Original Article

Home Exercise Program: Short Term effects on Physical Aptitude and Blood Pressure in Hypertensive Individuals

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Objective

To observe the influence of a four-month-unsupervised-exercise program performed at home on the blood pressure (BP) and physical performance in hypertensive adults.

Methods

A target group with 26 men and 52 women, and a control group with 9 men and 7 women were observed, with ages ranging from 25 to 77 years old. The target group underwent a home exercise program, basically with aerobic activity (60-80% of the estimated maximum heart rate for the age, 30min of walking at least 3 times a week), in addition to the flexibility exercises. Guidelines on the control chart and variables that could influence the treatment were given at each assessment. Patients were followed-up for four months, with assessments every 2 months observing: BP at rest; body weight, waist-hip ratio (W/HR), body fat percentage (%F), sum of skinfold measurements (SM) and central-peripheral skinfold ratio (C/P); trunk flexibility (TF); heart rate and workload ratio during submaximal test in cycle ergometer (HR/W), represented by the regression curve inclination between both (α).

Results

The target group demonstrated significant alterations in weight (-3.7 kg), WHR (-0.03), SM (-12 mm), %F (-4.4%), TF (+2.3 cm), HR/W (-0.02) and BP (-6 and -9 mmHg for systolic and diastolic pressure respectively). The control group presented small weight alterations (+1.3 Kg) and %F (+1.7%).

Conclusion

Unsupervised exercise home programs, even in short term, may present positive effects on the blood pressure and physical performance in hypertensive individuals.

Key words

Health, hypertension, cardiovascular disease, physical activity

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Arterial hypertension (AH) is a morbid condition present in the majority of adults, highly associated with cardiovascular diseases[1,2]. In the United States it is estimated that 27% of the adult population is affected by hypertension, only one fourth with controlled pressure levels[3]. In Brazil, arterial hypertension may be the most prevalent diseased in several regions, being the major cause of disability retirement, and accounting for 40% of the death[4].

There are several strategies of intervention to provide treatment for AH, such as changes in life style, dietary habits, and increase in physical activity[5]. Concerning physical activity, epidemiologic studies have identified inverse association between its regular practice and the incidence or risk for developing AH[6-8]. There are evidences that practicing aerobic exercises leads to a decrease in systolic and diastolic pressure in medium and long term[7,9,10]. Thus, exercise recommendation may be an important therapeutic strategy for hypertensive individuals.

There are data suggesting that even low-intensity exercises are able to induce blood pressure (BP) reduction in hypertensive individuals[10]. In fact, there are studies in which programs with intensity of approximately 20% of maximal workload on a cycle ergometer have been demonstrated to be effective in this sense[11]. Thus, it opens a new perspective for the use of unsupervised programs that do not need strict control of effort intensity, and that can have effect on the pressure levels of individuals with AH. Unsupervised programs are those where individuals perform their exercise outside formal places, such as hospitals, clinics, gyms or others, which means no supervision of an expert. Although the effects of the training cannot be controlled as accurately as the supervised programs, incorporating a physical activity as a long-term habit seems to be more likely to occur[12,13].

Commenting on these kinds of programs, Bar-Eli[13] states that attributions such as freedom, choice and responsibility on the activity, through strategies, such as self-monitoring the exercise, increase the adherence of the patient with physical activity programs. Programs that enable certain flexibility in their schedule have greater adherence, because individuals usually do not have all their time organized [12,14]. Thus, when traditional exercise training is not given, a program that presents a favorable cost/benefit ratio encompassing a greater number of patients is chosen.

The characteristics of this type of program is similar to the guidelines desired for public health strategies regarding physical exercise, once it requires significantly less human and material resources, encouraging the patients' autonomy in exercise practice, the possibility to achieve great population segments with low-cost programs tends to be greater than the regular supervised programs. However, a literature review reveals a lack of studies on the use of unsupervised exercise programs as a helping intervention strategy in the treatment of hypertension. We were only able to find one study whose approach was similar to ours[15]. Thus, the objective of the present study was to test the influence of a 4-month-unsupervised-home-exercise-program on blood pressure, anthropometric measures, sub maximal work ability and flexibility in hypertensive individuals.

Methods

Twenty-six men and 52 women, with ages raging from 25 to 77 (mean = 52 ± 12 years) were assessed, they were all classified as hypertensive according to the last report of the *Joint National Committee*[5]. The selection of the patients was conducted between 1999 and 2001, with no restrictions related to the beginning of the experimental procedures. We have excluded: a) patients with musculoskeletal and joint disorders or metabolic problems that limited or contraindicated the practice of programmed exercises; b) history of infarction for at least 2 years and unstable angina; c) systolic and diastolic hypertensive response in maximum effort test; d) ischemic response in maximum effort test; e) taking part in other regular exercise programs; f) history of renal failure (creatinine > 1.5); g) history of anemia (Hb < 10 g/dl); h) increase in the dose or change in the class of used medication during the observed period; i) attending to, at least, 75% of the sessions predicted by the program. All the patients were volunteers and gave their written consent according to the Resolution 196/96 of Conselho Nacional de Saúde (National Health Council) for human experiments. The experimental protocol was approved by the Ethical Committee of the Institution.

A group of 16 patients that performed the first evaluation, and declined the exercise program for personal reasons (lack of time, safety, etc) for no clinical reasons, was selected to be the control group compared to the experimental one. The control group was formed by 9 men and 7 women, with ages ranging from 32 and 64 (mean = 48 ± 9 years) and the measures of physical aptitude variables and of BP were conducted with an invitation to return to the program. After we were sure they had not taken part in any regular physical activity program during the 4 month interval, the tests were conducted enabling the comparison between the control and experimental group in 2 consecutive evaluations.

Assessment of the individuals encompassed: checking BP at rest; anthropometric assessment (body weight, height, hip-waist ratio, and skinfold measurements); measure of trunk flexibility; cardiorespiratory performance measure in sub maximal effort test performed on the cycle ergometer.

To obtain the fat percentage, we used the skinfold measurements method, measuring the chest diagonal fold, triceps, sub scapular, abdominal, supra iliac, thigh and leg, with a *Lange*® compass (EUA). In addition to fat percentage total adding of the skinfold measure was performed. The equation used for calculation of body density was that of Jackson and Pollock[16] for men and Jackson and cols.[17] for women. After body density calculation, fat percentage was estimated using Siri equation[18].

Flexibility was measured for the movement of anterior trunk and hips using the Sit and Reach test by Wells and Dillon[19]. In the test, patients were sitting with their knees stretched in front of a bench 45cm long and 35cm wide. They were asked to push a piece of wood placed 23 cm away from the bench, through anterior trunk flexion. The measure was written in centimeters according to the maximum reach point. Finally, to assess cardiorespiratory capacity, three-phase submaximal test was used, with the help of a cycle ergometer with mechanic brake by Monark® (Brazil). Due to the use of medication that could alter the cardiac frequency response, which would limit the validity of predictive equations of maximum VO_2, test was used to determine the ratio between load and heart rate (HR). The protocol was to apply three loads of 3 minutes, recording HR in the end of each stage. To determine cardiorespiratory capacity, regression curve was traced between the load and HR during the test. Evolvement of the results was obtained by the comparison between the inclination (α) of the curves obtained in the several assessments.

Reliability of the examiners of the study regarding the tests performed was determined by the test-retest method in 12 patients with ages between 19 and 40 years old, in the laboratory. Measures were performed with 2 days of interval and the examiner was not aware of the measure taken by other examiner. All the examiners applied the tests in all the voluntaries. Reproducibility of the measures was tested by the intraclass correlation coefficient, for agreement between intraobservers and interobservers. Results obtained for interclass and intraclass coefficients were: 0.74 and 0.78 (a for HR/W ratio); 0.78 and 0.82 (sum of skinfold); 0.78 and 0.80 (DBP); 0.84 and 0.86 (SBP); 0.90 and 0.90 (W/HR); 0.90 and 0.94 (Sit and Reach test).

The current study is part of a multidisciplinary Project involving Professional of several health areas. In the study, hypertensive patients underwent a mild to moderate basically aerobic unsupervised exercise program (60-80% of maximum estimated HR for the age), at least 3 times a week lasting 30 min each section, together with static exercises of flexibility performed 3 times a week. Individuals were followed-up for a period of 4 months to evaluate the influence of the program on blood pressure and physical performance variables.

When they arrived in the clinics, patients performed all tests in one section in the following order: weight, height, blood pressure at rest (sitting position), anthropometry, flexibility, and cardiorespiratory capacity. Next, they received guidance regarding control of walk intensity (assessed by HR in radial pulse), its duration and frequency. The correct performance of exercises and stretching was also explained and practiced. Finally, detailed instructions were given on filling up the control of intensity and physical activity frequency chart, with sessions predicted to last 30 minutes. Every 2 months patients were reassessed to follow-up and to adapt load to their new training conditions, as well as to observe the proper use of medications according to the prescription of the cardiologists of the service. All patients were receiving optimal medication following the guidelines of the *Joint National Committee*[5]. Anti hypertensive agents were: diuretics, beta-blockers, calcium channel blockers, angiotensin converting enzyme inhibitors and angiotensin II receptor antagonists.

Intraclass differences (experimental group and control group taken isolated) and interclass differences (control group x experimental group) were assessed for a 4-month-period, using two-way-repeated-measure ANOVA. Analysis was completed by Scheffé's *post-hoc* analysis. A 5% significance level for type I error was established. Calculations were performed with the help of the *software statistics 6.0 by Statsoft*® (USA).

Results

Adverse events during the study and negative cardiovascular outcomes in the period observed did not occur. In absolute values, evasion observed between the 1st and 4th month was 22%. Regarding the individuals included in the study, mean frequency of the performance of sessions predicted (walking and flexibility exercises) was 81%, using as a bases indication of 3 week sessions.

Figures 1 and 2 demonstrate mean value of variables observed, obtained for the control and experimental groups in the first 4 months of the study, together with the results from two-way-repeated measures ANOVA. Significant differences did not occur for none of the variables assessed, in the 1st assessment considered as baseline for the study. Regarding reassessments, the control group demonstrated significant alterations for weight and %F, both slightly increased ($p<0.05$). For the experimental group, although the differences were identified as soon as the 2nd month of the exercise program, they occurred mainly in the 3rd assessment.

After the program started, comparison between the individuals taking part of the program and those in the control group demonstrated advantage for the first group. The experimental group presented favorable alterations in the variables: weight (-3.7 kg), sum of skinfold measure (-12 mm), fat percentage (-4.4%), waist-to-hip ratio (-0.03), flexibility (+2.3 cm), work-heart rate ratio (α) (-0.02) and BP, (-6 and -9 mmHg for systolic and diastolic pressure respectively). The control group presented small alterations for weight (+1.3 Kg) and fat percentage (+1.7%).

Discussion

The current study tried to assess the impact of a 4-month-unsupervised exercise program on blood pressure and variables associated with physical aptitude in hypertensive patients. Some limitation to design the methodology must be mentioned: 1) patients assessed were not randomized and the control group did not receive placebo. At first, this could be done considering different exercise intensity however; we chose not to do it based on the already reduced intensity adopted in the prescription and the undefined dose-response ratio between aerobic exercise and blood pressure in hypertensive patients, according to studies[10,11]. Assessment of BP should be ideally performed using techniques avoiding biases, such as ambulatory monitoring (AMBP) which was not possible. However, reproducibility of the BP measures was tested on the examiners taking part on the study. The magnitude of ICC demonstrated that measure errors were not severely affecting the results obtained. Another aspect is that the control group did not undergo the same routine of clinical follow-up than that of the experimental group. Although this could have been a factor leading to differences, the only differences between the groups were that the control group did not follow the recommended

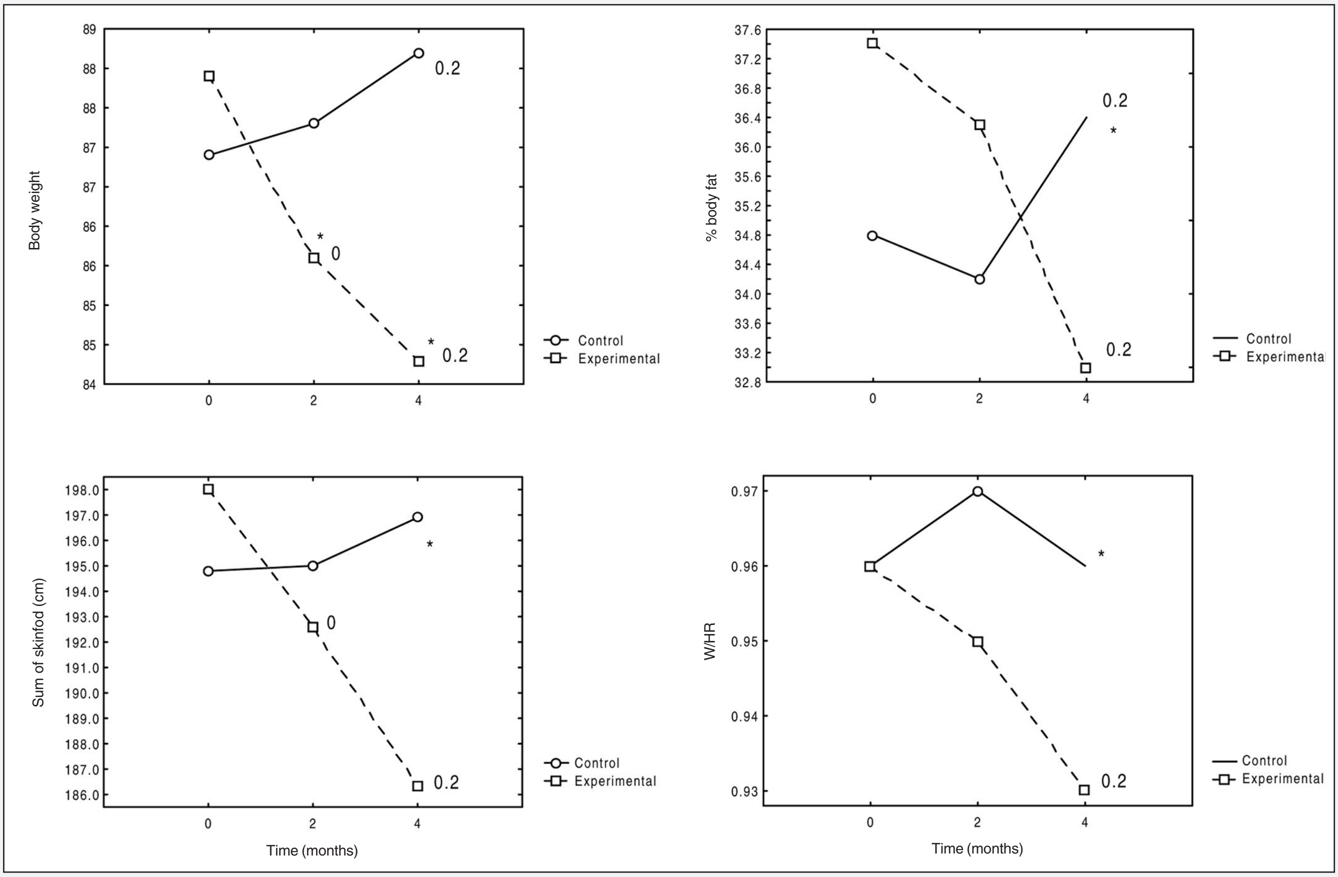

Fig. 1 - Mean values and two-way ANOVA results for repeated measures referring to anthropometric variables, followed-up for 4 months in the control and experimental groups. *significant difference between the control and experimental. The numbers refer to the significant differences between the assessments indicated ($p<0.05$).

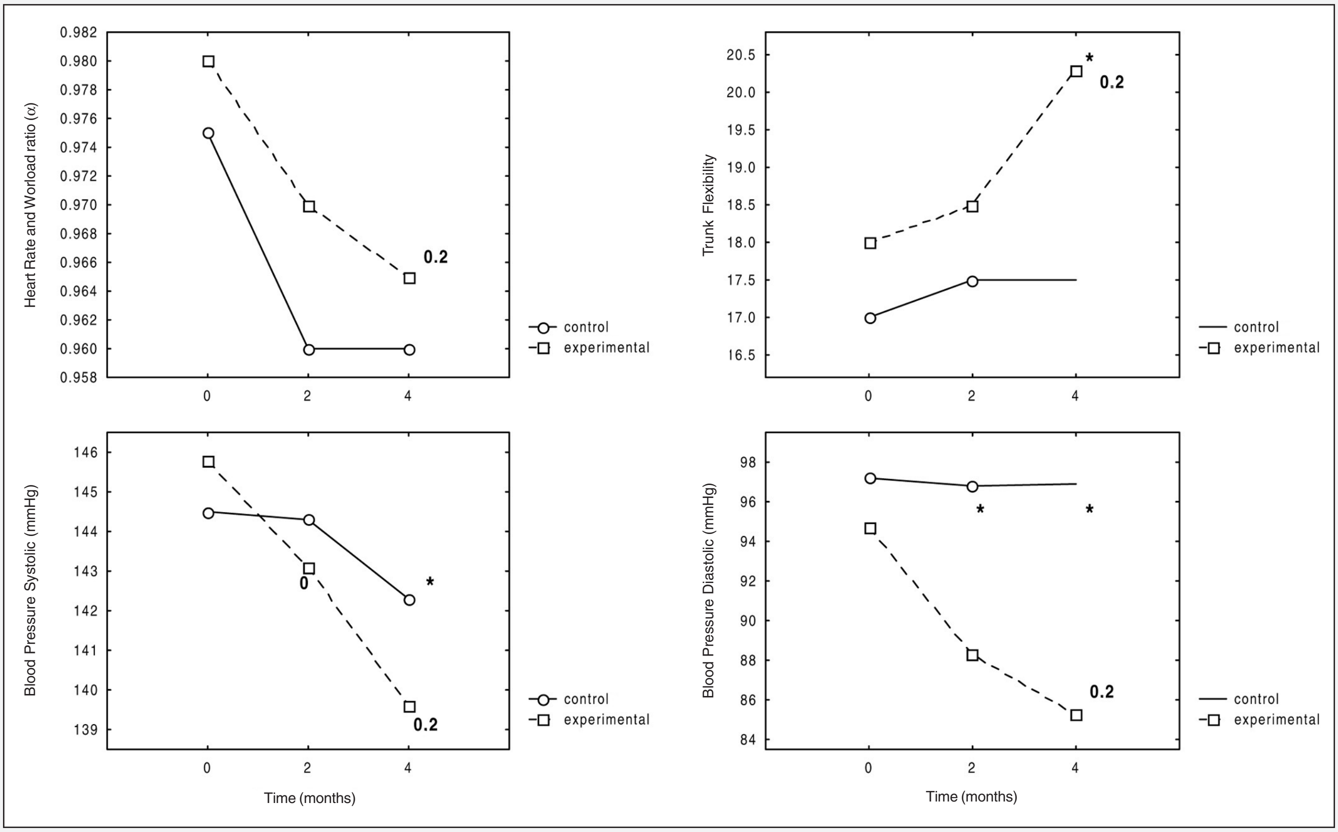

Fig. 2 - Mean values and two-way ANOVA results for repeated measures referring to physical aptitude and blood pressure variables, followed-up for 4 months in the control and experimental group*significant difference between the control and experimental groups. The numbers refer to significant differences regarding the assessments indicated ($p<0.05$).

routine of exercises because of personal reasons. Clinical follow-up in the period observed (two reassessments) was similar to that of the experimental group.

Results obtained for absolute values and evolvement of variables observed were similar to those of previous studies with supervised programs. Regarding body weight for instance, several authors reported the positive effects of its reduction to manage AH[9,20,21]. According to the report of the *Joint National Committee*[5], a 10 kg reduction on weight would have a significant impact (-5 to 20 mmHg) on BP, in overweight people and patients with hypertension. Additionally, the reducing effect of antihypertensive agents would tend to increase, and the risk for diabetes and dyslipidemia would tend to decrease. Ross and Janssen[21], stressed the direct ratio between the volume of physical activities and body weight reduction and stated that the reduction of weight would be greater in the first weeks of follow-up, since then the programs have little or none influence on total body weight. Results obtained in this study show positive effects, from the unsupervised program of exercises on body weight. However, the medication taken by patients was not strictly controlled, which would have been important since some drugs such as beta blockers may interfere in weight loss. However, one of the exclusion criteria of the study took into consideration some changes in class or dosage of drugs in the period. Although this strategy does not solve completely the chance of difference of this variable on weight loss, it probably reduces significantly the risk of distortions.

Evidence strongly suggests that an unequal distribution of body fat around the abdomen would be related to the development of chronic cardiovascular and metabolic diseases[5]. Ito and cols.[22] suggested that W/HR could be a complementary index to assess obesity and risk factors for cardiovascular and metabolic disease, with greater association with these factors than quantitative measures of body fat. Ledoux and cols.[23] considered that abdominal fat could be used as an indicator of AH probability confirmed by Melendez and cols.[24] in women from the city of Belo Horizonte. Central fat was a reliable predictor of obesity and AH in the population observed. Data indicate that our program may improve W/HR. Likewise; there was a tendency to decrease F% and skinfold measure. These results seem to corroborate those from the literature, regarding the effects of exercise in the quantitative and regional distribution of fat[5,9,25].

A good joint mobility is important for every day activities, with relatively short adaptation period after specific trainning[9]. Results obtained demonstrated rapid improvement of trunk flexibility in the study period.

Regarding cardiorespiratory capacity, there are several studies demonstrating improvement on the cardiorespiratory condition in hypertensive patients performing exercise programs similar to those of this study[26-28]. Results obtained here also indicated improvement in the submaximal work capacity in patients exercising, expressed by the ratio of HR and workload effort in the cycle ergometer. Because this test was performed in the cycle ergometer adopting the inclination of the regression curve between heart rate and workload as indicator of improvement of aerobic condition, the possibility that the positive effects were related to the loss of body weight, is decreased. Another hypothesis that should not be discharged is the influence of improvement in the cycling efficiency in the results obtained. However, we have to stress that the exercises were mainly walking training additionally, patients were assessed every two months. Thus, the effects that could be associated to the improvement of mechanic efficacy would tend to occur early. In the first 2 months significant differences between the control and experimental groups did not occur not even for intraclass comparison.

McArdle e cols.[29] reported that the variation in mechanic efficiency between the individuals in walking and/or cycling is not greater than 6% and Åstrand[30], demonstrated that the mechanic efficiency of young and elderly individuals in cycle ergometer is similar, decreasing the possibility of variability of the different effect of the variable in the sample. Thus, the possibility that the results referring to load-HR ratio over four months were significantly influenced by this variable is remote.

Several studies identified an inverse significant association between the physical exercise and BP or risk of AH[7,12,31-35]. According to the *American College of Sports Medicine*[9], there are evidences that the training with aerobic exercises would lead to a middle and long-term mean reduction of 10 mmHg in systolic and diastolic pressures. Ishikawa and cols.[36] studied 109 sedentary and hypertensive patients, undergoing a mild exercise program for 8 weeks, with several combined exercises. Petrella[37] assessed 39 studies, recommending moderate walking to complement the treatment of hypertensive patients and they found a 13 to 18 mmHg reduction in systolic and diastolic pressure. Although we have obtained a BP decrease, we have not reached that much. In the present study, decrease of BP was 6 mmHg for SBP and 9 mmHg for DBP, inferior to that reported in the literature. The lack of a more effective control of frequency, intensity and duration of activities help to explain this difference, however, without being able to prove it for the time being. The period observed was short and it may be predicted that effects may occur with the continuity of the program. On the other hand, this reduction cannot be neglected, considering the characteristics of the conducted program and that most patients were in the 1st stage of BP.

Many authors stated that high intensity exercises do not seem to be necessary to obtain benefits in reducing BP or decreasing mortality and morbidity rate, and that low intensity exercises are as efficient or even more efficient in the reduction of AH as those with increased intensity [10,11]. Fagard[10] demonstrated, through meta-analysis that mild to moderate aerobic physical activities (40-70% of the maximum consumption of oxygen or 60-80% of the maximum heart rate), performed at least 3 times a week would have the potential to positively influence the blood pressure profile of hypertensive patients.

Regarding the duration of aerobic exercises necessary for obtaining some response in BP reduction, Fagard and Tipton[38] suggest that only after 3 weeks to 3 months a reduction in BP could be observed as a result of physical training. In most cases, the effects of training would occur after 10 weeks, and after 9 months of training, exercise would not be able to induce additional reductions to pressure. On the other hand, Hagberg and cols.[39] reported that elder hypertensive patients were able to significantly reduce their BP with 3 months of moderate training, and that it would be even more reduced after 6 months. When BP variables were observed over the evaluations in our study, we found significant reductions. A greater follow-up period would be necessary to assess if the present prescription model of exercise would lead to results corroborating Fagard and Tipton's opinions[38].

It is interesting to notice that usually the studies available associating physical exercises and AH are related to activities prescribed in supervised programs. Analyses of domestic and unsupervised programs are rare. The lack of studies could be partly explained by the evasion of the sample (50-90%) associated to programs for this kind of patients, especially in unsupervised programs[15,40]. Andrew and cols.[40] stressed 3 main reasons for this low compliance: facility to have access to physical activity, perception of the usefulness of the program and aspects related to the family life. Smith and cols.[15] used an unsupervised strategy in which the prescription was sent to patients by mail together with informative leaflets on the importance and the nature of the exercises recommended. Results demonstrated a moderate increase in the level of daily physical activities, however, the authors concluded that the prescription on its own was harmless. In the first 10 weeks of the study, evasion was already observed. After 7 months, more than 40 of the approximately 400 initial patients had left the program for several reasons. Although there are significant differences between this program and the one we are recommending, which is more difficult because the participants must be physically present for the assessments, compliance with the program is a problem that has to be taken into account in our study. In this sense Mocellin[41] studied the reasons that made patients remain or leave the program, the most common reasons were the absence of a proper place in the clinics to perform exercises, restricted hours of the physical educators, and boredom of the repetition of body composition tests and physical conditioning.

In conclusion, taking into account the limitations of the study, and predicting that the effects observed may be attributed to the program administered, there seems to be a positive repercussion on almost all variables observed. It was possible to identify statistically significant changes in the blood pressure and physical capacity in a 4-month-period, therefore, relatively small. It is unknown, however, if these positive effects would occur if the model of prescription were maintained for longer period. Further studies must be conducted to test this hypothesis, establishing the limits of the efficiency of an *extra-muros* exercise program and the time when supervised activities with stricter control and exercise loads should be included in the patient's routine in order to maintain a continuous effect of the training.

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