

ACE-SUPPORTED RESEARCH: Year 2—Does the ACE Integrated Fitness Training® Model Really Work?

→ What You Need to Know:

This is the second report on an ongoing three-year study examining the effectiveness of exercise programming based on the ACE Integrated Fitness Training® Model. The results of this study provide additional support to the findings of previous ACE-supported research on the Model—namely, that the personalized approach optimizes training responsiveness and positively impacts cardiorespiratory fitness, muscular fitness and cardiometabolic health.

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Since first introducing the ACE Integrated Fitness Training (ACE IFT®) Model more than a decade ago, ACE has been supporting research to investigate its effectiveness in real-world settings, focusing on various elements related to the Model, including [training responsiveness](#), [exercising in a community setting](#), [exercise for older adults](#) and [behavior and lifestyle change](#).

In 2021, we presented the results of [Year 1](#) of a multi-year, multi-site study examining the effectiveness of personalized exercise programming using the ACE IFT Model at eliciting favorable comprehensive training responsiveness (i.e., cardiorespiratory fitness + muscular fitness + cardiometabolic health).

Here, we present the findings of Year 2 of this three-year investigation. Like the Year 1 study, this research was conducted by Lance Dalleck, PhD, and his team of researchers in the High Altitude Exercise Physiology Program at Western Colorado University. At the conclusion of this project, the research will provide a robust body of data from more than 100 participants.

The Study

Twenty-seven nonsmoking men and women ranging in age from 21 to 65 years old were recruited to participate in a 13-week study. All were physically inactive, which is defined as not having participated in at least 30 minutes of moderate-intensity physical activity on at least three days of the week for at least three months, and all were asked to continue their current dietary habits and to not perform additional exercise beyond that required for the research. None of the participants had evidence of cardiovascular, pulmonary and/or metabolic disease, as determined by the completion of a medical history questionnaire.

The participants underwent two days of baseline measurements prior to the beginning of the study. The following variables were measured:

- ▶ Resting heart rate
- ▶ Resting blood pressure
- ▶ Anthropometric measurements: height, weight, percent body fat, and waist and hip circumferences
- ▶ Fasting blood lipids

- ▶ Fasting blood glucose
- ▶ Muscular fitness assessments: Five-repetition maximum (5-RM) for the bench press and leg press exercises
- ▶ Maximal exercise testing: Maximal oxygen consumption (VO₂max) and maximal heart rate [note that heart-rate reserve (HRR) was calculated for each participant by subtracting resting heart rate from maximal heart rate]
- ▶ First and second ventilatory thresholds (VT1 and VT2)

After completing the baseline assessments, the participants were randomized into three groups:

- ▶ ACE IFT Model group
- ▶ Standardized training group
- ▶ Control group

Cardiorespiratory Training

The cardiorespiratory exercise was performed on various modalities: arm, cycle and rowing ergometers; elliptical crosstrainers; and treadmills. The standardized training group worked at an intensity based on a percentage of their HRR, while those in the ACE IFT Model group received programming based on their ventilatory thresholds. For both groups, a target heart rate was determined to coincide with either the HRR or ventilatory thresholds to establish a specific intensity for each exercise session.

The cardiorespiratory training programs progressed for both groups over the course of the 13 weeks. Frequency remained consistent for both exercise groups, at three workouts per week throughout the study.

For the standardized training group, cardiorespiratory exercise began in week 1 at 40 to 45% of HRR for 25 minutes per day. The duration of each training session was extended by 5 minutes each week until weeks 5 and 6, when intensity increased to 50 to 55% HRR for 45 minutes per day. Then, in weeks 7 and 8, duration increased to 50 minutes per day. For the final five weeks of the study, this group exercised at 60 to 65% HRR for 50 minutes per day.

For the ACE IFT Model group, cardiorespiratory exercise began at a heart rate below VT1 for 25 minutes per day. As with the standardized training group, the duration of training sessions was extended by 5 minutes per week until weeks 5 and 6, when intensity increased to a heart rate equal to or greater than VT1 but below VT2. Then, in weeks 7 and 8, duration increased to 50 minutes per day. For the final five weeks of the study, this group exercised at an intensity equal to or greater than VT2 for 50 minutes per day.

Muscular Training

Muscular training was introduced during week 4 and continued to be performed three days per week through week 13.

For the standardized training group, the program consisted of the following single- and multijoint exercises performed on machines:

- ▶ Bench press
- ▶ Shoulder press
- ▶ Lat pull-down
- ▶ Seated row
- ▶ Biceps curl
- ▶ Triceps push-down
- ▶ Seated leg press
- ▶ Seated leg extension
- ▶ Prone leg curl
- ▶ Seated back extension/flexion

Two sets of 12 repetitions were completed for each exercise. Resistance was progressed every two weeks by approximately 3 to 5% of the total weight lifted for the upper body and approximately 6 to 10% for lower-body exercises. A session rating of perceived exertion (RPE) of 5 to 6 on the 0-to-10 scale was maintained across the training program.

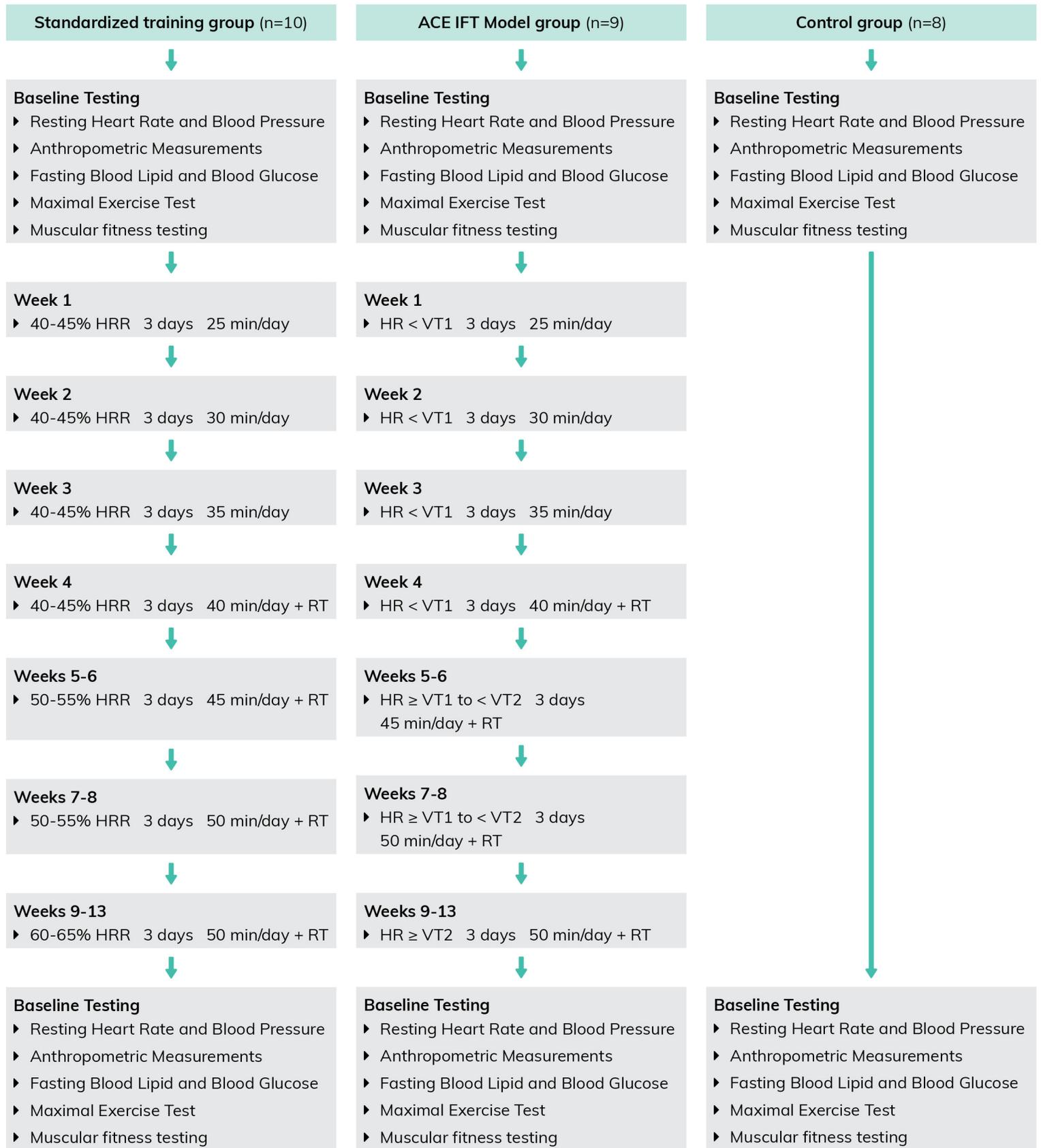
For the ACE IFT Model group, muscular training consisted of multijoint/multiplanar exercises using both free weights and machines. The machines allowed for free motion during the exercises, meaning that range of motion was not limited to a specific arc. The following exercises were performed:

- ▶ Stability ball circuit (glute bridges, crunches, Russian twists, planks)
- ▶ Lunge matrix
- ▶ Kneeling/standing wood chops
- ▶ Kneeling/standing hay balers
- ▶ Dumbbell squat to 90-degree knee bend
- ▶ Standing one-arm cable row
- ▶ Step-ups with dumbbell onto a 6-inch (15-cm) step
- ▶ Modified (assisted) pull-ups
- ▶ Dumbbell bench press

Two sets of 12 repetitions were completed for each exercise. The intensity of weighted exercises started at 50% of 5-RM and was progressed by 5% of 5-RM increments every two weeks. For exercises that did not include a weighted resistance (e.g., stability ball circuit), the number of repetitions was increased by approximately 5 to 10% to maintain an RPE rating of 5 to 6 on the 0-to-10 scale.

Figure 1 provides a flow chart of the experimental procedures and exercise programs for all three groups.

Figure 1. Flow chart of experimental procedures and exercise prescription for each of the two exercise training treatment groups



Note: HR = Heart rate; HRR = Heart-rate reserve; RT = Resistance training; VT1 = First ventilatory threshold; VT2 = Second ventilatory threshold

The Results

At the end of the 13-week program, participants from all three groups repeated the measurements taken at the outset. Note that the data and analyses presented here are for Year 2 participants only. Also, it is important to note that the three groups did not differ in physical or physiological characteristics prior to the study.

Here are the key findings, as presented in Table 1:

- ▶ After 13 weeks, the following measures were statistically significantly more desirable in the standardized training group as compared to the control group: body mass, body-fat percentage, resting heart rate, VO₂max, bench press 5-RM and leg press 5-RM.

- ▶ The change in body-fat percentage was statistically significantly more desirable in the ACE IFT Model group relative to the control group.
- ▶ The changes in VO₂max, blood glucose, bench press 5-RM and leg press 5-RM were statistically significantly more favorable in the ACE IFT Model group when compared to both the standardized training group and the control group (Figure 2).

Table 1. Physical and physiological characteristics at baseline and 13 weeks for control, standardized training, and ACE IFT Model groups (Values are mean ± SD)

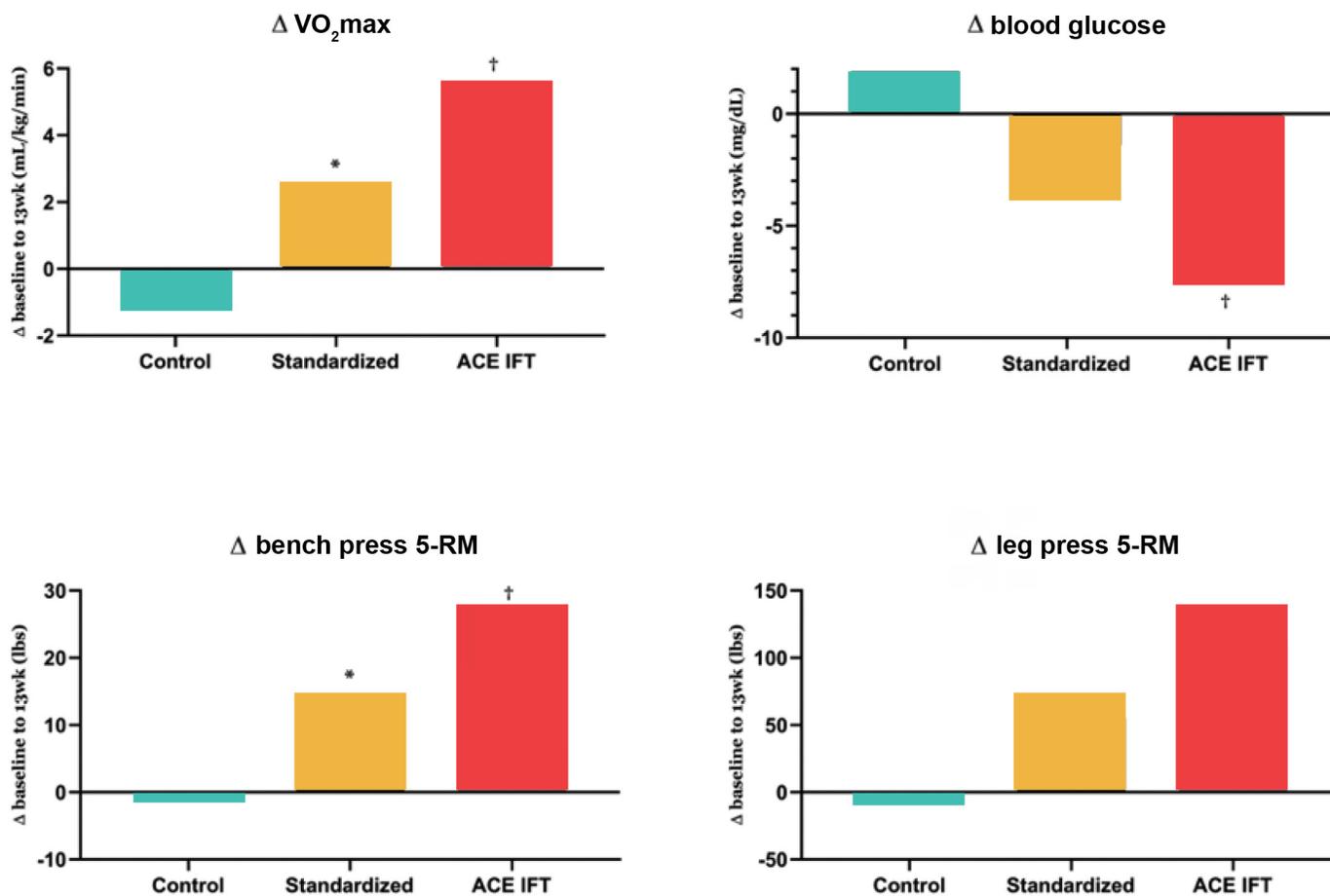
Parameter	Control group (n=8; women = 4, men = 4)		Standardized training group (n=10; women = 5, men = 5)		ACE IFT Model group (n=9; women = 5, men = 4)	
	Baseline	13wk	Baseline	13wk	Baseline	13wk
Age (years)	35.3 ± 7.8	—	36.0 ± 11.4	—	37.7 ± 14.6	—
Height (cm)	167.4 ± 7.0	—	168.2 ± 12.0	—	170.6 ± 7.6	—
Body mass (kg)	75.7 ± 8.1	76.0 ± 8.2	78.6 ± 17.1	77.5 ± 16.2 [†]	83.4 ± 20.7	82.7 ± 20.6 [*]
Waist circumference (cm)	79.2 ± 4.0	79.4 ± 4.0	84.3 ± 8.4	83.0 ± 8.1 [*]	83.0 ± 11.5	81.7 ± 10.9 [*]
Body fat (%)	27.9 ± 2.6	29.0 ± 3.3 [*]	25.9 ± 5.5	23.8 ± 5.1 [†]	26.8 ± 10.3	24.6 ± 8.8 [†]
Resting HR (bpm)	65.5 ± 9.0	69.6 ± 10.3 [*]	68.0 ± 7.8	65.4 ± 6.7 [†]	67.8 ± 6.3	68.4 ± 5.9
VO ₂ max (mL/kg/min)	32.4 ± 6.4	31.5 ± 6.2	29.0 ± 6.6	31.5 ± 7.7 [†]	31.5 ± 5.0	37.1 ± 5.5 [†]
Systolic BP (mmHg)	118.8 ± 6.8	118.1 ± 4.2	118.2 ± 13.4	115.0 ± 12.3 [*]	117.8 ± 14.5	113.1 ± 13.7 [*]
Diastolic BP (mmHg)	76.3 ± 6.2	77.8 ± 2.7	81.1 ± 9.1	81.2 ± 10.9	77.8 ± 12.2	76.4 ± 7.5
Total cholesterol (mg/dL)	175.4 ± 21.9	180.9 ± 23.0	231.8 ± 58.3	229.7 ± 53.1	217.6 ± 31.5	209.3 ± 34.6
HDL cholesterol (mg/dL)	57.9 ± 22.1	57.0 ± 20.1	48.7 ± 13.1	52.5 ± 12.8	57.7 ± 14.7	63.4 ± 10.5 [*]
LDL cholesterol (mg/dL)	92.8 ± 24.2	97.4 ± 23.4	148.3 ± 53.8	146.9 ± 53.2	131.0 ± 34.7	125.8 ± 27.0
Triglycerides (mg/dL)	108.4 ± 36.9	115.4 ± 27.6	166.1 ± 89.7	158.7 ± 78.3	131.6 ± 56.4	113.9 ± 44.1 [*]
Blood Glucose (mg/dL)	95.0 ± 7.4	96.9 ± 5.6	97.2 ± 10.2	95.8 ± 7.7	99.2 ± 7.8	91.7 ± 6.1 [†]
Bench press 5-RM (lb)	108.8 ± 37.9	107.5 ± 38.6	91.5 ± 42.4	106.0 ± 43.3 [†]	92.8 ± 41.4	119.4 ± 38.4 [†]
Leg press 5-RM (lb)	338.1 ± 153.2	330.0 ± 142.0	288.0 ± 102.4	343.0 ± 121.1 [†]	256.7 ± 124.6	363.9 ± 155.7 [†]

* Within-group change is significantly different from baseline, p<0.05; † Change from baseline is significantly different than control group, p<0.05;

‡ Change from baseline is significantly different than control and standardized training groups, p<0.05.

Note: HR = heart rate; bpm = Beats per minute; VO₂max = Maximal oxygen consumption; BP = Blood pressure; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; 5-RM = Five-repetition maximum

Figure 2. Baseline to 13-week change (Δ) in VO_2 max, blood glucose, bench press 5-RM and leg press 5-RM values for the control, standardized training, and ACE IFT Model groups (values are mean).



* Significantly greater ($p < 0.05$) baseline to 13-week Δ relative to control group; † Significantly greater ($p < 0.05$) baseline to 13-week Δ relative to both standardized training and control groups

Highlighting the Importance of Muscular Fitness

Over the past decade, low muscular fitness has garnered considerable attention as an independent and powerful predictor of chronic disease risk and premature mortality. Indeed, it has been reported that increased muscular fitness is associated with a [reduced risk of all-cause mortality](#). Additionally, various muscular fitness parameters (e.g., strength, endurance and power) have been found to be associated with common [cardiometabolic risk factors](#), including body mass index, waist circumference, blood lipids and blood pressure. It also has been demonstrated that there is a strong association between muscular strength and [mortality from all causes](#) in various clinical populations, including those with cardiovascular disease, cancer and arthritis. More recently, elevated levels of both upper- and lower-body muscular strength have been linked to [lower risk of mortality](#). Finally, it has been shown that a moderate level

of muscular strength is associated with a 32% [lower risk of developing type 2 diabetes](#).

“Taken together,” explains Dr. Dalleck, “this body of scientific literature highlights the critical long-term role of muscular fitness for overall client health.” In Year 2 of this ongoing study, it was demonstrated that a personalized exercise program using the ACE IFT Model enhanced training efficacy and limited training unresponsiveness with respect to both cardiorespiratory fitness (i.e., VO_2 max) and muscular fitness (i.e., 5-RM bench press and leg press). In particular, the muscular fitness findings are novel. As presented in Figures 3 and 4, the individual changes in 5-RM bench press and 5-RM leg press are consistently twofold greater across all ACE IFT Model group participants when compared to their standardized training and control group counterparts. “These muscular fitness responsiveness findings highlight the importance of personalizing the exercise program,” says Dr. Dalleck, “which is accomplished best with the ACE IFT Model.”

Figure 3. Individual variability in bench press 5-RM change (Δ) to exercise training in the ACE IFT Model, standardized training, and control groups

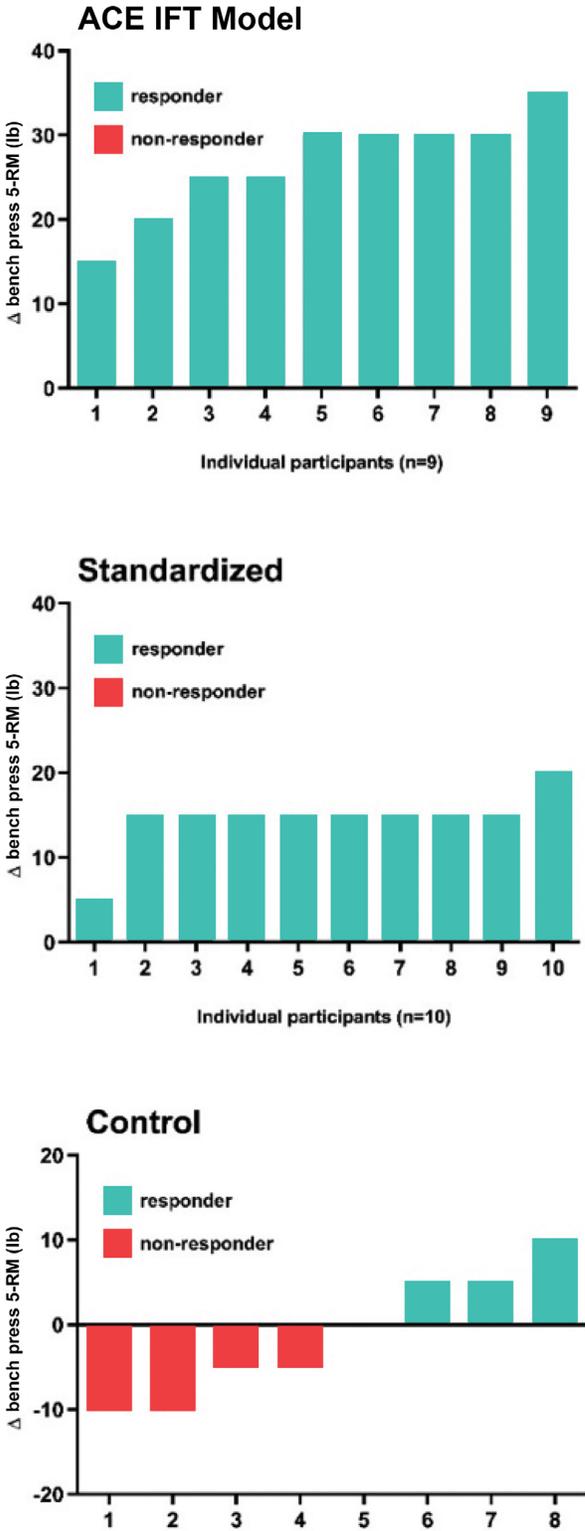
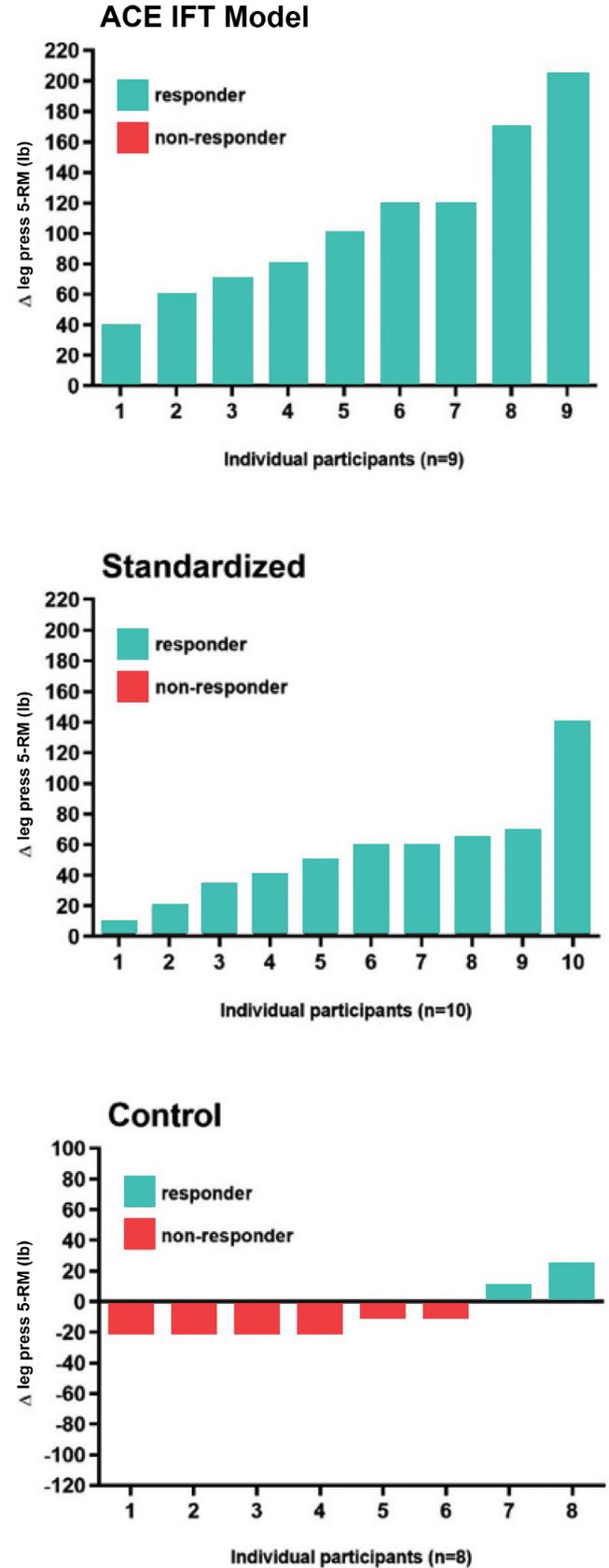


Figure 4. Individual variability in leg press 5-RM change (Δ) to exercise training in the ACE IFT Model, standardized, and control groups



In Conclusion

In the present study, a personalized exercise program using the ACE IFT Model, which combined cardiorespiratory training in conjunction with muscular training elicited significantly greater improvements in VO₂max, muscular fitness and various cardiometabolic outcomes (e.g., fasting blood glucose values) combined with diminished inter-individual variation in training responses when compared to standardized exercise training and a non-exercise control group. These findings continue to be encouraging and provide insightful data on the effectiveness of personalized exercise programming.

As Dr. Dalleck explains: “When we personalize the exercise program, for both cardiorespiratory and muscular training, versus a more standardized approach, we’re almost always seeing VO₂max and muscular strength improve, whereas with a more one-size-fits-all or standardized approach, we’re diminishing training responsiveness by about a third. This really underpins why the ACE IFT Model is so successful.” ▲

This study was first published in the peer-reviewed [*International Journal of Research in Exercise Physiology*](#).