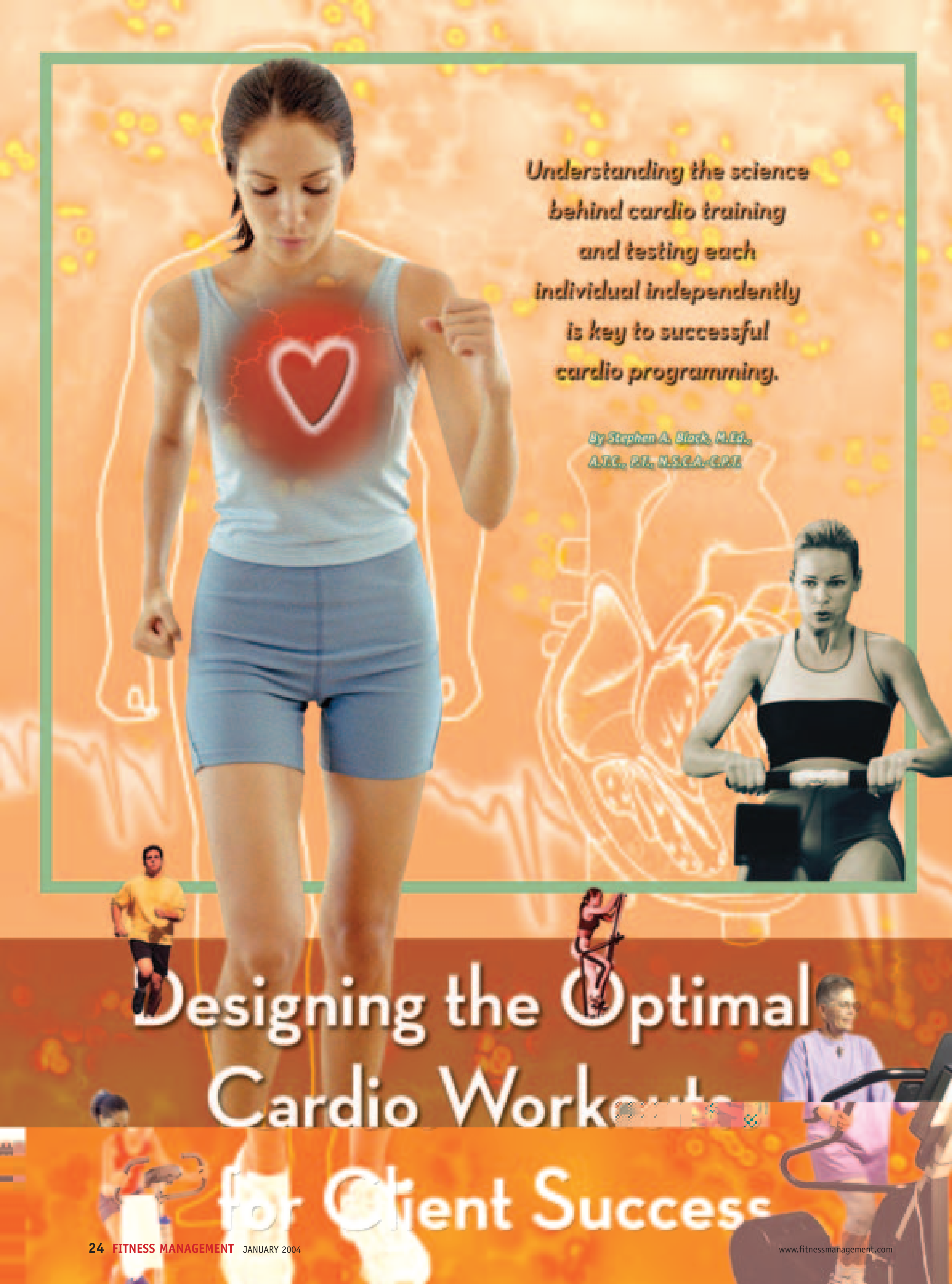

Designing the Optimal Cardio Workouts for Client Success

Understanding the science behind cardio training and testing each individual independently is key to successful cardio programming.

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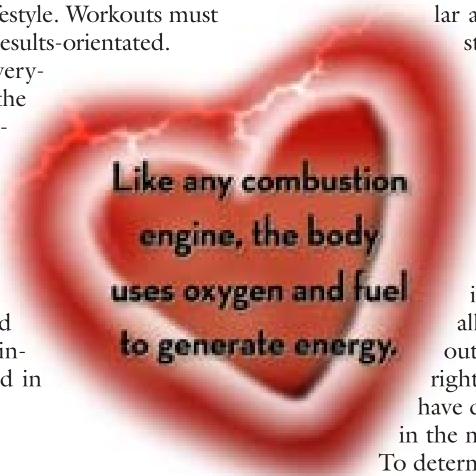
To achieve optimal results, fitness enthusiasts must train at an intensity that is appropriate to their goals, current level of fitness and within the constraints of their health. Intensity is important because too low an intensity will not produce optimal results, while too high an intensity can lead to overtraining and injury. To maximize training benefits, exercisers need practical and accurate approaches that fit their lifestyle. Workouts must be engaging, stimulating, motivating and results-orientated.

Cardiovascular training is a must for everyone. According to Ed Coyle, Ph.D., at the University of Texas, Austin, "If [your facility is] not conducting exercises testing with credible equipment and methods, [your members] will not get the desired results and [you may] lose your clients, if not kill them in the process."

To better understand cardio training, you will need to know the science behind it, and some practical applications. The principles presented in this article can be used in almost any training program.



Types of training

Moderate-intensity exercise is associated with many improvements in health-related variables. The improvement of endurance performance requires increases in qualities such as aerobic power and anaerobic threshold. To elicit positive changes in these qualities, a minimum intensity must be reached in training. Therefore, too low an intensity will lead to positive health benefits, but is unlikely to result in a change in endurance performance. On the other hand, a chronically high intensity with lack of sufficient recovery can lead to decreases in performance; this phenomenon is known as overtraining. A practical and accurate method for monitoring training intensity is required.

Like any combustion engine, the body uses oxygen and fuel to generate energy. The cardiovascular system delivers oxygen to the skeletal muscles, which then uses this oxygen to "burn" various fuels (carbohydrates and fat) to yield mechanical energy. A unique feature of the body is its ability to change in response to the demands placed on it. By working hard, the aerobic system is overloaded. During rest, the body adapts to make itself stronger. This is accomplished by improvements in cardiovascular and muscular function. The heart becomes stronger and more efficient, and the skeletal muscles become better at extracting oxygen from the bloodstream and excreting waste back into the bloodstream. Within muscle cells, the mitochondria boost their enzyme systems to oxidize fuels.

The science behind it

All of these changes occur over time. For improvement, the system must be continually overloaded. As an exerciser adapts, workouts should become more difficult. How is the right training level determined? Physiologists have discovered that the rate of oxygen "burned" in the muscles is the best measure of aerobic work. To determine this, exercisers use a treadmill, elliptical machine or cardio piece while the volume of inhaled and exhaled air is measured. Samples of exhaled air are periodically taken, and the oxygen concentration determined. The difference between the amounts of oxygen breathed in and out during the test is what the muscles have consumed to burn fuel. Also, the ratio of these substrates tell what the muscles have burned for fuel (carbohydrates and/or fat).

Equipment that does not measure both O_2 in and CO_2 out is inaccurate, and the resulting exercise prescription invalid and insignificant. The rate of oxygen consumption, in liters per minute, is called

Energy System	+/- AT	%VO_2 Max	%HR Max	Types of Training	Duration	Recovery Time	Goal	Primary Energy System Stressed
Aerobic Base Recovery	30 beats below AT	55-75%	55-70%	Easy Distance	30min-3hrs	None Needed	Maintain O_2 supply to working muscles	Oxidative
Tempo	20 beats below AT	60-80%	65-80%	Steady State Tempo	30-60min 15-25min	None None	Maintain O_2 Supply Active Population	Oxidative
Threshold	10-15 beats below AT	85-90%	87-92%	Lactate Threshold Cruise Interval Fartlek	5-10min 5-10min 5-25min	1/8th the time of repeat Variable With intensity Variable	Increase AT w/o accumulation of lactic acid	Oxidative / Fast Glycolysis
Anaerobic Endurance	10-15 beats above AT	95-100%	95-100%	Repeats @ 10K pace Repeats @ 3K pace	5-8min 2-5min	1/2 the time of repeat 1 1/2 the time of repeat	To adapt to the acidic effect of lactic acid and buffer its effects	Fast Glycolysis
Peak Interval	20+ above AT	110-130%	100%	Repeats @ mile pace Repeats @ 800m pace	30sec-2min 30sec-1min	2-3x repeat 4-5x repeat	Improve the ability to work in an anaerobic state and increase glycogen stores in the muscle	Fast Glycolysis / Phosphagen

Figure 1. Heart Rate Zones

Sample Workouts

Have your clients try these sample workouts on their favorite cardio equipment, or take to the streets. The speeds and times can be modified to fit the individual's ability to hold the heart rate, and time available. As always, be conservative in the beginning stages, and include adequate warm-up, stretching and cool-down time.

Fast Walk

Time (min.)	Approximate Pace (m.p.h.)	Heart Rate
0-3	4.0	Aerobic base
3-6	4.5	Threshold
6-9	4.8	Threshold
9-12	3.5	Tempo
12-15	4.0	Tempo
15-18	4.5	Threshold
18-21	4.8	Threshold
21-24	3.5	Tempo
24-29	4.0	Tempo
29-34	4.5	Threshold
34-39	4.8	Threshold
39-42	3.5	Tempo
42-45	4.0	Tempo
45-48	4.5	Threshold
48-51	4.0	Aerobic base

Walk/Run

Time (min.)	Approximate Pace (m.p.h.)	Heart Rate
0-3	4.0 walk	Aerobic base
3-6	4.5 walk	Aerobic base
6-9	5.5 run	Tempo
9-12	4.0 walk	Aerobic base
12-16	6.5 run	Tempo
16-19	4.0 walk	Aerobic base
19-22	6.5 run	Tempo
22-25	4.0 walk	Aerobic base
25-29	5.5 run	Tempo
29-33	6.5 run	Tempo
33-37	4.5 walk	Aerobic base
37-41	6.5 run	Tempo
41-44	5.5 run	Tempo
44-51	4.0 walk	Aerobic base

Fast Walk

In this workout, exercisers mix up faster sprints with slower recovery periods. Speedier walking calls more muscles into action — specifically the butt, hips, abs and arms. With each step, exercisers should roll from heel through foot, then push down with ball and toe into the next step. They should lean slightly forward from the hips (approximately 325 calories burned).

Walk/Run

With the Walk/Run, exercisers mix short stints of running with the walk to "crank up" the intensity without too much stress. If the extra impact makes the joints ache, it is OK for exercisers to power-walk the running intervals instead. They should run tall, but keep their upper body relaxed. Have them extend the back leg to lengthen the stride. They should avoid shuffling their feet, should pick up their knees with each footstep, and keep their arms close to their body (approximately 400 calories burned).

Sample Workouts *continued*

Hill Pyramid

Walking or running up hills burns calories faster than walking at a zero (or flat) incline. With a gradual incline, there is plenty of time to adjust to the higher verticals. Clients should keep a 4.0 mph (walking) or 5.5 to 6.5mph (running) pace as the grade slowly increases. They should keep their back straight, then lean slightly into the incline. Have them take quick, short strides, rather than long steps, lift their knees no higher than 6 inches for steep climbs, and decrease the incline if their heels feel over-stretched (approximately 325 calories burned).

Walk/Run

Time (min.)	Incline (percent grade)	Heart Rate
0-12	2	Aerobic base
12-22	4	Tempo
22-30	6	Threshold
30-36	8	Threshold
36-40	10	Anaerobic endurance
40-42	12	Anaerobic endurance
42-50	2	Aerobic base

VO_2. The test is performed at progressively harder levels until the individual "maxes out." The maximum rate of oxygen consumption is called the VO_2 max or VO_2 peak. VO_2 peak may not be practical in the health club environment.

With advances in software, a sub-max test can be delivered, and the software will extrapolate the VO_2 peak with extraordinary accuracy. Also, on the way to a sub-max, or VO_2 peak threshold, exercisers will pass through anaerobic threshold, which is another marker of cardiovascular fitness, and one that can be used to establish appropriate training zones for best and safe programming.

Anaerobic threshold (AT) represents how efficiently the muscles use oxygen to produce energy, or work. As such, AT represents the level of work the body can sustain over an extended period. When the body is called upon to perform above AT, lactic acid builds in the muscles, creating fatigue (the burning sensation felt), and the ability to continue to perform at this level is limited (a few seconds to a few minutes, depending on fitness level). Improving the anaerobic threshold is key to developing aerobic fitness. Generally speaking, an individual's AT may be between 52 and 95 percent of maximum heart rate. The more aerobically fit, the higher the AT.

Physiologically, in addition to burning fat in the aerobic zone, the body makes other, even more important, adaptations. Blood supply is increased through the new growth of blood vessels. This provides more nutrients to the working muscles, and helps take metabolic waste from the muscles. The mitochondria of the cells, where the energy production takes place, multiply up to 200 percent, providing a higher capacity for workload. The body also increases the level of hemoglobin and total blood volume. Oxygen in the blood is predominantly carried by hemoglobin, so with more hemoglobin, the working muscles get oxygen more efficiently. With the increase in blood volume, the cardiac muscle becomes larger, increasing the amount of blood pumped per heart beat. This means a lower heart rate at rest, and more efficient recovery. The additional benefit of exercising at the appropriate intensity is increased lean mass. Muscle tissue burns, on average, 50 calories per hour per pound.

Research on VO_2 has shown that there is a threshold below which no additional gains are achieved from aerobic exercise. For most people, this is a pace that allows for casual conversation during the workout, and is approximately 55 percent of VO_2 peak. Above this level, exercisers are sufficiently overloading the cardiovascular and muscular systems to bring about improvement. Related to this, group cycling is not beneficial if not performed properly. If participants exercise at too high an intensity for too long without sufficient recoveries, they become exhausted and don't lose any weight. They need to determine their "real" heart rate zones and adhere to them.

Gathering heart rate data

Methods for monitoring exercise intensity include the following:

- Using subjective ratings of perceived exertion
- Monitoring blood lactate levels
- Monitoring heart rate
- Monitoring O_2 uptake

Interpretation of lactate data is difficult for the average recreational athlete or fitness center member. Subjective ratings of exertion have been used to monitor intensity, but several studies have shown that recreational athletes and those new to exercise judge intensity poorly with this method. Heart rate (HR), however, can be considered both an accurate and practical measurement of exercise intensity. It should be noted, though, that HR is not a direct measurement of exercise intensity. Heart rate is often used as a tool to estimate O_2 consumed at a certain workload. There are factors, such as caffeine ingestion and dehydration, that can alter HR and affect its validity as an indicator of intensity.

Methods of monitoring HR are commonly used by endurance athletes as a measure of their training intensity, or as a pacing mechanism during competition. More recently, recreational exercisers are using HR monitors to regulate intensity with tremendous success in gaining fitness, reducing body fat and preventing injury. Youth fitness programs use HR to teach pacing and skill proficiency. Heart rate has been prescribed as a method for monitoring pre-competition emotional anxiety in weightlifters. Heart rate can be used to estimate energy expenditure in exercise lasting more than three minutes. This is due to the generally linear relationship between heart rate, power output and oxygen consumption. This relationship predicts that an increase in power output should be reflected in a proportional increase in HR.

Many methods can be used to measure HR. Commonly used methods include measurement of the pulse at the fingers or wrist, measurement of pulse pressure at the neck (carotid artery) or wrist (radial artery), measurement of opacity (how much light passes through) of the ear lobes and measurement of electrical activity of the heart at the chest.

The popularity of automated methods of recording HR has led to the inclusion of heart rate monitors on many pieces of aerobic fitness equipment. Studies conclude that the most valid and reliable system measures the electrical impulses of the heart at the chest. These systems commonly consist of a strap that is positioned just below the breast. Two electrodes lie on the inside of the strap, one on either side of the chest; they directly measure the interval between the "R" sections of the heart contraction. This method of monitoring HR is extremely accurate for men, women and children, as compared to an ECG reading. Other methods of recording HR may be unreliable; studies concluded that they might underestimate HR by up to 20 to 54 beats per minute.

As mentioned before, HR itself is not a direct indicator of exercise intensity. It is used to indicate intensity because it varies with exercise intensity. However, it can also be affected by a number of other factors, which include body position, hydration status and drugs (e.g., beta blockers).

Using heart rate to determine intensity

Exercise shouldn't be based on distance, time or physical workload; it should be controlled by the degree of physical effort as measured by physiological signs, especially HR. Exercisers are less likely to cross the line between healthy exercise for aerobic fitness (a target heart rate of 55 to 90 percent maximum) and risky stressful exercise with a HR monitor. Training below minimum intensity level won't show much improvement in aerobic capacity. Above the 90 percent level, lactic acid will build up, resulting in decreased performance and susceptibility to injury.

Using the various formulas available for estimating HRmax is fraught with error. Individuals do not have the same HRmax, nor do they burn the same substrate for fuel at the same given HR intensity. (For example, Lance Armstrong's HRmax using [220 – age] is 186, when, in fact, his tested HRmax is 201.) There are in excess of 350 different formulas for determining HRmax. The margin for error in several of the formulas is +/– 20. That could be catastrophic when setting up a cardio training program. Testing each individual is the key to successful cardio programming.

Designing exercise programs

See "Sample Workouts" for several examples of cardio workouts with different goals. Keep in mind that a successful end-result is dependent on the development of an aerobic base. The key components of an aerobic base include increasing the efficiency of the heart (stroke volume), increasing hemoglobin concentration (more oxygen transportation) and increasing muscle capillary density (better feeding system for the working muscles).

Key components of a successful weight-loss program include cardio work at the appropriate intensity, resistance training, appropriate calorie modulation and psychological readiness.

Based on goals, the HR zones in Figure 1 can be applied. Keep in mind that these zones can be further refined and narrowed as exercisers become more fit or desire to become competitive in their chosen activity.

Encourage cardio

The inclusion of innovative cardio programming can catalyze new growth opportunities within your facility. Not only will you have a better handle on members' exercise intensity, but you will create a whole new vertical revenue program. This way, your members are happy, and your bottom line is growing. Experience demonstrates a win/win scenario when appropriate, rational cardio programming is introduced, supported and optimized. **FM**

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