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ORIGINAL RESEARCH

Effects of interval training on the morpho-physiological parameters of hypertensive soldiers

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Abstract. The practice of interval training is one of the essential lifestyle change measures for the management of high blood pressure while having beneficial effects that go beyond event reduction and cardiovascular mortality. Interval training is a form of cardio training, alternating periods of effort with more or less short recovery periods, in the same session. It improves the physical condition in the management of cardiovascular pathologies in general and arterial hypertension in particular. The study aimed to find out the effects of endurance physical exercises of the interval training type for hypertensive soldiers in the Kinshasa garrison. One hundred military subjects with hypertension, including 36 junior officers and 64 military sub-officers, aged 20 years and over, were joined the study. They were subjected for 6 months to a physical training program such as interval training on a treadmill. The program was divided into periods of 30 minutes of work, alternating phases of activity, and phases of active rest lasting 5 minutes per interval, of low to moderate intensity, and with a frequency of three times per interval. Week of slow walking exercises via fast and accelerated. The primary aim was the reduction in blood pressure and weight. The paired student's t-test was used to compare continuous variables before and after the interval training exercise program. A significant reduction was observed in 6 months of interval training exercises combined with dietary advice adapted for most of the morpho-physiological parameters studied. Adapted physical exercises such as interval training, associated with dietary advice significantly reduce body weight, waist circumference, body mass index, heart rate, systolic blood pressure, diastolic blood pressure, and significantly increases VO_2 max.

Keywords. Hypertensive, interval training exercise, soldier.

Introduction

The practice of physical exercises, alternating periods of effort with more or less short recovery periods, in the management of arterial hypertension and its risk factors, has beneficial effects ranging from the reduction of events and cardiovascular mortality (World Health Organization, 2011). According to current WHO recommendations, the practice of exercise such as interval training has beneficial effects on health and improves the lifestyle of hypertensive patients (World Health Organization, 2011). It involves incorporating at least 30 minutes, 3 to 4 days a week, of moderate intensity training, although various other types and durations of training show its benefits (United Nations, 2012).

The therapeutic management of arterial hypertension is based on a basis consisting of lifestyle measures combining diet and training by interval training, but their implementation, both for the patient and his nursing staff, is essential. presently a serious problem (Jordan et al., 2008) is convinced that interval training is a beneficial, necessary and possible medical indication, is acquired through the results of fundamental and clinical studies and its own feedback (Gnakamene et al., 2009). Reductions in blood pressure, heart rate, and weight loss are variable depending on the more or less dynamic component of high-intensity interval

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training (interval exercises during rest and active recovery) (World Health Organization, 2013).

Monitoring the intensity of training sessions, by monitoring heart rate, marks a considerable advance in the physiological control of human adaptation to exercise (Kodama et al., 2009). A study published in the American Journal of Physiology in May 2017 showed that training is beneficial in improving pancreatic β cell function in adults with type 2 diabetes (Kokkinos et al., 2017). The study also showed that 6 weeks of interval training at the rate of 3 workouts per week resulted in an increase in ß cell function during the early phase of the glucose response, significantly correlated with a reduction in abdominal body fat (Smith et al., 2003). A study published in the journal Revista Medica De Chile shows that the practice of 12 weeks of interval training allowed in patients with type 2 diabetes, a decrease in body fat, clicked hemoglobin, as well as that an improvement in the quality of life of participants: physical condition, vitality, mental health (Berthoin et al., 2001). This pilot study was carried out mainly to demonstrate the perverse effects of interval training type training in hypertensive soldiers whose feasibility is detailed in the methodology.

Methods

The present follow-up study of 100 military subjects with hypertension, took place in the Kinshasa garrison. The Kinshasa garrison is one of the garrisons of the Armed Forces of the Democratic Republic of Congo where the command is within the staff of the 14th military region of the lieutenant Kokolo camp, headed by a Brigadier General. Simple random sampling was used to constitute a total of 100 military subjects with hypertension, aged 20 years and over, male, including 36 junior officers and 64 non-commissioned officers. Follow-up data were collected in two phases: On admission, time Zero, and at 6 months (M6). The morphological and physiological parameters before and after six months of interval training were measured respectively: weight in kilograms (kg) was measured using a SECA brand personal weighing scale calibrated to the nearest 1 kg, placed on a hard surface. The size in centimeter (cm) was taken using a SECA brand measuring rod. The Body Mass Index (BMI) in kilograms per square meter (kg/m^2) was calculated as the ratio of weight in kilograms to the square of height in meters. Blood pressure was taken using an OMRON IntelliSense Blood Pressure Monitor brand electronic device on a subject seated with his arm pronated.

The maximum oxygen consumption (VO_2max) expressed in ml/kg/min was evaluated using a professional Jkexer-Tech 779 brand treadmill. An electronic tool measuring 1.80 m in length and 70 cm in width, a 2.50 m treadmill supported by two arms made up of electrodes with monitoring including a speed of 1 to 26 km per hour. The Member stands upright on the treadmill belt, holding the electrodes incorporated in each arm of the carpet. The examiner enters the following participant information: sex, age (year), height (cm), and weight (kg) and activates the start button of the treadmill monitoring the execution of the exercise, varying the speed up to the exhaustion of the military allowing to take the time, the distance, the BMI, the heart rate to calculate the VO_2max from the indirect method of Cooper: VO_2max = (22.35 x Distance in km/h) - 11.288 (Berthoin et al., 2006). These hypertensive soldiers from the Kinshasa garrison were subjected to a 24-week interval training program, with a frequency of 3 to 5 times a week, of light to moderate intensity for 30 minutes per day. preceded by a 10-minute warm-up, in 5-minute intervals, composed of 8 or 12 cycles of 60 seconds of a sustained effort of interval exercise training of aerobic endurance type: (brisk walking, accelerated, jogging, and exercise on a treadmill), thus 30 seconds of active recovery, followed by 30 seconds of cool-down.

All subjects voluntarily accepted to participate in this study according to Helsinki declarations. Before they participated in the study, they were informed about the study and taken a signed consent form. The study was approved by a local ethics committee with the number ESP/CE/151/2020.

Statistical Analysis

Data were entered and analyzed by a microcomputer using SPSS software, version 12.0. Quantitative variables were presented as means and standard deviation with their extremes in tables, for normally distributed continuous variables and medians (EIQ interquartile space). The qualitative variables were expressed as absolute frequency (relative frequency in percentage). The student's t-test was used to compare the means of 2 groups; the Mann-Whitney U test was used for the proportion comparison made using logistic regression. The statistical significance level was set at $\alpha = 0.05$.

Results

The distribution of hypertensive soldiers in the Kinshasa garrison by rank is presented in Figure 1.

Out of 100 hypertensive soldiers from the Kinshasa garrison submitted to the program, 64 were non-commissioned officers and 36 junior officers. The morpho-physiological characteristics of the military before training are summarized in Table 1.

Table 1 reveals that the hypertensive subaltern officers were obese and less enduring than their overweight non-commissioned counterparts respectively: 30.9 ± 6.22 kg/m² vs 27 ± 4.1 kg/m² for the BMI and 38.0 ± 4.9 ml/min/kg vs 32 ± 3.9 ml/min/kg for cardio-respiratory endurance. The comparison of the averages of the morpho-physiological parameters before and after training is shown in Table 2.

A significant decrease in anthropometric and clinical parameters was observed during our program. A decrease of -9 kg in weight, and the body mass index - 4 kg/m², and an increase in cardio-respiratory endurance of about + 8 ml/min/kg. This decrease in weight and BMI resulted in a significant improvement in the drop in blood pressure. The junior officers experienced significant improvement in the anthropometric and clinical parameters listed in Table 3.

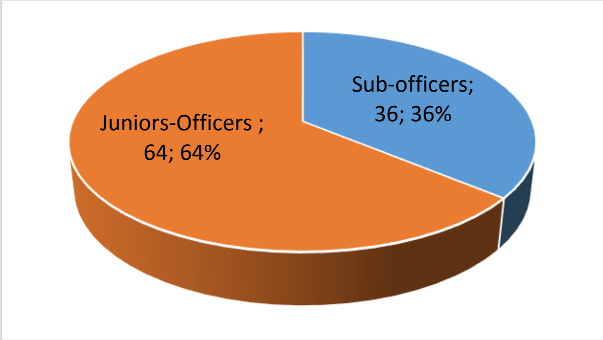

Figure 1. Distribution of military personnel with hypertension by army rank category.

Table 1
Morpho-physiological characteristics of non-commissioned officers and hypertensive military officers before the training.

Variables	Sub-officers	Juniors-Officers	*p*
Weight (kg)	90 ± 3.10	99 ± 5.0	0.001*
BMI (kg/m²)	27 ± 4.1	30.9 ± 6.22	0.002*
Waist circumference (cm)	116 ± 11.54	127.3 ± 1.6	0.072
Systolic Arterial Pressure (mmHg)	145 ± 10.7	149 ± 11.2	0.119
Diastolic Arterial Pressure (mmHg)	100.2 ± 8.7	100.6 ± 10.1	0.063
Heart Rate (bpm)	90 ± 4.41	95 ± 3.3	0.081
Cardiorespiratory Endurance (ml/min/kg)	38.0 ± 4.9	32 ± 3.9	0.051

* $p < 0.05$

Table 2
Comparison of the averages of the morpho-physiological parameters before and after the training of hypertensive military non-commissioned officers.

Variables	Before	After	*p*
Weight (kg)	90 ± 3.10	81 ± 5.0	0.001*
BMI (kg/m²)	27 ± 4.1	23 ± 4.1	0.004*
Waist circumference (cm)	116 ± 11.54	100.7 ± 1.6	0.005*
Systolic Arterial Pressure (mmHg)	145 ± 10.7	131 ± 9.2	0.041*
Diastolic Arterial Pressure (mmHg)	100.2 ± 8.7	89.1 ± 6.1	0.002*
Heart Rate (bpm)	90 ± 4.41	85 ± 3.3	0.001*
Cardiorespiratory Endurance (ml/min/kg)	38.0 ± 4.9	46 ± 7.2	0.003*

* $p < 0.05$

Table 3
Comparison of averages, morpho-physiological parameters of hypertensive military officers before and after the training.

Variables	Before	After	*p*
Weight (kg)	99 ± 5.0	84.3 ± 6.7	0.001*
BMI (kg/m^2)	30.9 ± 6.22	24.4 ± 4.2	0.003*
Waist Circumference (cm)	127.3 ± 1.6	119 ± 2.6	0.001*
Systolic Arterial Pressure (mmHg)	149 ± 11.2	129.5 ± 2.6	0.035*
Diastolic Arterial Pressure (mmHg)	100.6 ± 10.1	83.4 ± 7.1	0.002*
Heart Rate (bpm)	95 ± 3.3	78.3 ± 7.1	0.001*
Cardiorespiratory Endurance (ml/min/kg)	32 ± 3.9	53.0 ± 9.12	0.001*

* $p < 0.05$

Table 4
Comparison of the averages of the morpho-physiological parameters of non-commissioned officers and officers after the training the hypertensive soldiers.

Variables	After		*p*
	Sub-Officers	Junior- Officers	
Weight (kg)	89 ± 5.0	84.3 ± 6.7	0.001*
BMI (kg/m^2)	23 ± 4.1	24.4 ± 4.2	0.001*
Waist Circumference (cm)	100.7 ± 1.6	119 ± 2.6	0.001*
Systolic Arterial Pressure (mmHg)	131 ± 9.2	129.5 ± 2.6	0.001*
Diastolic Arterial Pressure (mmHg)	89.1 ± 6.1	83.4 ± 7.1	0.001*
Heart Rate (bpm)	85 ± 3.3	78.3 ± 7.1	0.001*
Cardiorespiratory Endurance (ml/min/kg)	46 ± 7.2	53.0 ± 9.12	0.001*

* $p < 0.05$

A significant improvement in anthropometric and clinical parameters was also observed in junior officers of the order of -15 kg in weight, and BMI - 6 kg/m^2, and an increase in cardio-respiratory endurance of the order of + 21 ml/min/kg. This decrease in weight and BMI resulted in a significant improvement in the drop in blood pressure. Throughout our training program, sub and junior officers significantly improved their anthropometric and clinical parameters, the comparison of which is shown in Table 4.

Table 4 shows the comparisons of morpho-physiological parameters and physical condition between the two categories of soldiers that a significant change was noted during the follow-up program. It has been shown that a significant increase in VO_2max was relatively shown for both categories of the military in the order of +8 ml/min/kg.

Discussion

This case study, carried out in the military garrison of Kinshasa, aimed to demonstrate the effects of interval training exercise of the aerobic type on the morpho-physiological profiles and the adaptation to the effort, of the military hypertensive to improve the care approach. The study concerned 100 military subjects with hypertension, including 64 non-commissioned officers vs. 36 junior officers, aged 20 years and over, male. The main observations resulting from it show that junior officers predominate in the category of non-commissioned officers with 64% vs. 36%, or 64 vs. 36. In 6 months, we subjected 100 military hypertensive subjects to an aerobic type of interval training exercise program where the results were significantly observed on the morpho-physiological parameters studied ($p<0.01$). Several studies have shown the positive effects of high-intensity interval training on vascular and metabolic capacities. The best known of these is the study carried out by Tabata (LitoBox, 2017), which shows that training alternating between very high-intensity phases (20 seconds) and rest phases (10 seconds) for 4 minutes in total helps to develop the aerobic capacities of the body in a consequent way, by reducing body weight and lowering blood pressure (Isomaa et al., 2001). Kelley et al. (2001) used the meta-analysis approach to analyze the effect of aerobic exercise on resting systolic and diastolic blood pressure with 47 clinical trials representing a statistical analysis of 2543 subjects. The results showed that a decrease in resting systolic and diastolic pressure in both hypertensive patients (systolic, -6 mm Hg, 95% CI, -8 to -3; diastolic, -5 mm Hg, 95% CI, -7 to -3) than in normal tense (systolic, -2 mm Hg, 95% CI, -3 to -1; diastolic, -1 mm Hg, 95% CI, -2 to -1). The difference in blood pressure drop between the hypertensive and normotensive groups is also statistically significant. The authors concluded that aerobic exercise decreases resting systolic and diastolic blood pressure in both hypertensive and normotensive adults (Kelley et al., 2001). In terms of public health, we must therefore offer this type of program which will allow better compliance and less cardiovascular risk because the effectiveness is quickly obtained. The regular and adapted practice of interval training results in a rapid drop in blood pressure figures, heart rate, and an increase in VO_2max (Astrand et al., 1960). The stress test on a treadmill before the prescription of physical exercises, therefore, makes it possible to adjust the intervention program, reassure the soldiers about these own possibilities, and assess the risk of a possible arrhythmia at the effort (Assadi et al., 2012). The level of physical condition regulated by adaptation to effort and heart rate as well as the VO_2max determined by treadmill, must in all cases be 15 to 6 beats per minute below the threshold frequency (Astrand et al., 1960). Aerobic endurance-type interval training and the control of other factors associated with arterial hypertension is one of the first-line non-pharmacological treatments for mild arterial hypertension according to WHO recommendations (World Health Organization, 2017). This study also shows that training results in a significant decrease in body weight and a drop in blood pressure and an increase in VO_2max. Interval training type exercises practiced in endurance or aerobics regularly associated with food advice, a low-calorie and low-sodium diet, and vitamin, significantly improve the morphological and physiological profiles of military hypertensives.

Acknowledgment

We thank all soldiers for accepting to participate in this study.

Conflict of Interest

The authors declared no conflict of interest.

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