The Effects of Nonsupervised Exercise Program, Via Internet, on Blood Pressure and Body Composition in Normotensive and Pré-Hipertensive Individuals

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Objective

To verify the effects of a six-month non-supervised phy-sical training program followed via the Internet on blood pressure and body composition in normotensive and borderline hypertensive individuals.

Methods

One hundred and thirty five individuals were divided into two groups: 1) normotensive individual (n = 57), 43 ± 1 years of age, systolic blood pressure (SBP) < 120 and diastolic blood pressure (DBP) < 80 mmHg (GI); and 2) borderline hypertensive individual (n = 78), 46 ± 1 years of age, SBP 120 to 139 and DBP 80 to 89 mmHg (GII).

Results

After a three and six-month physical training, GII individuals showed a significant reduction in SBP (-3.6 ± 0.94 and -10 ± 0.94 mmHg, $p < 0.05$, respectively) and PAD (-6.5 ± 1 and -7.1 ± 0.9 mmHg, $p < 0.05$, respectively), body weight (-1.12 ± 0.26 and -1.25 ± 0.31 kg, $p < 0.05$, respectively), BMI (-0.79 ± 0.4 and -0.84 ± 0.41 kg/m^2, $p < 0.05$, respectively) and waist circumference (-1.12 ± 0.53 and -1.84 ± 0.56 cm, $p < 0.05$, respectively). In the GI group, the physical training led to a decrease in waist circumference at the sixth month (-1.6 ± 0.63 cm, $p < 0.05$).

Conclusion

A non-supervised physical training program followed remotely via the Internet decreases blood pressure, body weight, BMI, and waist circumference in borderline hypertensive individuals, and is therefore a safe and low-cost strategy in the prevention of cardiovascular diseases and improvement of health status of the population.

Keywords

Non-supervised physical training, blood pressure, body composition.

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The number of overweight and obese persons has reached alarming levels in many industrialized countries. Brazil is unfortunately included in this excess weight syndrome. The results of the last census[1] show that 40% of the Brazilians are above the weight considered adequate. The point of concern of this statistical datum is the relation between obesity and certain diseases, especially those related to the cardiovascular system[2,3]. The occurrence of complications does not depend only on excess weight, but also on fat distribution. When fat is located in the waist area or around the viscera, an increase in the incidence of metabolic disorders associated with cardiovascular diseases, such as dyslipidemia and glucose intolerance, occurs. These disorders, in association with high blood pressure, characterize the metabolic syndrome[4-6].

Results of recent statistical studies show that, depending on the Brazilian region, 22% to 44% of the adult urban population has high blood pressure[7]. These figures become extremely important as high blood pressure is directly related to cerebrovascular events, coronary artery disease and mortality[8,9]. Also, the risk of these events is known to increase progressively with the increase in high blood pressure levels[10].

Evidences accumulated in the past few years show that non-pharmacological management should be the initial strategy to treat overweight individuals with mild to moderate hypertension[11-13]. In this sense, a low-calorie diet and exercises play a prominent role[14]. Results of recent studies show that regular exercise reduces total body fat mass, visceral and subcutaneous abdominal fat[15,16], and improves insulin resistance[17-19]. In addition, a single exercise session is known to decrease blood pressure in hypertensive individuals[20] and this hypotensive effect may continue with the repetition of exercise sessions throughout time[21-23]. However, these beneficial effects of exercises are restricted to supervised physical training programs or cardiovascular rehabilitation programs in patients already affected by cardiac events[24,25]. Therefore, the impact of a non-supervised physical training program on overweight and blood pressure is little known.

In the present study, we describe the effects of a non-supervised physical training program customized and followed remotely via the Internet on body composition and blood pressure in normotensive and borderline hypertensive individuals.

Our hypothesis was that a non-supervised physical training program customized and followed remotely via the Internet for up to six months would lead to a decrease in body weight, waist circumference and blood pressure in normotensive and borderline hypertensive individuals.

Methods

One hundred and thirty five subjects were selected from a total of 6,001 subjects enrolled in the Physical Training in the Park Program (Confipa), that has been developed in Ibirapuera Park for six years and in Carmo Park for three years, both located in the city of Sao Paulo, Brazil. The subjects met all the inclusion criteria established in the study: A) both genders; B) age range 18 to 74 years; C) body mass index (BMI) < 30 kg/m^2; D) absence of previous cardiovascular disease; E) non-use of medications, especially those related to blood pressure and body weight control; and F) compliance equal to or higher than ten monthly data entries on the performance of exercises in the personal chart of the Program computerized system for at least six consecutive months.

Fifty seven out of these 135 subjects were normotensive, with a systolic blood pressure < 120 mmHg and diastolic blood pressure < 80 mmHg; 78 were borderline hypertensive with a systolic blood pressure between 120 and 139 mmHg, and diastolic blood pressure between 80 and 89 mmHg, according to the high blood pressure classification of the Seventh Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure – JNC, 2003[26]. Table 1 shows physical characteristics, risk factors for coronary artery disease and hemodynamic parameters of the subjects involved in the study. The study was approved by the *Instituto do Coração* Research Ethics Committee (InCor – approval SDC 2493/04/113) and by the *Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo* Research Ethics Committee (number 719/04).

Measures and procedures

Non-supervised physical training program - The Physical Training in the Park Program developed by the Cardiovascular Rehabilitation and Exercise Physiology

Table 1 – Physical characteristics, risk factors and hemodynamic parameters

	Normotensive (n = 57)	Borderline hipertensive (n = 78)
Physical Characteristics		
Male gender (n)	16	34
Female gender (n)	41	44
Age (years)	43 ± 1	45 ± 2
Weight (kg)	64 ± 1.5	68 ± 1
BMI (kg/m^2)	24.5 ± 0.5	25 ± 0.5
Risk factors		
Number of factors	1 ± 0.13	1 ± 0.10
Sedentary lifestyle (%)	44	33
Stress (%)	30	19
Diabetes (%)	5.3	5.1
Cholesterol (%)	23	26
Smoking (%)	18	13
Hemodynamic parameters		
SBP (mmHg)	107 ± 1	120 ± 1
DBP (mmHg)	69 ± 1	80 ± 1

Values are mean ± SE. BMI- body mass index; SBP- systolic blood pressure; DBP- diastolic blood pressure

Unit of *Instituto do Coração* (InCor) HCFM-USP in Ibirapuera Park and Carmo Park located in the city of Sao Paulo in partnership with Sao Paulo City Administration, with the participation of the Sports Office, Health Office, Government Office and Environment Office, and the Data Processing Company of the City of Sao Paulo (PRODAM), started as of June, 1998, consists of non-supervised exercise sessions followed remotely via the Internet.

To be admitted in the Program individuals must fill out a questionnaire they receive in one of these Parks, with the objective of learning about the users' health status and collecting data to evaluate whether they are able to practice non-supervised exercises. Next, individuals are referred to watch a small lecture on risk factors for cardiovascular diseases, the benefits of exercises on these factors, and eating habits, whose objective is to make them aware of the importance of the regular practice of exercises and of a good health status.

The following phase consists of a brief interview with a physical education teacher to define their physical ability, which is based on their health status, symptoms and risk factors for coronary artery diseases, and age. Based on these data, individuals are classified in one of the three levels of cardiovascular risk (low, moderate or high), according to the guidelines of the American College of Sports Medicine 2000[27]. According to this classification, a decision is made on whether to refer the individual to a medical/clinical examination or to a medical/cardiologic examination, including exercise test, and even the indication of a supervised exercise.

Once the individual does not present any factor restricting his non-supervised exercise practice, the exercise programming is performed. The type and duration of the exercise are suggested according to the user's health status, age, physical ability, muscle-skeletal conditions, preexisting risk factor(s) for coronary artery disease and availability to practice the exercises. The intensity, in turn, is programmed in accordance with the physical ability estimated or obtained with the exercise test, when available, and the cardiovascular risk.

This procedure leads to a wide range of exercise intensity programming (40% to 70% of heart rate reserve). From then on, a computerized chart of exercise prescription is made available to users via the Internet. By means of this computerized chart, users are able to contact the teachers frequently, providing them with information on their well-being and on some physiological parameters, such as their heart rate during the exercise session.

In the present study, a compliance equal to or higher than ten monthly data entries on the practice of exercises in the personal chart of the Program's computerized system for at least six consecutive months was considered to include subjects in the sample. Finally, subjects are asked to attend a monthly follow-up appointment to update the exercise program. At this moment, blood pressure, body weight and waist circumference measurement are evaluated.

Evaluation of blood pressure - In the Physical Training in the Park Program, blood pressure readings are performed in accordance with recommendations for the diagnosis of hypertension of the Seventh Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure – JNC, 2003[26]. Blood pressure is measured twice on the same day, at least at two-minute intervals between each reading. When the difference between the two diastolic blood pressure readings is higher than 5 mmHg, further readings are taken on a different day(s), until the difference is lower than this value. The first reading is always taken after ten minutes of rest in the sitting position. Blood pressure is measured using the auscultation method, with a mercury column sphygmomanometer (K Takaoka, 207). Korotkoff sounds phase I and V are adopted to identify systolic and diastolic blood pressure, respectively. These readings are taken in the morning, between 7 and 11 o'clock prior to the practice of exercises that same day. On colder days blood pressure readings are not taken. In this case, subjects are told to come back some other day. A monthly blood pressure evaluation is requested (whenever the exercise program is updated).

In the present study the mean value of the two blood pressure readings was considered. Blood pressure levels were used to classify individuals as normotensive or borderline hypertensive. To verify the effects of exercises, blood pressure readings taken in the third and sixth months of follow-up in the program were considered.

Body weight and body mass index measurements - In the Physical Training in the Park Program body weight (kg) and height (m) are evaluated using a precision scale (Filizola®), with individuals in sports outfits. With these measurements, BMI is calculated as weight divided by height squared [BMI = weight (kg)/ height^2(m)]. In the present study, measurements taken in the third and sixth months of follow-up in the program were considered. These measurements and blood pressure readings were taken on the same day.

Waist circumference measurement - In the Physical Training in the Park Program, waist circumference (cm) is measured with a tape measure placed at the navel level. Measurements taken in the third and sixth months of follow-up in the program were used in the present study.

Statistical analysis

Results are shown as mean ± SE. The one way analysis of variance was used to detect possible differences between the means. When a significant difference was found results were analyzed using Newman-Keuls comparisons. The relation between variables was analyzed with Pearson´s correlation coefficient. The minimum significance level adopted was $p < 0.05$.

Results

Effects of the non-supervised program on body composition

Table 2 shows the results of body weight, BMI and waist circumference in the beginning and three and six months after non-supervised physical training followed remotely via the Internet in the normotensive and borderline hypertensive groups.

In the borderline hypertensive group the program caused a significant decrease in body weight after a three-month intervention ($p = 0.000002$). This reduction in body weight was maintained up to the sixth month of intervention (Fig. 1). Similar results were observed for BMI. The physical training program caused a significant decrease in BMI at the third month of program ($p = 0.021$). This reduction was maintained up to the sixth month of intervention (Fig. 2). In relation to waist circumference, the training program caused a significant decrease in this parameter at the third and sixth months (Fig. 3, $p = 0.0022$).

In the normotensive group the physical training program did not affect either body weight ($p = 0.1205$) or BMI ($p = 0.754$). However, waist circumference was significantly reduced at the sixth month of program (Fig. 3, $p = 0.0087$).

Additional analyses (Table 3) showed that in the borderline hypertensive group the alterations observed in weight, BMI and waist circumference measurement were independent of age and number of entries in the personal chart controlled via the Internet. However, these alterations were dependent on weight, BMI and waist circumference values at the beginning of the program. In addition, the alteration observed in weight was correlated with the alteration in BMI and in waist circumference.

Effects of the non-supervised program on blood pressure

Table 2 shows systolic and diastolic blood pressure readings at the beginning and three and six months after non-supervised physical training followed remotely via the Internet in the normotensive and borderline hypertensive groups. In the group of borderline hypertensive individuals the physical training program caused a significant and progressive reduction in systolic and diastolic blood pressures (Fig.4, $p = 0.0001$ e $p = 0.0001$, respectively) throughout six months of program. However, in the normotensive group, the physical training program did not change systolic and diastolic pressures ($p = 0.3826$ and $p = 0.5623$, respectively).

Additional analyses (Table 3) showed that the decrease in systolic blood pressure observed in the borderline hypertensive group is independent of age, weight, BMI, waist circumference, number of entries in the Internet, and percentage change in weight, BMI and waist circumference. However, the decrease in systolic blood pressure was dependent of its initial level. The decrease in diastolic blood pressure was also independent of age, weight, BMI, waist circumference, number of entries in the Internet, and percentage in weight, BMI and waist circumference, but it was dependent of the initial diastolic blood pressure.

Discussion

Effects on body composition

The reduction in weight and BMI in borderline hypertensive individuals after a non-supervised physical training program followed remotely has at least two

Table 2 – Body weight, body mass index, waist circumference, and systolic and diastolic blood pressure at the beginning and after a three and six-month non-supervised physical training program followed remotely in normotensive and borderline hypertensive individuals

		Beginning	3 Months	6 Months
Weight (kg)	N	64 ± 2	64 ± 2	64 ± 2
	BH	68 ± 0.5	67 ± 1*	67 ± 1*#
BMI (kg/m²)	N	24 ± 0.5	24 ± 0.5	24 ± 1
	BH	25 ± 0.5	24 ± 0.5*	24 ± 0.5*
Waist (cm)	N	84 ± 2	83 ± 2	82 ± 2*
	BH	86 ± 1	84 ± 1*	84 ± 1*
SBP (mmHg)	N	106 ± 1	106 ± 1	105 ± 1
	BH	120 ± 1	114 ± 1*	110 ± 1*#
DBP (mmHg)	N	69 ± 1	70 ± 1	69 ± 1
	BH	80 ± 1	76 ± 1*	73 ± 1*#

*Values are mean ± SE. N- normotensive; BH- borderline hypertensive; BMI- body mass index; SBP- systolic blood pressure; DBP- diastolic blood pressure. * = Significant difference in relation to the beginning of the program (p < 0.05); # = Significant difference in relation to the third month (p < 0.05)*

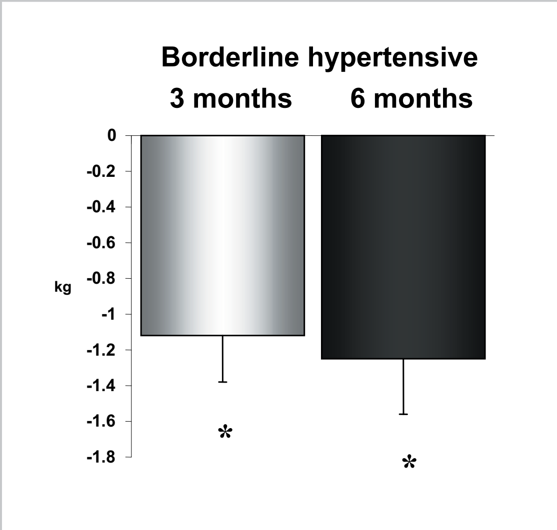

*Fig.1 – Absolute change in body weight at the third and sixth months of a non-supervised physical training program followed remotely via the Internet in borderline hypertensive individuals. Values are mean± SE. * = Significant difference in relation to the beginning of the program (p < 0.05)*

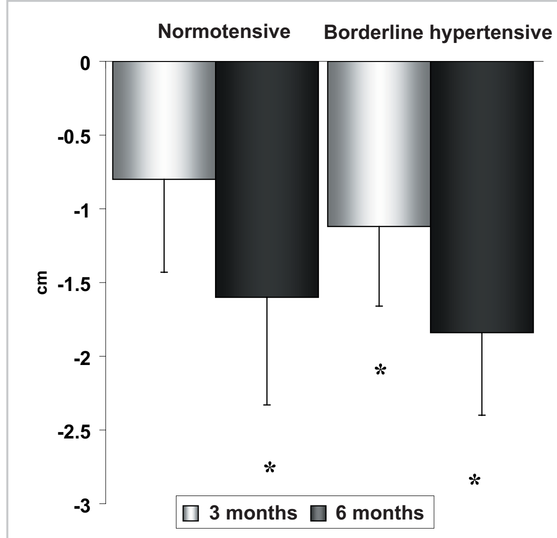

*Fig.3 – Absolute change in waist circumference at the third and sixth months of a non-supervised physical training program followed remotely via the Internet in borderline hypertensive individuals. Values are mean± SE. * = Significant difference in relation to the beginning of the program (p < 0.05)*

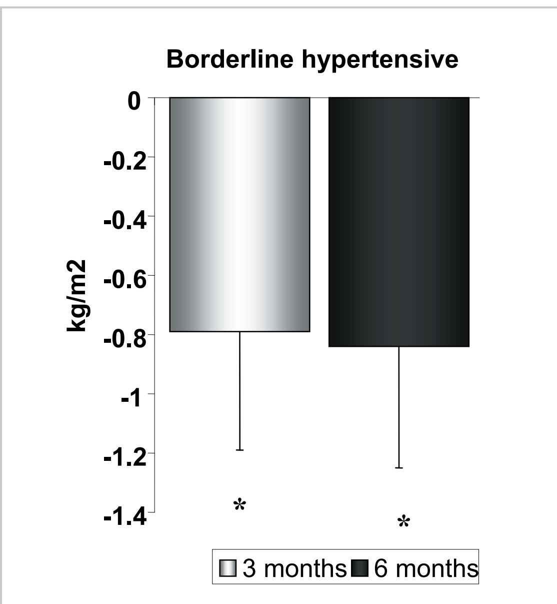

*Fig.2 – Absolute change in body mass index at the third and sixth months of a non-supervised physical training program followed remotely via the Internet in borderline hypertensive individuals. Values are mean± SE. * = Significant difference in relation to the beginning of the program (p < 0.05)*

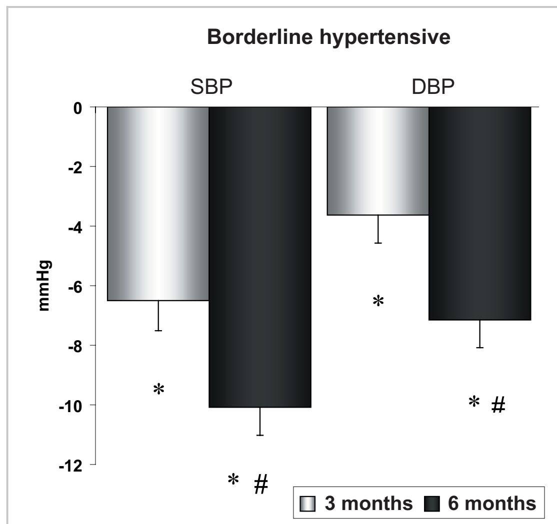

*Fig. 4 – Absolute change in systolic and diastolic blood pressures at the third and sixth months of a non-supervised physical training program followed remotely via the Internet in borderline hypertensive individuals. Note that the decrease in systolic and diastolic blood pressures at the sixth month is more prominent than that of the third month. Values are mean± SE. SBP = systolic blood pressure; DBP = diastolic blood pressure. * = Significant difference in relation to the beginning of the program (p < 0.05); # = Significant difference in relation to the third month (p < 0.05)*

important clinical implications. First, excess weight and obesity are associated with a series of risk factors for diseases especially those related to the cardiovascular system[2,3]. Second, mortality increases progressively with increases in BMI[28]. For instance, death risk is 1.3 times higher among women with BMI between 25 and 26.9 kg/m^2, when compared to that of women with BMI < 25kg/m^2.

Another result of major interest in the present study is the reduction in waist circumference after a non-supervised physical training program followed remotely in normotensive and borderline hypertensive individuals. Exceess fat in the abdominal and visceral regions is strongly related to a higher incidence of hypertriglyceridemia, hyperinsulinemia at rest, and HDL-cholesterol and apolipoprotein B reduction[29]. In addition, a 10% increase in waist circumference measurement causes a considerable increase in the number of patients affected by coronary artery diseases and even in mortality rate[30]. Therefore, our results suggest that a

Table 3 – Correlation and significance probabilities (p) between percentual changes of systolic and diastolic blood pressures, body weight, body mass index and waist circumference resulting from a non-supervised physical training followed remotely via the Internet, and sex, age, body mass index, waist circumference and number of monthly data entries via the Internet in borderline hypertensive individuals

Independent Variables	Dependent variables				
	% Delta SBP	% Delta DBP	%Delta Weight	% Delta BMI	%Delta Waist
Age	-0.057	-0.171	0.068	0.077	-0.078
Weight	0.051	-0.008	0.0257*	-0.267*	-0.177*
BMI	-0.045	-0.151	-0.324*	-0.372*	-0.280*
Waist Circ.	0.050	-0.131	-0.328*	-0.354*	-0.401*
SBP	-0.291*	0.112	0.056	0.000	-0.055
DBP	0.016	0.457*	-0.086	-0.051	-0.011
# Internet	0.005	0.208	0.078	0.090	0.022
%Delta weight	0.106	0.225	1	0.946*	0.519*
%Delta BMI	0.140	0.187	0.946*	1	0.521*
%Delta Waist	0.189	0.145	0.519*	0.521*	1
Delta % SBP	1	0.348*	0.106	0.140	0.189
Delta % DBP	0.348*	1	0.225	0.187	0.145

*BMI- Body mass index; SBP- systolic blood pressure; DBP- diastolic blood pressure; # Internet = number of individual data entered in the Internet; Waist Circ. = waist circumference. * = significant correlation, ($p < 0.05$)*

non-supervised physical training followed remotely via the Internet is a relevant strategy for the improvement of health conditions and prevention of diseases.

Effects on blood pressure

Regular practice of exercises, a low-calorie diet and reduction of sodium intake are well-established non-pharmacological approaches in the non-pharmacological treatment of high blood pressure[11-13]. More than that, they are the first strategy in the treatment of mild or moderate hypertension[26]. Previous studies have shown that a supervised exercise program leads to a decrease in blood pressure in humans with essential arterial hypertension[21-23,31,32], in addition to decreasing the risk of cardiovascular acidents[33,34] and the dependence on anti-hypertensive drugs[35].

The results of the present study broaden our knowledge of the fact that a non-supervised exercise program followed remotely via Internet causes a reduction in systolic and diastolic pressures – similar to those observed in supervised physical training programs. That is, the non-supervised program decreases blood pressure mainly among individuals with higher blood pressure levels. The decrease in blood pressure after a six-month physical training program is even more intense than after a three-month program. This alteration in blood pressure is independent of BMI, waist circumference and body weight loss. Previous studies of supervised exercise programs also show that the reduction in blood pressure may be independent of body weight reduction[35,36].

It is obvious that the present study was not designed to explain the mechanisms involved in blood pressure reduction after a non-supervised physical training program followed remotely. Nevertheless, we can suggest some mechanisms to explain the decrease in blood pressure in our study. Exercise might have decreased peripheral vascular resistance and, consequently, blood pressure[37,38]. Previous studies have shown that physical training decreases plasma levels of catecholamines[39] and muscle sympathetic nerve activity in hypertensive patients (unpublished data from our laboratory). Therefore, it would be no surprise if non-supervised physical training led to similar results in borderline hypertensive patients. Alternatively, there could have been a decrease in cardiac output.

Experimental studies have demonstrated that physical training decreases cardiac output in genetically hypertensive rats[40]. This decrease is associated with a decrease in heart rate as a consequence of an attenuation of the sympathetic tonus that controls the heart[41,42].

Limitations

We admit a series of limitations in our study. The number of subjects meeting all inclusion criteria and who could, therefore, be included in the study was limited (only 135 out of 6,001 subjects enrolled were included). One of the factors that contributed the most to this low number of inclusions in the study was the level of compliance to the program. In accordance with the inclusion criteria established, only those subjects who had at least ten data entries in the personal follow-up chart via the Internet in a month, for six consecutive months, were included in the study. The frequency of exercise practice was controlled by information provided by the individual in their personal follow-up chart, which is not a guarantee that the frequency of exercise actually occurred. This, however, is a limitation inherent to this type of study, whose objective was precisely to control individuals remotely via the Internet.

Another problem is related to the exercise intensity which was programmed according to the physical ability estimated or obtained in an exercise test, since individuals presenting a high risk of cardiovascular disease at the moment of the enrollment in the program were referred to an exercise test at the *Instituto do Coração*. This has led to a wide range of exercise intensity (40% to 70% of the heart rate reserve). Additionally, we cannot ensure that the exercise intensity was followed as programmed.

Prospects

A physical training program supervised remotely via the Internet is a safe, effective and low-cost mode of follow-up that should be implemented as a model for the prevention of diseases and health promotion for the Brazilian population. The program is an important alternative to reduce body weight, BMI, waist circumference and blood pressure, especially in borderline hypertensive individuals. However, it should be conducted with a support structure for occasional clinical diagnoses or even cardiac evaluation with exertion tests. In this sense, local health station and hospital support with a team specialized in exercise cardiology is key.

In conclusion, this six-month non-supervised physical training program followed remotely via the Internet promotes: 1) reduction in body weight and BMI in borderline hypertensive individuals; 2) reduction in waist circumference in normotensive and borderline hypertensive individuals; and 3) significant and progressive reduction in systolic and diastolic blood pressures in borderline hypertensive individuals.

No potential conflict of interest relevant to this article was reported.

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