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Study on the improvements of body composition indices in adult women by means of aerobic gymnastics

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Abstract

Introduction: Fitness in relation to health is a contemporary topic, which is topical due to the diversity of methods and programmes to support and improve health and is increasingly being addressed by the sports and medical scientific community. Regular physical activity and exercise are the actuators of our whole body's well-being, both somatic, functional, and cognitive. **Purpose:** Through this article, we wish to highlight the use of a personalized aerobic fitness program conducted collectively that can generate significant results based on transforming the perception of how participants look and feel good in their own bodies. **Materials & Methods:** The research sample consisted of nineteen young adult female subjects (N=19, age = 35,4 ± 5,02 years, Weight($_i$) 66,7 ± 12,61 kg, Height= 166 ± 6,69 cm) clients of a fitness center. They trained following a personalized program of an aerobic fitness class for 4 weeks, with a frequency of 2 workouts per week. **The results** indicate a significant improvement in the somatic parameters of the research participants, but in order to maintain the results obtained, physical activity should be continued after the end of the research. **Conlusions:** Within the limits of our study, we conclude that significant changes in body composition indices can be produced in adult women by performing an exercise routine under systematic and continuous conditions.

Keywords: fitness, aerobic gymnastics, adult women, physical activity, wellbeing

Introduction

Due to the evolution of human consciousness and as a consequence, of technology, numerous methods of assessing human body composition are available. The methods range from numerous simple techniques that can be applied by the researcher in the field or outside the laboratory, such as: weight, standing height, anthropometry (skinfold thickness and body circumferences) and bioelectrical impedance analysis (Lukaski, 2017, p. 14; Potteiger, 2021, p. 320) to more complex methods that are limited to the controlled environment of a laboratory precisely because they require sophisticated equipment and skilled personnel in providing technical assistance, and according to Heymsfield et al. (1997) some of the methods can be: isotopic dilution, densitometry, whole body plethysmography or even radiological methods.

The assessment of human body composition is a useful tool in various fields including medicine, nutrition, and sports science (Ackland et al. 2012). People who participate in regular physical activity whether recreational, competitive or occupational, are interested in body composition (e.g., lean or fat-free mass, muscle mass and fat) which can be associated with performance or simply health (Lukaski, 2017, p. 13; Ackland, et al. 2012).

Today's global situation forces each of us to be more responsible, to increase the care for the health of the body and the mind, for a better functionality and interaction with the environment but also with ourselves. Total or partial lack of physical activity can affect women's quality of life. According to a report by the World Health Organization (WHO), physical inactivity has become a global public health problem worldwide, predominantly affecting women and responsible for an estimated 3.2 million deaths each year (World Health Organization, 2014). Let's not forget that the world's population has been going through a very socially restrictive experience for two years due to the COVID-19 pandemic. A new word, "covibesity" (Khan & Moverley, 2020), has even been coined, associated with the lack of movement during the pandemic. This phenomenon refers to the rapid weight gain that occurred in some individuals during the SARS-CoV-2 pandemic (Camenidis & Băițel, 2021).

In contrast to the above, women's consistent participation in physical activities, has been identified as a keyway to promote fitness and well-being (D'abundo, 2007). It is not news that women like aerobic exercise programs. If you go to any gym/fitness center with aerobic fitness classes, you will find most females enrolled in these classes. One reason may be the beneficial effects that aerobic exercise programmes have on the dynamics of human morphological and cognitive functions and thus on health.

Physical activity in relation to health, or physical fitness (Stodden, Sacko & Nesbitt, 2015), as recognized by specialists in the field, is an important attribute in the proper interaction and functioning of contemporary humans with their environment, regardless of the gender of the individual. From a technical

perspective, physical activity in relation to health can be viewed as a measure of strength, endurance, and flexibility of the body (President's Council on Physical Fitness, 1980, p. 5).

On the other hand, from a general perspective, due to the fast-paced lifestyle, both for the young population and for the young adult population regardless of gender, constant participation in exercise programmes is a necessity to increase and maintain health, motor capacity and implicitly, improve moral qualities or moral values. Garber et al. (2011) state that during the last decade, attention has been focused on routines in which an active and healthy lifestyle based on physical training (e.g., resistance training, high intensity interval training, endurance training, stretching/flexibility training) predominates to prevent premature aging possible or due to lack of movement. Most often, ageing is accompanied by a progressive decline in skeletal muscle mass and strength, the consequences of which are reduced functional capacity and decreased ability to perform daily activities (Kraemer, 1997; Volpi, Nazemi & Fujita, 2012).

Despite numerous campaigns promoting regular exercise and physical activity, physical inactivity, and its negative effects, is developing at a rapid pace, and is already a known problem in modern life and worldwide (U.S Department of Health and Human Services, 1996; Guthold et al., 2008; Blair, 2009; Courel-Ibáñez et al. 2018). Lack of physical activity begins with a decline as early as adolescence, and is transient into adulthood (Kim et al., 2002). Advancing age, produces a concomitant decline in health and fitness, a major consequence supported, being the lack of regular exercise (Evans & Meredith, 1989; Nakamura et al., 2007). Evidence includes as early as adolescence as factors that may contribute to physical inactivity social support, or lack of inner motivation (Conroy et al., 2010; Power et al., 2011; Litt, Iannotti & Wang, 2011; Teixeira et al., 2012; Beauchamp, Puterman & Lubans, 2018). One more aspect we can say of concern is the way in which the present-day lifestyle of modern society has reduced the time and intensity of leisure-time physical activity among the adult population (35-65 years) (Church et al., 2011; Macías et al., 2014). For example, Macías et al. (2014) conducted a study in Spain based on 1330 adults of which 51% were women, reporting a 76.3% sedentary leisure time lifestyle, mainly in women (83.0%) and in participants aged 41-50 years (80.2%). These figures should be viewed with concern knowing that around us, we observe children, again more girls than boys, from an early age, with health problems due to sedentarism.

Therefore, without doubt, maintaining a healthy lifestyle from the age of school entry (within the anthropometric and motor, nutritional and medical limits appropriate to the age group) to adulthood is closely linked to maintaining optimal physical condition (fitness), i.e. muscular strength, muscular endurance, cardiorespiratory endurance, flexibility, body composition (Davis, 2008, p. 2; Howley & Thompson, 2022, p. 182; Gibson, Wagner & Heyward, 2019, p. 153) and physical activity (Nakamura, 2007; Stodden, Langendorfer & Roberton, 2009; Zaharia & Duck, 2014).

The focus of our research is around female subjects. We have chosen this category because in everyday life, we observe more and more women who due to their busy lifestyle, forget that regular sport, together with proper rest combined with optimal nutrition can keep them in good physical shape.

Through aerobic gymnastics "gymnastic structures are exploited for multi-objective purposes but with emphasis on body shaping-building" (Popescu, A. & Popescu, G., 2012, p. 20).

Also, in this study we tried to use the means of contemporary aerobic gymnastics translated into a personalized group program to achieve the set goals. Aerobic gymnastics is a component of fitness, and moreover, a sport rich in dynamic movements and exercises, the consequences of which are felt in the improvement of the indices and major functions of the human body (cardiovascular function, respiratory function, digestive function, nervous system function), at the somatic and motor level (improvement of the body scheme, maintenance of an optimal weight, development of motor qualities such as endurance strength, coordinative abilities) and cognitive (mental relaxation, improvement of memory, capacity for self-awareness).

In other words, by the nature of the complexity of the movements in aerobic gymnastics, practitioners can get the most out of the benefits it offers. The rewards of aerobic exercise are multiple and refer to the functional improvement of auditory, visual, kinesthetic analyzers, improvement of self-control mechanisms, modification of skin quality, protection against osteoporosis and other diseases, stress relief, psychological relaxation, improvement of self-image and self-confidence, artistic education, aesthetics (Popescu, A. & Popescu, G., 2012, pp. 25-26).

This sport is suitable for people who regardless of age or gender, go to a gym/fitness center/ to develop a systematic and continuous activity, regardless of whether the goal is to have a good physical condition, or just leisure physical activity (Leuciuc & Sobon, 2012).

Materials & Methods

Subjects and experimental design

The study was initiated to obtain a conclusion as to whether Limitless aerobic training in female subjects can produce significant changes in selected somatic parameters: weight (W), body mass index (BMI), body fat (FM), visceral fat (VAT), metabolic age (Metage), as well as body perimeters such as waist (Waist), arm (Arm), thigh (Thigh), and hip (Gluteal).

However, we consider that in the training routine, due to the dynamics and complexity of the exercises, the other muscle groups were not neglected, although they were not mentioned. Each subject was tested before and after the research period of the training routine. The research subjects are clients of a gym in Brasov County who enrolled in an aerobic program, called Limitless. The gym had the necessary

conditions to conduct the study. A total of 19 female subjects (N=19, age = 35.4 ± 5.02 years, Weight(s) 66.7 ± 12.61 kg, Height= 166 ± 6.69 cm) were included in this research.

Materials & Methods

Measurements of the somatic parameters were made using a Tanita DC-360P professional bioimpedance scale and a tape measure was used for body perimeters. In both cases, an initial assessment was carried out before starting the experiment and a final one after the weeks of training. For the assessment of somatic parameters, before stepping on the Tanita bioimpedance scale subjects were required to fill in some basic information (e.g., sex, age, height) which was integrated into the scale profile. After stepping on the scale, they had to wait for 15 seconds until the body composition analysis result was delivered on the LCD screen of the scale. To measure the targeted body perimeters, the technique involves placing a flexible measuring tape, made of cloth, over an area of the body and measuring the circumferences (Schoenfeld, 2021, pp. 69-70). Also, according to Schoenfeld, (2021, pp. 69-70) usually metric tape measurements are taken at the midpoint of the body area, but any place along the muscle can be measured. The reliability of body circumference assessments, however, is much more relevant than that reported for skinfold testing (Atherton, Phillips & Wilkinson, 2015).

Training program

Limitless aerobic training program was used in this research. Although its foundations have been laid since 2011, so far no one has bothered at least on a national level to scientifically communicate the results it can provide although according to the evaluation files of people who have gone through the Limitless program, the success rate is 93% (Limitless Romania, n.d.).

The Limitless training programme includes both exercises from classical aerobics and exercises from yoga classes, with isometric maintenance, exercises from the fit box performed on the punching bag, exercises specific to TRX training (toning exercises performed in conditions of balance maintenance, the TRX ropes not being stable) and cardio exercises performed on the rebound (trampoline) or exercises borrowed from the fit ball course, performed with the ball.

During the 4 weeks of training, the routine of the subjects involved in the study was two intense workouts per week. Each training session was preceded by a general preparation of the body for the effort through warm-up exercises.

The workout routines were monitored by the researchers and the gym staff responsible for implementing the Limitless workouts. What differentiates the Limitless programme from other aerobics programmes is that the workouts are conducted with two instructors. One of the instructors explains and

performs the exercises simultaneously with the subjects, and the second instructor corrects the subject's body position during execution.

Each training programme is different. In one workout, 2 exercises are worked 30 seconds each with a 10 second pause, 2 repetitions, and then the exercises are changed in another workout, 2 exercises are worked 20 seconds each with a 10 second pause between exercises, these are repeated 4 times. Another workout variant with 2 exercises each working for 40 seconds and 20 seconds break between them, repeating 2 times. Generally, the last workout contains 7-8 exercises of 45 seconds each and 15 seconds rest between exercises, performed 4 times.

In the workout you work with low weights and your own body weight. Also, in the workout there is emphasis on both the toning part of the muscle groups and the cardio exercises, which are combined with each other.

Importance is attached to the correct execution of the movement. In this respect it should be mentioned that before the start of the Limitless programme, participants have a biomechanics session, where movements are explained and demonstrated.

In conjunction with the training programme, participants also receive a personalized diet plan. This includes 3 main meals and 2 snacks per day. On training days, the quantities are higher.

A workout from the Limitless routine has been attached in Table 1.

Table 1. Example of training set A from the Limitless program.

Coach 1:
A: Squats (3-4 seconds/repetition)
B: From neutral bipedal position into Chair Pose (3-4 seconds/repetition)
Coach 2:
A: Left tree yoga with arms at sides, palms facing the ceiling
B: Tree yoga straight with arms at side, palms facing the ceiling
Coach 1:
A: Knee push-ups
B: Camel yoga
Coach 2:
A: Backbends with left leg in isometric position and arms up – warrior 1 yoga
B: Backbend with right leg in isometric position and arms up – warrior 1 yoga
* The first workout (A) is a combination of exercises involving the whole-body musculature and yoga to improve stability and physical effort.

Workout description:

Set an interval of 30 seconds by 10 seconds
Duration of each exercise: 30 seconds
Pause between exercises: 30 seconds
Breaks between workouts: 40 seconds
Structure of a set: A B, A B

Results

Table 2. Data presented with Mean and SD.

Variable	Initial ($_i$)	Final($_f$)
Age (y)	35,4 ± 5,02	
Height (cm)	166,1 ± 6,69	
Weight (kg)	66,7 ± 12,61	64,9 ± 12,04
BMI (kg/m^2)	24,1 ± 4,17	23,5 ± 3,98
Fat Mass (%)	29,4 ± 8,92	27,2 ± 8,01
Metabolic Age	32,2 ± 11,88	29,9 ± 11,46
VAT	3,8 ± 2,51	2,9 ± 1,82
Waist (cm)	89,6 ± 10,42	87,2 ± 10,15
Arm (cm)	27,8 ± 3,46	26,9 ± 3,08
Thigh (cm)	56,4 ± 4,59	54,8 ± 4,59
Gluteal (cm)	102,6 ± 10,35	100,6 ± 10,01

Legend: Initial ($_i$) – Initial assessment; Final ($_f$) – Final assessment.

After completion of the 4 weeks of intense training, the analysis of body index measurements using electrical bioimpedance and anthropometric measurements indicates a progress in body composition dynamics. The association between the improvement of the targeted variables and the working method is shown by the change in the means and standard deviation of the variables (Weight($_i$) 66,7 ± 12,61, Weight ($_f$) 64,9 ± 12,04; FM($_i$) 29,4 ± 8,92, FM($_f$) 27,2 ± 8,01; BMI($_i$) 24,1 ± 4,17, BMI($_f$) 23,5 ± 3,98; Metage($_i$) 32,2 ± 11,88, Metage($_f$) 29,9 ± 11,46; VAT($_i$) 3,8 ± 2,51VAT($_f$) 2,9 ± 1,82; Waist($_i$) 89,6 ± 10,42, Waist($_f$) 87,2 ± 10,15; Arm($_i$) 27,8 ± 3,46, Arm($_f$) 26,9 ± 3,08; Thigh($_i$) 56,4 ± 4,59, Thigh($_f$) 54,8 ± 4,59; Gluteal($_i$) 102,6 ± 10,35, Gluteal($_f$) 100,6 ± 10,01).

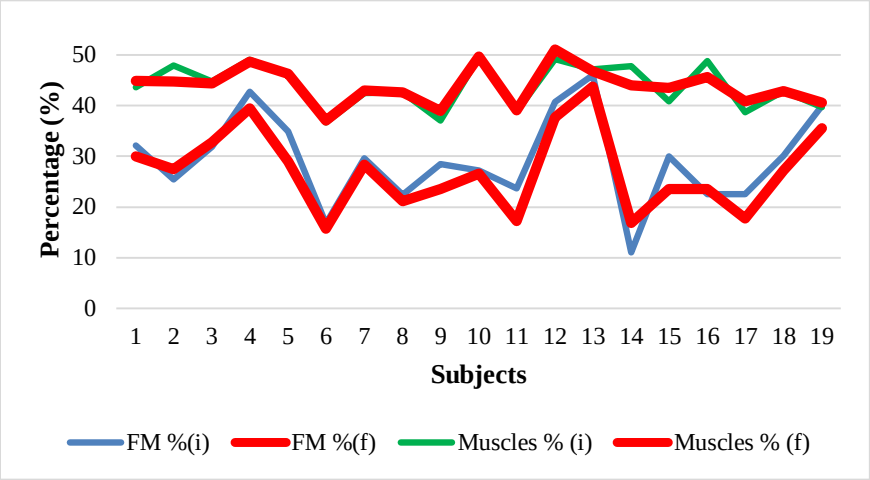

Fig. 1. Fat mass (FM) and muscle percentage of subjects before and after the experimental session.

According to Fig. 1, the dynamics of body fat (FM) and muscle mass percentage (Muscle) for each subject can be observed. The whole sample showed significant changes. A reduced percentage of FM helps to increase metabolism. Due to the intensity of the training and most possibly the diet, the subjects also lost muscle mass. Complementarily, significant results were also recorded in the body perimeters selected for the experiment which can be seen in Table 2 but also in Fig. 2.

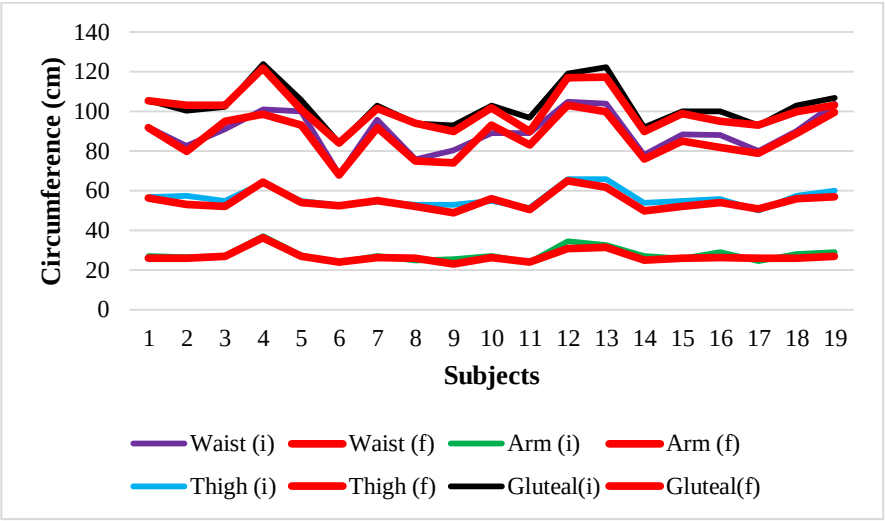

Fig. 2. The dynamics of the anthropometric measurements in initial and final stage of the research at selected body zones.

According to fig. 3, the research subjects had a BMI of 24.1 at baseline, close to the limit of 25, which indicates a moderate but not necessarily worrying weight, and at the final assessment the mean of the variable reached 23.5, which is still a small health risk.

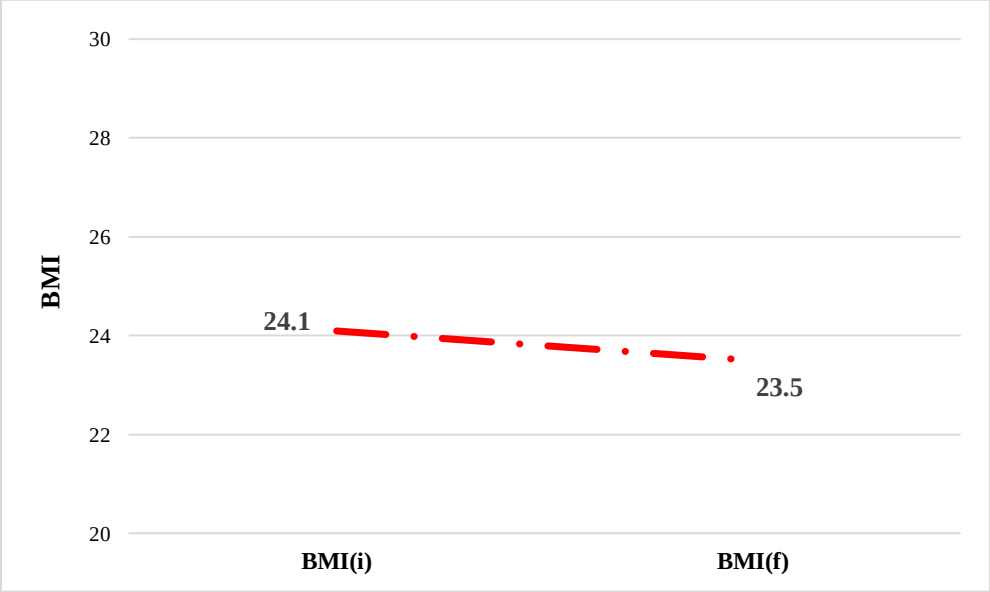

Fig. 3. Mean change in BMI at initial assessment ($_i$) and final assessment ($_f$).

Discussions

Evidence of improved cognitive function through fitness programs is provided by the study of Colcombe & Kraemer (2003) who subjected their subjects to fitness training, and at the end of the research period, subjects showed superior cognitive function in several areas, including executive function, controlled processes, spatial temporal processing and motor speed, compared to a group that did not undergo an exercise program.

Even the beneficial effects of simple responses, such as upper limb extension, can be produced by different neuromuscular patterns when task was altered (Camenidis et al., 2020).

According to Kalaska & Rizzolatti (2013, p.862), the motor cortex, although it plays an essential role in the control of voluntary movements, its neurons do not function as spinal motor neurons whose unique role is to encode patterns of muscle activity. Instead, the motor cortex contains a heterogeneous population of neurons that contribute to several operations required to convert a plan of action into motor controls that execute the movement pattern. The new evolutionary development in primates of a direct

monosynaptic projection onto spinal motor neurons allows the primary motor cortex to control hand and finger movements in a uniquely skilled manner. This feature was essential in the acquisition of dexterous hand movements that only higher primates and especially humans possess.

During the weeks of training through the Limitless program we first noticed in the subjects a significant improvement in well-being. The same was found in other studies on male subjects this time when weight training (Geanta & Herlo, 2020; Geanta & Ardelean, 2021a; Geanta, 2021b) circuit methods (Geanta & Ardelean, 2022), or via a method using electrostimulation (Ardelean, Geanta & Nicoară, 2022) were used. It is very easy to draw a first conclusion regarding the fact that physical exercise, regardless of the methods used, if there is systematization and continuity behind it, can generate beneficial cognitive effects.

Effects that also depend on the variety of exteroceptive, proprioceptive and interoceptive information, which are "analyzed, interpreted and organized in the cerebral cortex system [...] on the basis of which responses, both stereotypical. can be generated for habitual situations and unique, creative responses for new situations" (Epuran, 2011, p. 75).

Of course, the aim of this study is focused on improving body composition indices, but we felt it necessary to intervene at the beginning of the section on the complex benefits that repeated systematic and continuous exercise offers to the human body. Following the Limitless training programme and adherence to the diet plan, a favorable outcome in terms of weight and cm loss at selected body perimeters and an improvement in BMI can be observed. More and more adults can be more physically active. Due to the alarming statistics on the lack of fitness and therefore physical activity among the adult population concurrent with the evidence of the numerous health benefits of physical activity, several reports and campaigns have been published in an attempt to increase physical activity (Davies, 2008, p. 5).

As Schmidt (2019, p. 526) states, the way a person focuses attention influences performance and motor learning, thereby also improving somatic-functional indicators. The refinement of feedback through awareness of movement and how the motor actions to be performed are perceived can be achieved based on the evolution of somatic-functional indices and from "individual resources in sensory/perceptual systems, cognitive systems, and action systems" (Chui, 2020, pp. 41-43). And Pickenhain analyzing complex motor behavior states that "perception and action must be taken together as a binding entity because no brain function can be understood if we consider them as distinct. Perception and action are common constitutive elements of the organism's behavior which are related to the behavioral function of the organism as a whole" (Pickenhain, 1988, pp. 464-469).

Conclusions

Body composition assessment can provide the researcher with useful information about a competitive athlete, or a simple exerciser. Without a doubt, there is no single or combined method that can

be considered an absolutely accurate measure of a variable in this context (e.g. muscle mass, body fat). The nature of scientific research forces us to work with numbers, and the result obtained is only an approximation of the absolute.

Professional trainers in the fitness industry need to be an inspirational role model for their clients. When the presence and concomitant behaviors of a professional trainer demonstrate a healthy lifestyle, this generates added value to their words and programs (Howley & Thompson, 2012, p. 406).

Nonetheless, the Limitless program despite the short implementation period and low frequency of workouts, generated significant results, with our study achieving its objective while also being an encouragement to exercise among females.

However, there were variables that could not be directly monitored and controlled (e.g. proper nutrition, rest, extra sport life), precisely for this reason the results varied from subject to subject.

Clearly, if they continue the routines, the subjects will be able to progress in terms of training level concurrently with a much healthier lifestyle, getting out of sedentarism at least for a while.

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