

Effect of physical exercises on anthropometric parameters, blood pressure and heart rate of young people and adults in Matola city–Mozambique

Abstract

Introduction: physical inactivity is a risk factor for chronic non-communicable diseases, causing morbidity and mortality and weight gain in the economy of nations.

Objective: to analyze the effect of combined physical exercises on anthropometric and hemodynamic parameters in young and adults people in Cidade da Matola.

Methodology: 22 subjects from 23 to 60 years old (8 female and 14 male) were randomly selected in 2017. The anthropometric assessment consisted of weight, height, BMI and waist circumference. Hemodynamic variables were evaluated with an Omron M3-HEM-7131-E tensiometer. The sample performed combined physical exercises for three consecutive months. Using SPSS, 20.0, at 95% CI, the non-parametric WILCOXON test was applied to examine the effect of physical exercises on the variables of interest.

Results: globally, weight and BMI increased over the course of the intervention, however without statistical differences, on the other hand, height, WP, SBP, DBP and HR differed statistically: $P=(0.019; 0.008; 0.048; 0.006; 0.000)$ respectively. After analyzing the sex, only male individuals registered statistically significant differences for WP, DBP and HR: $P=(0.023; 0.006; 0.000)$ respectively. The age range of individuals aged ≥ 36 years revealed a significant effect of the intervention on the variables WP, DBP and HR: $P=(0.022; 0.042; 0.001)$ respectively.

Conclusions: although the sample size was small, globally, the effect of the intervention on the variables of interest was notorious, especially in Blood Pressure, Heart Rate and Waist Perimeter.

Keywords: physical exercises; overweight, obesity, heart rate and blood pressure

Volume 9 Issue 4 - 2020

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Received: June 28, 2020 | **Published:** August 14, 2020

Introduction

In developed countries as well as in developing countries, it has been reported that physical inactivity is one of the important risk factors for the increase of cardiovascular diseases and body weight beyond the ideal among people of different age groups, especially in adult population.¹⁻⁴

There is evidence that Mozambique, a nation in progressive construction of economic sustainability, therefore in the process of development, also faces the global effects resulting from the epidemiological transition, substantiated by the decline in physical activity, resulting from the reduction of existing spaces for its practice and the increasingly shorter lifestyle for motor skills.^{5,6}

To mitigate the harmful effects of sedentary lifestyle, the scientific literature recommends the practice of diversified physical exercises, under the scrupulous observance of recommendations inherent to suitability and specificity for each case, as being the effective, low-cost and most accessible means for anyone.^{1,4,6,7}

This finding is based on the fact that physical exercises combined with nutritional balance influence cardiovascular health indicators, especially blood pressure and heart rate as well as anthropometric indicators, particularly in the variables that determine body mass.⁸⁻¹¹

Anthropometric variables, namely weight and waist circumference for height and age, are essential predictors of health or disease. In this

context, Grossl, Augustemak de Lima, and Karasiak¹² report that the concentration of body fat, especially abdominal fat, is a determining factor in multiple cardiovascular and metabolic disorders and is, also associated with a high risk of death.

Machado, Rodrigues, Viana, and Sampaio¹³ report that central obesity represents the concentration of adipose tissue in the abdominal region and has been described as the type of obesity that offers the greatest risk to health, on the other hand, highlight that it is a risk factor for cardiovascular diseases, diabetes, dyslipidemia and metabolic syndrome.

This scenario makes overweight and obesity considered a public health problem and deserving of special attention from health entities.¹²

Additionally, blood pressure and heart rate indicators are positively influenced by physical exercise, that is, people with lifestyle habits associated with motor skills, regardless of whether they are obese or not are healthy in terms of cardiovascular forum pathologies, which suggests that physical exercises can be a protective factor against heart disease.¹⁴

However, although studies on the subject exist worldwide, little is known about the effect of combined physical exercises on anthropometric variables, blood pressure and heart rate in the young and adult population of Africa in general and of Mozambique in particular.

This scientific “adventure” is guided by the certainty of being able to contribute in the field of rigor of knowledge and in the perspective of closing the contextual cognitive gap on the subject under study.

The objective of this essay was to analyze the effect of combined physical exercises on anthropometric parameters, blood pressure and heart rate in young people and adults in Matola City, Mozambique.

Methodology

The sample of the present study, whose data collection took place in 2017 in a cohort of 68 participants in the Project of physical exercises for health called “Healthy Heart” carried out in the city of Matola, consisting of 22 people between young people and adults of both sexes (14 male and 8 female), aged between 23 and 60 years ($X \pm SD = 38.86 \pm 9.00$). Of these, 6 were under 35 years old and 16 were 36 years old.

It should be noted that for inclusion in this study, the participants authorized their participation in writing, as well as presenting the restrictions recommended by the clinical entities to the research team if they had them and complied with a battery of tests at the beginning and during the process constituted by the anthropometric assessment, blood pressure and heart rate at rest and fasting blood glucose, in order to rule out impeding pathologies for participation in the project and/or adapt physical exercises according to individual limitations.

All individuals who did not adhere to the subsequent evaluations were excluded from the study, thus determining the substantial loss of the sample. It is noteworthy that they were all previously informed about the procedures followed in the program and the use of information for the production of scientific reports.

Within the scope of the study, anthropometric variables were measured, namely body mass, waist circumference and hemodynamic variables, namely systolic and diastolic blood pressure and heart rate. All tests were carried out by a team of professionals with higher education in Physical Education and Sports Sciences, under the leadership of the main researcher, who previously administered training for this purpose.

The anthropometric assessment consisted of body mass, height and waist circumference, measured according to the procedures described by Frisancho.¹⁵

Body mass was measured using a digital scale of the *G-Tech* brand, properly calibrated and with a capacity of 150 kg. Before measuring the measure, participants were asked to take off their shoes and remove all accessories and heavy clothing, having stayed only with light clothes.

Then they were asked to climb on the scale with both feet resting on the platform, looking at a line on the horizon, in such a way that the weight was evenly distributed. After recording the value that appeared on the digital monitor, participants were instructed to get off the scale.

Height was measured using a *WCS* branded biometer with a scale ranging from 20 to 220 cm. The measurement was performed after the participants were instructed to take off their shoes and wear only light clothes.

The measurement was taken in a standing position with legs and feet parallel, weight distributed on both feet, arms relaxed at the side of the body and palms facing the body. The back was facing the wall and the head obeyed the horizontal alignment of the lower edge of

the orbital opening, with the upper margin of the external auditory conductor.

Based on these measures, the body mass index was calculated by the weight ratio and the square of the height expressed in meters, to indirectly determine the body composition of the participants in the study.

To assess waist circumference, participants were asked to slightly lower their pants and lift their torso clothes, always observing the need to never be completely naked, in order to directly touch the hip area, exactly the height of the crest iliac. The subjects were also asked to stand, with their feet together and their abdomen completely relaxed.

The appraiser positioned himself in front of the appraised and placed the *Sunny*® non-extensible tape measure around the waist, where he measured the navel height in centimeters.

Blood pressure and heart rate were assessed 10 minutes after rest, with an *Omron M3-HEM-7131-E digital tensiometer*. It should be noted that the armbands were selected according to the arm size of each participant.

For all variables, measurements were taken twice and, in case of differences, the average resulting from the two measurements was considered.

The group involved in the research was submitted to a combined physical exercise program that, for the purpose of the study, lasted for three consecutive months, with a volume of 180 minutes per week divided into three training sessions (Mondays, Tuesdays and Thursdays), plus one on each Saturday at the end of the month.

The contents of the program consisted of training the functional condition, through exercises of speed, strength, endurance, flexibility and general mobility.

The weekly physical exercise plan consisted of the following: on the first day of the week, the training was preceded by stretching and warming up guided by the instructor. Then they did 60 minutes of aerobic work, using musical cadence, with a low to moderate intensity, between 125 to 165 Bpm.

On the second day of the week, after stretching, the participants did 30 minutes of aerobic training with the intensity mentioned above, then did anaerobic training in order to tone specific muscle groups, namely the trunk, abdomen, upper and lower limbs.

The third workout of the week was covered by the first part of stretches and general warm-up, followed by 40 minutes of training of localized muscle groups and then the performance of aerobic work using rope and other means, lasting 20 minutes.

On Saturdays at the end of the month, participants were guided to a circuit of 15 kilometers of walking and slow running in the area reserved for the construction of the Citadel of Matola. Then they did stretching and playful games for relaxation.

This study follows a quasi-experimental design with a quantitative approach, as the participants were previously evaluated for anthropometric and hemodynamic parameters, subsequently submitted to a physical exercise program for 12 weeks (three months) and at the end of the process again evaluated.

Statistical analysis was performed in the Statistical Package for the Social Sciences (SPSS 20.0). After exploring the database in order to

remove the outlines, descriptive statistics were expressed in average values and the respective standard deviation of the main variables under study.

To examine the effect of physical exercises on the variables of interest in the pre- and post-intervention moments, the non-parametric WILCOXON test was applied, at a 95% confidence interval.

Results

Table 1 presents the results of the comparison of the anthropometric and hemodynamic variables of the sample as a whole between the pre and post-intervention moments using the 12-week physical exercise program. As can be seen, Weight and Body Mass Index (BMI) increased throughout the intervention, however without statistical differences, on the other hand, Height, Waist Perimeter, Systolic Arterial Pressure, Diastolic Arterial Pressure and Frequency Cardiac reduced at the end of the intervention, with statistically significant differences: P=(0.019; 0.008; 0.048; 0.006; 0.000) respectively.

The comparison of the results between the pre and post-intervention moments using physical exercises according to sex is

Table 1 Comparison of the results of the anthropometric assessment, blood pressure and heart rate in the pre and post intervention of the sample as a whole (p <0.05)

Variables	Pre-intervention (n=22)			Post-intervention (n=22)			Wilcoxon test	
	X±DP	Min	Max	X±DP	Min	Max	Z	P
Weight (Kg)	77.16±10.67	62.00	93.50	78.68±11.16	61.00	96.00	-0.960	0.337
Height (Cm)	1.67±0.08	1.55	1.91	1.66±0.08	1.55	1.90	-2.333	0.019
BMI (Kg / m ²)	27.81±4.94	21.37	37.46	28.35±5.08	21.55	39.96	-1.001	0.316
WP (Cm)	92.74±10.97	76.00	115.50	89.69±13.73	44.50	110.40	-2.646	0.008
SBP (mmHg)	133.95±21.22	102.00	180.00	130.09±19.17	104.00	174.00	-1.974	0.048
DBP (mmHg)	83.72±13.94	63.00	116.00	81.40±13.54	62.00	110.00	-2.711	0.006
HR (Bpm)	70.68±10.29	54.00	94.00	66.59±7.60	51.00	85.00	-3.419	0.000

Table 2 Comparison of the results of the anthropometric assessment, blood pressure and heart rate in the moments before and after the intervention according to sex (p <0.05)

Variables	Interventioned group (n=22)							
	Female (n=8)		Wilcoxon test		Male (n=14)		Wilcoxon test	
	Pre-Interv. X±DP	Post-Interv. X±DP	Z	P	Pre-Interv. X±DP	Post-Interv. X±DP	Z	P
Weight (Kg)	75.91±9.32	77.93±11.29	-1.153	0.248	77.87±11.64	79.10±11.49	-0.235	0.813
BMI (Kg/m ²)	24.57±3.14	25.19±3.48	-1.153	0.248	29.66±4.89	30.15±5.05	-0.235	0.813
WP (Cm)	86.65±8.82	81.81±16.60	-1.260	0.207	96.22±10.80	94.20±9.81	-2.261	0.023
SBP (mmHg)	128.87±11.16	127.12±12.11	-1.185	0.235	136.85±25.21	131.78±22.50	-1.610	0.107
DBP (mmHg)	79.87±7.16	78.62±9.44	-1.078	0.280	85.92±16.49	83.00±15.51	-2.746	0.006
HR (Bpm)	64.50±11.23	61.62±7.02	-1.021	0.307	74.21±8.14	69.42±6.54	-3.315	0.000

shown in table 2. As can be seen, for the female sex, even though the average values of Weight and BMI have shown increases when walking of the intervention and the other variables have registered a reduction in the average indicators, no change reveals differences with statistical significance.

On the other hand, among male participants, the mean values of Waist Perimeter, Diastolic Blood Pressure and Heart Rate decreased after three months of intervention, with statistical significance: P=(0.023; 0.006; 0.000) respectively.

The comparison of the effect of the physical exercise program according to the age group, in the two moments is shown in table 3. As can be seen, among young people, although there were no statistically significant differences, the trend of the mean values of all variables was to reduce over the 12 weeks of intervention.

However, the age group of individuals aged ≥ 36 years, therefore of adults, revealed a significant effect of the intervention on the variables Waist Perimeter, Diastolic Blood Pressure and Heart Rate: P=(0.022; 0.042; 0.001) respectively.

Table 3 Comparison of the results of the anthropometric assessment, blood pressure and heart rate in the moments before and after the intervention according to the age group (p <0.05)

Variables	Interventined group (n=22)							
	≤35 years (n=6)		Wilcoxon test		≥36 years (n=16)		Wilcoxon teste	
	Pre-Interv. X±DP	Post-Interv. X±DP	Z	P	Pre-Interv. X±DP	Post-Interv. X±DP	Z	P
Weight (Kg)	70.33±10.43	70.00±9.44	-0.677	0.498	79.72±9.87	81.93±10.16	-1.364	0.172
BMI (Kg/m ²)	24.50±3.82	24.38±3.48	-0.677	0.498	29.05±4.82	29.83±4.84	-1.362	0.172
WP (Cm)	84.21±11.14	77.31±18.12	-1.572	0.115	95.93±9.34	94.33±8.39	-2.275	0.022
SBP (mmHg)	131.00±11.83	125.00±15.09	-1.095	0.273	136.68±27.88	132.00±20.60	-1.876	0.060
DBP (mmHg)	79.50±9.64	75.83±10.22	-1.897	0.057	86.31±17.68	83.50±14.31	-2.029	0.042
HR (Bpm)	65.00±9.25	62.50±6.62	-1.510	0.130	72.81±10.10	68.12±7.55	-3.144	0.001

Discussion

Although the sample of the present study was reduced, the results revealed a marginal increase in weight and body mass index for the entire sample over the three months of intervention, however without statistical significance. Additionally, height, waist circumference and hemodynamic indicators pointed to a reduction in mean values, with statistical significance.

This scenario corroborates, in part, with the results found in the study by Lopes et al.,¹⁶ in which they evaluated the effect of a physical exercise program with and without nutritional guidance on anthropometric and metabolic variables of young people. In this study, after the intervention, both groups did not register statistically significant differences for weight, body mass index and waist circumference, except for height, coinciding in this aspect with the present study.

It is important to highlight that the behavior of the waist circumference recorded in the study by Lopes et al.,¹⁶ differs with the finding in this trial.

The average values found in this investigation reveal that, for the sample as a whole, there were statistically significant differences.

This scenario is also illustrated in a study carried out with a group of people with an average age of 33 years, who after a period of nutritional guidance and physical exercise revealed a reduction in blood pressure and heart rate indicators, with greater emphasis on the values of diastolic blood pressure.¹⁷

Another study carried out with the aim of verifying the effect of aerobic physical exercises on people at cardiovascular risk revealed that anthropometric parameters, namely weight, body mass index and waist circumference, as well as hemodynamics, especially blood pressure of the sample reduced marginally, but without statistically significant differences.³

The marginal effect of physical exercises on anthropometric and hemodynamic indicators revealed in the study by Viana et al.³ can be explained by the fact that only an aerobic exercise program was applied.

Still in this context, studies have recommended the use of a

combined physical exercise plan, namely aerobic and anaerobic ones with a focus on localized exercises so that chronic physiological adaptations in anthropometric and hemodynamic parameters can be established.^{18,19}

Indeed, the outcomes found here can be justified, in part, by the use of an intervention program that combined a protocol of aerobic and anaerobic activities, with predominance of exercises located in the abdominal fat mass.

In another analysis, the fact that the individuals in the present study superficially gained body weight after three months, but with a significant reduction in the average values of waist circumference may be justified by the reason that the muscle toning exercises have promoted an increase in bone and muscle density on the one hand, but it can also be considered that the lack of control and / or monitoring of the participants' diet was at the origin of the weight gain of the weight.^{20,21}

When comparing the intervention using combined physical exercises according to sex, the female participants did not register any effect; however the male gender showed statistically significant differences for waist circumference, diastolic blood pressure and heart rate.

These results, especially those related to anthropometric indicators, differ from those found in a study carried out with a group of postmenopausal women, who after two months of intervention using physical exercises registered a significant decrease in body mass.²²

Following the same pattern, the study by Rocca et al.,²³ carried out with women between the ages of 25 and 50, with the aim of evaluating the effect of a physical exercise program for weight loss found results equally different, from the point of view of anthropometric parameters, from those described in this research. It should be noted that the similarities in these indicators were only recorded for the waist circumference.

On the other hand, Gomes²⁴ reveals in his dissertation that both men and women showed significant differences in hemodynamic parameters, after the intervention using aquatic physical exercises. These results are similar to those found in this research, only for males, in diastolic blood pressure and heart rate.

The comparison of the effect of the combined physical exercise program according to the age groups, between young people and adults revealed significant differences between the pre and post-intervention moments in individuals aged 36 years or over, with greater emphasis on the perimeter waist, heart rate and diastolic blood pressure.

However, even though there were differences between the two groups in the present study, the reference literature has highlighted that the use of combined physical exercises results in changes in the chronic adaptation of body composition and hemodynamic indicators, both for young people, adults and elderly.^{22,25,26}

Conclusions

The sample of the present study consisted of 22 people, therefore relatively small, however it was possible to reach the following conclusions:

The combined physical exercise program promoted chronic adaptations among research participants, with greater emphasis on hemodynamic indicators;

Although sex and age were decisive, overall the effect of the intervention on the variables studied was notorious, especially in the indicators of diastolic blood pressure, heart rate and waist circumference, which are curiously predictors of cardiovascular forum pathologies;

The results of this research suggest the importance of using combined physical exercises for therapeutic purposes, especially against cardiovascular forum pathologies.

Acknowledgment

We thank all participants in the healthy heart program, which takes place in the city of Matola, Escola Maria Ana Mogas and the School Board for authorizing the use of its facilities.

Conflicts of interest

We declare that there is no conflict of interest.

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