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Mountaga Diop
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

Papa Serigne Diène
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

Ndiack Thiaw
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

Ndarao Mbengue
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar

Mame Ngoné Bèye
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

Daouda Diouf
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

Abdoulaye Ba
Physiology and Functional and
Physiological Explorations and
Biology Applied to Sport
Laboratory at the Dakar Faculty
of Medicine, Dakar, Senegal

Abdoulaye Samb
Physiology and Functional and
Physiological Explorations and
Biology Applied to Sport
Laboratory at the Dakar Faculty
of Medicine, Dakar, Senegal

Corresponding Author:
Mountaga Diop
STAPSJL Laboratory, Cheikh
Anta Diop University, Dakar,
Senegal

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Effects of A 2-month aerobic program on body composition, cardiovascular parameters, and the VO₂ max of Senegalese sedentary women aged 20 to 50

Mountaga Diop, Papa Serigne Diène, Ndiack Thiaw, Ndarao Mbengue, Mame Ngoné Bèye, Daouda Diouf, Abdoulaye Ba and Abdoulaye Samb

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Abstract

Introduction

Thinkers such as Dr. Kenneth Cooper well aware of the sedentary nature of people, especially women, who are victims of obesity have set out ways and means to provide a solution. They encourage people to enjoy and practice physical activity through a rhythmic music called aerobics.

Today, there is a proliferation of fitness centers in Senegal. There is a large female clientele. Some want to lose weight and improve their physical condition. Others go to the gyms to keep their figure.

VO₂ max and resting heart rate are among some objective criteria to assess physical fitness. However, we found no studies reporting positive effects of aerobics on body composition and cardiorespiratory variables in sedentary Senegalese women.

Objective: To study the effects of a 2-month aerobics program on the weight, body mass index, resting heart rate, blood pressure and VO₂ max of sedentary Senegalese women aged between 20 and 50.

Methods: The above variables in 12 sedentary Senegalese women aged 20-50 years were assessed before and after a 2-month aerobics program consisting of 3 one-hour sessions per week.

Results: After 8 weeks of aerobic exercise, among all the parameters studied, the VO₂ max, was the only one that underwent a slight reduction which is not statistically significant.

Conclusion: 3 weekly one-hour aerobics sessions over 2 months would appear to be insufficient to significantly modify these variables in sedentary Senegalese women aged 20 to 50.

Keywords: VO₂ max, aerobics, sedentary, body composition, cardiovascular

Introduction

With people's sedentary lifestyle, particularly women, who suffer from obesity, diabetes and hypertension, doctors such as Dr. Kenneth Cooper set out to find a solution to those problems by encouraging people to enjoy and practice physical activity through rhythmic music. Cooper created aerobics in 1968. According to Frugier and Choque ^[1], aerobics can be considered as an important activity that develops not only endurance, but also strength and speed. Today, aerobics is practiced in

Senegal, where there has recently been a spectacular growth as for the number of fitness centers. When you go to these gyms in the evenings, you find a large female clientele. Some come to lose weight and improve their physical condition. Others go there to tone their muscles, keep their figure and get rid of the anxiety and stress generated by their professional activities. Some come on medical prescription to prevent high blood pressure and diabetes, both caused by a sedentary lifestyle. Moreover, men and women who want to get into shape also take up aerobics.

Maximum oxygen consumption and resting heart rate are among the most objective criteria to assess physical condition and endurance. However, we have not found any scientific studies reporting the positive effects of aerobics on maximum oxygen consumption and resting heart rate in sedentary Senegalese women.

For all these reasons, we propose to study the effects of a 2-month aerobics program, with three one-hour sessions per week, on the weight, Body Mass Index, maximal oxygen consumption, resting heart rate and blood pressure of 12 sedentary Senegalese women aged between 20 and 50 years.

Materials and Methods

The aim of our work is to study the effects of a two-month aerobics program on the weight, body mass index, maximal oxygen consumption (VO_2 max), resting heart rate (RHR) and blood pressure (BP) of sedentary Senegalese women aged between 25 and 50. Our protocol therefore consists in three phases. A first phase (pre-test) devoted to measuring weight, height, maximum oxygen consumption (VO_2 max), resting heart rate and blood pressure (BP) before the aerobic training program. A second phase devoted to running the aerobics program for 2 months, with 3 weekly 1-hour sessions. A third phase (post-test) during which the same variables measured during the pre-test were reassessed.

Subjects

Our study sample is composed of 12 Senegalese women aged between 25 and 50, free of any chronic disease that might affect their physical integrity and not practicing any physical activity other than aerobics. Women suffering from any illness or disability as well as women who did not complete the aerobics program or who modified it were excluded from this study.

Waist measurement

The women's height was measured with a somatometer using a metal measuring rod. The measurement was taken without shoes. The woman had to rest her back and head directly on the somatometer. Once firmly in place, she was asked to breathe in as deeply as possible while stretching her neck upwards. The head was straight and the chin erect, pointing forward and parallel to the ground. As she withdrew her breath, the headgear was gently applied to the top of her head (vertex). Once the tape was firmly in place, the subject was asked to withdraw while keeping the tape pressed firmly against the wall. The height reading was taken directly under the base of the height gauge, with a desired accuracy of 0.1 cm.

Weight measurement

The women's weight was measured using a SECA brand bathroom scale. Each woman, wearing a minimum of clothing (loincloth and tee shirt), stood on the scales, remained motionless with her feet together, her body straight, looking straight ahead and distributing her weight over her feet. The reading was taken with an accuracy of 0.25 kg.

Measurement of resting heart rate (rHR)

We used a POLAR heart rate monitor. The heart rate was measured by the INSEPS senior nurse. He left the subject at rest for at least 10 minutes in a decubitus position, without electrostatic underwear, wetted the electrodes of the heart rate monitor and placed them just above the plexus after first cleaning the skin with a solvent and applying a conductive jelly tip. He then placed the receiver (polar watch) around the subject's wrist and started the polar watch's chronometer. 15 seconds later, the subject's heart rate was displayed.

Measuring blood pressure

We used a SPENGLER cuff-type blood pressure monitor. The

measurement was carried out by the head nurse of the INSEPS medical department.

Estimation of VO_2 max: Light Luc test

The subjects' VO_2 max was estimated using the light Luc test. The instructions are recorded on an audio tape. Two parallel lines must be drawn on the ground twenty meters apart. The length of these lines depends on the number of subjects to be assessed. A space of one meter separates two subjects. The test consists of performing as many round trips as possible at progressively accelerated speeds. The speeds are adjusted by means of a soundtrack emitting sounds at regular intervals. The subject himself adjusts his speed so as to touch the 20-meter line and change direction each time he hears a sound signal. The test begins with a brisk walk, but the speed increases slowly and progressively by 0.5km/h every minute. The aim of the test is to keep up the pace as long as possible. The test ends when the subject can no longer keep up with the set pace. He then stops and the last number announced is recorded. This is the number of stages completed by the subject.

The VO_2 max test was carried out on the INSEPS basketball court. The women were grouped by 5, corresponding to the number of experimenters available.

Immediately after the test, the papers on which were recorded the number of stages performed by each subject were collected. The VO_2 max for each was then calculated using the following formula:

$$VO_2 \text{ max} = -224 + 6.0 \times (\text{VMA})$$

Where VMA is the maximum aerobic speed, expressed in km/h and VO_2 max is expressed in $ml \cdot kg^{-1} \cdot \text{Min}^{-1}$.

Sequencing and description of the aerobics program

A week after the measurements were taken, the women began the two-month aerobics program, with of three one-hour sessions a week. The aerobics sessions took place in the INSEPS fitness room. The women gathered there in the evenings from 6pm to do the sessions collectively. The aerobics training program consisted of 24 sessions, broken down as follows.

- 8 sessions of Low Impact Aerobics every Monday,
- 8 sessions of Gym baton every Wednesday,
- 8 Step aerobics sessions every Friday.

Low Impact Aerobics (LIA)

A Low Impact Aerobics session consists of three parts. The warm-up, lasting 5 minutes, during which the subjects carry out muscle stretching exercises to prepare the body for effort. The main part of the session, which lasts 50 minutes, during which the subjects move around for 30 minutes, by regularly keeping, at least, one of their foot, in contact with the ground, along with arm movements. The subjects then rest for 5 minutes and begin 15 minutes of muscle strengthening in the form of push-ups, abdominal exercises and buttocks. The session ends with a 5-minute cool-down, during which the participants re-oxygenate their bodies with long, gentle muscle stretches.

Stick gymnastics

Stick aerobics is an aerobics session in which the exercises are performed with a stick. The main difference between LIA and stick aerobics is the use of the stick. It should be noted that with the stick, certain movements performed in LIA cannot be performed in stick aerobics. A Stick Gym session consists of three parts. The warm-up, lasting 5 minutes,

during which subjects perform simple stretches with the stick to prepare the body for exertion. This is followed by the main part of the session, which lasts 50 minutes. In this part, the subjects first perform 30 minutes of movements accompanied by arm movements with the stick, regularly keeping one foot in contact with the ground. The subjects then rest for 5 minutes and begin 15 minutes of muscle strengthening in the form of push-ups, abdominal exercises and buttocks. The session ends with a 5-minute cool-down, during which subjects re-oxygenate the body with long, gentle muscle stretches.

Step aerobics

Step aerobics is a training session that mainly calls on aerobic endurance and coordination, technically based on stepping movements centered on a step. The step is a platform that you climb like a staircase. The main difference between stick aerobics and step aerobics is the use of the step. The step aerobics session consists of three parts. The warm-up, lasting 5 minutes, during which the participants carry out stretching exercises to prepare the body for exercise. The main part of the session, which lasts 50 minutes. In this part, the subjects move around with their arms while climbing on the step, keeping one foot in contact with the ground for 30 minutes. After these 30 minutes of movement accompanied by arm movements using the step, the subjects rest for 5 minutes and then begin 15 minutes of muscle strengthening in the form of

push-ups, abdominal exercises and gluteal exercises. The session ends with a 5-minute cool-down, during which the subjects oxygenate their bodies again with long, gentle muscle stretches.

Measuring parameters studied at the end of the aerobics program

Two days after the end of the aerobics program, which consisted of 24 sessions of 1 hour each, including 8 sessions of LIA, 8 of stick aerobics and 8 of step aerobics, the women were called in for measurements of weight, height, VO_2 max, resting heart rate and blood pressure.

Statistical processing

We compared the means of each of these variables before and after the aerobics program, using a Student's t-test. Our error probability α is set at 0.05. α is the error we accept to make in deciding on the average difference. If the probability of error P found in the Student's T-test is less than α ($P < \alpha$), there is a statistically significant difference between the means being compared. If the probability of error P found in the Student's T-test is greater than α ($p > \alpha$), there is no statistically significant difference between the averages compared.

Results

Our results will be presented in Table forms.

Table 1: Comparison of average values of variables recorded before and after the aerobics program

Variables	Before	After	P set	P found	Decision
Weight (kg)	54,5 ±25,01	54,64 ±24,51	0,05	0,49	NS
BMI (Kg/m) ²	23,71 ±8,80	23,68 ±9,12	0,05	0,49	NS
FCr (bmp)	64,64 ±29,19	62,79 ±26,94	0,05	0,32	NS
PAS (cmHg)	9,86 ±3,59	9,50 ±3,46	0,05	0,24	NS
PAD (cmHg)	6,29 ±2,16	5,71 ±1,90	0,05	0,10	NS
VO_2 max (ml.kg ⁻¹ . mn ⁻¹)	34,44 ±14,31	35,30 ±15,69	0,05	0,35	NS

Discussion

Weight

According to Cazorla *et al.* [2], weight is one of the first indicators of a person's state of fitness, whether sporty or sedentary. Together with skinfold measurements, it forms part of the training follow-up and enables the energy intake-expenditure balance linked to diet and training to be assessed. The average weight of our sample before the aerobics program (54.5 kg) was 2.53 kg less than that of Behnke's reference woman (57.03 kg) [3]. After the aerobics program, the mean weight of our sample rose to

54.64 kg, an increase of 0.14 kg in absolute value, which was not statistically significant ($p > 0.05$; Table 1). Our results (increase in weight) are not in agreement with those of Aouadi *et al.* [4], who reported a significant reduction in weight in 39 sedentary women aged between 20 and 35 who had completed an 8-week aerobics program with 3 one-hour sessions per week. This difference in results could be explained by the different ages of the subjects in our samples. As our subjects were older, it would be more difficult for them to lose weight. The increase in the weight of our subjects could be explained by low energy expenditure, as Brooks and Mercier [5] have shown that to lose 1 kg, you need to expend 8000 to 9000 kilocalories (kcal).

We very much doubt that each of the subjects in our sample expended as much energy to lose 1 kg. This low energy expenditure would appear to be the result of a low intensity of exercise, which did not result in the use of reserves (fat) by

the muscles.

Body Mass Index (BMI)

Body mass index (BMI) is a simple, objective indicator of nutritional status that combines the simple anthropometric measurements of weight and height [6]. Several studies have shown that BMI is strongly correlated with body fat when age and sex are taken into account [7], [8]. For this reason, BMI is widely used in epidemiological studies to determine body composition, especially in adults. Based on studies carried out in Western populations, the WHO suggests that the BMI thresholds for leanness should be a BMI < 18.5kg/m² and for obesity a BMI ≥ 30kg/m² [9]. The mean BMI value before the aerobics program (23.71 kg/m²) did not fall significantly ($p > 0.05$; Table 1) at the end of the aerobics program (23.68 kg/m²). These 2 values fall within the range described by the WHO as a normal body weight zone [9]. The program as carried out did not lead to a reduction in body mass index, which confirms the non-significant reduction in weight. These results are not consistent with those of Marcus *et al.* [10] who reported a reduction in body mass index and muscle gain in a group of type 2 diabetics who followed an aerobics program combined with weight training for 3 months.

Resting heart rate (rHR)

Resting heart rate (rHR) partly determines the general physical condition of the heart. It generally fluctuates between 50 beats per minute for (high-level athletes practicing

endurance sports) and 80 beats per minute for (sedentary people) ^[11]. It can also be an indicator of recovery capacity after exercise. The greatest reduction in resting heart rate induced by physical activity has been reported in high-level athletes practicing endurance disciplines: Cross-country skiers, cyclists and marathon runners ^[8].

The resting heart rate of our sample before the aerobics program (64.64 beats/min) did not fall significantly ($p>0.05$; Table 1) at the end of the aerobics program (62.79 beats/min). However, in absolute terms, there was a decrease of one beat, which could be attributed to the strengthening of vagal tone due to physical activity ^[8]. This strengthening of the vagal nerve, the cardio-modulator, could be more accentuated if the intensity and duration of the aerobic program were greater. To obtain these effects, Brooks *et al.* ^[5] recommend a moderate intensity corresponding to 50 to 80% of maximum heart rate or 60% of maximum oxygen consumption. According to Garnier ^[11], a woman's maximum heart rate is 226 - age beats/min. The intensity of our aerobics sessions was well below 80% of the subjects' maximum heart rate. We believe that our subjects would not be able to sustain such an intensity because of their age and sedentary lifestyle.

Blood pressure

Blood pressure is the pressure exerted by the blood on the walls of the arteries as it flows. This pressure varies according to the phases of cardiac activity. Systolic blood pressure (the pressure exerted on the walls of the arteries during ventricular systole) is generally equal to 120mmHg in a healthy sedentary subject ^[12]. Diastolic blood pressure (pressure exerted on the artery wall by the blood during ventricular diastole) is generally equal to 80mmHg in a healthy sedentary subject ^[12]. The average blood pressure of our subjects before the aerobics program (SAP = 9.86 cm Hg and DBP = 6.29 cm Hg) showed that they were not hypertensive, as these values were below the limits (PAS = 14 cm Hg and DBP = 9 cm Hg) at which a subject is classified as hypertensive by the WHO. At the end of the aerobics program, the mean blood pressure of our subjects did not fall significantly ($p>0.05$; Table 1) (SBP = 9.50 cm Hg and DBP = 5.71 cm Hg). However, there was a slight decrease of 0.36 cm Hg in SBP. These results are in line with those of Saejong Park *et al.* in 2008 ^[13] and Bacon *et al.* in 2004 ^[36], who recorded a reduction in blood pressure after walking programs of 40 and 30 minutes respectively, divided into 10-minute sequences.

Maximum Oxygen Consumption (VO₂ max)

Measuring VO₂ max is still one of the best tests for quantifying a person's physical condition ^[14]. It is an accurate index of physical fitness, because the higher its value, the greater the individual's oxidative capacity. Wyndham *et al.* ^[15] reported VO₂ max values of between 40 and 49 ml. min⁻¹. kg⁻¹ in melano-African women. VO₂ max values are 10 to 20% lower in melano-African women because of the excess fat. The average VO₂ max recorded in our subjects before the aerobic program (34.44 ml. mn⁻¹. kg⁻¹) is much lower than in the women above. This shows that our subjects were not enduring. This mean value recorded before the aerobic program increased but non-significantly ($p>0.05$, Table 1) at the end of the aerobic program (35.30 ml.mn⁻¹. kg⁻¹). This non-significant increase in the mean VO₂ max of our sample is in line with the results of Aouadi *et al.* ^[4], who reported an improvement in the VO₂ max of 39 women aged between 20 and 35 years, who completed 3 one-hour aerobics sessions per week for 8 weeks. This non-significant increase in the mean

VO₂ max of our sample at the end of the aerobic program could be explained by the fact that our subjects did not perform the aerobic sessions at an intensity equivalent to 60% of their VO₂ max as suggested by Brooks ^[5].

Conclusion

Our study showed that one hour of aerobics, 3 times a week for 8 weeks, had statistically no significant effect on body composition variables (weight and body mass index), cardiovascular parameters (resting heart rate, systolic blood pressure and diastolic blood pressure) and maximum oxygen consumption (VO₂ max) as the twelve (12) sedentary Senegalese women in our sample were concerned. It would be interesting to continue this study by modifying the intensity and duration of the aerobics program and combining it with a controlled diet to see if the effects would be different from those observed in our study.

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