of accuracy between the two. For this study, results of 1 trial were analyzed. ICC values measured agreement in time differences for all systems. Statistical analysis was performed in RStudio (version 4.1.1). **RESULTS:** ICC values indicated perfect agreement between kinematic calculation of IGC using the OMC and force plate calculation of IGC (ICC(3,k) = .99, p<.001). Average difference between MKF and IGC for the OMC was 0.29±0.12 seconds. For the DSC, average difference was 0.28±0.12 seconds. ICC values were very high between the DSC and OMC (ICC(3,k) = 0.99, p<.001) when comparing time between MKF and IGC. **CONCLUSION:** As this was a pilot study, findings are limited in their generalizability due to a reduced sample size. However, this work demonstrates that a single DSC can detect IGC and MKF events during DVJ, which could be useful for event detection in clinics where force plates are not available. Future studies should evaluate the usefulness of this technique using a greater and more diverse sample population, in order to further assess its accuracy.

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**Shoulder Arthroscopy with versus without Suprascapular Nerve Release: Clinical Translation for Elite Volleyball Athletes**

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The mechanics associated with shoulder elevation, abduction, and external rotation place the overhead athlete (e.g., volleyball; VB) at increased risk for labral and rotator cuff pathology and suprascapular nerve (SSN) entrapment. Arthroscopic surgery is usually considered after conservative management fails to improve symptoms. **PURPOSE:** To compare the sports medicine outcomes and return to play between elite VB athletes who underwent shoulder arthroscopy and decompression of the SSN versus overhead athletes who underwent shoulder arthroscopy without SSN release. **METHODS:** In total, 56 high-level VB athletes diagnosed with a rotator cuff tear and/or a glenoid labral lesion and SSN entrapment whose symptoms did not improve with non-operative treatment were included in this study after agreeing to undergo surgery. Thirty-five athletes (mage = 27; range: 19-34) were included in the SSN decompression group (Group 1; agreed to undergo SSN decompression during shoulder arthroscopy) and 21 athletes (mage = 24; range: 21-32) were included in the non-SSN decompression group (Group 2; refused to undergo SSN decompression during shoulder arthroscopy). Preoperative/postoperative University of California at Los Angeles (UCLA) shoulder scores, bilateral postoperative Constant scores, and return to play information were collected. Follow-up evaluations took place from two to five years post-surgery: mGroup1 = 38.4, range: 24-50 months; mGroup2 =42.2, range: 26-53 months. **RESULTS:** Both groups had significantly improved UCLA scores after surgery ( $p < .05$ ). The postoperative UCLA ( $p = .01$ ) and Constant scores ( $p < .001$ ) were significantly higher in Group 1. The mean difference in Constant score between the affected and the unaffected side was four points (range: 2-12) in Group 1 and eight points (range: 4-14) in Group 2 ( $p = .0002$ ). In both groups, 100% of athletes reached the patient acceptable symptom state value for Constant score at follow-up. Based on UCLA score, Group 1 had significantly higher pre-to-post-operative improvement than Group 2 ( $p = .016$ ). The return to play rate was 97% in Group 1 and 84% in Group 2. **CONCLUSION:** Shoulder arthroscopy combined with SSN release may yield superior sports medicine outcomes and return to play in elite VB athletes with SSN entrapment and labral and/or rotator cuff pathology.

## Mid-Atlantic Chapter

### **Ambulatory Arterial Stiffness, Salivary Inflammation, and Physical Activity in Young Adults with and without COVID-19**

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COVID-19 illness may cause a dysregulated systemic inflammatory response, leading to cardiovascular damage and an increased risk for cardiovascular disease (CVD). Physical activity (PA) is inversely associated with systemic inflammation and CVD risk and may be a cardioprotective lifestyle factor for individuals recovering from COVID-19. **PURPOSE:** 1) To compare CVD risk, assessed as arterial stiffness and systemic inflammatory levels, between young adults recovering from COVID-19 and uninfected controls, and 2) to explore PA as a mediator for the relationship of COVID-19 infection history with arterial stiffness and systemic inflammation. **METHODS:** Analyses were performed on 23 COVID-19 (15 females, 25.0±8.9 years, 24.1±3.5 kg/m<sup>2</sup>) and 32 control participants (18 females, 24.4±6.5 years, 25.1±3.5 kg/m<sup>2</sup>). Arterial stiffness was estimated as pulse wave velocity (PWV) during 24-hour ambulatory blood pressure monitoring with an oscillometric blood pressure device. Systemic inflammation was assessed as salivary C-reactive protein (CRP) levels using the passive drool method. PA was objectively measured via accelerometry and assessed as moderate-to-vigorous PA (MVPA). An independent samples *t*-test was used to compare measures of arterial stiffness and systemic inflammation between the COVID-19 and control groups. Mediation analysis was used to determine whether there was a significant indirect effect of COVID-19 infection history through MVPA on arterial stiffness and CRP levels. **RESULTS:** There were no significant differences ( $p > 0.05$ ) between the SARS-CoV-2 and control groups in PWV (5.0±0.5 m/s vs. 5.1±0.5 m/s) or CRP levels (765.4±672.9 pg/mL vs. 526.3±674.8 pg/mL). Mediation analysis did not reveal a significant indirect effect of COVID-19 infection history through MVPA on arterial stiffness (estimate = 0.02, 95% CI = -0.05 – 0.24) or CRP levels (estimate = 0.03, 95% CI = -0.07 – 0.16). **CONCLUSION:** These results suggest there are no differences in arterial stiffness and systemic inflammation between young adults recovering from COVID-19 and uninfected controls, and that MVPA may not significantly mediate the relationship for COVID-19 infection history with arterial stiffness and systemic inflammation. Young adults recovering from COVID-19 may not have a heightened CVD risk compared to controls.

## Midwest Chapter

### Exercise is Medicine® on Campus: A National Analysis

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**PURPOSE:** Exercise is Medicine® on Campus (EIM-OC) is an initiative started by ACSM that calls upon colleges and universities to promote and increase physical activity. A major goal is to establish physical activity as a vital sign of health. The distribution of EIM-OC programs across the U.S. has not been described in detail. Our purpose was to perform a national analysis of the recognized EIM-OC programs in the U.S. **METHODS:** Recognized EIM-OC programs were analyzed with respect to recognition level (gold, silver, bronze), university enrollment, ACSM regional chapter, state, and population density (i.e., metro or non- metro county as defined by U.S. Department of Agriculture). Data were obtained from the EIM-OC website. To facilitate comparisons across regional chapters, the number of EIM-OC programs in each 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. University student enrollment for gold (23,338), silver (15,688), and bronze (10,779) programs differed ( $P < 0.01$ ). Regional Texas (5), Midwest (4.8), and Southeast (3.5) chapters had the highest frequency of EIM-OC programs. The Midwest (2.2), Southeast (2.1), and Mid-Atlantic (1.4) chapters had the highest frequency of gold programs. Thirty-five states had at least one EIM-OC program, with 26 states having at least one gold program. California and Michigan had the most EIM-OC and gold programs. Ninety-two percent of EIM-OC programs and 90% of gold programs were in metro counties (i.e.,  $\geq 50,000$  people). **CONCLUSION:** Universities earning EIM-OC gold level status (i.e., routine physical activity assessment and promotion) were mostly large flagship and/or research focused schools. Midwest and Southeast chapters ranked at the top for total EIM-OC programs including those with gold status. Two-thirds of states had an EIM-OC program with most gold programs in the eastern half of the country. These findings may direct future implementation of EIM-OC programs in regional chapters and states. Promotion of physical activity at smaller universities in non-metro counties is especially important because physical activity levels are lower among rural residents. We urge ACSM members to leverage EIM-OC to promote and facilitate physical activity on campus and in the community.

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## New England Chapter

### Relation of Strength Training Participation to Incident Knee Replacement: The Multicenter Osteoarthritis Study

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ACSM Guidelines recommend exercise as an effective approach to managing symptoms of knee osteoarthritis (OA). Strength training is often prescribed because lower extremity weakness is common with knee OA and an antecedent to functional limitation, which can lead to knee replacement (KR). However, little is known about the impact of strength training on incident KR. Understanding this relation may assist clinical decision making and lifestyle choices for individuals with or at risk for knee OA. **PURPOSE:** Determine the association of self-reported strength training to incident KR. **METHODS:** Participants were included from Multicenter Osteoarthritis (MOST), a NIH-funded, longitudinal cohort study of individuals with or at risk for knee OA. Strength training participation status was obtained at baseline using the Physical Activity Scale for the Elderly questionnaire. Participants were asked “Over the past 7 days, how often did you do any exercise specifically to increase muscle strength and endurance?”. Strength training was dichotomized into ‘never’ or ‘any participation’ (defined by  $\geq 1$ -2 days/week). Date of first KR was confirmed from medical records. Cox proportional hazard regression was used to model differences in the risk for incident KR in relation to strength training participation, accounting for competing events (death or early withdrawal). Participants without KR were censored at their last attended clinic visit. Analyses were adjusted for age, sex, body mass index (BMI), radiographic knee OA, self-reported moderate-vigorous aerobic activity (never versus any), and knee pain severity. **RESULTS:** 2,704 MOST participants were included (age =  $62.5 \pm 8.1$ ; BMI =  $30.7 \pm 6.0$  kg/m<sup>2</sup>; 60.2% female). The proportion of participants in the “Never” versus “Any” strength training participation categories were 57.3% and 42.7%. The proportion of participants who had incident KR was 16%, and 19% withdrew or died. After adjusting for confounders and competing risks, any amount of strength training participation was associated with a 20% greater risk for incident KR compared to no strength training (hazard ratio [HR] 1.20, 95% confidence interval [CI] 1.02–1.51,  $p = 0.03$ ). **CONCLUSION:** Participants who engage in strength training have a higher risk for incident KR. Future research focused on individualized, OA-specific strength training prescription is warranted.

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## Northland Chapter

### Body-Composition and Blood Lipid Changes Following 6-Weeks of Aerobic Exercise and Energy Restriction

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Inducing weight loss through the creation of an energy deficit via diet and exercise can create substantial health benefits; however, there is often remarkable variability between individuals in response to the same program. MicroRNA's may be able to predict responders and non-responders. **PURPOSE:** To examine preliminary data from a 12-week diet and exercise intervention where microRNA's are evaluated pre- mid- and post-intervention. This sub-study evaluated the anthropometric, blood lipid, cardiovascular, and body composition outcomes following the first 6-weeks of aerobic exercise and dietary intervention. **METHODS:** Twenty-six ( $M_{age}=39.13\pm 13.03yr$ ; 84.6% female) overweight (BMI 25.0 to 34.9kg/m<sup>2</sup>) volunteers participated in this study. Utilizing heart rate monitors, subjects performed at least 40 minutes of aerobic exercise a minimum of 4 times weekly at 55-60% of their respective heart rate reserve. Subjects were counseled by dietitians to create a 250-kcal deficit from their standard diet. Measures were obtained at weeks 0 and 6 of the intervention. Anthropometric measures were collected utilizing a stadiometer, scale, and tape measure. Resting heart rate and blood pressure were measured manually. Body composition and lean body mass were examined via dual-energy X-ray absorptiometry. Venous blood lipid values were assessed utilizing a Piccolo blood chemistry analyzer. Dietary intakes were estimated via three-day food logs and ESHA software. Paired sample t-tests ( $\alpha = 0.05$ ) and effect size calculations were conducted to compare pre- and post-testing values. **RESULTS:** Following 6 weeks of intervention, improvements were noted in all anthropometric measures, cardiovascular measures, and LDL. Several were associated with considerable effect sizes. Decreases occurred in HDL levels. **CONCLUSION:** Data from this study suggests the introduction of aerobic exercise combined with mild caloric restriction leads to favorable changes in anthropometric and cardiovascular measures. Consistent with other research, the creation of a caloric deficit led to weight loss. Losses in lean mass fell short of statistical significance. Such losses may be attributable to decreases in the fat-free content of adipose tissue. Decreases in HDL in response to the intervention warrant further investigation. Our next step is to evaluate the microRNA data to see if they have predictive capability.

## Northwest Chapter

### Hot Water Immersion versus Aerobic Exercise in Lowering Blood Pressure in Adults with Untreated Hypertension

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While aerobic exercise training is the current gold-standard non-pharmacological intervention for lowering blood pressure, passive heat therapy has proven to be an effective alternative means of reducing blood pressure. However, efficacy of heat therapy versus exercise training in lowering blood pressure has not been compared in adults with untreated hypertension. **PURPOSE:** To compare the effectiveness of hot water immersion (HWI) versus aerobic exercise training (EX) in lowering blood pressure in adults with untreated hypertension. **METHODS:** 13 volunteers (age [mean  $\pm$  SD]: 47 $\pm$ 9 years, 2F) completed resting vascular function testing, including measurements of blood pressure, cardiac output, and carotid-femoral pulse wave velocity (PWV). Systemic vascular conductance (SVC) was calculated as cardiac output/mean arterial pressure (MAP). Following pre-testing (PRE), subjects were randomized into either HWI (n=6, 1F) or EX (n=7, 1F). During HWI, subjects were immersed to the level of the sternum in 40°C water for 45 minutes. EX consisted of upright cycling at 60% of heart rate reserve (HRR) for 40 min, with 5 min each for warm-up and cool-down at 30% of HRR. Participants completed 30 sessions of either HWI or EX over 8-10 weeks followed by postintervention vascular function testing (POST). Values for each group are reported as means  $\pm$  SD of the change ( $\Delta$ ) from PRE to POST and were compared using an unpaired two sample t-test;  $\alpha=0.05$ . **RESULTS:** Following 30 sessions of either HWI or EX, the change in systolic blood pressure tended to be different between groups (HWI vs. EX; -5 $\pm$ 7 vs. +3 $\pm$ 4 mmHg; p=0.054), whereas change in diastolic blood pressure (DBP) was not different between HWI and EX (-2 $\pm$ 8 vs. +2 $\pm$ 7 mmHg; p=0.33). Change in MAP was not different between HWI and EX (-3 $\pm$ 7 vs. +2 $\pm$ 5 mmHg; p=0.18). Change in cardiac output was similar between HWI and EX (-0.43 $\pm$ 0.82 vs. -0.41 $\pm$ 0.89 L/min; p=0.96), as were changes in SVC (-3.7 $\pm$ 9.6 vs. -5.3 $\pm$ 9.1 mL $\cdot$ min<sup>-1</sup> $\cdot$ mmHg<sup>-1</sup>; p=0.80). Changes in PWV were similar between HWI and EX (-0.3 $\pm$ 0.6 vs. +0.1 $\pm$ 1.0 m $\cdot$ s<sup>-1</sup>; p=0.49). **CONCLUSION:** These data suggest that hot water immersion may be more effective than aerobic exercise training in lowering blood pressure in adults with untreated hypertension.

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**One Week of Time-Restricted Eating Improves Markers of Cardiometabolic Health in Healthy Adults**

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Cardiovascular disease (CVD) is the leading cause of death worldwide. Elevated insulin, triglycerides, and blood pressure are important markers for cardiovascular disease risk and are impacted by circadian physiology. Time-restricted eating (TRE) is a circadian-based dietary strategy that has been suggested to improve cardiovascular and metabolic parameters. Five weeks of TRE to a 6h eating window during the biological day improves cardiovascular and metabolic parameters such as blood pressure and insulin sensitivity in men at risk for CVD and diabetes. **PURPOSE:** Whether improvements in response to TRE can be induced acutely in healthy men and women are not known. Therefore, we examined the impact of one week of TRE in healthy men and women on CVD risk factors. **METHODS:** In my study, 13 healthy men adults (8F, age $\pm$ SD= 26.9 $\pm$ 3.9, BMI $\pm$ SD= 23.3 $\pm$ 2.1) participated in a 2-week protocol. During Week 1, energy was consumed over a 13h period with meals individually anchored to habitual wake time. In Week 2, participants were instructed to match food intake from Week 1 but restrict intake to an 8h period. At the end of each week, participants were admitted to the laboratory for an in-patient overnight stay. Blood samples were collected hourly overnight. Blood pressure was assessed 5min after waking in the morning of the in-patient overnight stay. **RESULTS:** Average nocturnal plasma triglycerides levels, insulin levels, and blood pressure were reduced during TRE compared to habitual eating. In this study, 1 week of TRE was associated with significantly lower triglyceride and insulin levels compared to a 13h eating period. **CONCLUSION:** This study suggests acute TRE may be an effective tool to reduce markers of CVD risk in healthy populations.

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## Southeast Chapter

### Daily Stretching with Ankle Dorsiflexion Splint Improves Measures of Microvascular Reactivity in Patients with Peripheral Artery Disease

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Peripheral Artery Disease (PAD) is a vascular disease that affects over 8 million Americans. PAD patients commonly have difficulty walking due to pain in the legs during physical exertion. Walking therapy has been recommended to improve walking performance and attenuate disease progression, but this therapy remains underutilized in PAD patients. Recent evidence indicates that muscle stretching via ankle dorsiflexion splints improves vascular health and walking performance in PAD; however, it is currently unknown how muscle stretching affects tissue oxygenation (StO<sub>2</sub>) in PAD.

**PURPOSE:** The purpose of this study was to determine the impact of 4 wks of calf muscle stretching on measures of tissue oxygenation in patients with PAD. **METHODS:** Fifteen PAD patients (71.3±8.3 yrs) were randomized to either a stretch (n=10) or a non-stretch group (n=5). Patients in the stretch group wore the splints for 30 min/day, 5 days/wk for 4 wks. A 5-min vascular occlusion test and a 6-min walk test (6MWT) were administered before and after the intervention. StO<sub>2</sub> was monitored via Near-Infrared Spectroscopy (NIRS) during the vascular occlusion test and the 6MWT. Tissue oxygen uptake and microvascular reperfusion were determined from the vascular occlusion test, while relative changes in StO<sub>2</sub> were determined at minutes 1 and 2 of the 6MWT. Change data were analyzed using paired t-tests and significance was accepted at p<0.05. **RESULTS:** Muscle stretching improved microvascular reperfusion following occlusion (Pre: 0.38±0.26; Post: 0.51±0.27 ΔStO<sub>2</sub>/sec). The relative increase in oxygen utilization at minute 1 (Pre: 63±26%; Post: 73±27%) and minute 2 (Pre: 69±23; Post: 84±17 %) of the 6MWT was greater after 4 wks of muscle stretching. The rate of tissue oxygen uptake during occlusion tended to increase after muscle stretching (Pre: -0.10±0.03; Post: -0.12±0.04 ΔStO<sub>2</sub>/sec; p=0.06). Walking distance also tended to increase following the intervention (Pre: 351±118m; Post:366±117m; p=0.08). There were no significant changes in any of the NIRS measurements in the non-stretch group. **CONCLUSION:** These results indicate that 4 wks of muscle stretching improves microvascular reactivity and StO<sub>2</sub> of the calf muscles during walking. This muscle stretching intervention may have value as a means of maintaining perfusion and function of the calf muscles in PAD patients with limited mobility.

## Southwest Chapter

### Self-Generated Lower Body Negative Pressure as a No-Power Countermeasure for Deep Space

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The absence of gravitational forces experienced during spaceflight produces headward fluid shifts which probably cause Spaceflight Associated Neuro-Ocular Syndrome (SANS). In order to counteract these fluid shifts and prevent SANS, especially when power is limited and a human centrifuge is unavailable, other strategies are needed. One possible strategy is the use of self-generated, lower body negative pressure (LBNP) which meets the low power and safety requirements of deep-space missions. **PURPOSE:** In this study we explored acute physiologic responses to self-generated LBNP in a horizontal model of simulated microgravity. **METHODS:** Participants of the study were tested during static 25 mmHg LBNP and compared dynamic self-generating 25 mmHg LBNP chamber as well as upright and supine postures without LBNP. After informed, written consent was obtained, five female and six male subjects' heart rates and blood pressures were recorded along with cross sectional areas (CSA) of left and right internal jugular veins (IJV) by quantitative ultrasound. **RESULTS:** Upright IJV CSAs increased significantly when compared to both static and dynamic LBNP. There was a large standard error in the supine posture and no significant differences when comparing the supine posture to the upright posture or either LBNP condition. However, static LBNP reduced IJV CSA by 70% when compared to the supine posture, while dynamic LBNP reduced IJV cross sectional area by 62% compared to supine posture. **CONCLUSION:** The administered self-generated LBNP and supine LBNP tests and analyses demonstrated that the dynamic, self-generated LBNP may have a similar impact on reducing IJV CSA when compared to traditional static LBNP, thus warranting longer-term tests of self-generated LBNP. In summary, our results suggest that self-generated LBNP at 25 mmHg is as a low-mass, low-volume, unpowered replacement for traditional LBNP hardware (for example, Chibis Suit) during deep-space missions.

## Hypoxic Preconditioning Attenuates Ischemia-reperfusion Injury in Older Adults

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Sudden restoration of blood flow to an ischemic vessel paradoxically damages endothelial cells. In young healthy adults, ischemic preconditioning, caused by repeated periods of brief ischemia induced by local cuff inflation prior to reperfusion, attenuates endothelial dysfunction following an ischemia-reperfusion injury. However, ischemic preconditioning does not consistently protect against ischemia-reperfusion injury in older adults. Intermittent systemic hypoxemia, induced via brief bouts of breathing low levels of oxygen, attenuates endothelial dysfunction following an ischemia-reperfusion injury in young adults. **PURPOSE:** To determine whether intermittent hypoxia protects against ischemia-reperfusion injury in older adults. **METHODS:** Twelve older adults (5 women, age:  $57 \pm 9$  years, height:  $173 \pm 8$  cm, body weight:  $75.8 \pm 13.4$  kg) visited the laboratory on two separate occasions. Endothelium-dependent vasodilation was assessed by brachial artery flow-mediated dilation using a semiautomated diagnostic ultrasound system before and after 20 minutes of upper arm blood flow occlusion to induce an ischemia-reperfusion injury. Blood flow occlusion was preceded by either intermittent hypoxia, consisting of three 4-minute hypoxic cycles at a targeted arterial oxygen saturation of 80% interspersed with 4-minute room air cycles, or intermittent normoxia, consisting of three 4-minute normoxic cycles separated by 4-minute room air cycles. **RESULTS:** Intermittent hypoxia resulted in an arterial oxygen saturation of  $80 \pm 2\%$ , which corresponded to oxygen levels of  $11.4 \pm 0.7\%$ . When preceded by intermittent normoxia, blood flow occlusion reduced flow-mediated dilation by  $4.1 \pm 2.6\%$  ( $6.5 \pm 1.7$  to  $2.4 \pm 1.7\%$ ). In contrast, flow-mediated dilation was reduced by  $2.0 \pm 1.5\%$  when blood flow occlusion was preceded by intermittent hypoxia ( $5.6 \pm 1.7$  to  $3.6 \pm 2.3\%$ ,  $P = 0.03$ ). When compared to intermittent normoxia, intermittent hypoxia resulted in a greater heart rate ( $60 \pm 10$  vs.  $68 \pm 10$  bpm,  $P < 0.01$ ) but did not affect cardiac output ( $5.1 \pm 1.4$  vs.  $5.8 \pm 1.8$  L/min,  $P = 0.11$ ). **CONCLUSION:** Hypoxic preconditioning attenuated the reduction in flow-mediated dilation induced by a 20-minute blood flow occlusion in older adults. Thus, exposure to intermittent hypoxia represents a promising strategy to protect against ischemia-reperfusion injury in populations at risk for ischemic events.