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The effects of indoor cycling training in sedentary overweight women

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Aim. **The aim of this study was to evaluate the body composition and physiological effects in young sedentary overweight women after an indoor cycle training period.**
Methods. **Fourteen subjects (22.6±2.1 yrs; 25-29.9 BMI) were trained for 12 weeks in a specific indoor cycling protocol (ICP) consisting of three sessions/week carried out in a fitness room. Body composition and physiological parameters were taken before the beginning of the study and after 12, 24 and 36 sessions.**
Results. **We observed a reduction of 2.6% and 3.2% in body weight and of 4.3% and 5% in fat mass after 24 and 36 sessions respectively (P<0.05). Lean mass increased by 2.3% and 2.6% respectively after 24 and 36 sessions. Body circumferences diminished in response to ICP. Resting heart rate decreased by 6.5% and 9% respectively after 24 and 36 sessions. After the tenth week, we found a reduction of 11 beats·min^{-1} in average training heart rate, an increase of 0.5 mL/kg^{-1}·min^{-1} in average training oxygen uptake and an increase of 8.6 Watts in average power output. Moreover, an increase in cardio-respiratory fitness was observed (37.1±4.3 *vs.* 40.2±4.6 mL/kg^{-1}·min^{-1}) after 36 sessions.**
Conclusion. **The decrease in body weight, without any restriction on food consumption, and the improvement in cardio-respiratory fitness suggests that ICP may be efficient for losing weight and preventing the increased risk of cardiovascular disease in young overweight women. Indoor cycling can be performed by young sedentary overweight women; however, it is fundamental to formulate training protocols which are intensity and length specific to the fitness level of the participants.**

KEY WORDS: Indoor cycling - Overweight - Exercise.

Acknowledgements.—The authors wish to thank the participants to the study, Dr. Amalia Pilano, Dr. Esamuela Mancuso, Mr. Salvatore Di Noto, Mr. Gabriele Morana and MD Caterina Mammina.

Received on September 25, 2009.
Accepted for publication on June 3, 2010.

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Indoor cycling lessons are normally undertaken in a fitness room where participants cycle together on modified stationary bikes and follow the music rhythm and the instructions of an indoor cycling trainer. Indoor cycling (IC), also known as spinning®, is a fitness activity characterized by steps of workout with variable intensity and a high/moderate involvement of the cardiovascular system as well as the skeletal muscles.[1-3] Several authors classified IC as a physical activity requiring considerable effort, essentially anaerobic, and therefore not suitable for everyone.[1, 3] According to other authors IC is a very versatile fitness activity; indeed involvement of the energetic and cardiovascular systems can vary according to the music (cadence rhythm), instructions of the instructor, and technique and strength applied to the flywheel.[4-6] Therefore, IC can be a predominantly aerobic, anaerobic or mixed activity. Despite the worldwide popularity of IC, incomplete and mostly non-scientific studies exist which are aimed at assessing its effects on metabolic and cardiovascular functions. It is known that traditional cycling training can be used for losing weight and increasing aerobic performance.[7, 8] However, the IC fit-

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ness activity presents completely different features compared with outdoor cycling, because it is performed with music, the aim of an instructor and the biomechanics of pedaling. Therefore, the training methods of outdoor cycling cannot be applied to IC lessons. Indicators of training intensity such as heart rate (HR) and the rating of perceived exertion (RPE) can allow participants to gauge their efforts and check their performance within safe ranges, to avoid overexertion and to maximize the benefits of their training time and effort.[7] A study carried out by Kang *et al*.[9] on 15 subjects showed that there were no differences in average $\dot{V}O_2$, HR, and RPE during exercise when doing a spinning protocol of variable intensity and an exercise regime performed at constant intensity. However, $\dot{V}O_2$ measured after a spinning protocol of variable intensity was higher than postexercise $\dot{V}O_2$ from a constant intensity protocol.

The authors suggested that this increase could play a role in mediating post exercise energy expenditure.[9] The main motivation for many sedentary, often overweight or obese people who begin a fitness physical activity program is weight control rather than the improvement in their cardiovascular fitness.[4, 7, 10]

The aim of the present study was to evaluate the effects of a specific IC protocol (ICP) on several anthropometric (body weight, lean mass, fat mass and circumferences) and cardio-respiratory (oxygen uptake and HR) parameters in sedentary overweight women.

Materials and methods

Study design

We formulated a universal and easily learned indoor cycling protocol following the guidelines of the Schwinn® Fitness Academy. Our protocol was mainly aerobic and characterized by a progressive increase in the exercise intensity varying the resistance applied to the bikes' flywheels. IC positions, music beats/min and leg revolution/min remained unchanged for each music track for the whole of the training protocols. These variables were selected according to the anthropometric features and the cardio-respiratory fitness of the participants. For the study only young overweight sedentary women were selected, because this population is the most inclined to attend the fitness area of IC. Our study utilized a pre- post-design in which the subjects were used as their own controls. Indeed, our purpose was to analyze the effects of our IC protocol on body composition and cardio-respiratory fitness (CRF) in overweight women before and after the training period.

Subjects

In order to select the participants, 76 young females filled in anamnesis and cardio-respiratory fitness (CRF) schedules.[11] Fourteen young healthy sedentary overweight women (22.6±2.1 years; 25-29.9 Body Mass Index), who had not performed any physical activity in the past, were recruited for the experimentation. With the aid of medical questionnaires and a specific software (WinFood$_{2.0}$, Medimatica s.r.l., Colonnella, Teramo, Italy) the theoretic 1560±170 Kcal daily food intake was calculated. During the study, participants followed a Mediterranean diet including breakfast, lunch, snack and dinner without any specific limit on food consumption. All the subjects gave their informed consent prior to participation in this study, which was approved by the local institutional Ethics Committee. The data including body composition, resting heart rate and resting systolic and diastolic arterial pressure were acquired before the beginning of the study and after 12, 24 and 36 sessions of ICP. Basal metabolic rate, fat and lean mass percentage were evaluated by multi-frequency bioimpedance analysis (InBody$_{320}$, Biospace, Beverly Hills, Los Angeles, CA, USA) between 7.00 am and 09.40 am. Arm, chest, abdomen, thigh and leg circumferences were measured according to the anthropometric standardization reference manual by Lohman *et al*.[12] Resting HR and arterial pressure were recorded between 9.00 am and 10.20 am by a digital blood pressure machine (Mx3 plus, Omron, Germany). The studies were performed during the post-menstrual period (6-11 days after the end of the menstrual cycle). During the first and tenth weeks, training HR (HR_{tr}), $\dot{V}O_2$ ($\dot{V}O_{2tr}$) and power output ($Watt_{tr}$) were recorded by HR monitors (S810i, Polar, Oulu, Finland), ergospirometer system (K4 b², Cosmed srl, Rome, Italy) and U5x upright cycle stationary bike (Matrix, Cottage Grove, OR, USA), respectively. For this evaluation we substituted one IC Schwinn bike with one U5x upright bike to measure the $Watt_{tr}$ parameter.

Procedures

The participants were trained for 12 weeks in a specific ICP that followed the guidelines of the Schwinn®

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TABLE I.—*Indoor cycling protocol*

Positions	Time	Bpm	Rpm
Warm up			
Seated flat	3’00”	95	95
Seated flat	3’28”	100	100
Seated flat	2’12”	102	102
Standing flat	30”	102	102
Seated flat	2’	102	102
Standing flat	30”	102	102
Seated flat	1’39”	100	100
Standing flat	20”	100	100
Seated flat	30”	100	100
Standing flat	20”	100	100
Seated flat	30”	100	100
Standing flat	20”	100	100
Training period			
Seated flat	1’08”	100	100
Rolling terrain	10”	100	100
Seated flat	10”	100	100
Rolling terrain	10”	100	100
Seated flat	10”	100	100
Rolling terrain	10”	100	100
Seated flat	1’10”	100	100
Seated climb	2’43”	128	64
Combo hill	1’	128	64
Seated climb	2’	128	64
Standing climb	1’	128	64
Seated climb	3’17”	130	65
Combo hill	1’	130	65
Combo hill (Increasing pyramid)	2’	130	65
Standing climb	1’30”	130	65
Seated climb	30”	130	65
Seated flat	5’43”	92	92
Seated flat	1’12”	100	100
Standing flat	15”	100	100
Seated flat	30”	100	100
Standing flat	15”	100	100
Seated flat	1’30”	100	100
Cool down			
Seated flat	1’54”	95	95
Standing flat	5”	95	95
Seated flat	25”	95	95
Standing flat	5”	95	95
Seated flat	25”	95	95
Seated flat	2’47”	92	92
Stretching on the floor	6’		

Bpm: music beats per minute; Rpm: revolutions per minute.

Cycling Official Program. The training period consisted of three sessions/week carried out from 7.00 to 8.00 pm in the fitness room at the University Campus of Palermo (CUS Palermo). Each session has lasted for 53’ 3’. The protocol was performed on stationary bikes (Spin Bike ICX Elite, Schwinn®, Givisiez, Switzerland). Position, length, music rhythm cadence (Bpm) and revolution per minute (Rpm) are shown in Table I. The hand positions adopted in the ICP were “narrow” or “position one”, “wide” or “position two”, and “standing” or “position three”. An incremental test created by Mac Dougall *et al.*[13] was used to measure $\dot{V}O_{2max}$, HR_{max} and $Watt_{max}$ at the beginning of the experimentation and after 36 ICP sessions. In particular, the initial power output was 25 Watts with an increase of 25 Watts every minute (Table II). This test was performed by all the subjects in the fitness room at the University Campus between 4 pm and 9.30 pm using U5x upright cycle stationary bike. The U5x bike was specifically chosen to collect data on Watts.

TABLE II.—*Initial power output.*

Minutes	Watts	R p m
0-1	25	60-70
1-2	50	60-70
2-3	75	60-70
3-4	100	60-70
4-5	125	60-70
5-6	150	60-70
6-7	175	60-70
7-8	200	60-70
8-9	225	60-70
9-10	250	60-70

Modified MacDougall’s test.

Statistical analysis

Data are expressed as means±SD. Repeated analysis of variance (ANOVA) with Bonferroni’s multiple comparison and linear trend test among the continuous variables and single values were performed by Statistica 8.0 Software (Tulsa, OK, USA). Intraclass correlation coefficients (ICCs) were calculated by Statistica 8.0, before experimentation and after 12, 24 and 36 IC-sessions for the following measurements: body weight, fat and lean mass, BMR, circumferences of calf, thigh, abdominal, chest and arm, resting HR, diastolic and systolic AP. Values were considered significantly different at $P<0.05$.

Results

Analysis of body composition and circumferences

ICCs showed a high internal consistency of the baseline and post-IC session measurements. ICCs for the measurements obtained before experimentation ranged

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TABLE III.—*Evaluation of BMR, body weight, composition and circumferences in response to ICP.*

	Before Experimentation		After 12 IC-sessions		After 24 IC-sessions		After 36 IC-sessions		P-value 0-36	Linear trend 0-36
Subjects (N.=14)	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Body weight (kg)	70.8	8.8	69.9	9.3	69.0*	9.2	68.6	9.2	0.0001	0.0001
Fat mass (%)	34.9	5.5	34.2	5.4	33.4*	5.2	33.2	5.3	0.0001	0.0001
Lean mass (%)	65.1	5.5	65.8	5.4	66.6*	5.2	66.8	5.3	0.0001	0.0001
BMR (kcal/day^{-1})	1434	102	1461	94	1457	96	1495	92	0.230	0.235
Calf circumference (cm)	36.9	1.5	36.2	1.7	36.0*	1.4	35.9	1.4	0.0001	0.0001
Thigh circumference (cm)	61.8	4.4	61.4	4.0	61.1*	3.9	61.0	3.9	0.0130	0.0016
Abdominal circumference (cm)	82.1	7.8	81.2	7.6	80.7*	7.7	80.4	7.4	0.0001	0.0001
Chest circumference (cm)	96.6	7.0	95.6	7.2	94.9*	7.1	94.4	7.2	0.0001	0.0001
Arm circumference (cm)	28.6	2.5	26.9	2.4	26.5*	2.3	26.4	2.2	0.0001	0.0001

*(P<0.05) before the experimentation vs. after 24 IC-sessions.

TABLE IV.—*Assessment of resting HR and resting arterial pressure in response to ICP.*

	Before Experimentation		After 12 IC-sessions		After 24 IC-sessions		After 36 IC-sessions		P-value	Linear trend
Subjects (N.=14)	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Resting HR [beats × min-1]	70.2	10.1	68.1	7.0	65.6*	5.1	63.9	3.9	0.001	0.0001
Systolic AP [mmHg]	125.5	11.2	123.6	11.4	124.0	7.2	121.4	8.0	0.531	0.184
Diastolic AP [mmHg]	73.7	5.7	71.4	4.0	73.6	3.5	72.6	5.8	0.560	0.849

*(P<0.05) before the experimentation vs. after 24 IC-sessions.

from 0.96 (body weight, fat mass, lean mass and BMR) to 0.99 (calf, thigh, abdominal, chest and arm circumferences). For post IC sessions data, ICCs ranged between the following values: body weight, fat mass, lean mass, BMR, 0.95 to 0.98; calf, thigh, abdominal, chest and arm circumferences, 0.98 to 0.99. No significant differences were found between the IC-sessions. The initial body weight (70.8±8.8 kg) showed a reduction of 2.6% and 3.2% respectively after 24 and 36 indoor cycling sessions (ICS). Moreover, we observed a significant decrease of 4.3% and 5% in fat mass respectively after 24 and 36 ICS (P<0.05). In contrast, lean mass significantly increased by 2.3% and 2.6% respectively after 24 and 36 ICS. All circumference measurements significantly diminished in response to ICP. In particular, calf circumference decreased by 2.4% and 2.8% after 24 and 36 ICS, respectively. We observed a reduction of 1% and 1.3% in thigh circumference respectively after 24 and 36 ICS. Abdominal circumference decreased by 1.7% and 2.1% respectively after 24 and 36 ICS. Chest circumference decreased by 1.8% and 2.3% respectively after 24 and 36 ICS. Finally, arm circumference decreased by 7.3% and 7.7% respectively after 24 and 36 ICS. During the experimentation, these parameters showed a significant linear trend. In addition, the basal metabolism rate did not undergo any significant modification in response to the training protocol (1 434±102 *vs*. 1495±92 Kcal Day^{-1}). These data are shown in Table III.

Physiological parameters

ICCs showed a remarkable internal consistency at baseline and post-IC sessions. ICCs for the measurements of diastolic and systolic AP and resting HR ranged from 0.96 to 0.98 both before experimentation and after the IC-sessions, without any significant difference between sessions. Resting HR decreased by 6.5% and 9% respectively after 24 and 36 ICS. However, we did not observe any significant difference in the systolic or diastolic pressure after 36 ICS as we expected. These data are shown in Table IV. In our study, the aerobic performance was quantified by

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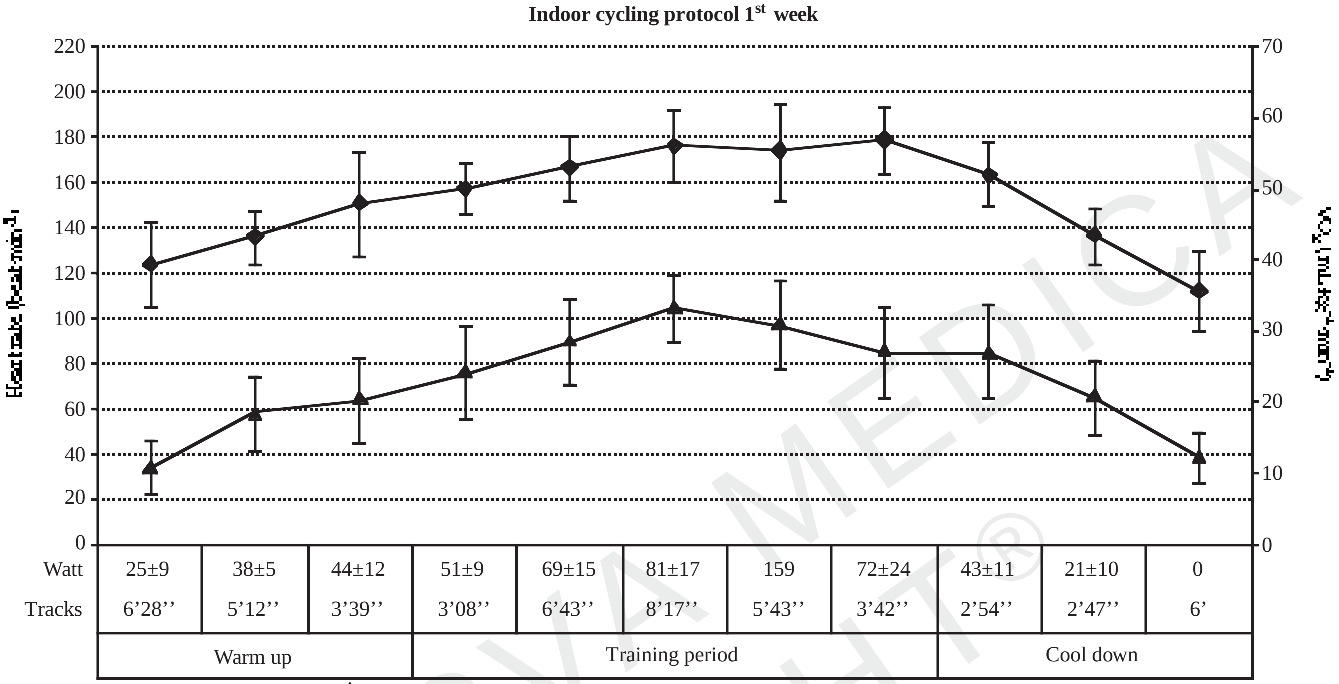

Figure 1.—Representation of HR and $\dot{V}O_2$ values measured during the first week of ICP. The values are indicated as means ± standard deviations. The X-axis shows power output (Watt), music tracks and session phases. The left Y-axis and the right Y-axis illustrate (◆) heart rate and (▲) oxygen uptake, respectively.

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$\dot{V}O_{2max}$ measured during the incremental test performed before and after the training protocol. We found a significant (P=0.0001) increase in $\dot{V}O_{2max}$ (37.1±4.3 *vs.* 40.2±4.6 mL·kg^{-1}·min^{-1}) after 36 ICS. This improvement was associated with a significant reduction in HR_{max} (189.9±4.3 *vs.* 185.7±6.5 beats·min^{-1}; P=0.0106) and increase in $Watt_{max}$ (213.0±24.7 *vs.* 238.0±25.7 Watt; P=0.0001). The training heart rate (HR_{tr}), training oxygen uptake ($\dot{V}O_{2tr}$) and power output (Watt) were recorded during the first and the tenth weeks of training in three of the fourteen subjects. These data are illustrated in Figures 1, 2. As expected, the profile of $\dot{V}O_{2tr}$, HR_{tr} and Watt was the same because all these parameters were modified according to the phases of the training session (warm up, training period and cool down), selected technique, hand position and music tracks. The profiles of HR_{tr}, $\dot{V}O_{2tr}$ and Watts in the tenth week were similar to the first week. However, a reduction of 11 beats·min^{-1} in the average HR_{tr} (152.6±23.1 beats·min^{-1}), an increase of 0.5 mL·kg^{-1}·min^{-1} in the average $\dot{V}O_{2tr}$ (23.4±7.3 mL·kg^{-1}·min^{-1}) and an increase of 8.6 Watts in the average power output (51±20.5 Watt) were observed in the tenth week of ICP.

Discussion

The purpose of our study was to evaluate whether indoor cycling (Spinning®) is a fitness activity suitable for losing weight and improving the CRF of young sedentary overweight women. There are conflicting opinions in current studies about the energetic systems mainly involved in this activity.[1-6] This confusion is due to the fact that IC is an extremely versatile fitness activity [4, 6] and its intensity depends on various variables (positions, time, bpm and rpm). Therefore, the first step of our work was to formulate a specific ICP that considered the anthropometric features, the CRF of the subjects and followed the American College of Sport Medicine (ACSM) guidelines. Since the beginning, the indoor cyclists followed the guidelines of the Madd Dogs Athletics Incorporation® and Schwinn® Cycling to program their training sessions. In particular, they followed guidelines regarding the target heart rate to be achieved during the different steps of a training session (warm up, training period and cool down) in accordance with the ACSM guidelines.[14] However, at present, only incomplete and mostly non-

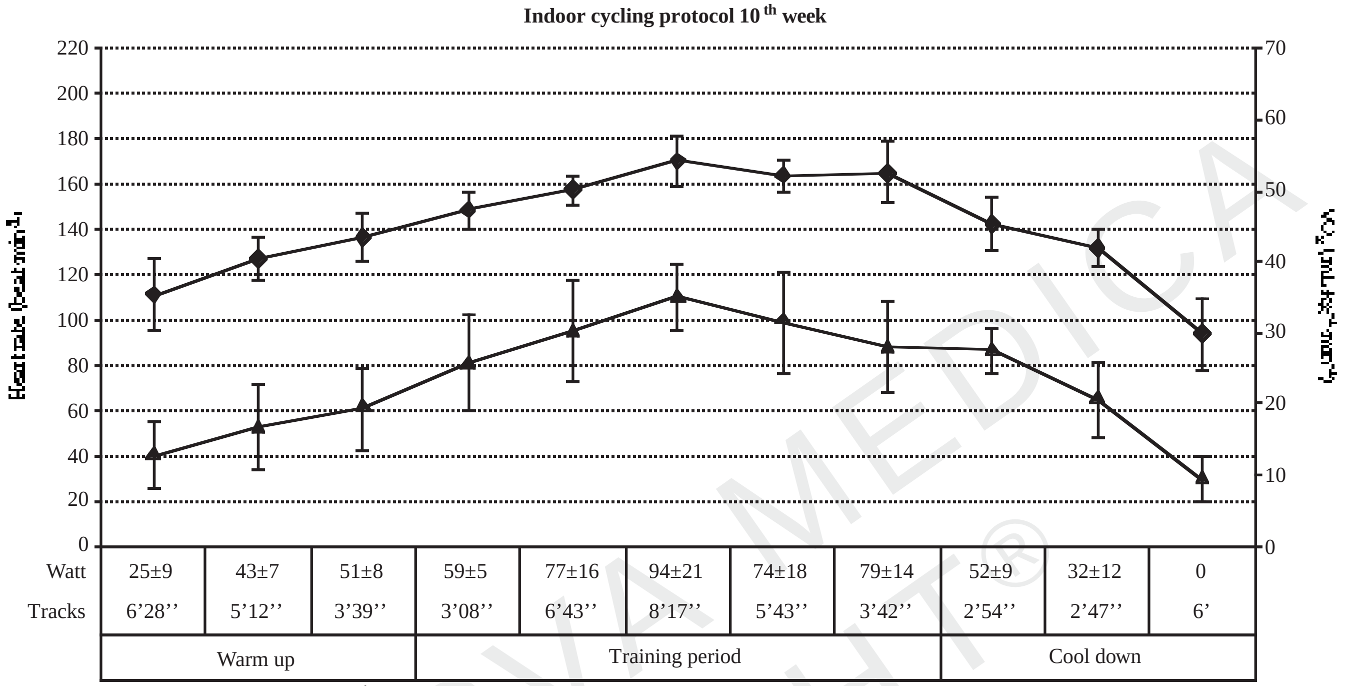

Figure 2.—Representation of HR and $\dot{V}O_2$ values measured during the tenth week of ICP. The values are indicated as means ± standard deviations. The X-axis shows power output (Watt), music tracks and session phases. The left Y-axis and the right Y-axis illustrate (◆) heart rate and (▲) oxygen uptake, respectively.

scientific studies aimed at assessing the impact of IC (Spinning®) on metabolic and cardiovascular functions exist.[4-6] Spinning® has been suggested as a physical activity program for losing weight;[4-6, 15] however, these studies have never been published in peer-reviewed scientific journals. In our study, the significant decrease in body weight without any dietary restriction suggests that our training protocol is efficient for weight loss in young sedentary overweight women. It is known that regular exercise can markedly reduce body weight and fat mass without dietary caloric restriction in overweight individuals.[7, 16] An increase in total energy expenditure appears to be the most important determinant of successful exercise induced weight loss.[7, 17] In addition, we found a significant variation in fat and lean mass in specific body regions as shown by bioimpedence and circumference values indicating that ICP affects both upper and lower body composition. In agreement with HR and $\dot{V}O_2$ values recorded during training sessions and ACSM,[14] ICP can be defined as an aerobic activity at mid-high intensity with brief phases during training periods (1-3 min) of anaerobic activity. Caria *et al*.[1] (2007) evaluated mean power output, HR and $\dot{V}O_2$ during spinning sessions in spinning instructors of both sexes. The authors concluded that the intensity of spinning sessions, ranging from moderate-to-heavy to very heavy, induced a high impact on cardiovascular functions they suggested that spinning was not suitable for unfit or sedentary individuals, especially the middle aged or the elderly. Previously, the same conclusions on spinning activity were also elaborated by Francis *et al*.[3] (1999). In a study by Battista *et al*.[2] (2008), although the average intensity during simulated indoor cycling classes was moderate, frequently there were exercise bouts with values of $\dot{V}O_2$ exceeding $\dot{V}O_{2max}$ and intensity greater than ventilator threshold. López-MiÀarro and Rodrìguez (2009) concluded that IC must be considered a high-intensity exercise mode for novice subjects of both sexes.[17] Unlike these studies, our ICP was formulated for young sedentary overweight women and the training intensity resulted as significantly lower as shown by HR_{tr} and $\dot{V}O_{2tr}$ values compared to the intensity of spinning sessions in Caria *et al*. (2007), Battista *et al*. (2008) and López-MiÀarro and Rodrìguez (2009) studies. Consequently, our pro-

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tocol determined a lower cardiovascular engagement than training sessions in previous studies.[1, 2] In agreement with Caria *et al.*, we found that the intensity of IC activity is strongly associated with changes in position, music rhythm cadence and revolution per minute as shown by HR_{tr} and $\dot{V}O_{2tr}$ profiles. Therefore, the indoor cycling trainers can select the intensity of a training session depending on the fitness level of the participants. In this way, it is the instructor who decides and monitors the workload of the IC session and it is not the IC activity which has a high impact on the cardiovascular system. In addition, while Francis *et al.*[3], Kang *et al.*[9], Caria *et al.*[1] and Battista *et al.*[2], measured metabolic and cardiovascular effects in the laboratory, our protocol to our knowledge was, for the first time, carried out in the fitness room duplicating a typical indoor cycling class. In addition, ICP induced an increase in the aerobic metabolism and improvement in muscle functions as shown by the increase in $\dot{V}O_{2tr}$ and Watts. The intensity of the ICP training period was variable like the variable intensity trial proposed by Kang *et al*. who suggested that the more frequently the exercise intensity fluctuates, the greater is the disturbance to homeostasis and therefore the greater the postexercise energy expenditure.[9] It is known that regular and prolonged aerobic training induces specific adaptations to the cardiovascular system.[14, 18, 19] In our study, the significant decrease in resting HR after 24 ICP sessions indicates the presence of heart adaptations. This data associated with the results of the incremental test suggests that our protocol induces an improvement in the CRF and, therefore, might be used to prevent cardiovascular diseases.[20, 21] In addition, it is important to underline that the profiles of HR and $\dot{V}O_2$ recorded in the first and tenth weeks are similar suggesting the applicability of this method to young sedentary overweight women in this age category.

Conclusions

In conclusion, according to the present study an IC lesson can be adapted to almost all fitness levels because each performance depends on the individual physical fitness, the specific training, subject's motivation and interpretation of the session. The performance of our ICP was easy to learn and allowed to improve physical health. Our ICP can be performed by both sedentary and lightly trained people who have low levels of CRF and want to lose body weight without any restriction on food consumption. Moreover, it is essential to have scientific references which can be applied in the fitness field and we sustain the importance of formulating specific ICPs.

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