IMPROVEMENTS IN METABOLIC AND NEUROMUSCULAR FITNESS AFTER 12-WEEK BODYPUMP® TRAINING

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ABSTRACT

Greco, CC, Oliveira, AS, Pereira, MP, Figueira, TR, Ruas, VD, Gonçalves, M, and Denadai, BS. Improvements in metabolic and neuromuscular fitness after 12-week Bodypump® training. *J Strength Cond Res* 25(12): 3422–3431, 2011—The purpose of this study was to evaluate the effects of a 12-week group fitness training program (Bodypump®) on anthropometry, muscle strength, and aerobic fitness. Nineteen women (21.4 ± 2.0 years old) were randomly assigned to a training group ($n = 9$) and to a control group ($n = 10$). We show that this training program improved the 1 repetition maximum squats by 33.1% ($p < 0.001$) and the maximal isometric voluntary contraction (MVC) by 13.6% ($p < 0.05$). Additionally, decreases in knee extensor electromyographic activity during the MVC (30%, $p < 0.01$) and during the squats (15%, $p < 0.05$) and lunges of a simulated Bodypump® session were observed after the training. Concomitantly, blood lactate and heart rate after squats of a simulated Bodypump® session were decreased by 33 and 7% ($p < 0.05$), respectively. Body mass, body fat, and the running velocity at the onset of blood lactate accumulation did not change significantly in response to this training program. We conclude that Bodypump® training improves muscular strength and decreases metabolic stress during lower limb exercises. However, no significant improvements in running aerobic fitness nor in body mass and body fat were observed. Practitioners of Bodypump® training may benefit from the increased muscular strength and the decreased muscular fatigability during exercise tasks whose motor patterns are related to those involved in this training program. However, these functional gains do not seem to be transferable into running aerobic fitness.

KEY WORDS group fitness program, muscle strength, running, aerobic fitness

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INTRODUCTION

Physical activities performed in groups have gained wide popularity in recent years around the world. Bodypump® is well known among the group fitness training programs. The Bodypump® program comprises 60-minute workout barbell classes, based on 10 tracks in a preestablished sequence, where each track represents a different exercise movement (see Table 1 for details). The claimed organic benefits from this exercise training program are the improvements in strength and endurance of major muscular groups and a considerable energy expenditure (up to 600 kcal per session) (19).

In general, the barbell classes present the characteristics of a typical resistance training program focused on endurance, that is, high number of repetitions at a low-to-moderate intensity (22). Despite the fact that major neuromuscular adaptations and strength gain are rather promoted by strength training, endurance resistance training seems also to improve muscular strength in untrained individuals (6,18). But, unfortunately, data on the chronic physiological adaptations in response to the barbell classes training programs are limited (22,24). O'Connor and Lamb (22) studied the chronic responses to a group fitness training program (Bodymax®), which is characterized by low-intensity exercises (1- to 5-kg free weights and barbells) and high number of repetitions (36 repetitions per set). After 12 weeks on this training program, the enrolled active women presented enhanced muscular strength and lower skinfold thickness, but other important functional variables were not assessed (e.g., muscular activation and metabolic responses during the training session).

Conceivably, cardiovascular fitness can be improved by performing moderate intensity exercises (65–75% HRmax) recruiting large muscle groups for at least 30 minutes (27). Nonetheless, traditional endurance resistance exercise training for the lower limbs (40–60% 1-repetition maximum [1RM], 1–3 sets × 8–10 exercises) is also able to induce cardiovascular and metabolic improvements (i.e., lower heart rate [HR] and blood lactate concentration during exercises) (11,14,17). In this regard, resistance training alone (6) or included as a concurrent training to the endurance training program (8) can lead to significant improvements in aerobic fitness, probably because the neuromuscular and metabolic adaptations are partially transferred from the specific resistance exercise training (note that these studies involved knee and hip extension exercises [6,8]).

Table 1. General characteristics of high-repetition training session.*

Music	Duration (s)	Muscle groups	Exercise	Volume (rep)	Intensity
1	330	Lower and upper limbs. Trunk	Squats Bent-over barbell Rows		10% 1RM 10% 1RM 3 kg
2	340	Lower limbs (quadriceps)	Squats	91	10% 1RM
3	300	Upper limbs (chest)	Bench press	69	3 kg
4	315	Trunk (latissimus dorsi, trapezium, paraspinals), lower limbs (gluteus and hamstrings)	Bent-over barbell rows	52	3 kg
5	275	Upper limbs (triceps brachialis)	Skull crushes Triceps kickbacks	72	3 kg 1 kg
6	250	Upper limbs (biceps brachialis, brachialis and brachioradialis)	Biceps curls	42	3 kg
7	295	Lower limbs (quadriceps and gluteus)	Lunges	90	10% 1RM
8	275	Upper limbs (deltoids)	Side raises, shoulder press	63	1 kg
9	265	Trunk (abdominalis)	Crunches, twisting crunches	70	
10	265	Lower and upper limbs, trunk	Stretch		

*1RM = 1 maximum repetition squat test; rep = repetitions.

According to a recent study from our group (24), the most demanding exercises during the Bodypump® barbell class are the squats and the lunges, performed in tracks 2 and 7, respectively. These exercises (corresponding to tracks 2 and 7) elicited an extensive electromyographic (EMG) activity in knee and trunk extensors, along with a high cardiovascular (80–85% maximal HR [HRmax]) and metabolic demand (~4–5 mmol·L^{-1} blood lactate). Therefore, it is reasonable to hypothesize that barbell classes such as the Bodypump® training program may improve muscular strength and also other physical capabilities, such as running aerobic fitness.

Despite the claimed benefits, the chronic effects of Bodypump® training program on physical fitness are not fully known. Hence, the main objective of this study was to evaluate the effects of 12 weeks of Bodypump® training program on neuromuscular (isometric and dynamic strength, and isometric and dynamic EMG) and metabolic variables related to fitness and performance (HR and lactate responses to exercise). The effects on running aerobic fitness were also evaluated. It has been hypothesized that (a) untrained healthy adult women may improve neuromuscular (increased strength, decreased EMG activity at submaximal intensities) and metabolic fitness (decreased HR and blood lactate concentration [LAC] during exercise) in response to a 12-week Bodypump® training program; (b) these putative adaptations may be transferred to other exercise tasks (i.e., running aerobic fitness).

Methods

Experimental Approach to the Problem

Our 12-week Bodypump® training program required the subjects to attend 2 training sessions per week. We focused on the likely adaptations of lower limbs trained by squats and lunges at low intensity and high volume. There were 2 independent variables: training (control and trained) and time (pre and post). The effects of the independent variables on muscle strength (isometric and dynamic), on muscle activity (isometric and dynamic EMG), and on metabolic ([LAC]), and cardiovascular (HR) variables were investigated. This design allowed us to evaluate the Bodypump® as a training program suitable (or not) to improve both the strength and metabolic fitness. This comprises our main hypothesis, which was tested through the statistical comparisons between pre and posttraining period variables. Similarly, the effect of the independent variables on running aerobic fitness (peak velocity and the onset of blood lactate accumulation [OBLA]) was assessed. These measurements in running were conducted to evaluate as to which of the likely improvements are transferred (or not) from the Bodypump® training to different exercise tasks (our secondary hypothesis, which was tested through the comparison between pre and posttraining period variables).

Subjects

Nineteen untrained healthy women (age = 21.4 ± 2.0 years; height = 164 ± 5 cm; and body mass = 61.7 ± 7.9 kg) without muscle–skeletal disorder history on the lower limbs and lumbar spine were enrolled in this study. They were undergraduate and postgraduate students from the Department of Physical Education at our university. This study was conducted in the autumn of 2006. All subjects were sedentary, that is, <2 sessions of recreational physical activities per week (9). In addition, subjects reported no or little experience with weight training and no exercise training engagement in the 6 months preceding the study. All subjects were informed about the procedures and experimental risks, and they signed an informed consent document before the beginning of this investigation. This study was approved by the Institutional Review Board of the university.

Experimental Design

Initially, subjects were randomly assigned into 2 groups: (a) training group (TG, $n = 9$) and (b) control group (CG, $n = 10$). There were no statistical differences in anthropometric (excepted body mass), neuromuscular and aerobic fitness indexes between the 2 groups pretraining. Then, the anthropometric data were collected, and the familiarization to the equipment was provided. To verify the effects of the training program on neuromuscular and metabolic variables and on aerobic running fitness, the following experimental procedures were conducted (over 2 days) during the 2 weeks before (Pre) and the 2 weeks after (Post) the training period: (a) Maximal squat movement test (1RM) and 1 Bodypump® class for familiarization and (b) Incremental test to exhaustion on a treadmill for the determination of the OBLA and maximal aerobic speed (MAS). The order of these 2 test days was randomized, but the order of the tests within a given day was the same for all subjects.

In the next week, they performed 5-second maximal isometric voluntary contractions (MVC) for knee extension (K-MVC) and trunk extension (T-MVC), followed by a simulated Bodypump® class with blood collection, HR measurement and EMG recordings. Subjects of the CG performed the same experimental procedures Pre and Posttraining periods. The CG did not perform any systematical physical activities during the 12 weeks corresponding to the training period. Figure 1 presents the timeline of the testing and measures. The subjects were asked to be fully hydrated and to avoid food ingestion during the 2 hours preceding the tests and training. For each subject, the tests (pre and posttraining) were performed at the same time of the day.

Anthropometric Assessments

Anthropometric measurements (height, body mass, and skinfold thickness) were determined before (Pre) and after (Post) the 12-week Bodypump® training program. Skinfold thickness was obtained at suprailiac, subscapular, and midthigh sites; these measures were taken by the same experienced researcher with a Cescorf caliper (Porto Alegre, Brazil). Three measurements of each site were taken on the right side, and their mean was considered. The body fat content was estimated with the method described by Siri (29).

Onset of Blood Lactate Accumulation and Maximal Aerobic Speed

The OBLA and MAS were determined during an incremental test to volitional exhaustion on a motorized treadmill (Inbramed Super ATL, Porto Alegre, Brazil) with the gradient set at 1% (16). The initial running speed was 6 km·h^{-1} with increments of 1 km·h^{-1} every 3 minutes. Each stage was followed by a 30-second rest period to collect blood sample from the ear lobe. Twenty-five microliters of blood was taken with a heparinized capillary glass tube and immediately

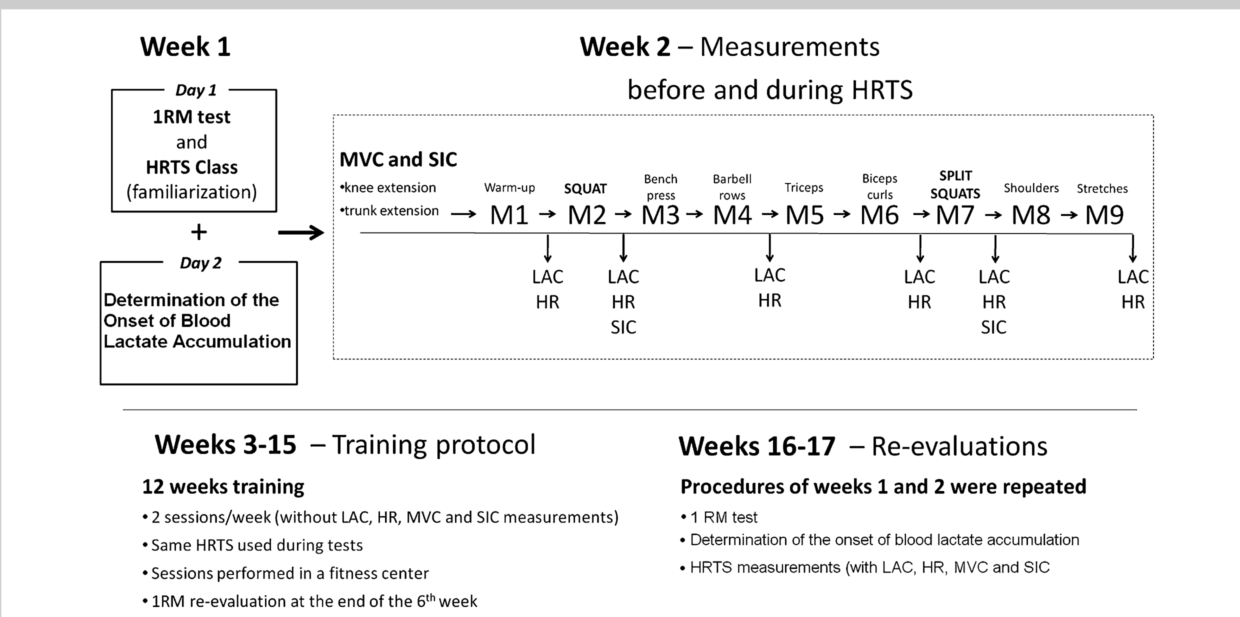

Figure 1. Timeline of the experimental procedures. 1RM = 1 repetition maximum; MVC = maximum voluntary contraction; SIC = submaximal isometric contraction; M1 to M9 = music order of high-repetition training session (HRTS); LAC = blood lactate collection; HR = heart rate collection.

Table 2. Anthropometric characteristics of CG and TG before and after the training period.*†

Group	CG ($n = 10$)		TG ($n = 9$)	
	Pre	Post	Pre	Post
Body mass (kg)	64.7 (8.0)‡	66.4 (7.8)‡	58.4 (6.6)	58.8 (7.3)
Body fat (%)	27.5 (4.2)	28.3 (2.9)	25.9 (3.9)	25.3 (3.2)

*CG = control group; TG = training group; Pre = before the training period; Post = after the training period.
†Values are given as mean (*SD*).
‡$p < 0.01$ in relation to TG.

transferred to microcentrifuge tubes containing 50 μl NaF (1%) for later [LAC] measurement (YSI 2300 STAT, Yellow Springs, OH, USA). The HR was continuously monitored by an HR monitor (S410, Polar, Kempele, Finland). The OBLA and HR corresponding to OBLA (HR_{OBLA}) were determined by linear interpolation using the fixed [LAC] of 3.5 mmol·L^{-1} (10). The MAS was considered as the highest speed maintained for at least 1 minute (2).

Maximal Isotonic Strength

Maximal strength during squat exercises was assessed by a 4 repetition maximum test using barbell and plate weights. We opted for the use of 4 repetitions instead of 1 repetition because the enrolled subjects had no previous experiences with squat exercises. To standardize the squat movement velocity at 1.5 seconds per each concentric–eccentric cycle, a metronome set at 40 b·min^{-1} was used (Qwick Time QT-3, Beijing, China). A series of familiarization trials were provided to assure the correct movement. The range of motion was partially controlled by instructing the subjects to squat until 90° knee flexion (0° = full extension) with the aid of a manual goniometer. The initial load was set at 10 kg, and for each successful 4-repetition bout, a 5- or 10-kg load was added according to the subjects' capacity; this was repeated until they were unable to successfully complete the 4RM. A 5-minute rest period was imposed between bouts. A conversion equation as described by Bompa and Cornacchia (3) was applied to determine 1RM from the 4-repetition maximum.

Isometric Contractions

To normalize the EMG data, three 5-second MVCs were conducted for knee extensors of the dominant limb (K-MVC) and trunk extensors (T-MVC), with a 2-minute rest between them. Custom-designed equipment was used in the isometric contraction tests. This equipment aids to maintain the knee and pelvis well stabilized at 90° flexion and the trunk in upright position. A strain gauge (MM 200, Kratos Dinamômetros, Embu, Brazil) was connected to the ankle with a strap, and to the upper trunk with a breast belt, for the measurements of knee and trunk extensions, respectively. The highest force among 3 trials (for knee and trunk extensions) was considered as the MVC. After the MVCs, one 5-second submaximal isometric contraction (SIC) for trunk extensors (25% MVC) and knee extensors (50% MVC) was performed. These SIC were also performed after track 2 (M2–squats) and track 7 (M7–lunges), to assess EMG activity to the same absolute force output at rest and at fatiguing conditions (i.e., post tracks 2 and 7). Squats and lunges were evaluated because they impose a high physical demand on lower limbs and trunk. Subjects were previously informed about the required level of force during SIC and then asked to sustain the force level with the aid of a display as feedback. The time interval to initiate SIC after the end of exercises varied from 44 to 71 seconds over the entire study. All measurement and tests performed between musics were conducted in 2–3 minutes. Because, in a previous pilot study, the subjects were unable to attain 50% MVC quickly, the intensity of 25% MVC was chosen for trunk extensors.

Experimental Bodypump® Session

This Bodypump® class was the MIX 46 (available in 2006 by Les Mills International, Auckland, New Zealand). Detailed information concerning exercise sequence and duration is presented elsewhere (24) and in Table 1. The exercises for upper limbs were performed using 1-kg weights. Considering

Table 3. Mean (*SD*) values of OBLA, HR_{OBLA}, HRmax, and MAS before and after the training period.*

Group	CG ($n = 10$)		TG ($n = 9$)	
	Pre	Post	Pre	Post
OBLA (km·h^{-1})	9.2 (1.0)	9.2 (1.1)	9.1 (1.7)	9.5 (1.2)
HR_{OBLA} (b·min^{-1})	185 (6)	183 (7)	179 (11)	184 (13)
HRmax (b·min^{-1})	196 (7)	194 (9)	196 (7)	196 (8)
MAS (km·h^{-1})	10.9 (0.9)	11.0 (1.1)	11.6 (1.4)	11.3 (0.8)

*OBLA = onset of blood lactate accumulation; HR_{OBLA} = heart rate corresponding to OBLA; HRmax = maximal heart rate; MAS = maximal aerobic speed; Pre = before the training period; Post = after the training period; CG = control group; TG = training group.

Table 4. Mean (*SD*) values of 1RM, K-MVC, and T-MVC before and after the training period.*

Group	CG ($n = 10$)		TG ($n = 9$)	
	Pre	Post	Pre	Post
1RM (kg)	61.7 (16.2)	63.9 (14.8)	51.6 (11.7)	68.3 (13.6)†
K-MVC (kg)	49.6 (9.1)	48.0 (9.1)	39.6 (8.2)	45.0 (8.6)‡
T-MVC (kg)	67.6 (16.9)	72.3 (19.7)	64.8 (15.7)	71.3 (15.6)

*1RM = 1 maximum repetition; K-MVC = maximal voluntary contraction of knee extension; T-MVC = maximal voluntary contraction of trunk extension; Pre = before the training period; Post = after the training period; CG = control group; TG = training group.
†$p < 0.01$ in relation to Pre.
‡$p < 0.05$ in relation to Pre.

that the main objective of this study was to evaluate lower limbs neuromuscular responses to training, squat and lunges exercises were performed using weights corresponding to 10% 1RM for squats (~5 kg). A metal straight bar (1 kg) and 1-, 2-, and 5-kg plate weights were attached to the bar and used during lower limbs exercises. Experimental Bodypump® classes took place in the Biomechanics Laboratory, guided by an official video tape as used by professional instructors. All sessions were supervised by an official instructor trained and licensed by Less Mills® that provided guidance to the subjects. The main characteristics of the class are shown in Table 1. The simulated Bodypump® classes were performed using the same absolute workloads before (Pre) and after (Post) the training program. The data collection during these Bodypump® classes was performed using exactly the same procedures in both moments.

Blood Lactate and Heart Rate Measurements

Immediately before the beginning of the Bodypump® classes and after musics 1 (M1–330 seconds), 2 (M2–340 seconds), 4 (M4–315 seconds), 6 (M6–250 seconds), 7 (M7–295 seconds), and 9 (M9–265 seconds), 25 μl of blood was collected from the ear lobe for lactate measurement, as described above. The HR was concomitantly recorded.

Electromyographic Recordings

Surface EMG activity was recorded at 1,000 Hz with a 4-channel system (Lynx®, São Paulo, Brazil) with a bandwidth from 20 to 500 Hz with an A/D card (resolution of 10 bits) using specific software (Aqdados 4, Lynx®). After shaving, cleaning, and skin abrading, surface electrodes (MEDITRACE® –Ag/AgCl) with a caption area of 1 cm were placed over the *vastus lateralis* (VL), *vastus medialis* (VM), *iliocostalis lumborum* (IC), and *longissimus thoracic* (LT) muscles of the right limb, parallel to the muscle fibers. Vastus lateralis and VM electrode position was according to that of Hermens et al. (15). Briefly, the VL electrode was positioned at two-thirds between the anterior superior iliac spine and the lateral patella edge. The VM electrode was positioned at 80% from the total distance between the anterior superior iliac spine and the interjoint space, in front of the medial collateral ligament. The IC electrodes were positioned according to De Foa et al. (9) at the L2/L3 interspine space dislocate 6 cm laterally, and the LT electrodes were positioned at the L1 spine process, 3 cm laterally (28). The MVC and SIC were calculated as the average force over a 1-second period at the force plateau level. The raw EMG signal was fully rectified, and the amplitude root mean square (RMS) was obtained by means of spectral analysis, using the power spectral density algorithm available in Matlab statistical toolbox (MathWorks, Natick, MA, USA). For EMG measurements, all normalizations were made using the correspondent MVC (posttraining contractions were normalized using posttraining MVCs).

Table 5. Mean (*SD*) values of RMS during maximal voluntary contraction of VL and VM muscles during knee extension and IC and LT muscles during trunk extension.

	Knee extension		Trunk extension	
	VL (μV)	VM (μV)	IC (μV)	LT (μV)
CG ($n = 10$)				
Pre	171.6 (50.2)	221.9 (89.3)	177.0 (51.6)	119.9 (44.9)
Post	221.2 (88.0)	159.3 (58.1)	150.3 (68.7)	124.3 (51.0)
TG ($n = 9$)				
Pre	207.4 (48.8)	219.0 (66.6)	231.7 (95.2)	177.7 (56.1)
Post	284.5 (77.7)†	280.8 (46.4)†	245.8 (96.7)	179.4 (59.1)

*CG = control group; TG = training group; Pre = before the training period; Post = after the training period; RMS = root mean square; VL = vastus lateralis; VM = vastus medialis; IC = iliocostalis lomborum; LT = longissimus thoracis.
†$p < 0.05$ in relation to Pre.

TABLE 6. Mean (*SD*) values of [LAC] and HR during the choreographic class, before and after the training period.

	[LAC] (mmol·L^{-1})		HR (b·min^{-1})	
	Pre	Post	Pre	Post
CG ($n = 10$)				
M1	2.3 (0.5)	2.5 (0.7)	126 (19)	127 (19)
M2	3.5 (1.0)	3.8 (1.0)	153 (22)	159 (21)
M4	2.0 (1.0)	2.4 (1.5)	127 (18)	128 (22)
M6	2.1 (0.7)	2.5 (1.4)	125 (24)	131 (25)
M7	4.6 (1.0)	5.0 (1.1)	166 (16)	166 (29)
M9	4.5 (1.1)	5.0 (1.1)	105 (22)	105 (16)
TG ($n = 9$)				
M1	3.0 (1.2)	2.3 (0.8)	115 (16)	121 (26)
M2	4.2 (1.7)	2.8 (0.9)†	154 (17)	143 (20)†
M4	2.6 (0.9)	1.9 (0.6)	121 (23)	120 (23)
M6	2.8 (1.4)	2.2 (0.7)	122 (23)	120 (23)
M7	5.3 (2.3)	4.2 (1.2)	160 (24)	153 (22)
M9	0.9 (2.0)	4.7 (1.5)	97 (17)	92 (12)

*CG = control group; TG = training group; Pre = before the training period; Post = after the training period; [LAC] = blood lactate concentration; HR = heart rate.
†$p < 0.05$ in relation to Pre.

Training Protocol

The training protocol comprised 12 weeks of the same Bodypump® class described above. The Bodypump® training (2 sessions per week, at the same time of the day and a minimum of a 48-hour rest period between sessions) was conducted in a habilitated gymnasium and guided by the same instructor responsible for the experimental classes. The initial workload (kg) used for squats and lunges was 10%

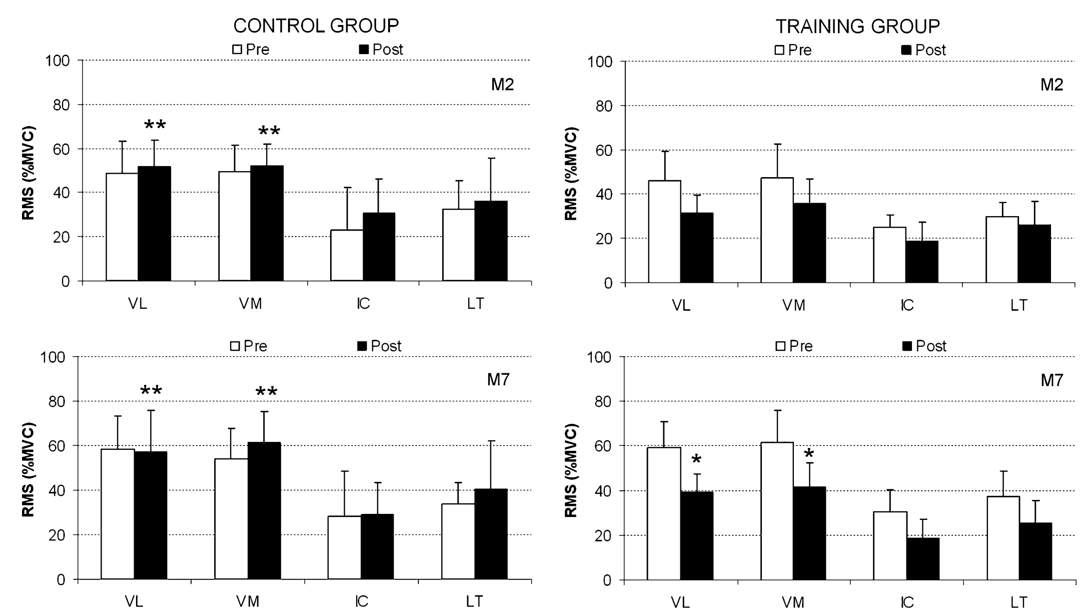

Figure 2. Mean (*SD*) values of root mean square (RMS) of vastus lateralis (VL), vastus medialis (VM), iliocostalis lomborum (IC), and longissimus thoracis (LT) muscles during submaximal isometric contractions after M2 and M7. *$p < 0.05$ in relation to Pre; **$p < 0.05$ in relation to training group.

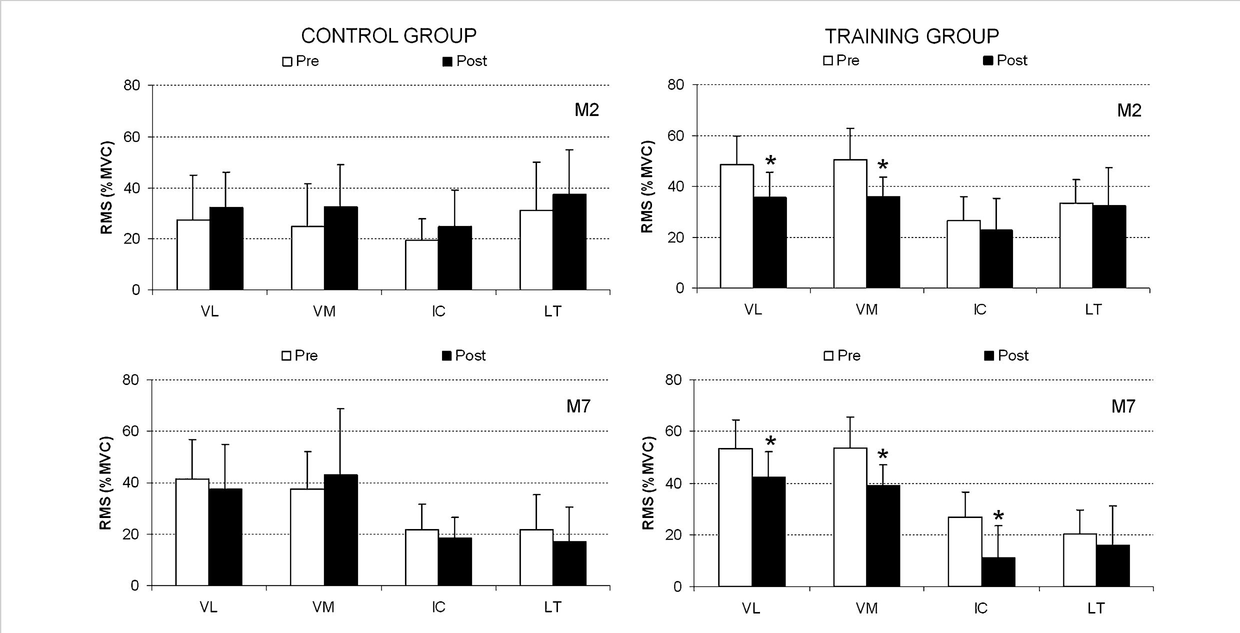

Figure 3. Mean (*SD*) values of root mean square (RMS) of vastus lateralis (VL), vastus medialis (VM), iliocostalis lomborum (IC), and longissimus thoracis (LT) muscles during submaximal isotonic contractions at M2 and M7. *$p < 0.05$ in relation to Pre.

squat 1RM. Upper limbs and trunk exercises were performed at a workload of 2 kg for barbells or 1 kg for free weights. Workload increments for squat and lunges were 5% every 2 weeks (4 sessions). At the end of the sixth week, a new 1RM test was performed to adjust the training workload of the lower limbs. The workload of other exercises was adjusted according to the perception of the subjects and the instructor.

Statistical Analyses

Data are presented as mean ± *SD*. Normality of the distribution was assessed with Shapiro–Wilk's test. Because, a normal distribution was observed, all data were analyzed by 2-way analysis of variance (group vs. time), complemented with Tukey post hoc test where appropriate. The statistical power for the n size used ranged from 0.76 to 0.82. All tests were performed using Statistica 6.0 for Windows. Significance was set at $p \leq 0.05$.

Results

Anthropometric Data

Anthropometric characteristics of CG and TG before (Pre) and after (Post) the training period are presented in Table 2. The CG presented higher values of body mass than TG before and after the training period ($p < 0.01$). There were no significant changes ($p > 0.05$) in body mass and body fat for both groups as a result of the training program.

Onset of Blood Lactate Accumulation and Maximal Aerobic Speed

Mean (*SD*) values of OBLA, HR_{OBLA}, HR_{max}, and MAS before and after the training period are presented in Table 3. No significant difference was found between CG and TG for OBLA, HR_{OBLA}, HRmax, and MAS before and after the training period ($p > 0.05$). None of these variables changed significantly after the training period for both groups ($p > 0.05$).

Maximal Strength and Electromyographic Activity

Mean (*SD*) values of 1RM and MVC at knee extension (K-MVC) and trunk extension (T-MVC) before (Pre) and after (Post) the training period are presented in Table 4. No significant difference was found between CG and TG for 1RM, K-MVC, and T-MVC before and after the training period ($p > 0.05$). There was a significant improvement in 1RM (~33%) and K-MVC in TG after the training period ($p < 0.01$). No significant changes were observed in CG ($p > 0.05$) for any variable.

Mean (*SD*) values of RMS during MVC of VL, VM, IC, and LT before and after the training period are presented in Table 5. The EMG activity during maximal isometric contractions of knee extension and trunk extension were similar between groups before and after the training period ($p > 0.05$). There were significant increases in VL and VM values for TG ($p < 0.05$) after the training period. No significant changes in EMG recordings were observed in CG ($p > 0.05$).

Blood Lactate Concentration and Heart Rate during the Bodypump® Class

Mean (*SD*) values of [LAC] and HR obtained during the experimental Bodypump® section are presented in Table 6. The [LAC] and HR values were similar between groups before and after the training period ($p > 0.05$). There was a significant reduction in [LAC] and HR at M2 for TG after the training period ($p < 0.05$). No significant changes in [LAC] and HR were observed at other points of the Bodypump® class and in CG ($p > 0.05$).

Electromyographic Activity during Submaximal Isometric Contractions

Mean (*SD*) values of RMS of VL, VM, IC, and LT during SICs performed after M2 and M7 of the experimental Bodypump® section are presented in Figure 2. The TG presented lower RMS values for knee extensors after M2 and M7 when compared to CG after the training period ($p < 0.05$). The TG presented significant reductions in RMS of VL and VM after M7 ($p < 0.01$). No significant changes in EMG activity were found for CG ($p > 0.05$).

Electromyographic Activity during Submaximal Isotonic Contractions

Mean (*SD*) values of RMS of VL, VM, IC, and LT during submaximal isotonic contractions at M2 and M7 are presented in Figure 3. The RMS values of VL, VM, IC, and LT during M2 and M7 were similar between groups before and after the training period ($p > 0.05$). There was a significant reduction in RMS during M2 for VL and VM ($p < 0.01$) and in M7 for VL, VM, and IC in TG ($p < 0.01$). No significant changes in EMG activity were found for CG ($p > 0.05$).

Discussion

To our knowledge, this is the first study that has evaluated the chronic effects of the Bodypump® training on neuromuscular and metabolic variables in sedentary women. Our main findings were that the training program increased isotonic and isometric muscle strength and lowers [LAC] and HR during a simulated Bodypump® class. But, contrary to our hypothesis, this training program did not significantly improve running aerobic fitness (i.e., OBLA and MAS). In practical terms, our results confirm the benefits of Bodypump® training on muscular strength and endurance, lowering the physiological strain during the class after the training period.

We recently observed (25) signs of neuromuscular fatigue (increases in EMG RMS) during a Bodypump® class (exercises performed in tracks 2 and 7). Under this circumstance, a higher motor unit firing rate (21) and additional motor unit recruitment (20) would be required to maintain a given level of force output. Thus, these previous results indicate that a Bodypump® training session imposes important demands on neuromuscular system. Our current data demonstrate, in fact, that a 12-week Bodypump® training program effectively improves neuromuscular efficiency as revealed by lower RMS responses (VL and VM) for track 2 and track 7 exercises (Table 4). A lower RMS (VL, VM, and IC) was also observed during SICs performed after track 7 (Table 5 and Figure 2). Thus, the same absolute load evoked a lower neuromuscular stress, because the maximal strength was higher after training (Table 4). These changes suggest an enhanced submaximal neuromuscular efficiency (force output/EMG ratio) (4), likely as a result of improvements in the pattern of motor unit recruitment and muscle activation (23). In contrast to these positive adaptations in thigh muscles, the Bodypump® training neither improved MVC of trunk extensor muscles nor changed RMS of LT and IC during and after squats and lunges. Importantly, the RMS of trunk extensors is lower than RMS of knee extensors for these exercises (24). Hence, the unchanged MVC and RMS of trunk extensors may be partially explained by the lower strength levels attained in these muscles, because they act predominantly to stabilize the trunk and not as agonists during upper and lower limbs exercises (23).

The Bodypump® training also significantly improved squat 1RM (~33%), MVC, and EMG (RMS) of VL and VM muscles (Table 4). These results are in line with those of the previous studies evaluating traditional circuit resistance training (15) and a similar barbell class training program (22). Harber et al. (14) reported 15–42% improvement in 1RM after 10 weeks of training (40–60% 1RM, performed 3 times a week). In the other study, O'Connor and Lamb (22) observed a significant increase in 1RM (23–50%) after Bodymax training (a high-repetition resistance training, 1- to 5-kg free weights, 36 repetitions per set, 3 times a week, for 12 weeks). Similarly to previous studies (1,31,32), our data highlight that maximal isotonic strength can be improved in untrained subjects even with the use of light loads and high number of repetitions for each exercise. These improvements are generally attributed to neural adaptations, which optimize the pattern of muscle fiber recruitment without significant changes in muscle mass (6,21). Here, such neural adaptation is supported by RMS responses in VL and VM at MVC (Table 5), which indicate higher muscle activation after the Bodypump® training.

The reduction in [LAC] and HR during squats suggest that the Bodypump® training improved local muscle endurance of knee extensors (Table 6). The reduction in [LAC] is in accordance to Harber et al. (14) that demonstrated an attenuated exercise-induced blood lactate rise after 10 weeks of traditional circuit resistance training program. In this regard, Piepoli et al. (26) have also described a significant reduction in HR during handgrip exercise after a resistance training program (2 or 3 sessions a day for 6 weeks for forearm muscles). Afferent inputs from working skeletal muscle are known to modulate the hemodynamic, autonomic, and ventilatory responses in exercising animals and humans (25,33). Thus, it is possible that the beneficial effect of exercise training is through the reduction in the activity of the muscle ergoreflex, either directly or via the inhibition of the metabolic signals activating the ergoreceptors (26).

The OBLA and MAS were not significantly improved after training (Table 3). The metabolic and cardiovascular gains (as evaluated during the Bodypump® class, Table 6) elicited by the Bodypump® training program were not accompanied by improvements in running aerobic fitness. This may indicate that the extent of the aforementioned positive adaptations were not transferred to running exercise, which is apparently in contrast to some data in the literature showing that traditional circuit resistance training can increase $\dot{V}O_2$max (~5%) in untrained individuals (13,30). In our study, the lower limbs exercises (squat and lunges, respectively, tracks 2 and 7) increased the HR to nearly 85%HRmax (Table 6). Conceivably, endurance exercises involving large muscular mass should promote significant adaptive cardiovascular stimuli (5). However, the relationship between %HRmax and %$\dot{V}O_2$max during resistive exercises is quite different from that observed in cyclic exercises, such as running (12). Meaning that at the same HR level, $\dot{V}O_2$ is significantly lower in circuit resistance training than in treadmill running (14). Moreover, the total exercise duration recruiting large muscle groups was relatively short (~10 minutes) in our study. Therefore, in our study, both exercise intensity and duration with respect to squats (track 2) and lunges (track 7) may have not been enough to promote the adaptations required to improve aerobic running fitness (27).

Based on our results, we conclude that a 12-week training program involving low-intensity and high-repetition exercises (i.e., Bodypump®) may significantly improve maximal muscle strength of lower limbs while reducing metabolic and cardiovascular stress during a simulated training section. The main functional improvements after the training period seem to evolve from neural and metabolic adaptations in knee extensors. However, these physiological gains observed during the simulated training section were not transferred into improved aerobic running fitness.

Practical Applications

Bodypump® is among the training programs available in many fitness centers worldwide. Improvements in strength and endurance of major muscular groups and considerable energy expenditure (up to 600 kcal per session) are the claimed benefits of Bodypump® training. Our present work indicates that a 12-week Bodypump® training program is effective in improving lower limb maximal strength and muscular endurance in untrained women. However, this training program does not seem to improve aerobic running fitness, which theoretically could be achieved by other resistance training protocols as shown in the literature (6).

In summary, Bodypump® group fitness training may be prescribed to untrained women for muscular strength and endurance purposes. Importantly, those practitioners who also aim at improving performance in other physical tasks (e.g., aerobic running and upper body strength) should incorporate specific training sessions in their routines.

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