How Adaptive Training Compares to Traditional Resistance Training

by Lance C. Dalleck, PhD, Aidan M. Dalleck, and
Bryant R. Byrd, MSc, with Daniel J. Green

As seen in
ACE

What You Need to Know

When researchers compared adaptive resistance training workouts to traditional resistance-training programs they found that participants who performed adaptive resistance training lost a higher percentage of body fat and made greater improvements in VO2max than those who performed traditional resistance training. Additionally, the adaptive-training sessions were highly time-efficient, lasting on average about 15 minutes, whereas the traditional resistance-training sessions lasted 45 minutes.

Author
Daniel J. Green
Contributor

Daniel J. Green is ACE's Senior Project Manager and Editor for Publications and Content Development. In addition to his work with organizations including the International Association of Fire Fighters and Agriculture Future of America, Daniel writes an ongoing blog series covering lifestyle change for NBCbetter.com. He has also written feature articles for local publications in Western North Carolina (WNC), including WNC Parent and WNC Magazine.

The American Council on Exercise has long promoted the benefits of personalized programming, as exemplified by the ACE Integrated Fitness Training® (ACE IFT®) Model, which couples coaching-inspired behavior-change principles with personalized and progressive exercise programming. In addition, when it comes to cardiorespiratory exercise, plenty of research supported by ACE and others has found tremendous benefit to high-intensity exercise, particularly high-intensity interval training (HIIT) and rreduced-exertion high-intensity interval training (REHIT). When these two factors are considered in tandem—that is, personalized high-intensity training—this is clearly a time-efficient way to improve cardiorespiratory health and fitness.

But are these types of workouts possible when it comes to resistance training, and do they yield similar benefits? Enter adaptive resistance exercise, which uses artificial intelligence to create a REHIT workout featuring safe, controlled and quantifiable resistance beyond what is currently possible with free weights or traditional resistance-training machines.

So, how do the benefits of adaptive resistance training stack up against those seen with traditional resistance-training programs? Lance Dalleck, PhD, and his team of researchers in the High Altitude Exercise Physiology Program at Western Colorado University designed and executed the following research study to find out.

For this study, the researchers used the ARX Alpha, which, according to the manufacturer's website, "was designed to deliver a full-body, ultra-efficient workout for users of all ages and experience levels." This machine allows users to track their progress and receive real-time feedback on every repetition. Importantly, the ARX Alpha adjusts the resistance throughout the range of motion of each repetition, during both the eccentric and concentric actions of the exercise. According to Dr. Dalleck, this means "you're working optimally throughout the entire exercise, making the workout more time-efficient."

The Study

The research team recruited 45 male and female participants ranging in age from 18 to 65 years old to take part in this 12-week study. None of the participants had performed resistance training within the previous six months and all agreed to continue their current dietary habits and not perform any exercise beyond what was included in the study. All the participants were nonsmokers, and none had any evidence of cardiovascular, pulmonary and/or metabolic disease.

All participants completed baseline testing that consisted of the following:

- Muscular fitness: One-repetition maximum (1-RM) and five-repetition maximum (5-RM) for all exercises that were to be included in the study
- Basic anthropometric measures: Height, weight, waist circumference and body composition
- Cardiorespiratory fitness: Maximal oxygen uptake (VO2max)

The participants' muscular fitness was tested at the midpoint of the study (at six weeks), and all testing was repeated at the conclusion of the study (at 12 weeks).

Following baseline testing, the participants were randomly placed into one of three groups:

1. **Non-exercise control group:** This group performed no exercise for the duration of the study.
2. **Traditional moderate-intensity resistance exercise (the MI-RE group):** This group performed a full-body resistance-training program that adhered to standard industry guidelines (Table 1). The following exercises were included in the program:

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

Table 1.
Exercise Program for the MI-RE Group

Weeks	Days/week	Sets/Repetitions	Intensity
1-2	2	1/10	60% 1-RM
3-4	2	1/12	70% 1-RM
5-7	2	2/12	70% 1-RM
8-12	3	2/12	70% 1-RM

Note: 1-RM = One-repetition maximum

3. Personalized adaptive resistance training (the ARX group): This group performed a full-body program using the ARX Alpha (Table 2).

Table 2.
Exercise Program for the ARX Group

Weeks 1-2
- Performed as a Super Set complex (i.e. no more than 20 sec between all sets)

Days	Exercise	Sets	Reps	Tempo (C/E)
M/Th	Torso Extension	1	6	7 sec/7 sec
M/Th	Leg Press	1	6	7 sec/7 sec
M/Th	Chest Press	1	6	7 sec/7 sec
M/Th	Row	1	6	7 sec/7 sec
M/Th	Torso Flexion	1	0	Static: 60 sec
M/Th	Calf Raise	1	0	Static: 60 sec

Weeks 3-4
- Performed as a Super Set complex (i.e. no more than 20 sec between all sets)

Days	Exercise	Sets	Reps	Tempo (C/E)	Rest Between Reps
M/Th	Torso Extension	1	6	7 sec/7 sec	3 sec
M/Th	Leg Press	1	6	7 sec/7 sec	3 sec
M/Th	Chest Press	1	6	7 sec/7 sec	3 sec
M/Th	Row	1	6	7 sec/7 sec	3 sec
M/Th	Torso Flexion	1	0	Static: 75 sec	N/A
M/Th	Calf Raise	1	0	Static: 75 sec	N/A

Weeks 5-12
- Performed as a Super Set complex (i.e. no more than 20 sec between all sets)
- Torso Extension & Leg Press = Super Set 1; Chest Press & Row = Super Set 2
- Performed as last two static exercises as independent sets (i.e. 20 sec between sets

Days	Exercise	Sets	Reps	Tempo (C/E)	Rest Between Reps
M/Th	Torso Extension	1	4	7 sec/7 sec	3 sec
M/Th	Leg Press	1	4	7 sec/7 sec	3 sec
M/Th	Torso Extension	1	4	7 sec/7 sec	3 sec
M/Th	Leg Press	1	4	7 sec/7 sec	3 sec
M/Th	Chest Press	1	4	7 sec/7 sec	3 sec
M/Th	Row	1	4	7 sec/7 sec	3 sec
M/Th	Chest Press	1	4	7 sec/7 sec	3 sec
M/Th	Row	1	4	7 sec/7 sec	3 sec
M/Th	Torso Extension	1	0	Static: 90 sec	N/A
M/Th	Calf Raise	1	0	Static: 90 sec	N/A

Note: C/E = Concentric/Eccentric

The Results

Anthropometric and Cardiorespiratory Outcomes

The physical and physiological characteristics of all participants are presented in Table 3. (Note that three participants in the exercise groups were unable to complete the study.) As you can see, body-fat percentage and VO2max improved significantly in both the MI-RE and ARX groups, though those improvements were more pronounced in the ARX group. Similarly, both groups improved in terms of weight and waist circumference, with more pronounced results in the ARX group.

Table 3.
Physical and Physiological Characteristics at Baseline and 12wk Control, MI-RE, and ARX Groups (mean ± SD).

Parameter	Control group (n=14)		MI-RE group (n=14)		ARX group (n=13)	
	Baseline	12 wk	Baseline	12 wk	Baseline	12 wk
Age (yr)	39.5 ± 12.5	–	38.9 ± 11.1	–	40.3 ± 15.5	–
Height (cm)	169.4 ± 6.7	–	170.4 ± 9.1	–	168.0 ± 8.4	–
Weight (kg)	70.3 ± 12.4	71.2 ± 11.9*	72.4 ± 14.0	71.9 ± 13.8*†	69.8 ± 10.7	68.1 ± 10.0*‡
Waist circumference (cm)	80.2 ± 6.8	80.8 ± 6.0	82.9 ± 9.3	82.4 ± 8.9	81.8 ± 6.7	79.7 ± 6.1*‡
Body fat (%)	25.2 ± 5.7	26.1 ± 6.1*	27.7 ± 5.5	26.0 ± 4.9*†	27.3 ± 6.5	22.9 ± 5.9*‡
VO_2max (ML-kg^{4}min^4	33.0 ± 6.2	32.5 ± 6.0	32.1 ± 7.7	33.6 ± 9.4†	34.1 ± 6.3	39.3 ± 6.0*‡

* 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 MI-RE groups, $p < 0.05$

Muscular Fitness Outcomes

At six weeks (the study's midpoint) and 12 weeks, all 1-RM and 5-RM measures for all resistance exercises—for both the MI-RE and ARX groups—were significantly greater relative to the control group (Tables 4 and 5). In the ARX group, the changes from baseline to 12 weeks in all 1-RM and 5-RM measures were significantly greater than those seen in both the baseline and MI-RE groups, except for the MI-RE baseline to 12 weeks leg press 5-RM, triceps extension 1-RM and 5-RM, and the biceps curl 5-RM (Figures 1 and 2).

Table 4.
Resistance Exercise 1-RM Values at Baseline, Midpoint, and 12 wk for Control, MI-RE, and ARX Groups (mean ± SD)

Resistence Exercise	Control group (n=14)			MI-RE group (n=14)			ARX group (n=13)		
	Baseline	Midpoint	12 wk	Baseline	Midpoint	12 wk	Baseline	Midpoint	12 wk
Back extension (lb)	205.0 ± 77.5	20.3 ± 83.0	206.8 ± 82.9	231.8 ± 57.9	242.1 ± 52.5	251.1 ± 49.3†‡	229.6 ± 51.8	252.3 ± 48.1*	173.9 ± 47.1†‡
Bicep curl (lb)	102.9 ± 41.4	100.4 ± 30.1	102.1 ± 41.4	84.3 ± 39.6	93.6 ± 41.2*	99.6 ± 42.2†‡	95.0 ± 45.1	104.2 ± 44.5*	120.4 ± 43.4†‡
Chest Press (lb)	148.9 ± 48.8	150.0 ± 47.4	150.7 ± 47.4	113.9 ± 53.2	122.9 ± 55.8	131.8 ± 54.8†‡	136.9 ± 67.3	154.6 ± 68.7*	177.7 ± 71.1†‡
Lat pull-down (lb)	139.6 ± 37.1	139.3 ± 39.0	137.1 ± 40.1	113.2 ± 45.1	124.6 ± 41.9*	128.9 ± 43.3†‡	124.6 ± 39.8	139.6 ± 43.8*	153.9 ± 41.3†‡
Leg curl (lb)	147.9 ± 47.5	153.6 ± 47.2*	149.3 ± 48.0	136.8 ± 48.7	150.0 ± 46.3*	159.3 ± 42.8†‡	160.0 ± 52.6	175.0 ± 52.0*	200.0 ± 50.7†‡
Leg extension (lb)	204.3 ± 60.4	201.4 ± 59.8	204.6 ± 61.4	176.4 ± 60.6	190.4 ± 66.2	208.2 ± 60.2‡	198.9 ± 48.3	214.2 ± 53.6*	243.9 ± 54.9†‡
Leg press (lb)	443.6 ± 171.7	439.3 ± 172.1	437.9 ± 169.5	328.2 ± 128.6	374.0 ± 123.1*	410 ± 143.3†‡	361.9 ± 164.4	437.1 ± 180.9*	494.9 ± 207.2†‡
Seated row (lb)	130.7 ± 47.0	131.1 ± 47.7	131.8 ± 46.6	115.7 ± 52.1	129.6 ± 52.0*	136.4 ± 54.3†‡	122.3 ± 43.9	131.1 ± 42.9*	156.9 ± 41.0†‡
Shoulder press (lb)	95.4 ± 39.4	92.5 ± 37.5	98.9 ± 34.8†	66.4 ± 47.1	73.2 ± 45.4*	79.3 ± 47.2†‡	78.5 ± 50.8	93.9 ± 52.3*	115.0 ± 51.8†‡
Triceps extension (lb)	102.1 ± 30.9	101.1 ± 27.5	104.6 ± 33.1	83.2 ± 35.9	95.0 ± 36.9*	100.7 ± 39.2†‡	90.8 ± 33.7	100.8 ± 35.5*	110.8 ± 40.0†‡

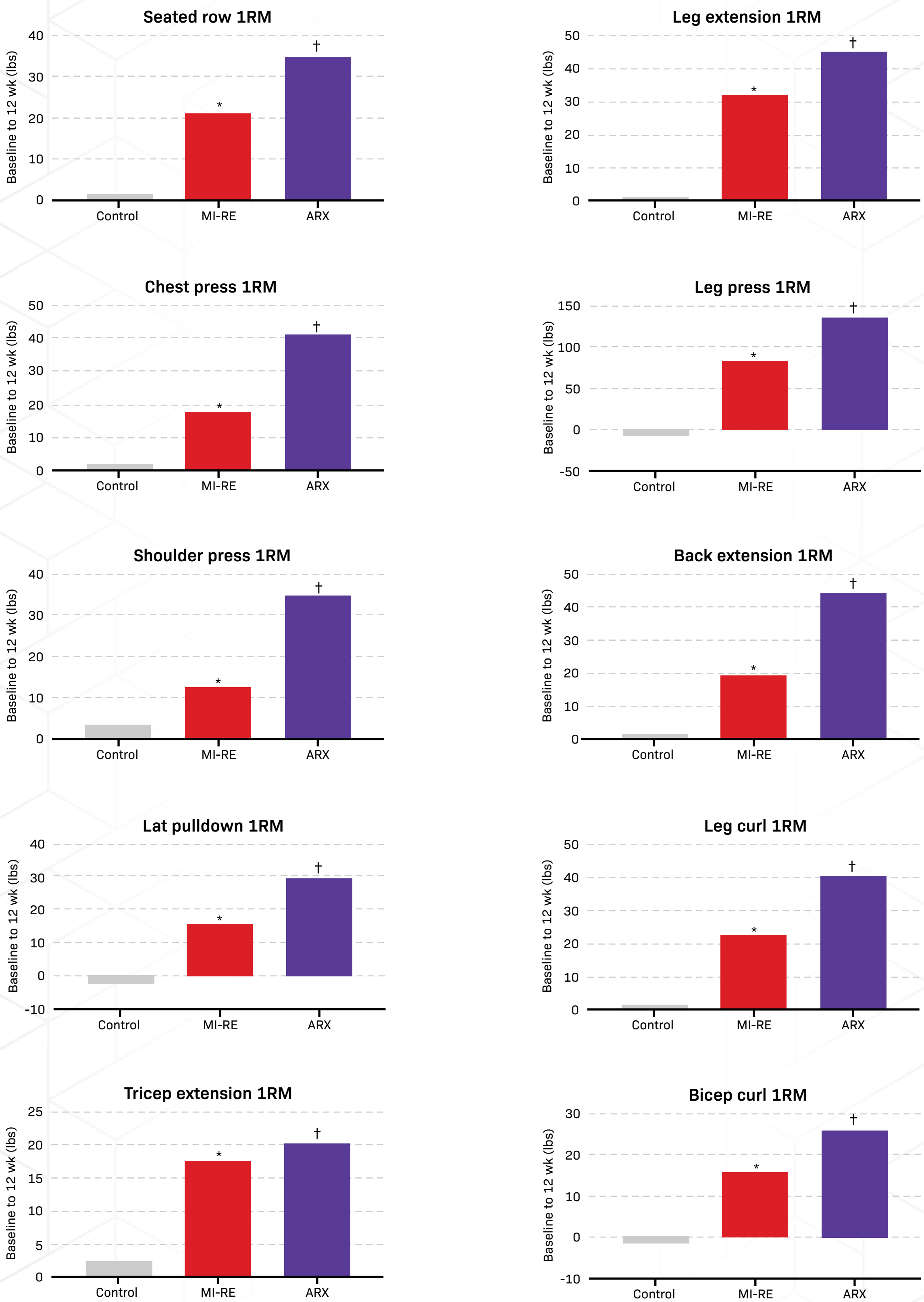
* Midpoint is significantly different from baseline. $p < 0.05$
† 12 wk is significantly different midpoint. $p < 0.05$
‡ 12 wk is significantly different from baseline, $p < 0.05$

Table 5.
Resistance Exercise 5-RM Values at Baseline, Midpoint, and 12 wk for Control, MI-RE, and ARX Groups (mean ± SD)

Resistence Exercise	Control group (n=14)			MI-RE group (n=14)			ARX group (n=13)		
	Baseline	Midpoint	12 wk	Baseline	Midpoint	12 wk	Baseline	Midpoint	12 wk
Back extension (lb)	182.9 ± 56.3	184.6 ± 56.8	181.1 ± 51.5	205.0 ± 59.9	218.2 ± 55.9*	228.2 ± 52.9†‡	194.2 ± 45.9	215.0 ± 41.5*	245.0 ± 43.8†‡
Bicep curl (lb)	86.4 ± 33.7	89.6 ± 33.4	87.9 ± 36.5	71.8 ± 37.1	81.1 ± 38.4*	87.9 ± 38.9†‡	79.6 ± 35.5	89.6 ± 35.5*	100.4 ± 36.6†‡
Chest Press (lb)	105.4 ± 32.1	106.1 ± 32.8	104.6 ± 32.6	91.8 ± 44.3	98.6 ± 45.1*	107.9 ± 44.6†‡	101.5 ± 42.9	118.1 ± 47.9*	135.8 ± 49.4†‡
Lat pull-down (lb)	122.1 ± 40.2	122.9 ± 39.5	125.7 ± 39.2	96.8 ± 42.4	109.3 ± 42.7*	117.9 ± 43.3†‡	106.5 ± 40.8	120.0 ± 39.8*	136.9 ± 43.4†‡
Leg curl (lb)	125.4± 43.6	127.1 ± 42.8*	123.2 ± 43.0	111.8 ± 43.9	126.4 ± 43.9*	137.9 ± 43.2†‡	129.6 ± 44.1	148.5 ± 44.6*	168.5 ± 41.7†‡
Leg extension (lb)	154.6 ± 44.4	153.2 ± 47.0	153.9 ± 46.4	140.4 ± 45.7	156.4 ± 46.4	170.4 ± 46.4‡	146.2 ± 39.6	165.0 ± 46.9*	191.5 ± 45.3†‡
Leg press (lb)	329.6 ± 133.2	336.8 ± 129.7	334.6 ± 122.8	265.0 ± 105.3	316.9 ± 122.3*	348.6 ± 135.2†‡	283.1 ± 123.9	350.9 ± 140.6*	408.6 ± 166†‡
Seated row (lb)	112.1 ± 44.9	114.3 ± 47.1	115.4 ± 46.6	96.1 ± 43.6	108.2 ± 44.4*	116.4 ± 46.3†‡	97.3 ± 36.6	113.9 ± 38.8*	127.3 ± 40.9†‡
Shoulder press (lb)	75.0 ± 34.2	78.6 ± 35.5	76.8 ± 36.4	53.2 ± 42.8	60.4 ± 42.7*	65.4 ± 47.2†‡	62.7 ± 41.7	75.8 ± 44.6*	92.7 ± 43.5†‡
Triceps extension (lb)	82.9 ± 28.8	84.3 ± 31.2	83.6 ± 29.5	67.2 ± 32.9	77.5 ± 32.2*	86.4 ± 33.4†‡	75.8 ± 32.8	87.7 ± 33.0*	97.3 ± 36.6†‡

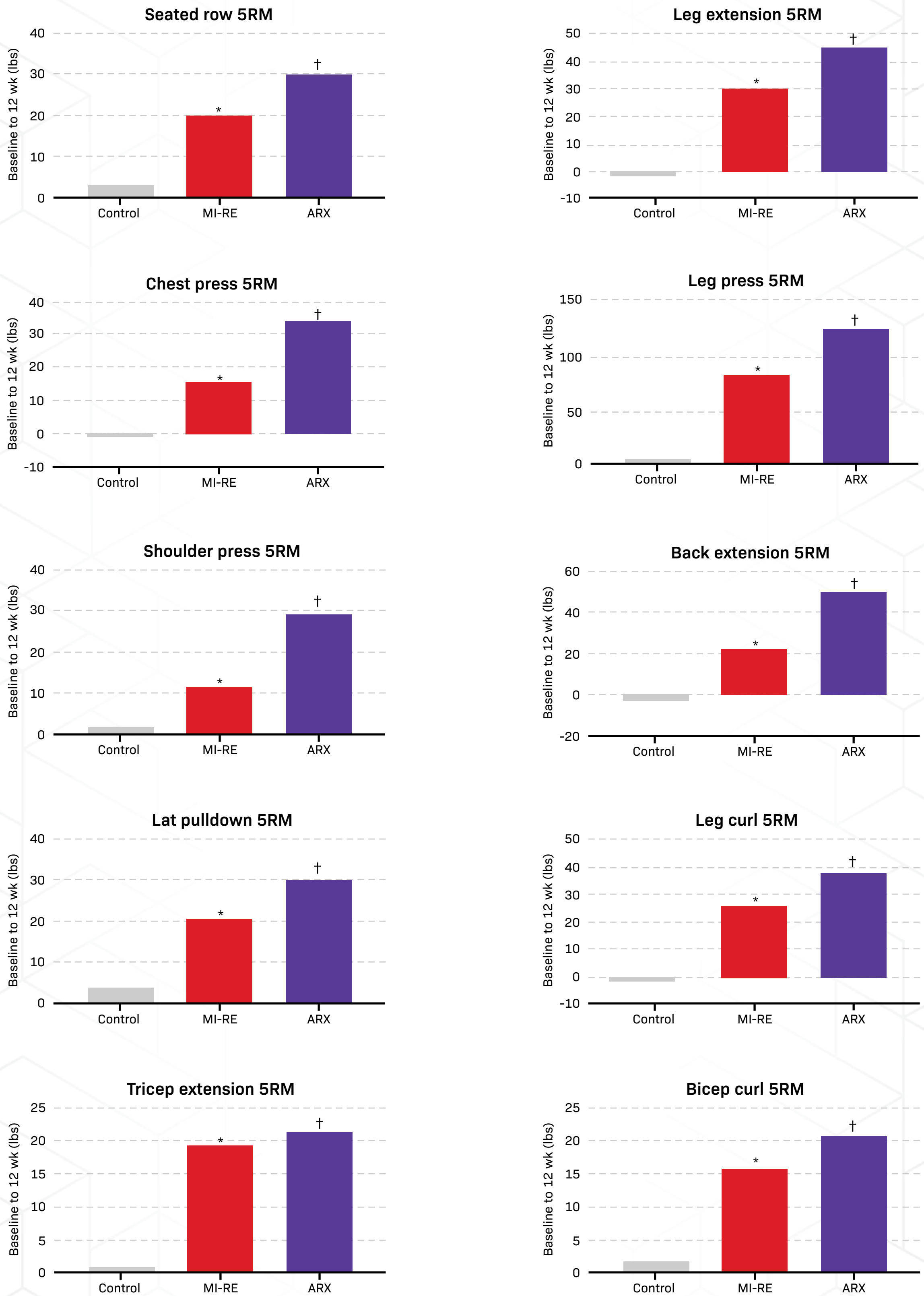
* Midpoint is significantly different from baseline. $p < 0.05$
† 12 wk is significantly different midpoint. $p < 0.05$
‡ 12 wk is significantly different from baseline, $p < 0.05$

Figure 1.
Baseline to 12-weeks changes 1-RM values for all resistance exercise for the control, MI-RE and ARX groups



Note: Values are mean.
* Significantly greater (p <0.05) baseline to 12 weeks changes relative to the group.
† Significantly greater (p >0.05) baseline to 12 weeks changes relative to both control and MI-RE groups.

Figure 2.
Baseline to 12-weeks changes 5-RM values for all resistance exercise for the control, MI-RE and ARX groups



Note: Values are mean.
* Significantly greater (p <0.05) baseline to 12 weeks changes relative to the group.
† Significantly greater (p >0.05) baseline to 12 weeks changes relative to both control and MI-RE groups.

The Bottom Line

According to the research team, there are three key points that can be made based on the participant outcomes from this study:

- Adaptive resistance training is superior to traditional moderate-intensity resistance exercise at improving muscular fitness.
- Relative to moderate-intensity resistance exercise, adaptive resistance training elicits larger reductions in body-fat percentage and a greater improvement in VO2 Dr. Dalleck highlights the improvement in VO2max as a substantial finding, as such improvements usually result from cardiorespiratory exercise, not resistance training.
- Adaptive resistance training achieves favorable training adaptations in a time-efficient manner, as it required approximately one-third of the time of the moderate-intensity workouts. The average ARX session was 15 minutes in duration, while the average MI-RE session was 45 minutes in duration.

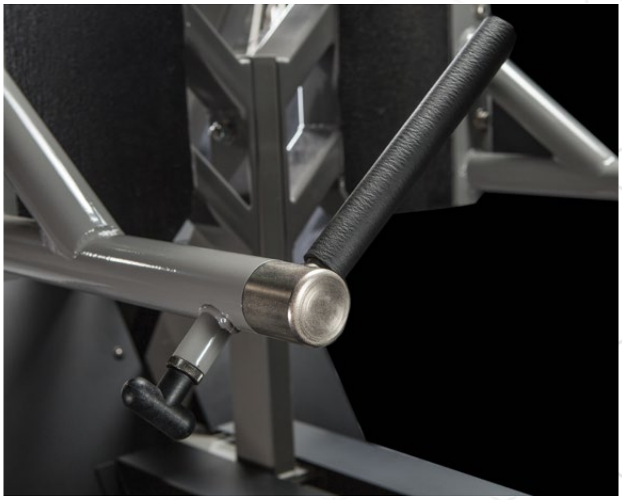
The importance of muscular fitness is sometimes overlooked in discussions of public health, despite an always-growing body of evidence. For example, consider the following:

- Increased muscular fitness is associated with a reduced risk of all-cause mortality.
- 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.
- There is a strong association between muscular strength and mortality in various clinical populations.
- Elevated levels of both upper- and lower-body muscular strength have been linked to lower risk of mortality.

Taken together, this body of scientific literature provides health coaches and exercise professionals with an evidence-based argument for the inclusion of muscular training in their clients' wellness programs. The results of this study are encouraging and may address the "lack of time" commonly cited by people as a key reason for not exercising regularly.

One obvious limitation of the findings of this study lies in its price tag, as the ARX Alpha machine costs just shy of $40,000. But, as Dr. Dalleck points out, fitness facilities often spend hundreds of thousands of dollars on fitness equipment, so the price is in line with industry standards. And, because these machines allow users to perform an effective full-body workout in about 15 minutes, this allows for quick turnover in usage with a relatively small footprint.

If you do not have access to this type of machine, you can create REHIT-style muscular-training workouts that yield similar comprehensive benefits by using functional training–type equipment such as kettlebells, suspension trainers and exercise bands to develop personalized, short-duration and high-intensity programming for your clients.



arxfit.com