EFFECT OF SUPERVISED, PERIODIZED EXERCISE TRAINING VS. SELF-DIRECTED TRAINING ON LEAN BODY MASS AND OTHER FITNESS VARIABLES IN HEALTH CLUB MEMBERS

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ABSTRACT
Storer, TW, Dolezal, BA, Berenc, MN, Timmins, JE, and Cooper, CB. Effect of supervised, periodized exercise training vs. self-directed training on lean body mass and other fitness variables in health club members. J Strength Cond Res 28(7):1995–2006, 2014—Conventional wisdom suggests that exercise training with a personal trainer (PTr) is more beneficial for improving health-related fitness than training alone. However, there are no published data that confirm whether fitness club members who exercise with a PTr in the fitness club setting obtain superior results compared with self-directed training. We hypothesized that club members randomized to receive an evidence-based training program would accrue greater improvements in lean body mass (LBM) and other fitness measures than members randomized to self-training. Men, aged 30–44 years, who were members of a single Southern California fitness club were randomized to exercise with a PTr administering a nonlinear periodized training program (TRAINED, N = 17) or to self-directed training (SELF, N = 17); both groups trained 3 days per week for 12 weeks. Lean body mass was determined by dual-energy x-ray absorptiometry. Secondary outcomes included muscle strength 1 repetition maximum (1RM), leg power (vertical jump), and aerobic capacity (V̇O₂max). TRAINED individuals increased LBM by 1.3 (0.4) kg, mean (SEM) vs. no change in SELF, p = 0.029. Similarly, significantly greater improvements were seen for TRAINED vs. SELF in chest press strength (42 vs. 19%; p = 0.003), peak leg power (6 vs. 0.6%; p = 0.0001), and V̇O₂max (7 vs. −0.3%; p = 0.01). Leg press strength improved 38 and 25% in TRAINED and SELF, respectively (p = 0.14). We have demonstrated for the first time in a fitness club setting that members whose training is directed by well-qualified PTrs administering evidence-based training regimens achieve significantly greater improvements in LBM and other dimensions of fitness than members who direct their own training.

KEY WORDS personal trainers, muscle strength and power, V̇O₂max, body composition

INTRODUCTION
A wide variety of exercise training methodologies are used for improving health- and performance-related fitness outside the research setting, e.g., among practitioners such as personal trainers (PTrs) working with private clients or within a health/fitness club. In addition, training guidance is available to individuals through print and electronic media. Indeed, a recent Internet search using key words “exercise for increasing lean body mass (LBM)” yielded over 8.6 million references. Whether these references provide appropriate guidance or whether this guidance can be correctly interpreted and applied by individuals without training and experience in strength and conditioning, such as members of health/fitness clubs is unknown.

In 2011, there were 51.4 million health club members in the United States representing a 24% increase over the previous 6 years (18). Reasons for joining fitness clubs are varied (18,26), but a recent report from the International Health and Racquet Sports Club Association (a trade association representing health and fitness facilities, gyms, spas, sports clubs, and suppliers worldwide) indicated that almost half of current health club members cited overall health/well-being and progress toward goals as reasons for sustaining membership (18). However, there are few published data to suggest that these outcomes are realized even when exercise training is supervised by PTrs. Significant improvements...
Exercise With Personal Trainers vs. Self-Training

in LBM, muscle strength, power, and endurance, as well as aerobic capacity have been demonstrated for decades in well-controlled research studies. However, these studies are generally administered by expert scientists using proven methodologies or new methods that are hypothesized to be of similar or greater benefit. No published study has evaluated the application of exercise training methods by personal fitness trainers outside the research setting, i.e., in a health club environment where exercise training methods and training guidance are less certain than in the insulated laboratory setting. Whether exercising health club members or individuals outside the club setting achieve their fitness objectives has not been reported but such data would provide useful information on successes that might alter the manner in which these individuals train to achieve important health- and performance-related outcomes.

The Equinox Health/Fitness Club chain has developed general templates for exercise training regimens using evidence-based recommendations (1) and scientifically supported methods (23, 29, 30). Members have the opportunity to exercise under the guidance of well-qualified PTrs who systematically apply these progressive, periodized exercise programming templates that are individually adjusted. However, not all health/fitness club members use PTrs to help fulfill their training objectives; nationally, only about 13% of health club members do so (17). Currently, there are no published data that indicate whether individual health/fitness club members who exercise with a PTr attain greater improvements in health-related fitness including body composition, muscle strength and power, and aerobic performance (5), compared with members who self-direct and self-regulate their own training programs.

The primary aim of this study was to evaluate the efficacy of the Equinox Fitness Club (EFC) training method administered by PTrs for increasing LBM compared with club members who self-direct their own training programs within the context of the club setting. Secondary outcomes included changes in other health- and performance-related fitness variables and compliance with the training protocol. We tested the hypothesis that subjects randomized to receive the periodized training regimen by individually assigned PTrs (TRAINED) would accrue significantly greater LBM than those randomized to directing their own training (SELF) over a 12-week training period. If this research hypothesis is accepted, it would provide PTrs with objective evidence for the efficacy of professional, supervised training and opposed to self-training. Additionally, if the hypothesis is accepted, it may suggest that health/fitness club members wishing to increase LBM should consider training with well-qualified PTrs who successfully administer scientifically based training regimens.

METHODS

Experimental Approach to the Problem
A prospective, randomized, single-blind study was used to investigate whether 12 weeks of periodized exercise training administered by PTrs (TRAINED) yielded superior increases in LBM compared with 12 weeks of self-training (SELF) in the context of a health/fitness club setting. The primary objective for all subjects was to increase LBM as measured by dual-energy x-ray absorptiometry (DXA). All subjects were asked to limit exercise training to 3 days per week with types, durations, and intensities assigned by trainers (TRAINED group) or self-selected (SELF group). Additional outcome measures included other body composition variables as well as muscle strength and power, and aerobic performance. Blinded investigators assessed outcome measures at baseline and after 12 weeks regardless of whether all 36 prescribed training sessions had been completed.

Subjects
The membership records at the Century City (California) Equinox Fitness Club were used to identify and recruit 40 healthy men, 30–44 years of age, with a history of exercising 5–7 days per month at the club over the previous 3 months. All members meeting these criteria were asked to volunteer for the study via in-person communications or e-mail with IRB approved text. Volunteers were subsequently excluded if they had a body mass index (BMI) > 30 kg m$^{-2}$, musculoskeletal conditions or unstable cardiovascular, pulmonary, metabolic, or other disorders that would preclude high-intensity exercise training. In addition, subjects were excluded if they had used any drug or supplement known to enhance anabolic responses. Dietary intake was not controlled apart from the requirement of not starting a dietary supplement that might affect LBM. A statistical power analysis indicated that 18 subjects in each of the 2 groups would provide 80% power to detect a change of 2.5 kg in LBM, the primary outcome variable, at $\alpha \leq 0.05$. The UCLA Institutional Review Board approved the study, and all subjects gave their written informed consent. After consent was obtained, subjects were randomized to either the TRAINED or SELF group.

Exercise Trainers
The PTrs used in this study were employees of the same fitness club from which the subjects had volunteered. Trainers possessed undergraduate or graduate degrees in exercise science or related disciplines as well as multiple nationally recognized fitness trainer certifications from organizations including the American College of Sports Medicine, National Strength and Conditioning Association, and National Academy of Sports Medicine. In addition, all fitness trainers participating in this study (a) had previously passed written examinations and oral interviews, (b) completed approximately 180 hours of continuing education provided by recognized leaders in the health and fitness industry, (c) completed 100 hours of in-house supervised internship, and (d) completed training in the protection of human research subjects. All PTrs were instructed at the outset of the study and periodically reminded to provide no dietary guidance or encouragement for additional training.
Procedures

**Body Composition.** Body mass, LBM, appendicular lean tissue mass (ALTM), and fat mass (FM) were measured in the Gonda Diabetes Center at UCLA using DXA following the manufacturer’s procedural recommendations (Hologic 4500A; Hologic Inc., Bedford, MA, USA). The DXA instrument underwent regular quality control with daily calibration for standard clinical densitometry testing using a lumbar spine phantom and weekly with a soft tissue phantom per manufacturer’s recommendations.

**Muscle Strength.** Maximal voluntary muscle strength was assessed using the 1 repetition maximum (1RM) method (3) for the seated leg press (Cybex Eagle, Medway, MA, USA) and seated chest press (Technogym, Fairfield, NJ, USA) exercises. Briefly, subjects performed a light warm-up including whole body exercise on a treadmill or cycle ergometer followed by light stretching. They were then positioned on the leg press or chest press machine with their backs remaining flat against the seat back. For the leg press, the seat position was adjusted so that there was 90° of knee flexion with the soles of the shoes flat on the foot plate. The seat position in both exercises was recorded for use in posttesting. Subjects were allowed several practice trials of each exercise with minimum resistance to ensure good form, full range of motion movement, and good breathing technique. Standard procedures for progressively increasing resistance were followed leading to an attempt to complete 1–2 repetitions at a load estimated to be near maximum (3). The subject rested for 2 minutes and then attempted to achieve the 1RM. For each 1RM trial, subjects attempted 2 repetitions. If 2 repetitions were completed, 2-minute rest was given and the load was increased. If the 1RM attempt failed, 2-minute rest was provided and the load was decreased to the midpoint between the last successful lift and the failed lift. The 1RM was defined as the highest weight lifted through a full range of motion 1 time only.

**Leg Muscle Power.** Leg power was estimated using a previously validated (20) electronic jump mat (Just Jump; Probotics, Inc., Huntsville, AL, USA). Subjects stood on the mat with feet at hip width and then performed a countermovement jump for maximal height. Jump height was recorded with a handheld computer interfered with the jump mat. Three trials were given with 30-second rest between trials. The best trial was used to calculate peak and average leg power using published equations that required jump height and the subject’s body mass (15). Jump height (Ht) was determined from “hang time” defined as time (s) from the feet leaving the mat to their return and the following equation: Ht = t^2 × 1.227, where t is hang time in seconds and 1.227 is a constant derived from the acceleration of gravity.

**Aerobic Performance.** Aerobic capacity, (VO₂max), and the lactate threshold determined by gas exchange, (VO₂θ), were measured during an incremental, symptom-limited maximal treadmill exercise test using standard procedures (2,10,33) with an incremental walking-running treadmill protocol (19) depending on estimates of VO₂max before testing (10). Oxygen uptake (VO₂), carbon dioxide output, (VCO₂), and pulmonary minute ventilation (VE) were measured breath-by-breath with a previously validated portable metabolic measurement system (Oxycon Mobile; CareFusion, Yorba Linda, CA, USA). These data were continuously monitored and recorded during 3 minutes of warm-up and throughout the exercise test. Similarly, heart rate was continuously monitored with a Polar Heart Rate Monitor (RS400; Polar Electro, Kempele, Finland) with signals transmitted wirelessly through a chest strap to the Oxycon Mobile for display and storage. Trained and experienced investigators conducted all testing in accordance with established guidelines for cardiopulmonary exercise testing (2,10,33). Maximal oxygen uptake was determined from the highest 15-second average and accepted as maximal in the presence of a plateau in VO₂ with increasing work rate or if these criteria were not met, a respiratory exchange ratio, R, >1.10 and maximal heart rate (HRmax) ±10 b.min⁻¹ of age predicted (220–age). Gas exchange indices of VO₂θ were ascertained graphically from plots of VCO₂ vs. VO₂ and/or the ventilatory equivalents for oxygen (VE/VO₂) and carbon dioxide (VE/VCO₂) (8). Two investigators (B.A.D. and T.W.S.) independently selected VO₂θ. If VO₂θ selected by the 2 investigators agreed within 150 ml.min⁻¹, the average was accepted. If the difference was >150 ml.min⁻¹, a consensus value was achieved by discussion. Rating of perceived exertion (RPE) was taken periodically during the test and at maximal exercise using the Borg 6-20 scale (4).

**Exercise Training.** Templates for the supervised training regimen were developed by senior EFC staff and guidance from outside experts including exercise physiologists, physical therapists, certified PTrs, and athletic trainers. Evidence-based recommendations (1) and scientifically supported methods (23,29,30) were used to develop the core of the training templates. The training regimen consisted of a 3-cycle, nonlinear program in which acute program variables including exercise selection, volume, and intensity were varied over both the 4-week mesocycles and within the weekly microcycles. The volume or intensities of each training session were categorized as high (H), moderate (M), or low (L) and applied on a given day during the course of each week of training. Exercise selection for each subjects’ training program was based in part on use of a screening method (7,8) that highlighted fundamental movement patterns that could be performed without compensation and movements that were dysfunctional; these were subsequently addressed by corrective exercise during the course of the 12 weeks. Once a TRAINED subject was competent in a previously
dysfunctional movement pattern, the movement was included for resistance training. The periodized training program did not include traditional forms of endurance training such as continuous jogging or cycling. However, short duration (≤30 seconds) high-intensity intervals were employed progressively throughout the 12 weeks of training. The PTrs received explicit training and practice in all training methods, the details of which were applied with modification according to individual subject's medical and exercise history, abilities and limitations, and the primary objective of LBM accretion.

The club’s training program templates are proprietary but can generally be described as follows. Training cycle 1 included functional and core exercise training designed in part to alleviate muscle/joint imbalances but also included low intensity, high volume resistance training using multi- and single-joint bilateral and unilateral exercises appropriately applied to individual characteristics. Cycle 2 training uses the movement patterns mastered and corrected in cycle 1 and applies a higher intensity, lower volume loading scheme with training now focusing on the training objective; in this case increasing LBM. Cycle 3 training further progresses the client to a high intensity, high volume regimen to increase both the time under tension and the absolute stress placed on the muscle. It is also during this time that other training variables are manipulated to further stimulate LBM gain, i.e., speed of movement and explosiveness of exercises.

Subjects randomized to TRAINED received up to 36 coaching sessions over a 12-week period at no cost. These subjects made formal appointments for their thrice-weekly training sessions with 1 of 5 PTrs who were assigned to that subject for the duration of the study.

In contrast, subjects randomized to SELF were permitted to train using methods of their own choosing but with the understanding that increased lean mass was the primary objective. Members in the SELF group were incentivized with a 2-month membership extension and 6 no-cost personal training sessions at the end of the study. Records of work performed during training sessions for the TRAINED subjects were kept by their individual PTrs. Members in the SELF group were asked to keep simple logs of each session that included mode of exercise, frequency, and duration of training. Intensity was subjectively rated on a 0–5 scale, where 0 = nothing at all; 1 = very light; 2 = light; 3 = moderate; 4 = hard; 5 = very hard.

**Measurement Logistics**

All DXA studies were performed at the UCLA Gonda (Goldschmied) Diabetes Center by a trained and
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**RESULTS**

**Subject Participation**

The consort diagram shown in Figure 1 summarizes the flow of subjects from recruitment to the end of the study. A total of 54 male club members responded to recruitment letters and e-mails and were subsequently screened for eligibility criteria. Eleven did not meet 1 or more inclusion criteria. Forty-three subjects were randomized to train either with a PT (TRAINED) or to self-directed training (SELF). Nine subjects discontinued the study, 5 from TRAINED and 4 from SELF. Reasons for discontinuation included relocation or inability to meet time commitments. Thirty-four men completed the study with an equal number of completers in each group.

Baseline characteristics for the 34 subjects who completed the study are shown in Table 1. The 2 groups were well balanced without significant differences in any of the variables shown. Specifically, the primary outcome measure, LBM, was not significantly different at baseline although TRAINED subjects averaged 0.9 (2.6) kg less LBM than SELF, $p = 0.73$. When comparisons of LBM were assessed by ranked pairs of TRAINED and SELF subjects, all but 1 paring yielded a mean difference of 0.5–6 kg.

**Body Composition and Anthropometry**

**Lean Body Mass.** The TRAINED group experienced a statistically significant mean (SEM) increase in LBM of 1.3 (0.4) kg, over 12 weeks of training with changes ranging between 2.0 and +2.1 kg (Table 2). In contrast, those members who designed and implemented their own training program (SELF) experienced a 0.0 (0.4) kg change in LBM. The distribution of individual changes in LBM is shown in Figure 2. A similar pattern was seen with ALTM as shown in Table 2 with significant increases noted in TRAINED, but not SELF and significant differences favoring the TRAINED group. Fat mass and % fat were significantly higher in the TRAINED group at baseline. The distribution of individual changes in LBM is shown in Figure 2. A similar pattern was seen with ALTM as shown in Table 2 with significant increases noted in TRAINED, but not SELF and significant differences favoring the TRAINED group.

**Table 1**. Subject characteristics at baseline.*

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI (kg m$^{-2}$)</th>
<th>LBM (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAINED ($N = 17$)</td>
<td>SELF-trained ($N = 17$)</td>
<td>TRAINED ($N = 17$)</td>
<td>SELF-trained ($N = 17$)</td>
<td>TRAINED ($N = 17$)</td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>36.3</td>
<td>3.4</td>
<td>36.3</td>
<td>4.0</td>
<td>31–43</td>
</tr>
<tr>
<td>179.2</td>
<td>6.3</td>
<td>179.2</td>
<td>6.0</td>
<td>170–192</td>
</tr>
<tr>
<td>86.3</td>
<td>8.9</td>
<td>82.6</td>
<td>10.2</td>
<td>72.7–104.5</td>
</tr>
<tr>
<td>26.8</td>
<td>2.1</td>
<td>25.8</td>
<td>2.3</td>
<td>22.2–29.6</td>
</tr>
<tr>
<td>67.3</td>
<td>6.9</td>
<td>68.2</td>
<td>8.0</td>
<td>54.9–79.5</td>
</tr>
</tbody>
</table>

*BMI = body mass index; LBM = lean body mass.

**Table 2**. Changes in body composition after 12 weeks of exercise training.*†

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>BMI (kg m$^{-2}$)</th>
<th>LBM (kg)</th>
<th>ALTM (kg)</th>
<th>Fat mass (kg)</th>
<th>% Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAINED ($N = 17$)</td>
<td>SELF-trained ($N = 17$)</td>
<td>TRAINED ($N = 17$)</td>
<td>SELF-trained ($N = 17$)</td>
<td>TRAINED ($N = 17$)</td>
<td>SELF-trained ($N = 17$)</td>
</tr>
<tr>
<td>Baseline</td>
<td>12 wk</td>
<td>Change</td>
<td>$p$-within</td>
<td>Baseline</td>
<td>12 wk</td>
</tr>
<tr>
<td>84.4 (9.6)</td>
<td>83.4 (9.3)</td>
<td>−1.0 (3.1)</td>
<td>0.420</td>
<td>82.6 (10.2)</td>
<td>81.1 (9.0)</td>
</tr>
<tr>
<td>26.8 (2.1)</td>
<td>26.7 (2.3)</td>
<td>−0.2 (0.8)</td>
<td>0.400</td>
<td>25.8 (2.3)</td>
<td>25.3 (1.9)</td>
</tr>
<tr>
<td>67.3 (6.9)</td>
<td>68.5 (7.2)</td>
<td>1.3 (1.5)</td>
<td>0.004</td>
<td>68.1 (4.8)</td>
<td>68.1 (1.8)</td>
</tr>
<tr>
<td>29.2 (3.3)</td>
<td>30.0 (3.1)</td>
<td>0.7 (0.6)</td>
<td>0.0002</td>
<td>30.3 (4.4)</td>
<td>30.1 (4.1)</td>
</tr>
<tr>
<td>19.9 (4.3)</td>
<td>18.2 (4.9)</td>
<td>−1.8 (1.9)</td>
<td>0.269</td>
<td>15.4 (4.1)</td>
<td>14.3 (3.6)</td>
</tr>
<tr>
<td>23.0 (4.1)</td>
<td>21.1 (4.8)</td>
<td>−2.0 (1.8)</td>
<td>0.206</td>
<td>18.5 (3.6)</td>
<td>17.5 (3.4)</td>
</tr>
</tbody>
</table>

*BMI = body mass index; LBM = lean body mass; ALTM = appendicular lean tissue mass.
†Body weight, BMI, LBM and ALTM were not significantly different between groups at baseline. Fat mass and % fat were significantly higher in the TRAINED group at baseline.
group. The 0.7-kg increase in ALTM represents 53% of the increase in LBM.

Fat Mass and % Fat. Both groups decreased FM and percent body fat but only the 1% fat decrease in SELF reached statistical significance (Table 2). There were no differences between groups for change in these variables.

Body Weight and Body Mass Index. There was a mean weight loss of 1.0 (1.0) kg and 1.5 (3.5) kg in the TRAINED and SELF groups, respectively, but neither change was statistically significant. Correspondingly, there was no change in BMI.

Muscle Strength and Power

Muscle Strength. Maximal voluntary strength in the chest press and leg press exercises increased significantly in both groups (Table 3). Improvements in the TRAINED group tended to be greater than SELF for both exercises but only the change in chest press strength was significantly different between groups. Expressed as percentage improvements, the TRAINED group increased chest press and leg press strength by 42 and 35%, respectively, whereas improvements in these exercises in the SELF group were 19 and 23%, respectively. Individual changes in upper and lower maximal voluntary strength are shown in Figure 3.

Muscle Power. Estimated peak and average leg muscle power improved significantly in the TRAINED group but not in the SELF group (Table 3); individual changes for these variables are shown in Figure 4. The 6 and 10% increases in peak and average leg power in TRAINED were significantly greater than the corresponding 0.6 and 0.1% increases in SELF.

Aerobic Performance

Aerobic Capacity (Vo₂-max). Maximal oxygen uptake expressed both in absolute measures (L·min⁻¹) and relative to body weight (mL·kg⁻¹·min⁻¹) improved significantly

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**Table 3.** Muscular strength and power responses to 12 weeks of exercise training, mean (SD)*.†

<table>
<thead>
<tr>
<th></th>
<th>TRAINED (N = 17)</th>
<th>SELF-trained (N = 17)</th>
<th>p-between</th>
<th>p-within</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>12 wk</td>
<td>12 wk</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chest press 1RM (kg)</strong></td>
<td>55.6 (13.0)</td>
<td>59.7 (15.6)</td>
<td>&lt;0.0001</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>79.1 (12.7)</td>
<td>67.7 (14.3)</td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td>Leg press 1RM (kg)</td>
<td>99.5 (23.9)</td>
<td>106.8 (30.4)</td>
<td>&lt;0.0001</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>136.9 (27.3)</td>
<td>126.4 (26.1)</td>
<td></td>
<td>0.140</td>
</tr>
<tr>
<td>Leg power (W)</td>
<td>Peak 7,733 (645)</td>
<td>Peak 7,779 (594)</td>
<td>&lt;0.0001</td>
<td>0.436</td>
</tr>
<tr>
<td></td>
<td>8,194 (695)</td>
<td>7,829 (680)</td>
<td>&lt;0.0001</td>
<td>0.043</td>
</tr>
<tr>
<td></td>
<td>Average 1,552 (290)</td>
<td>Average 1,528 (294)</td>
<td></td>
<td>0.043</td>
</tr>
<tr>
<td></td>
<td>1,710 (291)</td>
<td>1,545 (326)</td>
<td></td>
<td>0.043</td>
</tr>
</tbody>
</table>

*1RM = 1 repetition maximum.
†Chest press, leg press, and leg power values were not significantly different between groups at baseline.

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**Figure 2.** Distribution of individual changes in lean body mass (kg) for the TRAINED and SELF groups.

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by 6 and 7%, respectively, in the TRAINED group, whereas mean changes for the SELF group decreased by 3 and 0.8%, respectively (Table 4). Differences in the changes in $V_{\text{O}2\max}$ between groups were statistically significant. Individual changes in $V_{\text{O}2\max}$ are presented in Figure 5.

Gas Exchange (Lactate) Threshold ($V_{\text{O}2\theta}$). The metabolic rate above which blood lactate accumulates did not change significantly in either group nor was the difference in change between groups significant (Table 4).

Cardiovascular and Perceptual Responses
Maximal heart rate and subjective RPE at maximal exercise did not change from baseline to end of study assessments (Table 4). These peak values were 100% of age predicted for HRmax and within the expected range for RPE at maximal exercise (8). Neither HRmax nor RPE at maximal effort was
different between groups at baseline or at the end of the study.

**Estimates of Training Volume**

**TRAINED Subjects.** Thirteen of 17 subjects submitted training logs. Because of the complexity of the periodized training routine (i.e., the large proportion of body weight, core and functional exercises that used a variety of non-traditional resistance implements), accurate training volume (duration x frequency x intensity) could not be calculated. TRAINED subjects averaged 150 minutes per week in their planned sessions plus an additional group average of 1.8 days per week of training that was outside the specified training program. Specifically 2, 5, and 4 TRAINED subjects added 1, 2, or 3 days per week, respectively, as reported in anonymous exit questionnaires. Unfortunately, because we did not anticipate subjects from either group to exceed the specified 3 days per week training regimen, we have no data on the composition of the extra days of training for the TRAINED group.

**SELF-TRAINED Subjects.** Eleven of 17 subjects in the SELF group completed training logs. Because these subjects kept their own logs, all training days even those beyond the protocol-specified 3 days per week were recorded. Subjects in this group averaged 172 minutes per week over the 12-week training period with an average intensity of 3.3 (corresponding to “moderate-to-hard”) on a 0–5 scale. The majority of training time was spent in resistance training (39%) with walking and jogging contributing 27% and other activities 29% of total training time. The mean number of increased training days in this group was 1.3 days, which was not significantly different from the additional 1.8 added training days in the TRAINED group (Table 5).

**Adherence to Training Protocol**

All subjects in the TRAINED group attended 100% of their scheduled training sessions, and all SELF-trained subjects recorded at least 3 days per week of training. However, only a small number of subjects limited their training to the protocol-specified 3 days per week at the fitness club. Over 50% of both TRAINED and SELF subjects who completed training logs added 2 additional days of training; 4 of the TRAINED subjects and 1 SELF-trained subject added 3 days of training. No one added 4 days per week.

**Effect of Added Training Days**

Not having anticipated subjects adding days of training to the established protocol, we conducted a post hoc evaluation of whether the added days of training in either group was responsible for the changes observed. Subject training logs for the SELF group were labeled with their identification numbers and therefore easily identified for an analysis of change in the primary outcome variable, LBM. Added days of training in the TRAINED group were only acknowledged in the anonymous exit questionnaires (data not shown). Attempts to identify subjects in the TRAINED group by the unblinded investigator were successful, allowing analysis of their change in LBM by added days of training. Additionally, it was determined that the mode of exercise on the added days was exclusively aerobic exercise. Overall TRAINED subjects gained 1.3 (1.5) kg LBM (Table 2). Subjects who added 2 or 3 training days increased LBM by 0.7 (1.7) and 0.6 (1.7) kg, respectively, compared with 1.6 (0.07) and 1.5 (1.1) increases in men who had no additional training and 1 added day, respectively. The mean change in SELF-trained subjects was 0.0 (1.6) kg. The single individual who added 3 days of training

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**Figure 5.** Distribution of individual changes in aerobic capacity, \( V_{O_2\text{max}} \), for the TRAINED and SELF groups.

**Table 5.** Summary of 12 weeks of exercise training in the SELF-trained group.*

<table>
<thead>
<tr>
<th>Workout type</th>
<th>Walk-jog</th>
<th>Resistance training</th>
<th>Sports</th>
<th>Other</th>
<th>Total minutes</th>
<th>Minutes per week</th>
<th>Average intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
<td>623</td>
<td>876</td>
<td>118</td>
<td>656</td>
<td>2,273</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>Number of workouts</td>
<td>16</td>
<td>20</td>
<td>3</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of minutes</td>
<td>39</td>
<td>42</td>
<td>44</td>
<td>49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td>3.2</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
<td>3.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Intensity was rated on a 0–5 scale as follows: 0 = nothing at all; 1 = very light; 2 = light; 3 = moderate; 4 = hard; 5 = very hard.
showed a 0.8-kg decrease in LBM; individuals adding 1, day increased LBM by 0.7 (1.0) kg; men who added 2 days decreased LBM by 1.7 (1.6) kg.

**Discussion**

To our knowledge, this is the first study to describe the effectiveness of supervised, periodized training in a health/fitness club setting relative to individuals training with similar frequency and goals without benefit of supervision or a scientifically based exercise prescription. Although the study did not control for diet or expect departures from the protocol-specified training frequency, the outcomes are very likely to be reflective of applications in similar environments.

The principal finding of this study was the significant increase in DXA-determined LBM seen in the TRAINED group compared with no change in the SELF group. Correspondingly, TRAINED subjects showed significant increases in ALTM, which accounted for more than half of the increase in lean mass. In contrast, those subjects who directed their own exercise training lost only 0.2 kg of ALTM. Thus, our hypothesis that health club members who received a supervised, periodized training program would have greater increases in LBM than self-TRAINED members was accepted.

The 1.3-kg increase in LBM seen in TRAINED subjects is similar to increases reported in other resistance training studies of similar duration. One study randomized moderately trained men 18–35 years of age to a 12-week heavy resistance exercise training program that was either supervised by a qualified PTr or self-supervised (22). Unlike our study, however, the exercise training program was the same for all subjects regardless of supervision and was conducted in a research environment. However, the supervised subjects experienced a significant 1.4-kg increase in fat-free mass (determined by the skinfold technique), whereas those in the unsupervised group showed a nonsignificant 0.3-kg increase. Interestingly, these outcomes are very similar to those in this study and give additional support to the value of qualified supervision of exercise training. A recent study reported a 1.8-kg increase in LBM in untrained 36-year-old men who completed 12 weeks of progressive heavy resistance training (25). In contrast to the TRAINED subjects in this study who regularly exercised 5–7 days per month, these men had not exercised for at least 2 years perhaps giving them a larger window of adaptation and hence, possibly contributed to the 0.5-kg difference in change in LBM between men in the 2 studies. Finally, Montiero et al. compared strength trained men assigned to 12 weeks of non-periodized (NP), linear periodized (LP), or nonlinear periodized (NLP) resistance training using split routines (23). Although LBM was assessed with the less accurate skinfold technique, men in the NP group lost 2.1 kg LBM without significant weight loss, whereas men in LP and NLP both increased LBM by 0.8 and 0.2 kg. Thus, the 1.3-kg increase in LBM seen in this study compares favorably to increases in LBM in men of similar age after structured resistance exercise training conducted in research settings.

Figure 2 demonstrates that in addition to a significantly greater mean change in LBM, 82% of TRAINED subjects increased LBM above zero change with a mean increase of 1.8 (1.1) kg in these subjects. Correspondingly, 52% of the self-trained members who increased LBM achieved only a 0.6 (1.1) kg increase. Despite assurance that all subjects understood that the primary objective of training was to increase LBM, subjects who self-trained either did not understand how this could best be accomplished or did not include adequate amounts of resistance training of sufficient intensity or correct manipulation of the acute program variables to signal increases in LBM (29). Unlike the TRAINED subjects who performed no traditional form of endurance exercise as part of their programmed training, 11 of 17 subjects in the SELF group who had complete training logs spent an average of 61% of their total weekly training time in activities other than resistance training. To these points, Nybo et al. (25) have recently reported changes in DXA-determined LBM after 12 weeks of thrice-weekly training using 3 different types of training. Subjects assigned to strength training improved LBM by 1.8 kg, whereas subjects in the high-intensity interval running program and the prolonged running program (60 minutes, 65% \( V_{\text{max}} \)) increased LBM by 0.2 and 0.6 kg, respectively. Control subjects increased LBM by 0.1 kg. Collectively, these data support both the well-accepted convention that resistance training is the most potent stimulus for skeletal muscle growth (31) and evidence-based recommendations regarding the effective manipulation of acute program variables in periodized training programs (1).

There were no significant differences between groups with respect to changes in FM or percent body fat, but there was a trend for men in the TRAINED group to show larger improvement in these variables than men in the SELF group. The reason for this is unclear but may be within the error of measurement. The training intensity in TRAINED subjects is not known but it is possible, if not likely, that they trained with greater overall intensity and therefore had higher metabolic rates than the SELF subjects thereby contributing to increased fat utilization. The study protocol did not control for diet apart from specifically excluding the use of supplements thought to aid in increasing lean mass, e.g., creatine monohydrate. Consequently, without a focused nutritional plan to accompany the exercise regimens used in this study, fat loss may have been more difficult to achieve.

Significantly greater chest press strength and leg power gains were seen in the TRAINED group relative to SELF along with a trend toward greater improvement in leg press strength, 38 vs. 24% in TRAINED and SELF groups, respectively. The large and significant differences between groups for improved peak and average leg power (9-fold greater improvements in TRAINED compared with SELF) can be attributed to the periodization scheme used with
TRAINED subjects in which training for power is routinely included in the third 4-week cycle of the 12-week training program. The improvements seen in the TRAINED group are similar to those reported in the literature with subjects of similar characteristics and training duration (23,24,27). Individual changes in strength and power for the 2 training groups are displayed in Figures 3 and 4. As with the individual changes in LBM, the proportions of subjects in the TRAINED group who increased strength and power above zero change are substantially greater than in the SELF group. Although the mean change in leg press strength (Figure 3) was not statistically greater than that of the SELF group, 100% of the TRAINED subjects improved vs. 76% of SELF subjects. A similar pattern can be seen with the chest press exercise although this difference between groups was significantly different favoring the TRAINED subjects.

The individual responsiveness to training for leg power (Figure 4) again shows substantial differences in the proportion of subjects in the 2 groups who achieved greater than zero change. This has important performance implications because most activities of daily living are associated with power rather than strength, and most ballistic sports and games demand a power component of muscle function. Thus, inclusion of a safely administered power component in a periodized training program can provide important functional attributes that may be valuable in everyday living as well as in some sport and game activities. However, this remains to be demonstrated.

Changes in aerobic capacity (VO2max) were significantly different between the TRAINED (6–7%) and the SELF groups (~3%), as shown in (Table 4). Improvements in VO2max of 5–30% after training are typically reported with the magnitude of increase dependent on the type of training. Improvements in VO2max after different types of resistance training programs are not consistent with some regimens resulting in little to no change (16) or increases in the range of 4–9% with circuit weight training (14,26). One study examined changes in VO2max after 8 weeks of 1 of 4 types of progressive resistance training with increases in load throughout the study (28). Subjects in all groups were encouraged to move quickly through the 9-station exercise routine suggesting a circuit-training–like approach. Improvements ranged from 2.7% using an “explosive” resistance training routine (1 × 15, 40% IRM) to 13.2% for a heavy strength routine (days 1 and 2: 1 × 10RM and day 3: 1 × 3RM). The “endurance” trained group (2 sets, 15RM load) and the “strength” trained group (3 sets, 6RM load) increased VO2max by 9 and 11%, respectively. In another 12-week study, subjects who performed 2 days per week of heavy strength training improved VO2max by 3%, those assigned to 150 minutes per week of prolonged running experienced a 2% increase in VO2max, and subjects who performed high-intensity interval run training improved 14% (27). Hence, the 6–7% improvements in VO2max demonstrated in the TRAINED subjects in this study are within the range of changes for similar types of training. It is curious, however, that the SELF-trained subjects showed a slight decrease in VO2max. All of the SELF-trained subjects exercised at least 3 times per week with about one-fourth of the total training time spent in endurance type training. It is possible that the overall self-regulated intensity (average 3.3 on a 5-point scale), and perhaps inadequate progression was insufficient to increase VO2max beyond baseline values. It is also possible that these subjects focused more on increasing LBM, the main objective of this study.

Figure 5 shows the distribution of changes in VO2max for individual subjects. In addition to the higher mean change in the TRAINED group, it is notable that nearly half of the SELF-trained individuals exhibited a decrease in VO2max. Table 5 indicates that about 27% of total training time over the 12-week study in the SELF group was spent in aerobic type exercise, whereas 39% of exercise time was spent in resistance training. This contrasts with no programmed endurance training in the TRAINED group. It is evident that the NLP training program applied to the TRAINED subjects was not only adequate to increase LBM, but aerobic capacity as well. This is consistent with reports of improved VO2max after resistance training (26,32) and with concurrent resistance and endurance training (9). Somewhat surprising in view of the significant increase in VO2max in the TRAINED group, there was no improvement in VO2θ after training and no difference in change between groups (Table 4). The training regimen used in this study were not specifically designed to improve aerobic function suggesting a reason for the somewhat small improvements observed. However, the degree to which aerobic performance might have been improved in TRAINED subjects who inappropriately added 1, 2, or 3 days of aerobic training could not be determined.

This study was conducted in the health/fitness club environment with member volunteers. As such, limitations must be considered when interpreting the data. Although subjects were informed of the 3-day per week training regimen during the consenting process, this was largely not adhered to by either group. Subjects in both groups added training days beyond those specified in the protocol. However, the additional number of training days was similar between groups and the impact of the added training did not appear to drive the training response. That is, men who exercised 2 or 3 additional days showed less rather than more improvement in the primary outcome variable. From a practical point of view, it is possible that subjects working with a coach may have been inspired to add training to show effectiveness of the method while subjects in SELF may have added training to demonstrate that they were able to improve as much as members who trained with a PT although this is purely speculative. This has been described as “John Henry Effect,” where respondents receiving less desirable treatments demonstrate compensatory rivalry (9). It is also possible that men in the TRAINED group took it on themselves to add aerobic exercise training for a more
comprehensive exercise program (13) because by design, their training was exclusively periodized resistance exercise training. Future studies of this nature should include mechanisms to more carefully monitor training frequency so its influence on improvement could be better controlled. The extent to which the findings reported here might be seen in other locations or health/fitness club chains is uncertain. However, we speculate that with random allocation of subjects in the environment under study, subject demographics would have little impact on outcomes.

The study was powered only for change in LBM. It is therefore uncertain if a type II error could have accounted for the nonsignificant difference in leg press strength. We did not control for the Hawthorne effect in which subjects change their performance in response to being observed (12). However, this is unavoidable and therefore may be an added value in working with a PTr; hence, it is a factor that may occur outside strictly controlled laboratory studies which may affect desired outcomes. A future study could overcome this attention effect by using a PTr to accompany the member during training but only contribute to general conversation and log the exercise regimen.

This study also had several strengths. Dual-energy x-ray absorptiometry was used to assess the primary outcome variable, LBM. This method is considered by many to provide acceptable accuracy under normal and most clinical conditions (6,34) and has small error and excellent precision (21). The day-to-day coefficient of variation in our laboratory using a soft tissue phantom was 0.4%.

The pool of members from which the subjects were drawn were of similar demographics and similar exercise training history suggesting that baseline fitness would be equivalent between groups and therefore the “window for improvement” would be similar. Clear strengths and major features of this study included the application of current evidence-based recommendations that suggest the superiority of nonlinear (e.g., undulating) periodization schemes in which acute program variables are manipulated frequently in a nonlinear pattern (11,29). In addition, the use of high caliber, well-trained, and experienced PTrs is an obvious strength. Although it might be expected that members exercising with a PTr would improve more than individuals training alone, the variety of training and experience among PTrs working today may not have led to the outcomes observed in this study. The more homogeneous and extensive background and training of the PTrs used in this study were undoubtedly factors in the successes observed. Considering both the training regimen and its administration, it is unclear whether the club’s progressive, 3-cycle, nonlinear, periodized training template or its implementation by the expert trainers used in this study had the primary influence on the improvements reported here. We posit that the combination of both factors reinforced the well-accepted understanding that evidence-based training programs administered by expert trainers yield superior results.

In conclusion, significant increases in LBM are more probable when fitness club members exercise with expert supervision using a well-designed periodized exercise training program compared with members who choose to train on their own. Additionally, improvements in muscle strength and power and some measures of aerobic function tended to improve more when members underwent personal training as opposed to training themselves. Although it is difficult to parse out the contribution to improved fitness from the training method vs. its administration, in practice they form a successful combination that yields superior improvements in the measures of fitness studied in this project.

**Practical Applications**

A. The data reported in this study provide the first research evidence for greater improvements in LBM and some other measures of health-related fitness in health club members who exercise with well-qualified PTrs as opposed to directing their own training. Under the conditions imposed by this study, personal fitness trainers now have objective evidence for the efficacy of supervised exercise training.

B. Although we could not parse out the separate benefits of the scientifically based, periodized training regimen used in this study from its application by the well-qualified PTrs, the combination was shown to be significantly more effective in improving outcomes than when members trained themselves. This suggests that similar combinations in other settings may yield similar results although this remains to be shown. We do not know if PTrs who are less qualified or those who use training designs other than the NLP scheme used in this study would obtain similar results when administered under similar circumstances. Logic suggests, however, that PTrs with more education, credentialing, and experience who apply evidence-based recommendations for training would obtain superior results.

C. Exercise scientists engaged in strength and conditioning research might consider investigations that are carried out in different exercise training settings including other fitness clubs, private training centers, in-home training, corporate fitness, and clinical settings. In addition, studies to differentiate the effectiveness of different levels of PTr preparation and experience on client-important outcomes would be useful for advancing the personal training profession, as well as entities that employ these individuals.

D. The positive outcomes reported in the club members who exercised with a PTr in the fitness club setting suggests that health/fitness clubs should seek the best qualified and experienced PTrs and maintain quality control over their application of training methods. This is not meant to stifle the art of the PTr but rather to gain a degree of uniformity for exercise training using...
evidence-based recommendations within the health/fitness club environment.

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REFERENCES


